Los Angeles
World Airports

Design and Construction Handbook

June 2011

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1.0 GENERAL REQUIREMENT

1.1 Scope, Purpose and Introduction

This Handbook establishes broad design and construction guidelines for all infrastructure, terminal buildings, renovations, and other public facilities owned, operated or maintained by Los Angeles World Airports (LAWA), including LAX, VNY, PMD, and LA/ONT airports (referred to as "Airport"). Additionally, it serves as a roadmap and reference guide for design teams that have been contracted to provide design services at the Airport. The issues highlighted in this guide are important to the Airport and provide help navigating the regulatory process as well as obtaining LAWA review and approval. The ultimate goal of this guide is to help you meet the Airport's expectations for what is built, how it is built and how it will operate after construction is complete.

This handbook is not intended to limit creativity or innovation. LAWA encourages Designers to recommend alternates when deviations from the guidelines provide an advantage or benefit to the Airport. Modifications, alterations and deviations shall be approved in writing by LAWA prior to implementation. Designer shall provide LAWA with documentation that the proposed modifications to these guidelines comply with applicable local, state and federal regulations. Additionally, this document does not absolve the Designer from performing their own independent research and due diligence related to performance of their work. Adherence to these guidelines is intended to result in project development that conforms to the goals and objectives of LAWA.

Additional Design Standards and Criteria are contained in the following manuals for projects of specific scope and location on Airport property. They are incorporated herein by reference. The current version of the following standards can be found under LAX- Business Standard Documents and Guidelines on the LAWA website. http://www.lawa.org/

1. Tenant Construction Approval Process
2. LAWA Concessions Design Guidelines (Planning)
3. CAD Standards
4. GIS Standards
5. DDMS Standards, LUSAD
6. Survey Manual
7. Survey Control Networks, LAX, VNY, ONT
8. Airfield Pavement Design Standards
9. LAWA Public Restroom Design Standards (Planning)
10. Sustainable Airport Planning, Design, and Construction Guidelines VNY Streetscape and Landscape Plan (Planning)
11. Construction Safety Policy Documents (ADG)
12. City of Los Angeles Street Design, Storm Drain Design, and Sewer Design Standards (City of LA)
13. Utility Investigations and Shutdown Procedures
14. Barricade, Scaffold and Messaging Concept, Presentation (Planning)

1.11 Glossary of Terms

1.2 Request for Variances and/or Interpretation Statement – It is recognized that in some instances variances to the requirements contained in this Handbook may be deemed necessary. A request for variance shall be submitted along with any substantiating documentation to the Engineer/Airport Contact.
Each request should include the specific section and materials affected as described in this handbook; the purpose of the variance request; any referenced or related code or agency regulations involved; the impact of the variance; date requested and specific action requested if any.

1.3 Procedures for Changes to this Handbook –
This Instruction implements and describes the general procedures for updating the Design and Construction Handbook. The Handbook serves as a reference resource for technical information, policy, and procedures. Therefore, any changes to the text must be done in a measured and controlled approach. As changes are being considered, all chapters of the original handbook will remain in effect until they are replaced by an officially approved change. All changes, additions and revisions will come from LAWA Planning and Design. As new adjustments are completed, they will be cleared and approved, which will cancel the corresponding portions of the old handbook sections. After each approval, it will then be posted on the Internet at http://www.lawa.org/laxdev/Handbook.aspx as part of the updated Design and Construction Handbook. A log will be kept of changes to the documents to readily track the latest and most current updates.
Should you have any revisions, additions, changes or adjustments to be considered, follow the steps below, then send your submission to: Jgoetz@LAWA.org. Attn: Mr. Jim Goetz.

Your submission will begin the review process for your suggestion to be considered for inclusion into the Design and Construction Handbook.

Procedure;

Written submission of change, addition, adjustment, correction or reference in the Design and Construction Handbook to include:

1. **Purpose.** Clearly state the purpose for the intended change to the handbook in as much detail as possible.
2. **Scope.** Submit the scope of the change identifying correct placement and sections where the intended adjustment would be most logical. Write a detailed scope of the change, in the exact language, format, and pagination that conforms with the existing textural format of the handbook. As you would intend to see it published.
3. **Reference**. Identify and reference any related or affected sections of the handbook that would be influenced by the proposed request. Should any outside agency standards, codes, etc., be noted, include complete footnote notations inclusive of all information available to allow for clear guidance of the reader to easily find the referenced material.
4. **State Impact**. Identify the goal and benefit, intended by the suggested change. Identify the impact, if any, of not implementing the suggested change.

After submission is received, a vetting process will occur with the appropriate stakeholders to evaluate the proposed change. The accepted changes will be logged, and included in the most current copy of the Design and Construction Handbook, posted on the internet at http://www.lawa.org/laxdev/Handbook.aspx .

Action required. As the planned chapters of the revised Manual are cleared, updated, and published, hard copies of the cancelled portions of the old Handbook should be destroyed.

1.4 Project Type – Projects contracted for by LAWA will be referred to as "LAWA Projects". All other projects will be referred to as "Tenant Projects".

1.5 Federal, State, Local Statutes, Codes, and Regulations

This section provides an overview of the regulatory requirements and procedures for development work at LAX. Mentioned in this section are the codes and guidelines that the Designer is encouraged to become familiar with. This list is neither exhaustive nor all inclusive. The Designer is responsible to be aware of these and any other code regulations that apply to their specific project.

The City of Los Angeles, Department of Building and Safety (LADBS) is the lead agency for plan check approvals for most building projects at LAX and VNY. The exceptions include, but are not limited to, airfield or special structures that are reviewed and approved through the FAA and roadway projects that fall under the City of Los Angeles Department of Transportation. **LAWA is not a self-permitting agency.**

LADBS will determine other City or County agencies with jurisdiction over the project where review and sign-off is necessary to obtain final plan check approval and permit for construction. Examples include the City of Los Angeles Fire Department, the Disabled Access Division and for projects that involve food service facilities, the Los Angeles County Department of Public Health. In addition, depending on the scope of the project, review and approval may be required by Federal agencies such as the Department of Homeland Security Transportation Security Administration, Customs and Border Protection and the Federal Aviation Administration.

Applicable Building Codes –

AS CODES ARE OFTEN UPDATED, IT IS ENCUMBENT UPON THE DESIGNERS TO BE AWARE OF THE CURRENT APPLICABLE CODES FOR THEIR PROJECT.

Designers are required to comply with the requirements of the applicable building codes adopted by the State of California, County of Los Angeles and as amended by the City of Los Angeles.:

> **The 2008 Los Angeles Building Code** is based upon the 2007 California Building code with LA City Amendments. Please refer to www.ladbs.org for any additional information pertaining to Los Angeles Building Codes and Permit Processing Procedures.
>
> **The 2008 Los Angeles Electrical Code** is based upon the 2007 California Electrical Code (which is based upon the 2005 National Electrical Code) with 2008 LA City Amendments.

The 2008 Los Angeles Mechanical Code is based upon the 2007 California Mechanical Code (which is based upon the 2006 Uniform Mechanical Code) with 2008 LA City Amendments.

The 2008 Los Angeles Plumbing Code - is based upon the 2007 California Plumbing Code (which is based upon the 2006 Uniform Plumbing Code) with 2008 LA City Amendments.

Accessibility Requirements: All plans shall comply with the City of Los Angeles and Title 24, California Code of Accessibility Regulations in conjunction with the American with Disabilities Act (ADA) and ANSI 117.1.

Other applicable codes may include but are not limited to:
The California Retail Food Code – Part 7 of the California Health and Safety Code, effective January 1, 2009.

Retail Construction Guidelines as issued by the County of Los Angeles, Department of Environmental Health.

The Los Angeles Industrial Waste Control Ordinance – Section 64.30 of the Los Angeles Municipal Code.

2010 California Green Building Standards Code – otherwise known as the CALGreen Code that is in effect as of January 2011.

LADBS Case Management and Preliminary Plan Check Services

LAWA works closely with LADBS make sure they are aware of projects at the Airport that will require plan check services. When starting the plan check process, please be aware LADBS has a designated case manager with oversight of plan check, permit and code matters at LAX. Designers are strongly encouraged to schedule a Preliminary Plan Check review early in the design process. The LADBS Case Manager is responsible for assigning a plan checker for the project who will provide a preliminary plan check review.

Lily Teng
Structural Engineer Associate
Case Manager/Plan Checker
LADBS Case Management Neighborhood Government Services Division
221 N. Figueroa, Room 180
Los Angeles, CA 90012
TEL: (213)482-6871
FAX: (213)482-6874

The Preliminary Plan Check review will help the designer understand the LADBS process including the necessary clearances for the project. This service allows the future applicant for plan check to meet with a plan checker to discuss applicable code requirements, submittal procedures, and any other issues or concerns regarding their project. Upon completion, the design professional will have a better understanding of the various code requirements as well as the required clearances from other governing authorities having jurisdiction over the project. The Preliminary Plan Check review affords the designer the opportunity for building department input early in the design process thereby,

minimizing processing delays during plan check allowing the applicant to begin construction in a timely and cost effective manner. This service is available for a fee for the following disciplines:

1. Building Code
2. Disabled Access
3. Signs
4. Land Subdivision (zoning)
5. Mechanical (HVAC) System
6. Electrical
7. Plumbing
8. Fire Sprinkler Systems

Designers are strongly encouraged to take advantage of this opportunity and utilize this service. The preliminary plan check application is available on-line at www.ladbs.org.

If a project includes Food and Beverage services, it is recommended that the Designer's team includes an experienced kitchen consultant familiar with the Los Angeles County, Department of Public Health plan check procedures.

The Plan Check Submittal – As part of the overall project process, the Designer will be required to submit drawings to LADBS for plan check approval. Please read the section on the LAWA Review Process to understand the relationship between LADBS plan check approval and the LAWA Project Review Process.

Special Conditions – For projects within the City of Los Angeles special conditions may apply, including but not limited to:

Los Angeles Research Report Numbers: All building, electrical and mechanical products, either existing or new, including kitchen equipment, dishwashers, coffee makers, water purifiers, etc., that are specified for projects within the City of Los Angeles are required to have a Los Angeles Research Number. These numbers shall be listed on the drawings submitted for plan check. For a list of approved products for the City of Los Angeles refer to http://netinfo.ladbs.org/rreports.nsf.

Industrial Waste Permit - All Food Service Establishments (FSE) that generate waste Fats, Oils and Grease (FOG) are required to obtain an Industrial Wastewater Permit from the City of Los Angeles. Such a permit is issued by the Los Angeles Department of Public Works Bureau of Sanitation, Industrial Waste Management Division. When applying for an Industrial Waste Permit, all new FSEs are required to install a 750-gallon or larger Gravity Grease Interceptor (GI).

Environmental Health - All Retail Food Facilities are required to submit drawings to Los Angeles County, Environmental Health Department. A Retail Food Facility is defined as a place where food is stored, prepared, served, packaged, transported, salvaged or otherwise handled for dispensing or sale to the general public. This list includes but is not limited to, bakeries, restaurants, cocktail lounges, micro breweries, soda fountains, coffee shops, or other food and beverage entities.

The Los Angeles Department of Cultural Affairs - As part of the plan check approval process, all building projects will require a permit application clearance from the office of Cultural Affairs. This

office was created in an effort to promote long-term design excellence in all public architecture and public art that best reflects Los Angeles' international stature as a vibrant and creative cultural center. The Los Angeles City Cultural Affairs Commission has the power to review and approve all public architectural designs and public art projects in the City of Los Angeles. Upon determining that such a clearance is required, proceed with the following two step procedure for contacting the department:

> **Step 1** – Call Haroot Avanesian at 213.202.5501 and leave him voice mail message that you'll be sending him a follow-up email with the plan check number and a brief description of your project.
>
> **Step 2** – Send an email to haroot.avanesian@lacity.org describing your project. In this email elaborate on the exterior of the proposed facility including any new roof mounted mechanical equipment, lighting etc. that is proposed.

Upon submitting this information, you will be contacted by the department for further review and clarification. In some instances, an electronic clearance may be granted. The review process and detailed submittal requirements will be determined by the Department of Cultural Affairs on a case by case basis.

Please note that projects at Ontario International Airport will require similar approval process to the above through the City of Ontario.

1.5.1 California Environmental Quality Act (CEQA) – All projects require a CEQA determination prior to LAWA issuing a Notice-To-Proceed. LAWA will determine whether the project is exempt from CEQA or require further evaluation in the form of an Initial Study, leading to the preparation of a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report.

CEQA Language summarizes the CEQA process and includes a list of projects and activities that are possibly exempt from CEQA. Please note that there are many exceptions where an exemption may not apply.

If a project is not exempt from CEQA, the applicant is responsible for having the CEQA documents prepared under the direction of LAWA Facilities Planning staff. This process takes a minimum of eight months for a Negative Declaration and one year for an Environmental Impact Report for the least complicated projects that are small in size and scope with no major environmental impacts. It is not uncommon for it to take longer to complete the CEQA process given the complexities of construction within an airport environment. As such, the applicant should be aware that a Notice-To-Proceed will not be issued until completion of this process and should plan accordingly.

Regional / Land-Use Clearances

California Environmental Quality Act (CEQA)

The California Environmental Quality Act requires that **all** Projects on LAWA property must receive a final determination in regards to their environmental impact. This determination is required prior to LAWA issuing a Notice-To-Proceed. A brief explanation of the CEQA process is as follows:

What is CEQA?

CEQA stands for the California Environmental Quality Act. It is a state law that requires government agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts. The State CEQA statutes and guidelines can be viewed at: http://ceres.ca.gov/ceqa/guidelines/

The purpose of CEQA is to:
a) disclose to decision makers and the public the significant environmental effects of proposed activities;
b) identify ways to avoid or reduce environmental impacts;
c) require implementation of feasible alternatives or mitigation; and
d) provide for public input

Who must comply with CEQA?

All public agencies are subject to the requirements of CEQA. A public agency must comply with CEQA when it undertakes an activity defined by CEQA as a "project". A project is an activity which must receive discretionary approval.

Are certain projects exempt from CEQA?

Yes, CEQA has determined that certain projects will not cause either a direct or indirect physical change in the environment.

Consistent with state statutes, the Los Angeles City Council on July 31, 2002 adopted new City CEQA Guidelines that identify various projects that could be exempt from CEQA. A copy of the City CEQA Guidelines can be viewed at:
http://cityplanning.lacity.org/EIR/CEQA_Guidelines/City_CEQA_Guidelines.pdf
A list of exemptions that are commonly used for LAWA projects is included at the end of this section.

Are there exceptions when exemptions may be applied?

Yes, there are exceptions to most exemptions. Exceptions apply depending upon the location, timing and circumstances of the project and its surroundings. All projects are reviewed on a case by case basis and must be viewed as a whole and not a portion of the entire project.

Section 15300.2 of the State CEQA Guidelines provides guidance of certain situations where an exemption may not apply:

15300.2. EXCEPTIONS
(a) Location. Classes 3, 4, 5, 6, and 11 are qualified by consideration of where the project is to be located – a project that is ordinarily insignificant in its impact on the environment may in a particularly sensitive environment be significant. Therefore, these classes are considered to apply all instances, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.
(b) Cumulative Impact. All exemptions for these classes are inapplicable when the cumulative impact of successive projects of the same type in the same place, over time is significant.
(c) Significant Effect. A categorical exemption shall not be used for an activity where there is a reasonable possibility that the activity will have a significant effect on the environment due to unusual circumstances.
(d) Scenic Highways. A categorical exemption shall not be used for a project which may result in damage to scenic resources, including but not limited to, trees, historic buildings, rock outcroppings, or similar resources, within a highway officially designated as a state scenic highway. This does not apply to improvements which are required as mitigation by an adopted negative declaration or certified EIR.
(e) Hazardous Waste Sites. A categorical exemption shall not be used for a project located on a site which is included on any list compiled pursuant to Section 65962.5 of the Government Code.
(f) Historical Resources. A categorical exemption shall not be used for a project which may cause a substantial adverse change in the significance of a historical resource.

What happens when a project does not qualify for an exemption?

Projects that are not exempt from CEQA require environmental review. An initial study is prepared and the results of that study will determine whether a Negative Declaration, Mitigated Negative Declaration or Environmental Impact Report is prepared.

The process for preparing a (Mitigated) Negative Declaration can be found in Article 6 (Sections 15070 to 15075) of the State CEQA Guidelines. It includes a public review period of no less than 20 days.

The process for preparing an Environmental Impact Report can be found in Article 7 (Sections 15080 to 15097) of the State CEQA Guidelines. The process includes sending a Notice of Preparation to the State Clearinghouse and each responsible and trustee agency notifying them that an EIR will be prepared. Responses from agencies and the public at this stage will help determine the scope of the EIR and the significant environmental issues and reasonable alternatives and mitigation measures that will need to be explored in the Draft EIR. Once the Draft EIR has been completed, it is released for public review and comment for a period of no less than 45 days.

The purpose of the public review period for both the (Mitigated) Negative Declaration and the EIR is to ensure the sufficiency of the document in identifying and analyzing possible significant environmental impacts and how they may be avoided or mitigated. Comments are most constructive if they disclose additional possible impacts, alternatives, or mitigation measures. Responses to the comments are prepared and both the comments and responses are then compiled in the final document for consideration by the decision-maker. The review by other agencies and the public helps to ensure that the document is as complete as possible so that decision-maker can make an informed decision on the project.

After the public review process, LAWA staff will incorporate any comments, LAWA's response to comments and the environmental study into a final document that is presented to the decision-maker to assist them in their decision making. A project cannot be considered for approval unless the decision-maker receives and reviews the document prior to making a decision.

Possibly Exempt Projects or Activities (Excerpt from the City of Los Angeles CEQA Guidelines)

General Exemptions

A. General Exemptions typically are applied to administrative and/or ministerial activities.

Article II, Section 2a

Emergency Projects, such as

1) Projects undertaken, carried out, or approved by a City agency to maintain, repair, restore, demolish or replace property or facilities damaged or destroyed as a result of a disaster in a disaster-stricken area for which a state of emergency has been proclaimed by the Governor pursuant to Chapter 7 (commencing with Section 8550) of Division 1, Title 2 of the Government Code.

2) Emergency repairs to public service facilities necessary to maintain service.

3) Specific actions necessary to prevent or mitigated an emergency.

Article II, Section 2d

Feasibility and planning studies for possible future action, although such studies shall include consideration of environmental factors.

Article II, Section 2f

Continuing administrative, maintenance and personnel-related activities.

(This subsection should not be construed by City Agencies to exempt their ongoing programs that may have significant impacts on the environment.

Article II, Section 2i

Any activity (approval of bids, execution of contracts, allocation of funds, etc.) for which the underlying project has previously been evaluated for environmental significance and processed according to the requirements of these Guidelines.

(This subsection is used when a Negative Declaration or Environmental Impact Report was prepared for the underlying project.)

Categorical Exemptions

Categorical Exemptions are based on findings by the Secretary of Resources that an activity falling under a particular class of projects will not have a significant environmental impact. Categorical exemptions, however, ***cannot*** *be used for projects where such project may have a significant effect on the environment.*

Article III, Class 1 Existing Facilities

Class 1 consists of the operation, repair, maintenance or minor alteration of existing structures,

facilities or equipment, involving negligible or no expansion of use.

Article III, Class 1 (1)

Interior or exterior alterations involving remodeling or minor construction where there will be negligible or no expansion of use.

Article III, Class 1 (3)

Operation, repair, maintenance or minor alteration of existing highways and streets, sidewalks, gutters, bicycle and pedestrian trails, storage areas, parking lots, aircraft parking areas, wharves, railroads, runways, taxiways, navigable waterways, bridle trails, service roads, fire lanes and golf-cart paths, except where the activity will involve removal of a scenic resource including but not limited to a stand of trees, a rock outcropping or an historic building.

Article III, Class 1 (4)

Restoration or rehabilitation of deteriorated or damaged structures, facilities or mechanical equipment and systems to meet current standards of public health, safety and environmental protection.

Article III, Class 1 (5)

Additions to existing structures provided that the addition will not result in an increase of more than:

a) 50 percent of the floor area of the structures before the addition or 2,500 square feet, whichever is less; or

b) 10,000 square feet of:

i. The project is in an area where all public services and facilities are available to allow for maximum development permissible in the General Plan and

ii. The area in which the project is located is not environmentally sensitive.

Article III, Class 1 (6)

Addition of safety, security, health or environmental protection devices for use during construction of or in conjunction with existing structures, facilities or mechanical equipment, or topographical features (including navigational devices).

Article III, Class 1 (7)

New copy on existing on and off-premise signs.

Article III, Class 1 (8)

Maintenance of existing landscaping, native growth, water supply reservoirs; and brush clearance for weed abatement and fire protection (excluding the use of economic poisons as defined in Division 7, Chapter 2, California Agricultural

Code).

Article III, Class 1 (11)

Demolition and removal of individual small structures listed in this subdivision except where the structures are of historical, archaeological or architectural significance:

a) Single-family residences not in conjunction with the demolition of two or more units;

b) Motels, apartments, and duplexes designed for not more than four dwelling units not in conjunction with the demolition of two or more such structures;

c) Stores, offices, and restaurants designed for an occupant load of 20persons or less, if not in conjunction with the demolition of two or more such structures;

d) Accessory (appurtenant) structures including garages, carports, patios, swimming pools, and fences.

Article III, Class 1 (12)

Outdoor lighting and fencing for security and operations.

Article III, Class 1 (18)

Issuance of permits, leases, agreements, berth and space assignments, and renewals, amendments or extensions thereof, or other entitlements granting use of the following existing facilities and land and water use areas involving negligible or no expansion of use and/or alteration or modification of the facilities or its operations beyond that previously existing or permitted:

c) Municipal Airports

Article III, Class 1 (20)

Modernization of an existing highway, street, alley, walk, mall or minor drainage channel by construction of improvements, resurfacing, reconstruction, eliminating jut-outs, widening less than a single lane width, adding shoulders or parking lanes, adding auxiliary lanes for localized purposes (turning, passing, and speed change), correcting substandard curves and intersection, bottleneck bridge widenings not to exceed the width of the adjacent existing roadway approaches, and other bridge widenings less than an additional lane on the bridge. This exemption shall not be used where extensive tree removal will be involved.

Article III, Class 1 (24)

Relocation of an existing use within a publicly owned facility.

Article III, Class 1 (31)

Establishment or modification of any rate, fee or charge for the use of existing

municipal facilities and services involving negligible or no expansion of use.

Article III, Class 1 (32)

Installation, maintenance or modification of mechanical equipment and public convenience devices and facilities which are accessory to the use of the existing structures or facilities and involve the negligible or no expansion of use.

Article III, Class 1 (35)

Minor extensions of, and connections between, existing taxiways which permit alternative aircraft ground maneuvering operations and involve negligible or no expansion of use.

Article III, Class 2 Replacement or Reconstruction

Class 2 consists of replacement or reconstruction of existing structures and facilities where the new structure will be located on the same site as the structure replaced and will have substantially the same purpose and capacity as the structure replaced.

Article III, Class 2 (2)

Replacement of a commercial or industrial structure with a new structure of substantially the same size, purpose and capacity.

Article III, Class 2 (6)

Replacement or reconstruction of existing heating and air-conditioning systems.

Article III, Class 2 (7)

Replacement of existing pedestrian stairways, including such additional rights of way as needed to bring the stairways up to current standards of length and width, providing that the project does not impact cultural resources or remove mature trees.

Article III, Class 3 New Construction of Small Structures

Class 3 consists of construction and location of limited numbers of new, small facilities or structures, installation of small new equipment and facilities in small structures; and the conversion of existing small structures from one use to another where only minor modifications are made in the exterior of the structure. The numbers of structures described in this section are the maximum allowable within a two year period.

Article III, Class 3 (4)

Installation of new equipment and/or industrial facilities involving negligible or no expansion of use if required for safety, health, the pubic convenience, or environmental control.

Article III, Class 3 (17)

Projects involving less than 35 dwelling units or 15,000 square feet of commercial, industrial, governmental or institutional floor space where, as determined by the appropriate City department, the project is not in a designated

hillside ("H") area or in an officially mapped area of severe geologic hazard, conforms with or is less intensive than the adopted plan, is not in an officially designated Paleontological, Historical, Archaeological or Seismic Study Area, and, if residential, is more than 1,000 feet from a freeway, railway, or airport, except where the mitigation of potentially significant noise and air quality impacts to an insignificant level is ensured. If any grading is required in connection with such projects, this Categorical Exemption shall not apply unless the grading is also exempted by Subsection d of Subsection 1 of this Article.

Article III, Class 5 Alterations in Land Use Limitations

Class 4 consists of minor alterations in land use limitations in areas with less than a 20% slope which do not result in any changes in land use or density.

Article III, Class 5 (30)

Granting easements to other local agencies, utilities or private persons to accomplish activities that are categorically exempted by these Guidelines.

Article III, Class 6 Information Collection

Class 6 consists of basic data collection, research, experimental management and resource evaluation activities which do not result in a serious major disturbance to an environmental resource. These may be for strictly information gathering purposes, or as part of a study leading to an action which a public agency has not yet approved, adopted, or funded.

Article III, Class 6 (1)

Permits for test holes in public areas which will be used for engineering evaluations for street, sewer, storm drain, buildings or utility installations.

Article III, Class 6 (2)

Basic data collection, field testing, research, experimental management and resource activities of City Departments, bureaus, divisions, sections, offices or officers which do not result in serious or major disturbances to an environmental resource.

Article III, Class 11 Accessory Structures

Class 11 consists of construction or placement of minor structures accessory to (appurtenant to) existing commercial, industrial, or institutional facilities.

Article III, Class 11 (1)

On-premise signs.

Article III, Class 11 (2)

Parking lots under 110 spaces where no decking or undergrounding is involved.

Article III, Class 11 (5)

Signs located on City property managed by a City department which has a sign policy adopted by the City Council or, in the case of a proprietary department, by

its Board of Commissioners.

Article III, Class 11 (6)

Construction or placement of minor structures accessory to (appurtenant to) existing commercial, industrial or institutional facilities.

Article III, Class 11 (7)

Construction or placement of buildings, or additions to buildings, involving the addition of less than 15,000 square feet, which additions are accessory to existing commercial, industrial or institutional facilities.

Article III, Class 11 (8)

Authorizations by the Department of Airports for the installation, maintenance, relocation, replacement and/or removal of: structures, lighting, fencing and security facilities; noise and environmental monitoring systems and facilities; mechanical and electrical equipment; and, other facilities which are accessory to the use of existing or approved airport structures, facilities, or operations, and involve negligible or no expansion of airport operations beyond that previously existing or permitted.

1.6 Airport Contact – Reference is made throughout this document to "Airport Contact". For the purpose of this Handbook, "Airport Contact" is defined as LAWA Project Engineer/Project Manager.

1.7 LAWA Insurance Requirements - A current insurance certificate is required for every Contractor performing work on the premises of the Airport and any other entity requiring Security Badging. The insurance will need to be in place, and certificate available, before applying for Security Badging.

The minimum coverage will be specified by LAWA's Risk Management Division - Insurance Compliance Services. That no contractor's vehicles or equipment shall have access to the airfield unless the proper liability insurance has been provided. It is the responsibility of the Tenant to require and verify that the Tenant's Contractor has adequate insurance coverage.
Refer to http://www.lawa.org/welcome_LAWA.aspx?id=4162

1.7.1 Hold Harmless Agreement - That the Tenant shall defend, indemnify, and save harmless the City of Los Angeles and all its officers, agents, and employees from all suits, actions, or claims of any character, name, or description brought for or on account of any injuries or damages received or sustained by any person, persons, or property arising out of or based upon any event or condition occurring or existing as a result of the construction hereby approved during the course of construction or at any time following completion thereof.

1.7.2 Hold Harmless Agreement (Federal funded projects only) - FEDERAL TORT CLAIMS ACT: In accordance with and subject to the conditions, limitations, and exceptions set forth in the Federal Tort Claims Act of 1948, as amended (28 USC 2671 et Seq.), hereafter termed 'the Act', the Tenant will be liable to persons damaged by any personal injury, death or injury to, or loss of property, which is caused by a negligent or wrongful act or omission of any employee of the Government while acting within the scope of his office or employment under circumstances where a private person would be liable in accordance with the law of the place where the act or omission occurred. The foregoing shall not be deemed to extend the Government's liability beyond that existing under the Act at the time of such act or omission or to preclude the Government from using any defense available in law or equity.

1.8 Bond Requirements – LAWA Performance and Payment Bond Requirements - That before beginning work, the Tenant's general contractor shall secure a Labor and Material Payment Bond for private work in the amount of fifty percent (50%) of the construction contract price, as specified in Sections 3235 through 3241 of the Civil Code of the State of California. The Tenant, not the City of Los Angeles (LAWA), is to be the obligee under the bond. The original of said bond shall be filed for record with the Los Angeles County/San Bernardino County Recorder as provided by law. A conformed copy of the recorded bond must be approved as to form by the City Attorney prior to the Tenant's general contractor beginning work.

1.9 Manual for Design of Streets and Roadways – City of Los Angeles Street Design Manual, latest version, shall govern the design of streets and roadways. For projects at Ontario Airport, see ONT traffic and transportation guidelines. These manuals maybe reviewed at lacity.org.

1.10 Manual for Storm Drain Design – City of Los Angeles Storm Drain Design Manual, latest version, shall govern the design of storm drains at LAX and VNY. For projects at Ontario Airport, see Water and Sewer Design and Pipeline Construction Guidelines. These manuals maybe reviewed at

lacity.org.

1.11 Manual for Sewer Design – City of Los Angeles Sanitary Sewer Design Manual, latest version, shall govern the design of sanitary sewers at LAX and VNY. For projects at Ontario Airport, see Water and Sewer Design and Pipeline Construction Guidelines. These manuals maybe reviewed at lacity.org.

1.12 Federal Aviation Administration (FAA) Standards - These standards may be obtained from the Federal Aviation Administration at FAA.gov or from:

Federal Aviation Administration
P.O. Box 92007, AWP-600
Los Angeles, CA 90009

If applicable, completion of Airspace Study Application form 7460 is required. Approval from the Federal Aviation Administration (FAA) is required for projects resulting in a change in the Airport Layout Plan or for the use of cranes and certain other construction equipment. Permits for construction will be limited until required FAA approvals are obtained.

1.13 Customs and Border Protection – U.S. Customs and Border Protection (CBP) All contractors, tenants, site personnel and design stipulations will be subject to the requirements of the CBP Agency as well as the Department of Homeland Security. These regulations are expected to change from time to time. It is incumbent upon the tenant and design agent to be cognizant of the project areas or designs that may be require interface with these agencies, and secure any and all approvals that may be necessary.

1.14 Federal Department of Homeland Security (DHS) Standards - For projects impacting Security Screening, Federal Inspection, etc. refer to DHS standards that may be obtained from dhs.gov. All designs or projects including any Homeland Security Facilities shall be reviewed and approved by local Transportation Security Administration (TSA) Federal Security Director's office, and local Customs and Border Protection Office.

1.15 Tenant Projects Approvals –

Before a Project is initiated:

Maintenance Projects –

Projects that are categorized as maintenance projects do not need to be submitted for a formal concept review or be subjected to other formal review processes. Although initial determination of projects lays with the tenant, LAWA reserves the right to categorize projects as may be necessary.

Maintenance projects are those projects that do not create a cardinal change to areas of operations, movement, security, life safety, utilities, building systems, or other impacted disciplines. A maintenance project does not impact other tenants or other operations.

Should a project require any type of Permit to proceed, it is **NOT** considered a maintenance project.

Typical maintenance projects may include; simple painting, carpet repair, rearranging FF&E, etc.

Consult with your Business Relations Manager for maintenance projects.

General

The intent is to provide the Tenant with as much information as we can as early as possible, even before a project is initiated.

The **Design and Construction Handbook** is a document available to all Tenants on LAWA's internet site for Project Approvals at

http://www.lawa.org/welcome_LAWA.aspx?id=4162

This document includes detailed information regarding procedures and processes and includes checklists and guideline specifications. The intent is to help guide tenants and designers to attain the consistency and quality desired by LAWA. Throughout the process, the Tenant will be referred back to the Design and Construction Handbook. The Project Approval Site also contains other useful information for the Tenant including: forms, list of contacts, and the LAX Address Map.

To Initiate a Project:

All projects begin with a **5% Concept Review**. To start a new project, a Tenant will submit a **Concept Request Form** along with appropriate attachments to LAWA, to the LAWA Project Approval email address: projectapprovals@lawa.org . Ultimately, Commercial Development Group (CDG) will be the primary point of entry for new Tenant Project Approvals. During the transition and roll out period, Facilities Planning will assist with monitoring the LAWA Project Approval email address and inputting and distributing the information. The Tenants may hand their submittal to another LAWA representative with whom they have familiarity, an ADG PM for example. It will be the responsibility of all LAWA staff to make sure the submittal gets to the right place as soon as possible.

The **Concept Request Form** is a tool to let the Tenant know the appropriate information we need up front to evaluate the project. There are instructions accompanying the form, explaining each field and the attachments that should be included. The form provides basic information about the project, such as Project name, Contact Information, Location, Estimated Milestones, Scope Description, and List of Potential Impacts that will need to be coordinated. Every Concept Request Form should be accompanied by a copy of the **Master Lease Exhibit (MLE),** which is a drawing that specifies the Tenant's leased area affected by the project. The submittal should also include other exhibits such as sketches, drawings, photographs, and/or cut sheets, that clearly define the scope of work. It is important that these forms are filled out as completely as possible and the attachments are provided so that we can efficiently and effectively review the proposed project. The Concept Request Form is very straight forward. However, the Tenant may request assistance from their BRM to complete it. It is CDG's responsibility to make sure the form is filled out completely and that the attachments are submitted. CDG will, ultimately, be responsible for inputting the information from the form as well as uploading the documents into the Project Tracking Database.

Concept Review Stage:

Design and Construction Handbook

Once the **Project Request Form** and its attachments are submitted LAWA will conduct an internal review. First, the project will be evaluated by CDG from a business standpoint. The BRM will recommend that the project either be approved or denied, complete the finding of facts (leasing issues, acquisitions, etc.), and determine any other necessary comments or conditions specific to the project. Next, Facilities Planning will lead the review of the project from a technical standpoint.
Each division within LAWA will review the project (or at minimum be made aware of the project) through the **Project Approval Team** (PAT). The PAT consists of representatives from all of LAWA's divisions organized into teams by project type: Terminal, Airside, Landside, Infrastructure, Concessions, and Bradley West. There are also teams for Van Nuys, Ontario, and Palmdale. The PAT members will be responsible for reviewing the projects based on their individual expertise and will meet regularly to follow up with all active projects. During the Concept Review, the Facilities Planning Project Planner assigned to the project will be responsible for distributing the projects and collecting the comments from the PAT Team members. At this stage, the reviewers will be determining if the project is feasible, fits with the planning goals of the airport, and determining additional information needed. The reviewers will be reviewing the drawings to make these determinations, but will not perform a quality control analysis.

For projects in the Concept Review Stage, the recommendations and conditions will be presented to a group of LAWA's Executives, the Executive Project Approval Team (EXPAT) at their regularly scheduled weekly meeting. The EXPAT will officially Approve or Deny the project. Next, LAWA will send a response to the Tenant, either a Project Approval or Denial Letter. This letter will indicate this decision and outline how the Tenant should move forward in the process. The letter will be drafted by Facilities Planning and signed by Debbie Bowers. Our goal is that is if the project is denied, the Tenant will also get a phone call explaining the reason for denial, before the physical letter arrives by mail.

The **Concept Approval Letters** are concise and specific to the project. Each letter will reference the Design and Construction handbook for general conditions, but will no longer include an extensive list of general conditions like the former Construction Approval Letters. Instead, the letters will focus on information specific and unique to the proposed project including, but not limited to: additional information, such as drawings and exhibits, that will need to be submitted, contact information for reviewers with whom the Tenant will need to coordinate certain items in order to get sign off, a checklist for the subsequent review, and an indication of all further reviews required. A Tenant must have a Concept Approval Letter before moving forward in the process.

Please note, a Concept Review Letter does not mean that Construction may begin.

The Tenant can expect to receive a Concept Response within 2-3 weeks of submitting a complete Concept Submittal.

Additional Reviews:
Some projects will require additional technical reviews, between the Concept Review and Notice to Proceed, at intervals that are appropriate for the scope of the project and that correspond to standard design development milestones. If any other reviews are required before preceding to the Notice to Proceed Stage it will be decided by the PAT during the Concept Review. These requirements will be outlined in the Concept Approval Letter. These reviews are modeled after the same industry standards

that the Capital Improvement Projects (CIP) Process mirrors, LAWA is moving towards the goal of having “one process” regardless of the project type.

30% Conditional Review
If a 30% Conditional Review is required, the Tenant will submit a 30% Package according to the standards in the Design and Construction Handbook. The package should address the comments and conditions outlined in the Concept Approval Letter. Facilities Planning will lead the review of the project through the Project Approval Team (PAT). The Facilities Planning Project Planner assigned to the project will be responsible for distributing the projects to and collecting the comments from the PAT Team members. The PAT will meet for their regularly scheduled meeting to discuss any issues or concerns. The 30% Conditional Review Response letter will be written by Facilities Planning, signed by Cynthia Guidry, and sent to the Tenant.

60% Progress Review
If a 60% Progress Review is required, the Tenant will submit a 60% Package according to the standards in the Design and Construction Handbook. The package should address the concerns and conditions outlined in the Concept Approval Letter (and 30% Conditional Response Letter if Conditional Review was required). Airport Development Group (ADG) will lead the review of the project through the Project Approval Team (PAT). The ADG Project Manager assigned to the project will be responsible for distributing the projects to and collecting the comments from the PAT Team members. The PAT will meet for their regularly scheduled meeting to discuss any issues or concerns. The 60% Progress Review Response letter will be written by ADG, signed by Intissar Durham, and sent to the Tenant.

90% Progress Review
If a 90% Progress Review is required, the Tenant will submit a 90% Package according to the standards in the Design and Construction Handbook. The package should address the concerns and conditions outlined in the Concept Approval Letter (and 30% Conditional Response Letter and/or 60% Progress Response if these reviews were required). Airport Development Group (ADG) will lead the review of the project through the Project Approval Team (PAT). The ADG Project Manager assigned to the project will be responsible for distributing the projects to and collecting the comments from the PAT Team members. The PAT will meet for their regularly scheduled meeting to discuss any issues or concerns. The 90% Progress Review Response letter will be written by ADG, signed by Intissar Durham, and sent to the Tenant.

Notice to Proceed Review:
For most projects LAWA anticipates the next submittal after the Concept Review will be for a Notice to Proceed Review. The Tenant will submit **Conformed Documents** that incorporate the comments and conditions set forth by LAWA in the Concept Review Letter, that bear a stamp of approval from the Los Angeles Department of Building and Safety (LADBS), and according to the standards in the Design and Construction Handbook. Airport Development Group (ADG) will lead this review of the project through the Project Approval Team (PAT). The ADG Project Manager assigned to the project will be responsible for distributing the projects to and collecting the comments from the PAT Team members. Once all conditions are met, the Tenant will receive a **Notice to Proceed Letter** written by ADG and signed by Intissar Durham.

Construction may now begin.

Please note: all projects must go through a Notice to Proceed Review. Construction may not begin until the Tenant has been issued a Notice to Proceed Letter.

Construction and Closeout:

During construction, the Airports Development Group (ADG) Project Manager serve as the single point of contact for the Tenant and Contractor for all construction related matters during the construction period. The ADG Project Manager will ensure that the construction taking place is consistent with the Conformed Documents submitted to ADG that served as the basis for the issuance of the Notice to Proceed. The ADG Project Manager will serve as the liaison between the Tenant and Construction and Logistics Management (CALM) to ensure logistics are coordinated and executed in compliance with established guidelines and procedures. Construction Inspection Division (CID) will verify that the quality of Tenant's construction reasonably comports with the Tenant's Conformed Documents submitted and approved by the Department of Building and Safety and LAWA and report discrepancies to the ADG Project Manager.
At the end of Construction, LAWA's Airport Development Group working with Inspections will complete the **Project Acceptance Checklist** with the Contractor. When all conditions have been met, ADG will notify CDG via the Project Acceptance Memo that the project is ready for Closeout. LAWA will issue a **Project Closeout Letter**, written by CDG and signed by Debbie Bowers, to the Tenant, effectively closing the project (releasing the bonds, etc.).

Conclusion:
This process was designed to have formal reviews required when necessary, but also to encourage informal sharing of information between LAWA and the Tenant. If LAWA needs a simple question answered or more information in order to approve a project, the plan is to try to address these issues with the Tenant directly, without adding unnecessary formal reviews.
The process is consistent and organized so that the basic flow of information is the same within each stage**.** Different divisions will lead the process internally as the project progresses. However, the way that the Tenant submits to LAWA at each phase and the manner in which LAWA will issue a response will be the same throughout the process. By providing information up front and clearly outlining and documenting the process, LAWA anticipates that the New Tenant Approval Process will be beneficial for both LAWA and the Tenants.

> **Submittals –** For LAWA Initiated Projects- At the request of LAWA, applicant may be required to follow the submittal requirements specified for LAWA Projects.

A. Complete and dated plans and specifications (including traffic control plans if applicable) of sufficient clarity to indicate the location, nature and extent of the work proposed and with sufficient detail to indicate that the proposed work conforms to the provisions of this Handbook, and other applicable laws, statutes, orders, and regulations. Plans and specifications shall be prepared by an architect, engineer or other design professional licensed in the State of California to practice as such and shall bear the seal of the design professional responsible for preparation of the plans and specifications. Submit eight (8) sets of construction documents along with two electronic copies. Designer shall provide full size prints if needed, otherwise 11 X 17 size will suffice.

B. If applicable, completion of Airspace Study Application form, is required. Approval from FAA is required for projects resulting in a change in the Airport Layout Plan.

C. Applicant is required to schedule a meeting with Herb Glasgow of the Airport Planning Office, (phone 424 646- 5180) to discuss the project scope. Based upon the scope, Mr. Glasgow will provide the technical input for completing the CEQA Checklist (Checklist) and any other needed Planning actions. The purpose of this checklist is to identify the environmental regulations that apply to the proposed construction or to the operation of the completed work, structure, or facility. The Applicant must submit to Airport Contact the Checklist and all applicable attachments. An Approval Permit cannot be issued until all required information has been received.

Building Construction Projects - For building construction projects, provide the following information on the cover sheet of the drawings:

- The street address of the structure The name and address of the Lessee
- The edition of the codes under which the project is designed
- Building Code Use and Occupancy Classification
- Building Code Construction Type
- Design Occupant Load and Exiting Analysis
- Fire/Life Safety system criteria
- U-factors of building envelope systems and a statement signed and sealed by the architect of record that the building envelope complies with the Energy Code Tabulation of building components and systems and a statement signed and sealed by the engineer of record that all building components and systems comply with the Energy Code.

Pre-Design Checklist for Tenant Projects

During the Pre-Design Meeting, LAWA PM and the Tenant will discuss all phases of the project to identify which activities do and do not
apply to this project. The following list can be a handy reference for addressing the various requirements and activities. It is suggested that the list be printed and marked up at initial meeting.

Issues Addressed	Information Discussed	Documents Distributed	N/A
Standards and Regulations			
Regulations for Airport Construction			
Building & Safety Role			
LAWA CAD Drawing Standards			
Signage and Graphics Standards			
Architectural Design Standards			
Case Work Standards			
Electrical Systems Standards			
Mechanical Systems Standards			
Communication System Standard			
Radio Frequency Standards & Guidelines			
Industrial Waste System Standards			
Storm Drainage/Sewer System Standards			
Domestic Water System Standards Contractor's Contact list			
Review project scope with Fire Department for potential impacts			
Long Lead Items			
FAA Regulations - Notice of proposed Construction or alterations - Form 7460			
Airport Security Plan			
Badges, Access to secure areas for A/E, Contractors, Vendors Contractor's Performance Bond Contractor's Labor and Material Payment Bond			
Pre-Design			
Tenant A/E is responsible for all site verifications			
Air and Water Availability report			
Issues Addressed	**Information Discussed**	**Documents Distributed**	**N/A**
Design			
Impacts to Public and AOA areas Wayfinding Signage			
Connection to Electrical System			
Connection to Chiller Water, Steam and Condensate or Air Handling Units			
Connection to Communications System			
Connection to Radio Frequency System (including Wireless System(s))			

Connection to Industrial Waste System			
Connection to Storm Drainage System			
Connection to Water System			
Connection to Sanitary Sewer System			
Core drilling and filling vacated holes in terrazzo flooring			
CEQA Questionnaire			
Construction Barricades and Signage			
Tenant A/E to identify logistics requirements -lay down area, AOA traffic, deliveries, security, noise, temp power-on drawings for Contractors to bid.			
Building Department Plan Check Package			
Construction			
Pre-Construction Meeting			
Contractor's site specific safety plan and project inspector			
Contractor's Certificate of Insurance and Bonds			
Identify Submittal log items			
Tenant contact list with 24/7 On-call contacts			
Temporary water/power requirements			
Utilities Shut Down Request Form			
Construction Barricades, Signs			
Site Logistics & Project Phasing plans			
Project Close-Out			
Commissioning Inspection Card Sign-Off As-constructed drawings, specifications and manuals Update of Master Lease Exhibit			

Issues Addressed	**Information Discussed**	**Documents Distributed**	**N/A**
Inspection Card Sign-Off			
Deficiency List			
Completion Requirements			
Lien Releases			
O&M Manuals			
As-Built Submittals			
Certificate of Occupancy			

1.16 Consultant Participation During Construction Bid Phase of LAWA Issued Project – In general the following process is usually followed in the selection of contractors. Construction bids are solicited through general advertisements. A pre-bid conference is conducted prior to the opening of the bids to discuss the scope of the work and answer questions from bidders. The design consultant is expected to conduct or participate in this conference to provide answers to pertinent questions and to assist in preparing any resulting contract addenda. At the advertised time, the bids that have been received will be publicly opened and read aloud. The consultant may be asked to assist in analyzing the bids to determine the responsive low bidder. A notice to proceed with construction will be issued after Board approval of the final construction contract.

1.17 Consultant Participation During Construction Process of LAWA Issued Project - Prior to the start of construction, a pre-construction conference is held to review contract requirements, operational and site restrictions, notification procedures and required inspections. Depending upon contract scope requirements, the consultant may be responsible for assisting in the review of shop drawings, submittals, requests for information, change orders and other documents and may be required to attend periodic or regular construction progress meetings. On some projects, partnering sessions may be conducted. LAWA representatives, the consultant, the contractor and/or the construction manager and the major sub contractors will be included in the partnering sessions.

1.18 Consultant Participation at Completion of Construction on LAWA Issued Projects - Depending upon contract requirements, the consultant generally participates in a final project "walk-through" at the completion of construction and is usually responsible for reviewing the contractor's certified as-built drawings and specifications submittal and for preparing the final record drawings.

1.19 Software Requirements and Project Design Delivery - Production and maintenance of project documentation shall comply with LAWA CADD Standards Manual available at lawa.org. The final deliverables shall consist of the construction Contract Documents which shall be complete and shall set forth in detail all work required for the architectural, civil, structural, mechanical, plumbing, electrical, fire protection and fire detection, communication, security and utility service systems, including transportation interfaces, site work, and all necessary bidding information. Designers on LAWA issued projects are required to use Prolog and Primavera, among others.

1.20 Basis of Design Manual - ***Basis of Design (BOD)*** **-** The BOD is a narrative and analytical documentation prepared by the design A-E along with design submissions to explain how the owner's project requirements are met by the proposed design. It describes the technical approach used for systems selections, integration, and sequence of operations, focusing on design features critical to overall building performance. Most design projects require that various engineering calculations be performed and/or design criteria/material cut sheets be assembled that provide the basis for information on the construction plans and specifications. These values and calculations shall be assembled in a "Basis of Design Manual" for each project. These documentation requirements will vary for each specific design discipline. The basis of design should be approved in the planning phase before advancing the design effort to the next step.

1.21 Required Submittals - During the planning and design stages of project development, certain submittals are required in bound form for LAWA review and approval. The submittals described below are considered the minimum requirements. At LAWA's discretion, intermediate reviews may be

required. Intermediate reviews may be deemed necessary when the scope of the project has been changed or if an earlier review found the plans and specifications unacceptable, either as a whole or in part. Immediately after Concept approval, Consultant or Tenant shall provide LAWA with a Drawing/Specification Submittal Schedule that indicates the proposed submittal dates for all of the following packages.

The minimum acceptable stage of completion of the plans and specifications will be:

1.21.1 Design Criteria Phase (30%) - For all LAWA projects, the plans and specifications shall at a minimum include:

B. A boundary survey and/or site topographic survey shall be made on the ground of the proposed building or construction site. All points shall be tied to the existing Airport Coordinate System. Refer to LAX Survey Control Network and LAWA Survey Standards. Ground survey verification of existing utility alignments and actual flow lines may be required.

C. All existing buildings, facilities, contours, roadways, utilities, or signs in the immediate area of the project site or relevant to the proposed work should be shown on a preliminary site plan.

D. Layouts of the proposed roadways, access drives, parking areas, site utilities and building locations should be shown.

For Airfield Projects, the plans and specifications shall at a minimum include:

A. All existing terminals, runways, taxiways, taxi lanes, aprons, ground support equipment areas, emergency roads, buildings and structures, contours, underground utilities, or signs in the immediate area of the project site or relevant to the proposed work should be shown.

B. All existing FAA NAVAIDS, duct banks, guidance signs, lighting fixtures, electrical ducts, vaults, handholds, and circuit locations should be shown and identified.

C. Layouts of proposed paving, drainage, and electrical improvements.

D. Limits and dimensions of all object free areas, safety areas, exclusion zones, NAVAIDS, critical areas, and FAR part 77 airspace surfaces that affect project site.

E. Locations of proposed buildings, signs, NAVAIDS, AOA fences, and other site structures.

For Building Projects, the plans and specifications shall at a minimum include:

Building Code summary sheet showing governing codes and requirements for building and site.

A. Floor Plans

B. Elevations

C. Schedule of materials to be used.

D. Design Data - The building program and any special studies which will affect the project.

E. Tower Line-of-Sight Studies (if required)

F. Service entrances, Trash locations

G. Design Live Loads

H. Preliminary Site Logistics Plan as referenced in Section 1.31

I. Preliminary Project Phasing Document as referenced in Section 1.31

J. Proposed Construction Schedule

Architectural Drawings:

A. 1 Sheet Index
B. Project Description
- Update Code Research Information
- Identify occupancy types.

C. Egress Plan
- Update Occupant load summaries.
- Update egress loads.
- Indicate required fire separations and proposed opening protection.
- Any openings adjacent to the concourse corridor shall not exceed 60% of wall area.

D. Accessible Path of Travel / Existing Rest Room Plans
- Indicate path of travel from the Accessible Parking Spaces within the existing parking structure to the area of renovation.

E. Demolition Plan
- Identify all existing walls that are to be demolished.
- Identify which walls are to remain.
- Identify existing equipment that is to be removed and discarded.
- Identify existing equipment that shall remain.
- Prepare “cut, cap & make safe” drawings.
- Provide photos of existing conditions to LAWA.

F. Overall Site Plan
G. Floor Plans
- Major plan dimension completed
- Typical wall sections
- Designate wall types
- Indicate Room names and numbers.
- Identify fire rated construction.
- Identify all floor mounted equipment.

H. Overall Roof Plan
- Indicate all existing roof mounted equipment and roof penetrations.
- Indicate all proposed roof mounted equipment and all propose roof penetrations.

I. Reflected Ceiling Plan
   - Indicate ceiling layout with proposed heights
   - Indicate lighting plan
   - Indicate all ceiling mounted emergency egress devices.
   - Indicate all soffits and bulkheads.
   - Indicate all access panels (coordinate with mechanical drawings).

J. Door Schedule
   - Indicate door number, size, fire rating, frame type and door type.
   - Indicate typical head and jamb details
   - Coordinate lock standards with LAWA.

K. Finish Plan – w/ Material Sample Board
   - Identify all finishes on plan
   - Place all proposed finishes on sample board.

L. Furniture Plan
   - Update proposed furniture layout at public areas.
   - Provide Furniture descriptions and outline specifications.

M. Overall Interior Elevations, N/E/W/S
   - Define Tenant Storefront designs.

N. Building Cross Sections
   - Indicate heights of proposed finish ceilings.
   - Identify adjacent spaces.

O. Primary Wall Sections
   - Indicate top and bottom connections to existing structure.

P. Details – (¾" = 1'-0" minimum).
   - Provide ADA compliant casework and equipment details.
   - Provide waterproofing detail(s) for any interior "wet areas" such as kitchens including drains. In addition include waterproofing details for any new roof openings or other exterior openings.
   - Provide floor drains under all "wet" equipment.
   - Provide typical storefront details.
   - Provide typical fire stop details.

Q. Wayfinding and Signage Drawings and Details
   - Location Plans
   - Identify all sign types with corresponding signage schedule.
   - Perform structural and electrical coordination.

Food Service Drawings: (if required)

A. Sheet Index

B. Food Service Equipment Schedule with Utility Requirements

C. Food Service Equipment Plan

   - Hand sinks shall indicate soap and paper towel dispensers
   - Mop sink area shall show supply shelf and adjacent wall finishes.

- Locate grease interceptor on plan, identify hours of operation / meals per hour (sizing and calculations for existing or new by Mechanical Engineer)
- Provide menu
- Identify if washable dishes/utensils or disposable paper plates/plastic utensils will be used for dishwasher requirements.
- Identify trash dumpster location on property
- Identify how many employees per shift
- If project is change of use to Food facility – provide parking analysis
- Locate and identify employee changing room / locker room
- Locate bathrooms that employees / patrons will use.
- If mop sink is located remotely, indicate path from project area.
- Identify linear feet of dry storage capacity.
- Identity all utility access panels.
- Indicate wet and dry storage areas

A. Elevations / Details

B. Food Service Equipment Cut Sheets Exhaust Hood Drawing

Structural Drawings:

A. Provide sizes, weights, and location of HVAC units - both suspended and roof mounted.

B. Indicate weights of all equipment including food service.

C. Indicate details for new roof penetrations, if any.

D. Provide preliminary structural calculations

E. Indicate typical soffit and door support details.

F. Indicate vertical and lateral support for suspended ceilings, if any.

G. Indicate support details for any low walls.

H. Indicate framing details for openings wider than 4 feet in any interior partition.

I. Provide typical details for signage and equipment support.

J. Provide demolition drawings with photographs.

Mechanical Drawings:

A. Sheet Index

B. General Notes, Symbols, Legend, Preliminary Equipment Schedules

C. Demolition Drawings with Photographs.

D. Floor Plan

- Update location of existing mechanical rooms and equipment
- Locate IT Rooms, Electrical Rooms and Communication Rooms that will require air conditioning
- Update mechanical heating/cooling loads.
- Update primary ductwork layout.
- Update Zoning Plans
- Locate new AC Units on Plans
- Identify points of connection (poc).

E. Reflected Ceiling Plans
- Update location of air distribution devices.
- Locate all required access panels.

F. Roof Plan
- Locate new equipment with sizes and weights.

G. Standard Details

H. Manufacture's brochures identifying air handling and refrigeration equipment.

Electrical Drawings:

A. Sheet Index

B. General Notes, Symbols, Legend, Lighting Schedule, Panel Schedules

C. Demolition Drawings with Photographs

D. Single Line Diagram with Load Calculations

E. Floor Plan

- Finalize all information identified in previous submittal.
- Fire Alarm Plan
- Identify all Points of Connection and electrical shut offs.
- Locate dedicated utility room.

F. Reflected Ceiling Plan
- Update Lighting Layout

G. Standard Details

H. Coordinate Electrical Drawings with Signage Package

Plumbing Drawings:

A. Sheet Index

B. General Notes, Symbols, Legend, Preliminary Equipment Schedules

C. Demolition Drawings with Photographs.

D. Floor Plan
- Indicate all major horizontal pipe work, new and existing.
- Indicate water source information.
- Indicate sewer connection information, if applicable.
- Locate standpipes and risers on plans
- All plumbing fixtures are shown.
- Identify Water Heater(s) – characteristics and capacity
- Identify all floor drains and floor sinks – new and existing.
- Provide floor drains under “wet” equipment.
- Clearly identify all new floor penetrations.
- Identify direct and indirect drainage.
- Identify all required access panels.
- Indicate all gas lines –with shut off valves and corresponding meter(s) in the dedicated utility room.
- Identify all points of connections (poc).

E. Standard Details.

Fire Protection Drawings:

A. Floor Plan
- Locate Fire Control Room, identify all fire alarm panels.
- Locate all fire sprinkler risers.

B. Reflected Ceiling Plan
- Update sprinkler layout.
- Indicate Standpipe and Valve Locations

Communication Drawings:

A. Sheet Index

B. Demolition Plan
- With Survey Photos

C. Single Line Diagrams

D. Construction Floor Plan
- Indicate conduit sizes for all routes previously indicated.

E. Typical Details
- Connection Point Details at the MPOE and the dedicated utility room.
- Details pertaining to any proposed roof mounted equipment.

Security Drawings:

A. Sheet Index

B. Demolition Plan

C. Single Line Diagrams

- With Survey Photos.

D. Construction Floor Plan

E. Typical Details

Additional Required Documents:

A. Updated Cost Estimate

B. Updated Construction Schedule

C. Updated Site Logistics Plan

D. Provide “Cut Sheets” for all proposed equipment

E. Provide a Set of Outlines Specifications in CSI format and Basis of Design Narrative.

F. Updated LAWA submittal schedule

G. Updated Constructability Review form

1.21.2 Design Development Phase (60%) - For all LAWA projects, the Design Development plans and specifications shall include all information in previous submittals plus all annotated comments from previous submittals and shall at a minimum indicate:

A. Proposed landscaping, exterior signing, exterior lighting, fencing or other site elements.

B. Preliminary horizontal and vertical alignments for all roadways, drainage systems, and applicable exterior utilities tied into Airport coordinate system.

C. Preliminary paving and parking layouts with horizontal and vertical ties to site survey and representative cross-sections.

D. Preliminary Cost Estimates, Construction Schedule and Phasing Plans.

E. Perspective Rendering - May be required if the project has visual impact on the Airport development as a whole.

F. Design data and analysis.

G. Soil tests data and analysis.

H. Outline technical Specifications

Design Development plans and specifications for Airfield Projects shall at a minimum include:

A. Horizontal and vertical layouts for all proposed airfield paving, emergency roads, and drainage features.

B. Layouts for proposed airfield electrical circuits, NAVAIDS, and underground utilities.

C. Typical sections for each type of paving, including surface drainage.

D. Site access points and haul routes. Typical details for all paving, jointing, sealing, drainage, electrical, utilities, etc.

Design Development plans and specifications for Buildings shall at a minimum include:

A. Floor Plans

B. Framing Plans

C. Ceiling Plans

D. Roof Plans

E. Sections and Elevations

F. Details of typical conditions

Architectural Drawings:

A. Sheet Index

Project Description

- Update Code Research Information, as required.
- Provide parking area calculations, if required.
- Provide a diagrammatic building section highlighting the function of each level of the terminal.
- Provide a vicinity map.
- Provide a preliminary list of deferred permits, if any.
- Indicate a list of abbreviations and the Airport Acronyms utilized at LAX.

B. Egress Plan

- Update Occupant load summaries & corresponding egress loads

C. Accessible Path of Travel / Existing Rest Room Plans

D. Demolition Plan

- Indicate photos of existing conditions

E. Site Logistics Plan and Phasing Document(s)

- Prepare preliminary phasing drawings. Drawing shall be for each phase of construction

F. Zone Plan (if required).
- Indicate the sheet zones of the building

G. Site Plan
- Clearly identify the area of the Terminal being renovated.
- Identify all setbacks, easements, (utility and otherwise), overall building dimensions.

H. Floor Plans
- Call out all building sections.
- Make certain that all new walls have been identified by type of assembly with the proper fire rating.
- Identify all existing building expansion joints with corresponding detail call out, both horizontal and vertical.
- Indicate two building grids: one for existing construction and one for new construction.
- Call out areas with enlarged plans.
- Indicate any overhead features with a dashed line.
- Indicate new and existing drinking fountains.
- Locate all fire extinguisher cabinets, recessed or wall mounted.
- Verify plumbing fixture count with plumbing drawings.
- Make certain that a north arrow is indicated on the plans.
- Identify all new millwork.

I. Enlarged Floor Plans
- Provide enlarged floor plans for areas such as toilets, kitchens and various utilities rooms in order to better convey information that cannot be clearly identified and noted on a smaller drawing.
- For enlarged toilet rooms, indicate all accessories and compartments per LAWA standards.

J. Roof Plan
- Coordinate all new equipment pad locations, sizes and equipment weight(s) with MEP drawings.
- Confirm the ability of the existing roof structure to accommodate any new roof load with the Structural Engineer of Record.
- Call out related roof details, if any.

K. Reflected Ceiling Plan
- Clearly identify all finish materials.
- Indicate all ceiling heights.
- Update lighting plan based upon approved fixtures. Provide dimensions as to how to locate these fixtures.

- Identify all light coves and provide detail call out.
- Locate, verify and coordinate all ceiling mounted fixtures such as but not limited to: life safety devices, security cameras, signage, ventilation grills. Coordinate with corresponding disciplines.
- Begin detailing all soffit conditions. Indicate how the soffit is attached to the roof/floor assembly above with required kickers and connection call outs.
- Indicate all existing building expansion joints with a corresponding detail call out. Begin to detail conditions such as these taking into account the adjacent finish materials on both sides of the joint.
- Identify all plenum fire stops, if required by code.
- Consider a separate interstitial plan in order to identify various equipment and systems located between the ceiling plane and the structure above.

L. Door Schedule
- Check that all door numbers are identified on the plans with the proper size, fire rating, frame and door type.
- Indicate all door and frame types.
- Indicate typical door thresholds and note the transition between floor materials under the doors.
- Indicate all head and jamb details
- Indicate door hardware groups for all doors.

M. Finish Plan
- Update finish call outs based upon approved on finish materials.
- Identify all material transitions.

N. Furniture Plan
- Update furniture layout based upon approved furniture.
- Highlight code required horizontal clearances for egress.

O. Interior Elevations
- Confirm that all finish materials are clearly identified.
- Locate all wall mounted equipment such as but not limited to: Electrical outlets, fire extinguisher cabinets, fire hose cabinets, signage, strobes, defibrillator cabinets, lighting, etc.
- Indicate all access panels as required by MEP disciplines.
- Indicate all louvers and grills required by Mechanical plans.
- Indicate electrical switchgear and panels.
- Indicate all pipe and duct penetrations.
- Indicate vertical dimensions and where required, horizontal dimensions.

P. Building Cross Sections
- Indicate heights of proposed finish ceilings.
- Identify adjacent spaces with the corresponding room number.
- Identify all primary materials and note material transitions and terminations.

Q. Wall Sections
- Indicate top and bottom connections to existing structure.
- Call out all material finishes.
- Profile all equipment adjacent to wall.
- Indicate louvers and required heights. Coordinate with Mechanical drawings.

R. Details – (¾" = 1'-0" minimum).
- Further develop ADA compliant casework and equipment details.
- Further develop waterproofing detail(s) for any interior "wet areas" such as kitchens including drains or exterior.
- Provide typical fire stop details for both vertical and horizontal conditions.
- Provide enlarged details generated from wall sections.
- Wall Types.
- Expansion and control joints.
- All material transition details – floor and wall.
- The use of 3D details is encouraged for clarity purposes.
- Details for all wall recessed equipment such as fire hose cabinets.

S. Wayfinding and Signage Drawings and Details
- Location Plans
- Identify all sign types with corresponding signage schedule.
- Perform structural and electrical coordination.

Food Service Drawings: (if required)

A. Sheet Index

B. Food Service Equipment Schedule with Utility Requirements

C. Food Service Equipment Plan

D. Elevations / Details

E. Food Service Equipment Cut Sheets

F. Exhaust Hood Drawing

Structural Drawings:

A. Further develop structural calculations.

B. Further soffit and door support details.

C. Further develop vertical and lateral support for suspended ceilings.

D. Further develop support details for any low walls.

E. Indicate framing details for openings wider than 4 feet in any interior partition.

F. Provide typical details for signage and equipment support.

Mechanical Drawings:

A. Sheet Index

B. General Notes, Symbols, Legend, Preliminary Equipment Schedules

C. Demolition Drawings with Photographs

D. Floor Plan
- Identify all exterior and interior louver openings. Coordinate with Architectural drawings.
- Locate all mechanical rooms. Reference to an enlarged plan.
- Size all ductwork and coordinate layout with Architectural drawings.
- Locate all fire dampers and control dampers. Coordinate locations with Architectural and Electrical drawings.
- Duct connections to all equipment including hoods that require supply or exhaust air.

E. Enlarged Mechanical Room Floor Plan
- Indicate all required clearances for maintenance and otherwise.
- Dash in areas designated for future expansion.

F. Enlarged Cross Section of Mechanical Room
- Indicate all ductwork and below clearances.

G. Reflected Ceiling Plans
- Confirm location of air distribution devices. Coordinate with Architectural Drawings.

H. Roof Plan
- Confirm roof equipment pad sizes and weights.
- Confirm all required roof penetrations.
- Provide detail for vibration isolation
- Confirm screen wall requirements, if any, with Architectural drawings

I. Standard Details
- Begin to layout all required details

Electrical Drawings:

A. Sheet Index

B. General Notes, Symbols, Legend, Lighting Schedule, Panel Schedules

C. Demolition Drawings with Photographs

D. Single Line Diagram with Load Calculations

E. Floor Plan(s)
- Indicate all switches for lighting control
- Locate all receptacles
- Locate Cable trays. Indicate size and location
- Indicate service entrance and main disconnect
- Indicate exit lights
- Locate Fire Alarm Plan and associated life safety devices. Coordinate with Architectural drawings
- Locate all transformers and required clearances
- Locate all switchgear, switchboards and similar equipment

F. Reflected Ceiling Plan
- Identify all light fixtures

G. Details
- Identify and begin to layout all details

H. Coordinate Electrical Drawings with Signage Package

Plumbing Drawings:

A. Sheet Index

B. General Notes, Symbols, Legend, Preliminary Equipment Schedules

C. Demolition Drawings with Photographs

D. Floor Plan
- Verify all major horizontal pipe work, new and existing
- Coordinate new standpipes and risers with architectural drawings
- Confirm that plumbing fixtures are shown based upon the code requirement
- Coordinate water heater(s) location with architectural drawings
- Coordinate all floor drains and floor sinks with architectural drawings
- Verify that vertical pipes do not conflict with structural beams, column base plates, HVAC ducts or any other equipment of other disciplines
- Verify clearances of all new pipe chases
- Group vent pipes as much as possible in order to minimize penetrations
- Design pipes crossing expansion joints to accommodate movement

E. Plumbing Riser Diagrams

F. Standard Details
- Begin to define and layout all required details

Fire Protection Drawings:

A. Floor Plan
   - Coordinate fire sprinkler riser with architectural drawings

B. Reflected Ceiling Plan
   - Update sprinkler layout

Communication Drawings:

A. Sheet Index

B. Demolition Plan

C. Single Line Diagrams

D. Construction Floor Plan
   - Verify all conduit sizes for required right of ways and required radii

E. Typical Details
   - Connection Point Details at the MPOE and the dedicated utility room
   - Details pertaining to any proposed roof mounted equipment
   - Coordinate all connection details to existing structure with Structural Engineer of Record

Security Drawings:

A. Sheet Index

B. Demolition Plan

C. Single Line Diagrams

D. Construction Floor Plan
   - Coordinate locations of all security equipment with Architect of Record

E. Details
   - Coordinate connection details to existing structure with the Structural Engineer of Record

Additional Required Documents:

A. Updated Cost Estimate

B. Updated Construction Schedule

C. Updated Site Logistics Plan and Phasing Drawings

D. Provide a corresponding Set of Specifications in CSI format

1.21.3 Construction Document Phase (100%-review) - For all LAWA issued projects, the Construction Document plans and specifications shall include all information in previous submittals plus all annotated comments from previous submittals and shall include:

A. Complete drawings with all plan, profile, detail, section, schedule, calculation and miscellaneous sheets included

B. Specifications complete in final typed form

C. Final Construction schedule, including duration for all anticipated Utility Shutdowns

D. Final cost estimate

E. Construction Phasing Plans

F. Temporary Power and utility plans and cutover procedures

G. Storm water pollution prevention plan

H. Completed Construction Coordination and Logistics Checklist (see sample attached)

Construction Document plans and specifications for Airfield Projects shall include:

- All proposed paving and facilities.
- Proposed grading and surface contours.
- Final profiles and flow lines for all drainage systems.
- All required sections and details.

Architectural Construction Document plans and specifications shall include:

The submittal consists of drawings, specifications, calculations any other documents that are to be issued for construction.

This submittal shall also incorporate any and all comments or revisions requested by LAWA during the previous submittal reviews.

In this submittal it is expected that all appropriate assemblies, components and equipment have corresponding Los Angeles Research Report (LARR) numbers clearly identified on the drawings. This requirement is applicable to both new and existing elements.

The Architect of Record is to perform a quality control review of all drawings checking and rectifying obvious errors, omissions and drawing conflicts between disciplines.

This submittal serves as the official plan check submittal to the Los Department of Building and Safety and any other governing agency with jurisdiction over a project such as the Los Angeles County Department of Health.

This submittal to LAWA may be waived if it is determined by LAWA that the information provided in the previous submittal sufficiently fulfills LAWA's expectations.

The required documents for this submittal are to include the following:

Architectural Drawings:

A. Sheet Index
- Finalize drawing list.

B. Project Description
- Finalize Code Research Information
- Finalize parking tabulations
- Finalize list of deferred permits, if any
- Confirm that all notes are applicable to the work indicated in this set of drawings

C. Egress Plan
- Finalize Occupant load summaries & corresponding egress loads

D. Accessible Path of Travel / Existing Rest Room Plans
- Finalize all disabled access requirements for the project
- Confirm compliance with Accessibility requirements for both new and existing plumbing fixtures

E. Demolition Plan
- Finalize all demo information mentioned in the previous submittal
- Identify items which are to be relocated, salvaged and/or returned to LAWA
- Perform final coordination with MEP and Structural disciplines

F. Phasing Plan(s)
- Include a separate narrative to LAWA that describes potential impacts to adjacent areas
- Verify that any outdoor staging areas will not impact existing airport operations

G. Barricade Plan(s)
- Indicate a barricade plan that indicates the barrier between the area of construction and adjacent functions
- Provide enlarged section view details of this barricade
- Include description and diagrams of refuse removal and disposal
- Provide details of the graphic vinyl wall treatment being proposed for the barricade

H. Zone Plan

I. Site Plan
- Finalize all site info
- Verify new and existing utilities that relate to the renovation project

J. Floor Plans
- Finalize all information mentioned in the previous submittal
- Verify that all floor depression are indicated on the floor plans
- Perform final discipline coordination
- Verify that all disciplines are utilizing the same background with the same match lines
- Perform a final quality control review. Verify the accuracy of all detail call outs, references, partition tags, fire ratings, etc.

K. Enlarged Floor Plans
- Finalize all information mentioned in the previous submittal
- Verify that rest room finishes, accessories and all specialty items are specified in the project manual

L. Roof Plan
- Finalize all roof penetrations and equipment pads
- Perform a final cross check will related disciplines

M. Reflected Ceiling Plan
- Perform final coordination with Mechanical, Electrical, Security and Communication drawings
- Confirm that ceilings s are in compliance with LADBS Safety Document# P/BC 2008-040: Recommended Standards for Suspended Ceiling Assemblies
- Verify that ceiling framing can support 20 pounds of combined ceiling, mechanical, electrical, and plumbing loads
- In the case that the ceiling loads, including light fixtures, exceed four pounds per square foot, both the vertical and lateral support systems are to be substantiated by corresponding structural calculations

N. Door Schedule
- Perform a final cross check with the floor plan and determine that all doors are included in the door schedule with the proper hardware group

O. Finish Plan
- Verify that all finishes are indicated in the specifications

P. Furniture Plan

Q. Interior Elevations
- Confirm that all finish materials are clearly identified and are specified in the project manual

R. Millwork Drawings
- Confirm that all finish materials call outs
- Finalize all enlarged details
- Confirm compliance with Accessibility requirements

S. Building Cross Sections
- Confirm profiles with the section cuts indicated on the floor plans.
- Confirm clearances for ductwork and other systems above the ceiling line.

T. Wall Sections
- Confirm indicated finishes with Finish Plan
- Confirm profiles with the section cuts indicated on the floor plans
- Confirm all material call outs and related dimensions
- Indicate LARR numbers as required

U. Details
- Verify that all LARR numbers are indicated on the details, as required

V. Wayfinding and Signage Drawings and Details
- Perform final coordination between Architectural, Structural and Electrical drawings

Food Service Drawings: (if required)

A. Sheet Index

B. Food Service Equipment Schedule with Utility Requirements

C. Food Service Equipment Plan

- Incorporate all submittal requirements dictated by the Los Angeles County Health Department.

D. Elevations / Details

E. Food Service Equipment Cut Sheets

F. Exhaust Hood Drawing

Structural Drawings:

A. Finalize all drawings, as required

B. Finalize structural calculations

C. Finalize all details including soffit framing with connection call outs

Mechanical Drawings:

A. Sheet Index

B. General Notes, Symbols, Legend, Preliminary Equipment Schedules

C. Demolition Drawings with Photographs.
- Finalize all demolition and phasing drawings.

D. Floor Plan

E. Perform a final cross check with Architectural drawings.

F. Coordinate duct routing with other disciplines and reconcile any "collisions".
- Enlarged Mechanical Room Floor Plan

G. Perform a final cross check with Architectural and Electrical drawings.
- Enlarged Cross Section of Mechanical Room

H. Confirm all minimum clearances below ductwork.
- Reflected Ceiling Plans
- Perform final coordination with Architectural Drawings.
- Roof Plan

I. Perform final coordination with Architectural drawings and structural drawings, as required.
- Standard Details

J. Finalize all details. Indicate LARR numbers, as required.

Electrical Drawings:

A. Sheet Index

B. General Notes, Symbols, Legend, Lighting Schedule, Panel Schedules

C. Demolition Drawings with Photographs

D. Finalize all demolition and phasing drawings.

E. Single Line Diagram with Load Calculations

F. Confirm provisions for emergency egress lighting

G. Include Temporary Power connections and relocations

H. Floor Plan(s)

I. Perform final coordination with all other disciplines including signage and wayfinding

J. Reflected Ceiling Plan
- Perform final coordination with Architectural RCP and the light fixture schedule.
- Confirm that all lights are readily accessible by LAWA maintenance staff.

K. Details
- Finalize all details.

Plumbing Drawings:

A. Sheet Index

B. General Notes, Symbols, Legend, Preliminary Equipment Schedules

C. Demolition Drawings with Photographs.

D. Floor Plan
- Verify all major horizontal pipe work, new and existing.
- Coordinate new standpipes and risers with architectural drawings.
- Confirm plumbing fixture count with code requirements.
- Coordinate water heater(s) location with architectural drawings.
- Coordinate all floor drains and floor sinks with architectural drawings.
- Verify that vertical pipes do not conflict with structural beams, column base plates, HVAC ducts or any other equipment of other disciplines.
- Verify clearances of all new pipe chases.
- Group vent pipes as much as possible in order to minimize penetrations.
- Design pipes crossing expansion joints to accommodate movement.

E. Plumbing Riser Diagrams

F. Standard Details
    - Finalize all required details.

Fire Protection Drawings:

A. Floor Plan
    - Finalize fire sprinkler risers with architectural drawings.
B. Reflected Ceiling Plan
    - Finalize fire sprinkler layout.
    - Coordinate with Architectural Reflected Ceiling Plan along with other disciplines.

Communication Drawings:

A. Sheet Index
B. Demolition Plan
    - Finalize demolition and phasing plan(s).
C. Single Line Diagrams
D. Construction Floor Plan
    - Finalize all IT room locations.
    - Verify that all Telecommunication rooms and/or closets comply with LAWA requirements.
E. Enlarged IT Room
    - Finalize layout for IT room. Room size is 8' x 10' minimum.
    - Confirm that the IT room is free from electromagnetic interference.
    - Verify that there are no 'wet" spaces above this room.
    - Verify that the service elevator can accommodate cabinet and equipment loading and servicing.
    - Verify that the size of a LAWA IT room is designed large enough to accommodate all of the planned equipment required for existing and new technology, plus a growth factor of 50 percent
    - Verify that the floor finish for this room is anti-static vinyl tile.
    - Verify that the IT room complies with all other LAWA requirements for IT rooms.
F. Typical Details
    - Finalize all details.

Security Drawings:

A. Sheet Index
B. Demolition / Phasing Plan(s)
    - Finalize demo and phasing plan(s).
C. Single Line Diagrams
    - Finalize power requirements for each type of equipment.
D. Construction Floor Plan
    - Finalize locations of all security devices and fields of view.
    - Finalize layout for telecommunications room.
    - Perform final Coordination with Architectural drawings and the Architect of Record.
E. Details
    - Provide a detail drawing of each device.
    - Finalize connection details to existing structure with the Structural Engineer of

Record.
- Provide interfacing details with existing equipment including off site systems including portals.

F. Schedule
- Provide a schedule of security devices that has been coordinated with the architectural door hardware schedule using common nomenclature.

G. Miscellaneous
- Installation standards and LAWA specific commissioning and testing procedures are to be included in the specifications.

Additional Required Documents and Information:

- All Architectural drawings are to be stamped and signed by a professional Architect registered in the State of California
- All Mechanical, Electrical, Plumbing and Fire Protection Drawings are to be stamped with appropriate professionals and signed by the corresponding design engineer of record who is registered in the State of California
- All Structural drawings and calculations are to be stamped and signed by the Professional Engineer of Record that is registered in the State of California
- Submit updated Cost Estimate
- Submit updated Construction Schedule, Phasing Plan and Site Logistics Plans
- Provide a Cost Loaded Schedule per LAWA standards (when required)
- Submit a narrative describing the phasing strategy emphasizing any potential impacts to other assigned areas within the Terminal Building. This is in addition to the phasing drawings listed in the drawing requirements
- Provide a separate and complete set of Discipline Coordination Drawings
- Provide a full set of Specifications in CSI Format, including schedules for doors and hardware, equipment, furniture, finishes, etc.
- Provide a letter addressed to LAWA signed by the Architect of Record certifying that all elements of the design, including but not limited to, casework, equipment and signage, indicated on their drawings are ADA compliant
- Submit final LAWA Sustainability Scorecard

- Make certain that the signatures for the LAWA Chief Airports Engineer are indicated in the LAWA title block.

1.22 Plan Check Corrections Submittal - All building department corrections shall be included. This submittal to LAWA shall include all required drawing revisions required by governing authorities as a condition of plan check approval. In addition, this submittal shall also include a Cost Loaded Construction Schedule (when applicable or required). All revisions depicted in this submittal shall be identified by a cloud with a corresponding date of the revision. LAWA's review of these documents may require up to 30 days.

1.23 Plans Issued for Construction Submittal - This submittal shall have all clouds and revision dates removed from the drawings and be stamped or signed by the governing authorities. The final approved specifications, material boards and any other documents that are required for the construction including every sheet of the construction documents shall be noted Issued for Construction with the corresponding date of issue. Please contact your designated Airport Contact to confirm the official date of this issue. The Designer shall also include the following drawing information in this submittal:

- Construction refuse removal and collection strategy with trash bin locations approved by LAWA.
- Phasing and construction barricade drawings.
- Inter-disciplinary composite coordination drawings.
- Project Construction Logistics Plan showing site access, contractor staging, employee parking, construction deliveries (locations and time of day), etc.
- Construction Barricade Plans and Signage.

Upon determining that all comments from all stakeholders have been incorporated into the drawings, LAWA will authorize the project. A set of the approved and stamped construction drawings with corresponding specifications and material boards shall remain on the jobsite at all times during the entire duration of the project. Obtaining the Building Permit is the responsibility of the Contractor. A set of Building Permit Plans shall be kept at job site at all times as well as a copy of the permit.

The documents at this point should be ready to be signed pending approval by the Airport Contact. Once these documents are approved and signed, they can be provided to contractors for bidding purposes. (See Project Solicitation)

1.24 Specification Format –For LAWA issued projects, all non-AIP projects, specifications shall be in accordance with the Construction Specification Institute (CSI). For all airfield construction projects, contract documents shall be prepared in accordance with AC 15015370-10. These documents shall be prepared with the guidance and direction from the Airport Contact.

1.25 Coordination of Design - Every effort shall be made to coordinate the design between disciplines. This section applies to LAWA issued and Tenants projects.

1.25.1 HVAC - The final HVAC drawings shall, as a minimum, be checked for the following:

- Electrical lighting fixtures shall be checked for conflict with air diffusers, ceiling grilles, sprinkler heads, ceiling type speakers, and other ceiling mounted devices.
- Ductwork shall be checked for clearance between ceiling construction and underside of beams, recessed lighting fixtures and other interferences where space is limited.
- Large mechanical system piping shall be coordinated with building structure to assure clearances and accessibility for maintenance. Piping and electrical switchgear locations are to be coordinated.
- Coordinate requirements for louvers, equipment supports and other devices serving mechanical systems, but furnished under the general construction section of the project.
- Coordinate special types of or Board furnished equipment for correct rough-in requirements.
- Plans and specifications shall be checked for conflicts.
- Plans shall be coordinated for size and location of all chases.

1.25.2 Plumbing - The final Plumbing drawings shall, as a minimum, be checked for the following:

- Piping shall be coordinated with building construction, beams, etc., to assure clearances and accessibility for maintenance. Piping and electrical switchgear locations are to be coordinated.
- Piping shall be checked for clearance between ceiling construction and underside of beams, recessed lighting fixtures and other interferences where space is limited.
- Piping, ductwork, electrical conduits, etc. shall be checked for interferences that would prevent proper installation of each system.
- Coordinate special types of equipment for correct rough-in requirements.
- Plans shall be coordinated for size and location of all chases.

1.25.3 Electrical - The final Electrical drawings shall, as a minimum, be checked for the following:

- Electrical lighting fixtures shall be checked for conflict with air diffusers, ceiling grilles, sprinkler heads, ceiling type speakers, etc.
- Large electrical system conduit and pull boxes shall be coordinated with building construction, beams, etc., to assure clearances and accessibility. Piping and electrical switchgear locations are to be coordinated.
- Plans and specifications shall be checked for conflicts.
- Plans shall be coordinated for size and location of all chases.
- 5. Electrical rooms shall be checked for appropriate size and clearances required by code for replacement and maintenance operations.

1.25.4 Fire Protection - The final Fire Protection drawings shall, as a minimum, be checked for the following:

- Piping shall be coordinated with building construction, beams, etc., to assure clearances and accessibility for maintenance. Piping and electrical switchgear locations are to be coordinated.
- Routing of sprinkler piping shall have minimum turns to avoid building construction, etc.

- No areas are to be left without fire protection/detection, such as wedges in terminals and utility closets when one project is subdivided into several phases.

1.25.5 Communications - The final Communications drawings shall, as a minimum, be checked for the following:

- Ceiling type speakers shall be checked for conflict with light fixtures, air diffusers, ceiling grilles, sprinkler heads, etc.
- Large communication system conduit and pull boxes shall be coordinated with building construction, beams, etc., to assure clearances and accessibility.

1.25.6 Security -The final Security drawings shall, as a minimum, be checked for the following:

- Security system components and types and locations shall be coordinated through Airport Police to properly interface with existing system.
- Coordinate design to allow for uninterrupted operation of existing security systems. Security must be maintained during construction.
- Large security system conduit and pull boxes shall be coordinated with building construction, beams, etc., to assure clearances and accessibility.

1.25.7 Exterior Utilities - The final Exterior Utility drawings shall, as a minimum, be checked for the following:

- Electrical lighting poles, manholes, handholds and underground conduit shall be coordinated with existing utility locations as well as installation of other new utilities.
- Plans and specifications shall be checked for conflicts.

1.26 Project Solicitation – **On LAWA initiated projects -** Bids will be solicited in accordance with City of Los Angeles Bidding Statutes. LAWA will coordinate and be responsible for the contracting arrangements. Public Advertisement for Bids by LAWA will run on BAVN; www.labavn.org.

1.27 Pre-Bid Conference - **On LAWA initiated projects -** LAWA will conduct a Pre-Bid conference for the bidders. The designer will brief the bidders on the overall scope of the project, answer questions from bidders and arrange for and conduct a site tour.

1.28 Addenda - **On LAWA initiated projects -** If questions come up during the Pre-Bid Conference or if there are clarifications required, the designer will provide answers to the Airport Contact. LAWA is responsible for issuing all Addenda.

1.29 Bid Opening – **On LAWA initiated projects -** LAWA will conduct the bid opening at the Airport. After the bid opening the Airport will perform a bid analysis. Upon completion of the bid analysis a recommendation to award the contract to the lowest responsible and responsive bidder will be issued to the Board for approval.

1.30 Pre-Construction - Upon approval of the project, the applicant, his design agents, and his contractor shall meet with LAWA staff for a pre-construction conference. At such time, principal aspects of coordination will be established: project schedule, coordination, inspections, as well as any other items of a timely nature to the project.

1.30.1 Preconstruction Conference -The Applicant must contact LAWA for the purpose of scheduling a pre-construction conference. The conference should include the Applicant, the Applicant's Contractor and the Contractor's major Subcontractors. The Contractor will be briefed on rules, regulations and procedures to be followed for construction projects on the Airport. The Contractor must submit an emergency phone list, any required submittals and a construction schedule. After posting the Construction Permit and placing approved construction documents at the project site, the Contractor may begin construction. An inspection is required before covering or concealing any electrical, plumbing, utility, mechanical, fire sprinkler, fire alarm or structural systems. Work may not progress beyond any point for which an inspection is required until the Contractor receives an approved inspection report for the inspected work.

1.31 General Construction Requirements for Projects located at LAX -

1.31. A Contractor Product, Material, and Equipment Substitutions

Submit request for substitution at least twenty (20) days prior to submitting product or system information for Airport Contact/Project Manager's approval.

Substitution request form shall be in CSI Form 13.1A or a different form as approved by LAWA. The form shall be accompanied by a statement, explaining why substitution is needed. The substitution should benefit LAWA and either require no extra cost or provide better product at the same cost. The statement should include at a minimum:

A. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

B. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

C. Samples, where applicable or requested.

D. Certificates and qualification data, where applicable or requested.

E. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.

F. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

G. Research reports evidencing compliance with building code in effect for Project, from LADBS.

H. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter

from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.

I. Cost information, including a proposal of change, if any, in the Contract price.

J. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.

K. Contractor's certification that all additional costs and impacts are included in the substitution request and that Contractor assumes full liability for all additional costs and impacts that may arise in the future as a result of the proposed substitution.

L. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

1.31. B Submittal Procedures:

A. This Section includes administrative and procedural requirements of the Contractor for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals. Prepare and submit Submittals for MEP, Communications, Security, etc.

Deviations: The Submittals shall clearly identify all deviations from the standards by either highlight, encircle, and/or itemize deviations on submittals.

Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

1.31.1 Weekly Progress Meetings - Airport Contact will schedule and administer weekly progress meetings. Progress meetings shall be at the job Site in office space provided by the Contractor. Minutes of each meeting are to be prepared by the Construction Manager on the project and shall be distributed to those in attendance. At a minimum, each meeting shall address the following items.

- Safety and security issues
- Quality Control issues and testing schedule
- Contractor activities – 3 week look ahead
- Schedule
- Submittals
- RFI’s
- Change Orders

Issues shall be carried forward in the meeting minutes for one week following closeout before removing from the minutes. Attachments to the meeting minutes shall include the following.

- 3-week look-ahead schedule
- Full schedule update, if presented in the meeting
- Master Submittal Log
- Master RFI Log
- Master Change Order Proposal Log

1.31.2 Contractor's Equipment and Facility

- Contractors will be required to furnish and maintain all equipment and facilities as required for the proper execution of the work.

- Contractors will be required to restore the Operations and Storage Yard, if any is provided, and adjacent areas to their original condition prior to final acceptance of the Project, or at the discretion/option of LAWA, left in place at completion of the Project and Ownership shall thereupon be vested to the City.

- Equipment and materials shall be stored off the Project Site until they are to be used on the Work. All other operations of the Contractor shall be confined to the areas authorized or approved by the Airport Contact.

1.31.3 Removal and Disposal of Structures and Obstructions

All structures or obstructions which are not to remain in place or to be used in the new construction shall be removed as directed by the Airport Contact. The resulting material shall become the property of the contractor and shall be disposed of off LAWA property in accordance with local laws and regulations.

1.31.4 Construction Barricades and Enclosures –

General Requirements

- The barricade plan shall be a component of Section 1.31.8c Project Phasing Documents. The plan shall include directional/wayfinding needs and probable location of any access doors (both equipment and personnel) and fire watch windows, where required.

- Obtain approval from the Airport Contact prior to installation of any enclosure or barrier.

- The Contractor shall post a professionally-printed sign indicating the Contractor's contact information: Company name, contact person, and reliable emergency phone number. This signage shall be posted at each barricade location as approved by the Airport Contact.

- All barricades in public spaces and visible to the traveling public shall be painted and covered in LAWA approved messaging, in conformance with Section 1.31.5 Temporary Signage for Barricades.
- No unapproved signage such as warning or directional signage shall be affixed to the Public side of the partition. The need and location for additional directional signage shall be coordinated with the Airport Contact.

- Provide temporary partition enclosures with required polyethylene to separate work areas from LAWA/public occupied areas; to prevent penetration of dust and moisture into LAWA/public occupied areas; and to prevent damage to existing materials, equipment, structures and other facilities.

- Continuously secure barriers and enclosures in a manner to prevent unauthorized entry into construction areas.

- Shield security and other stationary cameras from welding arc flash with visual barriers at the welding location. Do not obstruct the camera view unnecessarily. Notify the Airport Contact prior to shielding any cameras in order to obtain clearance from LAWA Security.

- All barricades and enclosures shall be fully installed and complete within 24 hours of initiating the installation. If more than 24 hours is required for large areas, provide a plan for phasing of the installation. One week prior to installation, the floor area to be enclosed by a barrier or partition shall be clearly marked to indicate location and alignment, matching the Barricade Plan.

- Barricades and enclosures shall be installed and maintained in straight lines and with 90-degree corners typically. In high traffic areas for improved visibility, the use of 45 degree corners may be required as directed by the Airport Contact.

- Partition panels shall neatly adjoin existing walls where necessary. Existing finishes shall be protected prior to installation of partitions. Gaps between existing walls and enclosures shall be 1-1/2” maximum. Provide braces as necessary to support enclosure, flush with surface of panels.

- Existing floor and carpet areas beneath panels and within barrier and enclosure areas shall be protected with masonite-type board, polyethylene sheeting, cardboard, carpet or other suitable material.

- Paint for all Barriers and Enclosures, including exposed fasteners, hinges and other hardware shall be Pantone 1205 yellow/cream” paint, 2 coats minimum unless directed otherwise by the Airport Contact.

- Where approved by the Airport Contact, barricade panels shall be pre-painted prior to installation or; painting shall occur immediately after installation between the hours of 2300 and 0500. Nails, screws and other fasteners shall be installed flush with the face

of the partition. All wood, fasteners, hinges and other hardware exposed to Public view shall be painted.

- A neat, clean, uniform appearance of all Barriers and Enclosures shall be maintained at all times. Scuffed, dirty or discolored messaging panels or polyethylene sheeting shall be cleaned or replaced as directed by LAWA.

- Provide electrical power outlets for any advertising, safety and/or exit signs to be relocated from their existing locations in or on walls to the surface of the construction barricades that would cover or otherwise block them.

- Barricades and enclosures may be reutilized for subsequent phases of work at different locations if they are in acceptable condition as determined by the Airport Contact. Panels shall not be reused if visible damage to exterior surfaces includes holes, dents or splintering.

- Public Safety Convenience: The Contractor shall conduct all operations with the least possible obstruction and inconvenience to LAWA, its occupants and the public.

- Permit traffic (pedestrian and baggage) to pass through the work area with least possible inconvenience and delay.

- Maintain existing signing and lighting systems in operation as the work proceeds unless otherwise approved by LAWA.

Pedestrian Barriers

- Pedestrian Barriers shall be constructed with integral base or other devices to resist an overturning moment created by the force of 50 pounds per lineal foot applied horizontally at the height of 3 feet 6 inches perpendicular to the partition for the full length of the partition.

- Pedestrian Barriers shall be 3-feet-6-inch minimum height constructed of 1/2-inch ACX fire retardant treated plywood fastened to either 3-5/8-inch -18 GA light gage steel or 2”x4” fire retardant treated timber studs with continuous framing at top and bottom.

- Face of Barrier exposed to the Public shall be smooth and free from protrusions with edges and corners eased and shall be covered in LAWA approved messaging, in conformance with Section 1.31.5B.

- When approved by Airport Contact for locations requiring barriers for less than 10 days, batten strips shall be securely fastened to the exterior face of barrier along the top edge and to neatly conceal all vertical joints and corners as shown in the sketches provided at the end of this section. Batten strips shall be 1/2-inch x 4-inches wide with exposed corners rounded or beveled at 45 degrees and shall be painted to match exposed face of barrier.

- For Barriers with height of less than 6-feet-0 inch which enclose a vacant space, such as the lower portion of a scaffold, provide fire retardant debris screen stretched horizontally over the enclosed space or as directed by the Airport Contact when no work is being performed within the space. Submit debris screen product and color for approval prior to installation.

- When approved by the Airport Contact, orange cones, stanchions, warning barrier fence or marker tape may be used as a temporary Pedestrian Barrier around the construction area where hazard exists to the public, airport facilities and staff, or Contractor personnel.

Partition Enclosures

A. Where sound insulation is required due to construction activities, sound insulated wood barricades shall be provided meeting the following:
    - Barricades shall be floor to ceiling in areas where ceiling heights are 12-feet or less.

    - Barricades shall be 12-feet high in all other work area.

    - Barricades shall be constructed of ½ inch ACX fire retardant-treated plywood fastened to either 3-5/8 inch, 18 gauge steel or 2”x4” fire retardant-treated timber studs with continuous framing at the top and bottom.

    - The face of the barricade exposed to public view shall be smooth and free of protrusions and sharp edges. All public-side faces in public spaces shall be covered per the requirements of Section 1.31.5B.

    - R-11 un-faced insulation shall be installed between the studs and covered with polyethylene sheeting on the construction side of the barricades.

    - Insulating quilts shall be installed on the construction side of the barricades against the polyethylene sheeting from the top of the barricades to the soffit above.

    - Batten strips shall be securely fastened to the exterior face of the barricade along the top edge to neatly conceal the joints. Strips shall be ½ inch x 4 inches wide with exposed corners rounded or beveled at 45 degrees and shall be finish painted.

    - Doors shall be of similar fire-retardant material as the barricade; shall be framed to prevent warping; flush with the barricade walls; with clean and maintained hardware.

B. Where sound insulation is not required due to construction activities, the Contractor may utilize 8-foot high modular barricade systems from Mallforms, or approved equal. The following minimum requirements shall be met.

- Each modular panel shall consist of two 38.26 inch wide by 46.42 inch high stacked portions separated by panel framing.
- The dimensions stated are measured clear inside the framing.
- The barricade system shall be covered with messaging per Section 1.31.5B in all public spaces.
- Partition Enclosures shall be capable of resisting 5 psf applied over the entire surface of each side, separately.
- Partitions shall be constructed to safely support dislocated or relocated functioning appurtenances such as telephones, advertising signs, fire extinguishers, and other similar items as shown on plans or where required. The Contractor shall be responsible for the structural integrity and capacity of the partitions carrying the additional weight of these items.
- Where barricades are required to support back-lit advertising signs the barricades shall be capable of supporting up to 300 lbs. Areas covered by electronic signage are relieved from the requirements of Section 1.31.5B for the areas the electronic signs occupy.
- Barricades in non-public areas do not need to maintain the coverage requirements of Section 1.31.5B.
- All chains and locks used at Doors visible to the Public shall be clean and free from rust. Verify chain and lock arrangement with the Airport Contact to allow 24 hour access to enclosure areas for Contractor and authorized LAWA personnel.

Polyethylene Enclosures

A. Polyethylene Enclosures: Enclosures constructed with polyethylene that completely enclose the work area above from the top of the barricades to the ceiling above shall be provided and installed to contain the entire work area and prevent dust migration to areas outside the work space. Polyethylene Enclosure support framework shall be capable of supporting .5 psf applied over the entire surface of each side, separately.

B. Polyethylene sheeting shall be white in color and at least 6-mil thickness. Exterior sheeting exposed to Public view shall be installed on the outside of the support framework to cover the framework. Sheeting shall be used in widths selected to minimize the frequency of joints. All polyethylene sheeting used shall be fire retardant and meet City of Los Angeles Fire Department requirements.

C. Polyethylene sheeting shall be secured continuously at the top of the barricade and continuously at the deck or soffit above the barricade with fire-rated tape, white in color. Joints between polyethylene sheets shall be securely taped, and there shall be no wrinkles or puckers. One type of tape shall be used for all enclosures. Sheeting and tape samples shall be submitted for approval by the Airport Contact prior to installation.

D. The use of Polyethylene Enclosures shall be minimized except as required for dust control or as directed by the Airport Contact.

1.31.5 Temporary Signage for Barricades

A. General Requirements

1. Install temporary signage and messaging, at all construction barricade locations, to help direct passenger traffic around work areas and to alternate paths of travel. Maintain all temporary signage and messaging for the length of time the barricades are in place.

2. All barricade signage (messaging and directional/wayfinding) provided shall be professionally produced and provided by Praxis Integrated Communications (Praxis), 213-689-0800.

3. Contractor shall post all required safety and notification signage on the barricade doors.

4. All barricades in public spaces and visible to the traveling public shall be covered in LAWA approved messaging per Article B of this Section.

5. No unapproved signage such as warning or directional signage shall be affixed to the public side of the partition by the Contractor.

6. All signs shall be maintained in neat and clean appearance at each location. Scuffed, dirty, discolored or damaged signs shall be replaced as directed by the Airport Contact.

7. Signage may be reused for subsequent phases of work at different locations if they are in acceptable condition as determined by the Airport Contact. Signage with visible damage shall not be reused in public areas.

8. Application of this signage shall be planned and installed to enable the traveling public clear and simple direction around the construction area. All directions to alternate routes of travel between floors shall be consistent, and in compliance with the Americans with Disabilities Act (ADA).

B. Barricade Coverings and Messaging Signage Products

1. Barricades remaining in place for 30 days or less shall be provided in accordance with Sections 1.31.5 A and B. Coverings for barricades in place for longer than 30

days shall be provided by Praxis. Coverings shall utilize designs developed by Praxis and approved by LAWA.

2. There are three different types of barricade signage designs utilized at LAWA. Each type is as follows and shall be used as stated:

   a. Vinyl Barricade Wrap Signage: used wherever an 8 ft. to 12 ft. wooden barricade is erected. Each barricade shall be precisely measured and a vinyl messaging wrap shall be provided and installed on the public side of the barricade. This type of wrap is required to cover 100% of the public side of the barricade, except for the entrance doors when code required signage is necessary. Vinyl wraps that become torn, tattered or damaged shall not be reutilized on future barricades.

   b. Modular Panel Barricade System Signage: used wherever the modular Mallforms® barricade system, or approved equal, is erected. Messaging panels, printed on Sintra® boards, shall be inserted into the individual barricade panels between the aluminum frames to create a consistent messaged barricade system. All messaging panels shall be pre-printed utilizing the Praxis designs and installed per barricade plan. 100% of the barricade panels shall be covered except for the entrance doors when code required signage is necessary. Printed Sintra® messaging panels may be reutilized on future barricades provided they are in clean, undamaged condition.

   c. Exterior Mesh Fence Barricade Signage: used for exterior barricade messaging to cover 100% of the fencing, except for the entrance doors when code required signage is necessary. Signage shall consist of pre-printed messaging designs on mesh fabric durable enough to withstand prolonged exterior exposure. Mesh fabric covering may be reutilized on future fencing provided the material is in clean, undamaged condition.

C. Temporary Directional /Wayfinding Signage Products

1. All temporary directional/wayfinding signage shall be designed and produced by Praxis.

2. Contractor shall provide all necessary directional/wayfinding signage at each barricade system where travel pathways are disrupted. At a minimum, ten (10) directional signs are required at each barricade to direct passenger traffic around the temporary disruption.

3. Placement of this signage shall be approved by the Airport Contact prior to installation.

D. Contractor Required Construction Signage Products

1. Contractor shall provide professionally produced Contractor information signage for each barricade. The signs shall include the Contractor's contact information: Company name, contact person, and reliable emergency phone number. These signs shall be posted at each barricade location as approved by the Airport Contact.

2. Contractor shall post all Cal/OSHA required safety and construction signage on barricade doors.

E. Application and Usage:

1. Tenants

a. Tenants are required to retain Praxis Consultants to create a graphic design for the vinyl barricade or modular panel barricade system based on the estimated square footage, directional/way finding needs, and door/window locations indicated on the approved barricade plans.

b. The proposed design will be sent as a PDF file to the Airport contact, with copy to Eric Moody (emoody@lawa.org) of LAWA's Airport Development Group for review and comments.

c. The tenant will have contractor and/or Praxis make modifications until the Airport Contact approves the design/layout, messaging, and directional/way finding locations.

d. Praxis will create the graphic design message, produce the graphic materials, install the graphics, and de-install them when they are ready to come down.

2. LAWA Initiated projects

a. The Airport Contact will forward the Contractor's approved barricade plan to Praxis. The plan shall include directional/wayfinding needs and probable location of any access doors (both equipment and personnel) and fire watch windows, where required.

b. Praxis will create a design for the vinyl barricade or modular panel barricade system based on the estimated square footage, directional/wayfinding needs, and door/windows location indicated on the approved barricade plan.

c. The proposed design will be sent as a PDF file to Eric Moody (emoody@lawa.org) of LAWA's Airports Development Division for review and comments.

d. Praxis will make modification until LAWA approves the design/layout, messaging, and directional/wayfinding locations.

e. Praxis will produce directional/wayfinding signage so that it is ready to install immediately upon barricade construction.

f. LAWA will notify Praxis the date certain the barricade will be erected.

g. Within 24 hours of confirmation that barricade is up, Praxis will conduct a site visit for final barricade measurements and to confirm all door and window locations.

h. Praxis will revise initial design/panel plan as necessary per results of site visit and send PDF file to LAWA for final approval.

i. Praxis will make modifications until LAWA approves the submittal. Praxis will send artwork to the printer for the vinyl barricade wrap.

j. The time from the Praxis site visit to delivery of the barricade wrap shall not exceed 7 calendar days.

k. For the modular panel barricade system, the Praxis installation team will produce the panels and install the panels per the approved panel barricade plan.

l. For the exterior mesh fence barricade, vinyl will be installed either by the Praxis Installation team or by the Contractor.

m. LAWA will notify Praxis of the date when barricades are ready to come down. Within 24 hours of notification, Praxis will de-install the graphics and place them in a predetermined storage facility for future use.

F. Installation: Typical vinyl wrap of wooden barricades may consist of, but not limited to the following minimum activities:

1. Printed artwork/messaging shall be on a vinyl material and applied precisely and professionally to exact placement specifications of the constructed barricade. It is important to note that the intention of the vinyl wrap design is to be reutilized for as many future barricades as possible for cost savings. Because of this, it is extremely important to follow the installation and de-installation guidelines to ensure that the printed vinyl stays in the best condition possible for reutilization.

2. Four (4) Contractor personnel per barricade are required for installation. Overview supervision of the installation shall be by the vendor, GP Color. Contractor shall not install any wraps without the presence of the GP Color supervision.

3. Careful handling of 10-foot long rolls of vinyl is required to avoid damage (i.e. tearing, stretching) to the printed vinyl wraps.

4. Hanging the vinyl shall follow proper placement procedures including affixing to barricade using staple gun, inserting wood dowels into pocket on bottom edge, stretching and smoothing out any wrinkles, and affixing with more staples.

5. Large vinyl wraps shall be tiled together to form seamless overlaps and produce the desired finished messaging product.

6. Confirm the coordination of the placement of windows and doors with artwork schematics so that no messaging appears on doors or is cut off by windows.

7. Installations shall occur during the off-peak hours, 11p.m. - 6 a.m.

1.31.6 Utilities

A. General

1. Pursuant to Section 4216 of the Government Code, at least 2 working days prior to commencing any excavation, the Contractor is required to contact the regional notification center (Underground Service Alert of Southern California) and obtain an inquiry identification number.

2. The following is a list of utility companies and representatives whose facilities may be impacted by this Project. The list is NOT all inclusive.

   Agency/Company Phone Number
   City of L.A., Dept. of Water and Power -Water (213) 481-5411
   City of L.A., Dept. of Water and Power- Power (213) 367-4215
   Southern California Gas Company (310) 605-4181
   SBC Regional Engineer Office (Los Angeles County) (310) 847-1121

B. Utility Protection

1. All utilities encountered during the execution of the Work shall be maintained continuously in service, unless other arrangements satisfactory to the utility LAWA and the Engineer are made. Utilities shall include, but not be limited to, all above or below ground conduit, pipes, wet wells, ducts, cables, and appurtenances associated with oil, gas, water, steam, irrigation, sewer, storm drain, wastewater, air, electrical, power, instrumentation, communication, telephone, TV, and lighting systems, whether or not owned by the City. All valves, switches, vaults, and meters shall be maintained readily accessible for emergency shutoff.

2. Fire and police call boxes and conduits shall be protected by the Contractor. Should said facilities be damaged by the Contractor's operations, immediate notification shall be given to the Airport Response Coordination Center at (424) 646-5292.

3. When placing concrete around or contiguous to any non-metallic utility installation, the Contractor shall:

   a. Furnish and install a two (2) inch cushion of expansion joint material or other similar resilient material; or

   b. Provide a sleeve or other opening which will result in a two (2) inch minimum-clear annular space between the concrete and the utility; or

   c. Provide other acceptable means to prevent embedment in or bonding to the concrete.

4. Where concrete is used for backfill or for structures which would result in embedment, or partial embedment, of a metallic utility installation; or where the coating, bedding or other cathodic protection system is exposed or damaged by the Contractor's operations, the Contractor shall notify the Airport Contact prior to concrete placement. The Airport Contact will arrange to secure the advice of the affected utility LAWA contact regarding the procedures required to maintain or restore the integrity of the system.

5. All underground utility conduits shall have a minimum cover of eighteen (18) inches and shall have identifying detectable tape placed in the trench above the conduit. The detection tape shall be made of metalized foil laminated between two layers of inert plastic color film, six (6) inches wide and a minimum of 4.5 mils thick. The tape colors are to be as follows.

   a. Safety Red = Electric and lighting conduit and cables.
   b. Safety Yellow = Gas, oil, steam, petroleum or gaseous materials.
   c. Safety Orange = Telephone, alarm, or signal cables and conduit.
   d. Safety Blue = Potable water or irrigation.
   e. Safety Green = Sewer or drain lines.

6. The detection tape shall be placed directly above and reasonably horizontal for the full length of the conduit. For conduits with less than four (4) feet of cover, install tape four (4) to eighteen (18) inches below the subgrade surface and at least twelve (12) inches above the conduit. For conduits with more than four (4) feet of cover, install tape at least three (3) feet above the conduit.

7. Upon completion of the Work, the Contractor will remove all enclosures or protective coverings and leave the work area in a finished condition.

C. Damage to Existing Utilities and Improvements

1. Any utility that is damaged by the Contractor shall be immediately reported to the Airport Response Coordination Center at (424) 646-5292 and immediately repaired to a condition equal to, or better than, the condition they were in prior to

such damage. Repair Work shall be continuous until the utility is placed back in service.

2. All repairs to a damaged utility shall be inspected and approved by an authorized representative of the utility and LAWA before being concealed by backfill or other Work.

3. Any improvement that is damaged by the Contractor shall be immediately reported in writing to the Airport Contact and immediately repaired to a condition equal to, or better than, the condition they were in prior to such damage. Repair Work shall be continuous until the improvement utility is placed back in service.

4. All repairs to a damaged improvement shall be inspected and approved by the Airport Contact before being concealed by backfill or other Work.

5. In case of damage which in the opinion of the Airport Contact threatens the safety of persons or property, the Contractor shall immediately make all repairs necessary for removal of the hazard. Should the Contractor fail to take prompt action to this end, LAWA has the option to remove any hazard resulting from damages caused by the Contractor without waiving any other rights LAWA may have, and costs shall be charged to the Contractor.

D. Removal/ Relocation of Utilities

1. The Contractor shall disconnect from the service panel and remove all wire from an electrical duct bank that is being abandoned. The Contractor is responsible for the proper disposal of the wire.

2. Where the proper completion of the Work requires the temporary or permanent relocation and/or removal of an existing utility, relocation and replacement work shall be performed upon approval from and in a manner satisfactory to LAWA.

E. Utility Shutdowns

1. General

a. Utility Shutdowns have become increasingly complex at LAX due to the increase in construction activity and the age of the facility. By nature, utility shutdowns affect a variety of stakeholders, including tenants, airlines, security personnel, and various departments within LAWA (IT, CDG, Maintenance) as well as the traveling public. Impacts to life safety and security systems are particularly critical when considering utility shutdowns. To minimize negative impacts, LAWA has developed procedures and guidelines for contractors to use when requesting a utility shutdown.

b. Contractor requested Utility shutdowns are discretionary on LAWA's part. Not until LAWA has been fully apprised of the potential risks and impacts, and

received necessary contingency plans, will the USR be granted. It shall be the sole responsibility of the Contractor to provide the above information, in accordance with the provisions in this section.

c. The procedures and guidelines provided herein may be changed at any time by LAWA for security, safety, and other operational reasons.

d. The only utility shutdowns exempt from this process are those emergency shutdowns identified by ARCC or EFMD.

2. Definitions

a. Contingency Plan: Based upon the findings identified in the Impact Analysis a Contingency Plan may be required. It will identify those actions necessary to mitigate disruptions and maintain operational readiness during a utility shutdown. The Contractor shall provide all necessary management and material to execute the plan.

b. Contractor: As used herein, the Contractor is the entity with overall responsibility for executing the scope of work necessitating the utility shutdown. This could be the General Contractor for a specific capital construction project, a tenant improvement contractor, concessionaire, or LAWA EFMD.

c. Disruption of Operations Notice (DON): A DON addresses the shutdown of space for a given length of time when no associated utility shutdown is involved. If a utility shutdown is involved, only a USR is required.

d. Impact Analysis: The Impact Analysis identifies all systems, operation, and parties that will be affected by the proposed shutdown of the utility and specifically what that impact is. It shall include sufficient field forensic investigations to verify as-built conditions and that all systems and parties affected by the shutdown have been identified. Drawings and work plans shall be developed to convey actual field conditions and affected physical areas and infrastructure of the facility. This research shall also identify the affected stakeholders and the resulting impacts to their operations. This Impact Analysis will be used by LAWA to determine the need for development of a contingency plan.

e. Utility Shutdown Control Center (USCC): is the central repository of all USR's generated at LAWA and is responsible for managing the review and approval process of all USR's at LAWA.

f. Utility Shutdown: A utility shutdown is any disruption or disconnect of continuity (including abandonment) of any system for any length of time. This includes, but is not limited to: electrical, water, natural gas, fuel, fire alarm, security/ACAMS, sewer, communications, HVAC, sprinkler, etc.

g. Utility Shutdown Request (USR): The USR form identifies the time and date of the proposed shutdown, the type of shutdown, specific location, work area, affected buildings/systems, point of contact for the contractor, etc. It also includes a required Impact Analysis. A check list is attached to the form to assist the contractor in addressing the impact analysis.

3. Protocols

a. Utility Shutdowns are defined as a singular event; one turn off/one turn on.

b. Generally Shutdowns should occur during a maximum of a four hour window during the hours of 12 am and 5 am within a 24 hour period, unless otherwise approved by LAWA.

c. One USR is required for each 24 hour period, even if the preceding shutdown is being duplicated.

d. A single USR form is required for the physical shutdown of a single utility. If by shutting down one utility causes loss of other systems or utilities, those other systems and utilities are identified and addressed in the Impact Analysis. For example; a shutdown of electrical may cause the loss of the Fire Alarm. The loss of the Fire Alarm is addressed as an impact.

e. A USR is required for the physical shutdown of each utility even when occurring during the same time period. For example, if both electrical and water are proposed to be shut down during a given period, two URS Forms are required. Each utility shutdown will result in different impacts, likely independent of the other, and therefore will undergo independent evaluations and approvals.

f. Utility Shutdown Request (USR) must be submitted 30 calendar days prior to the proposed utility shutdown

g. USR's are submitted electronically to the Utility Shutdown Control Center at USR@LAWA.org

h. Status of USR review is available on the USR SharePoint site. Do not call the Utility Shutdown Control Center for status of any USR.

i. No interruption to Airport Operations will be allowed during periods deemed by LAWA as Holiday Construction Restriction Periods. These periods are typically from the Friday before the week of Thanksgiving through the Monday after Thanksgiving (nine calendar days), and the Friday before the week of the Christmas holiday through the Monday after New Years. The contractor will verify the Holiday Construction Periods with LAWA prior to beginning construction.

j. Only LAWA Engineering and Facility Management Division (EFMD) personnel are permitted to disrupt or disconnect any utility system.

k. LAWA personnel required to be at all shutdowns include the EFMD personnel conducting the shutdown and LAWA inspectors. In addition, some shutdowns require LAWA ITG, LAX Police Department, and LAWA subcontractors. All other resources necessary for the successful shutdowns and restoration are provided by the Contractor.

l. Only one primary switchboard should be shutdown at any given time.

m. Electrical shutdowns may be required to be scheduled at a minimum of three days apart.

n. A utility shutdown may be canceled the night of the shutdown for any of the following reasons.

   i. All elements identified in contingency plan are not in place
   ii. Contractor is not ready within 30 minutes of scheduled shutdown
   iii. Security and operational readiness issues identified by ARCC

o. If a shutdown is canceled for any reason, the Utility Shutdown Control Center shall be contacted immediately. The USCC will then notify all stakeholders of the cancelation.

4. LAWA Roles and Responsibilities:

a. LAWA EFMD (performs ALL shutdowns): LAWA EFMD is a division within the Facilities Management Group (FMG) and is the ONLY party allowed to physically disrupt or disconnect any utility system. The role of EFMD at LAX is to provide maintenance of the overall facility. Utility shutdowns are therefore resource constrained, and will be scheduled based on availability of those resources.

b. LAWA Inspection (participants on ALL shutdowns): LAWA Inspectors will be present at the beginning and end of all utility shutdowns. Inspection will certify that the service has been re-established satisfactorily and will document the same.

c. LAWA Project Manager (participant in ALL shutdown requests): The designated LAWA Project Manager is the single point of contact for the contractor for all utility shutdowns. The PM has the initial responsibility to approve and/or reject the USR and oversees the Contractor in the development of the Contingency Plan and the utility shutdown request.

d. LAWA Utility Shutdown Control Center: The USCC is responsible for coordinating and managing the review and approval process and of all USR's.

Included in this process is the verification of the Contractor's Impact Analysis and coordination with the stakeholders.

5. Contractor Responsibility:

   a. The Contractor is responsible for submitting a USR for every proposed utility shutdown a minimum of 30 calendar days prior to the requested shutdown date.

   b. Contractor is responsible for performing an Impact Analysis to be included with the USR. The Impact Analysis must include the specific location of the utility shutdown, documentation of field forensic investigations to verify as-built conditions and all systems and parties affected by the shutdown, and the specific impact to each system and party affected. Documentation can include written narrative, diagrams, sketches, and photos as appropriate. The Impact Analysis must include a specific work plan for providing contractor personnel and equipment to support the shutdown, including requirements generated by the impacts to other systems and parties. The Impact Analysis must also indentify the need for support from other entities such as LAWA ITG, LAX Police Department, and LAWA Subcontractors.

   c. Development and implementation of a contingency plan, if requested by LAWA, to mitigate specific impacts during the shutdown. Any and all resources, including equipment and manpower, required for the execution of the contingency plan are the responsibility of the contractor. This includes, but is not limited to, temporary signage, temporary power, clean-up of collateral damage, operational work-arounds, etc. This may include all areas and systems impacted by the shutdown.

   d. The Contractor is responsible for issuing a rolling 45 day look ahead calendar that that includes the identification of all projected USR's. The calendar shall be submitted weekly to the LAWA PM and shall identify the contractor's utility shutdown number (CUSR) and the date and type of the proposed shutdown. If modifications are needed the schedule shall be submitted to the LAWA PM within 24hrs of identification of the change.

   e. The Contractor is responsible for implementation of the approved USR including all supporting elements and required contingencies within the designated schedule.

   f. During the utility shutdown, the Contractor is responsible for documenting previously unknown conditions and their inclusion on record drawings.

   g. The Contractor is responsible for contacting ARCC 30 minutes prior to the actual utility shutdown and immediately following the utility restart. If there is any delay in the shutdown or restart from the approved schedule, the

Contractor is responsible for notifying the ARCC as soon as that information is known.

6. Process and Procedures for Submitting USR's

   a. The Contractor electronically submits the USR, including the Impact Analysis (mandatory) to the Utility Shutdown Control Center at USR@LAWA.org. This starts the 30 calendar day period allowed for processing the USR. Any revisions or additions to the submitted USR, necessitating the re-submittal of the USR, will result in the restart of the 30 calendar day period.

   b. The LAWA PM will review the submitted USR for need, completeness of the USR (including the mandatory Impact Analysis), and compliance with the 30 day notification period. Any required changes the USR or Impact Analysis along with any requirement for a contingency plan will be transmitted to the Contractor from the LAWA PM. The LAWA PM will provide the initial approval of the USR.

   c. Following the approval of the LAWA PM, the USR, Impact Analysis, and Contingency Plan, if required, will be reviewed by the Utility Shutdown Control Center. This review will include a technical review of the Impact Analysis, coordination with stakeholders impacted by the USR, and coordination of schedule with LAWA EFMD for the utility shutdown.

   d. Upon a satisfactory review of the USR, including the Impact Analysis and Contingency Plan, the Utility Shutdown Control Center will notify the LAWA PM to schedule a Stakeholder Coordination Meeting. This meeting is chaired by the LAWA PM and includes the Contractor and all applicable stakeholders identified in the USR or as part of the review process. The purpose of the meeting is to review all elements of the utility shutdown including the review of impacts and applicable contingencies to assure all known elements have been addressed. The USR and applicable Contingency Plan can be modified in this meeting provided all stakeholders are in agreement, the modification does not impact any additional stakeholder not in attendance, and the resulting shutdown in the field can be fully supported.

   e. Upon satisfactory completion of the Stakeholder Coordination Meeting, the Utility Shutdown Control Center will obtain final approval signatures.

   f. The Utility Shutdown Control Center will return the approved USR to the Contractor with copies to the LAWA PM and all stakeholders identified in the USR as well as other parties identified by the USCC.

   g. Following approval of a USR, if the USR is cancelled for any reason, the Utility Shutdown Control Center will immediately notify all stakeholders.

7. Sample Forms and Checklists

a. Utility Shutdown Request Application (USR)

b. USR Impact Analysis

c. USR Impact Analysis Check List

d. Utility Shut Down Process Flow Diagram

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UTILITY SHUTDOWN REQUEST

APPLICATION

PLEASE NOTE: Fill this form out electronically. In order to "SAVE", ***please PRINT to PDF.***

Contract No. _____ Contractor USR Tracking # (CUSR) _____ - _____ LAWA USR Tracking # _____ - _____

Construction Project: _____ LAWA Project Manager: _____

1. Email one (1) form for each utility being requested for shutdown. You must fill out separate forms for each shutdown request.
2. Shutdown information times shall be in half-hour increments.
3. Email completed form to the Utility Shutdown Control Center at usr@lawa.org.
4. Requests must be received 30 days prior to the utility shutdown time - NO EXCEPTIONS.
5. Utilities will be shutdown and restored by LAWA personnel ONLY.
6. The shutdown will not occur unless the Contractor is present at the shutdown location and work area.
7. Please complete the form in its entirety including attached Impact Analysis and Impact Analysis Checklist. INCOMPLETE FORMS WILL NOT BE PROCESSED.

All emails received on SATURDAY, SUNDAY, or after 1300 will be marked as "RECEIVED" on the following business day.

SHUTDOWN TIMES MAY CHANGE WITHOUT NOTICE DUE TO AIRPORT OPERATIONAL PRIORITES

(Select ONE utility per form)

☐ Water ☐ Electrical ☐ Gas ☐ Fire Alarm ☐ Security / ACAMS
☐ Sewer ☐ Sprinkler ☐ Communications ☐ HVAC ☐ Other _____

Specific Location: _____ Work Area Adjacent To: _____

Affected Buildings/Systems: _____

Purpose: _____

Airfield ? ☐ Terminal ? ☐ Floor/Level: _____ Landside: _____

CONTACT INFORMATION:

Subcontractor: _____ Contact Name: _____

Phone: _____ Fax: _____ Email: _____

SHUTDOWN INFORMATION:

Day: _____ Date: _____ Time: _____

RESTORE INFORMATION:

Day: _____ Date: _____ Time: _____

Comments: _____

Contractor Requestor's Name: _____

Phone: _____ email: _____ Submitted: _____

DO NOT WRITE BELOW THIS LINE, FOR UTILITY SHUTDOWN CONTROL CENTER USE ONLY

Date Received: _____ Time: _____

APPROVED ☐
NOT APPROVED ☐

Comments: _____

_____ _____
Chief - Utility Shutdown Control Center Date

24-HR INCIDENT DESK: LAX 424-646-9076 • VAN NUYS 818-909-3527 • ONTARIO 909-953-5611

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World Airports

UTILITY SHUTDOWN REQUEST

IMPACT ANALYSIS

PLEASE NOTE: Fill this form out electronically. In order to "SAVE", ***please PRINT to PDF.***

Contract No. _____ Contractor USR Tracking # (CUSR) _____ - _____ LAWA USR Tracking # _____ - _____

Construction Project: _____

Utility to be Shutdown

Specific Location

Affected Systems/Equipment

Impact of Work on Systems/Equipment/Stakeholders

Plan to Mitigate Impacts

Proposed Work Plan for Implementing the Shutdown

ATTACH DOCUMENTATION OF FIELD FORENSIC INVESTIGATION, SKETCHES, DIAGRAMS, PHOTOS, AND ADDITIONAL NARRATIVE EXPLANATION AS APPROPRIATE. PROVIDE NAME OF SPECIFIC STAKEHOLDERS IMPACTED.

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UTILITY SHUTDOWN REQUEST

IMPACT ANALYSIS CHECK LIST

PLEASE NOTE: Fill this form out electronically. In order to "SAVE", ***please PRINT to PDF.***

Contract No. _____ Contractor USR Tracking # (CUSR) _____ - _____ LAWA USR Tracking # _____ - _____

Construction Project: _____

Utility to be shutdown: _____ Location: _____

☐ Field Forensic Investigations and Documentation Complete Date: _____

NOTE: CONTRACTOR IS REQUIRED TO COMPLETE AND DOCUMENT FIELD FORENSIC INVESTIGATIONS TO VERIFY AS-BUILT CONDITIONS

Impacted Facilities

	Yes	No	Description
Terminal	☐	☐	
Parking Structure	☐	☐	
Other Buildings	☐	☐	
Roads	☐	☐	
Airfield	☐	☐	
Other Facilities	☐	☐	

Impacted Parties

	Yes	No	Description
Airlines	☐	☐	
Concessions	☐	☐	
Other Contractors	☐	☐	
FAA	☐	☐	
LAWA	☐	☐	
Others (Specify)	☐	☐	

Impacted Systems

	Yes	No	Description
Water	☐	☐	
Sewer	☐	☐	
Electrical	☐	☐	
Fire Sprinkler	☐	☐	
Fire Alarm	☐	☐	
Gas	☐	☐	

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UTILITY SHUTDOWN REQUEST

IMPACT ANALYSIS CHECK LIST

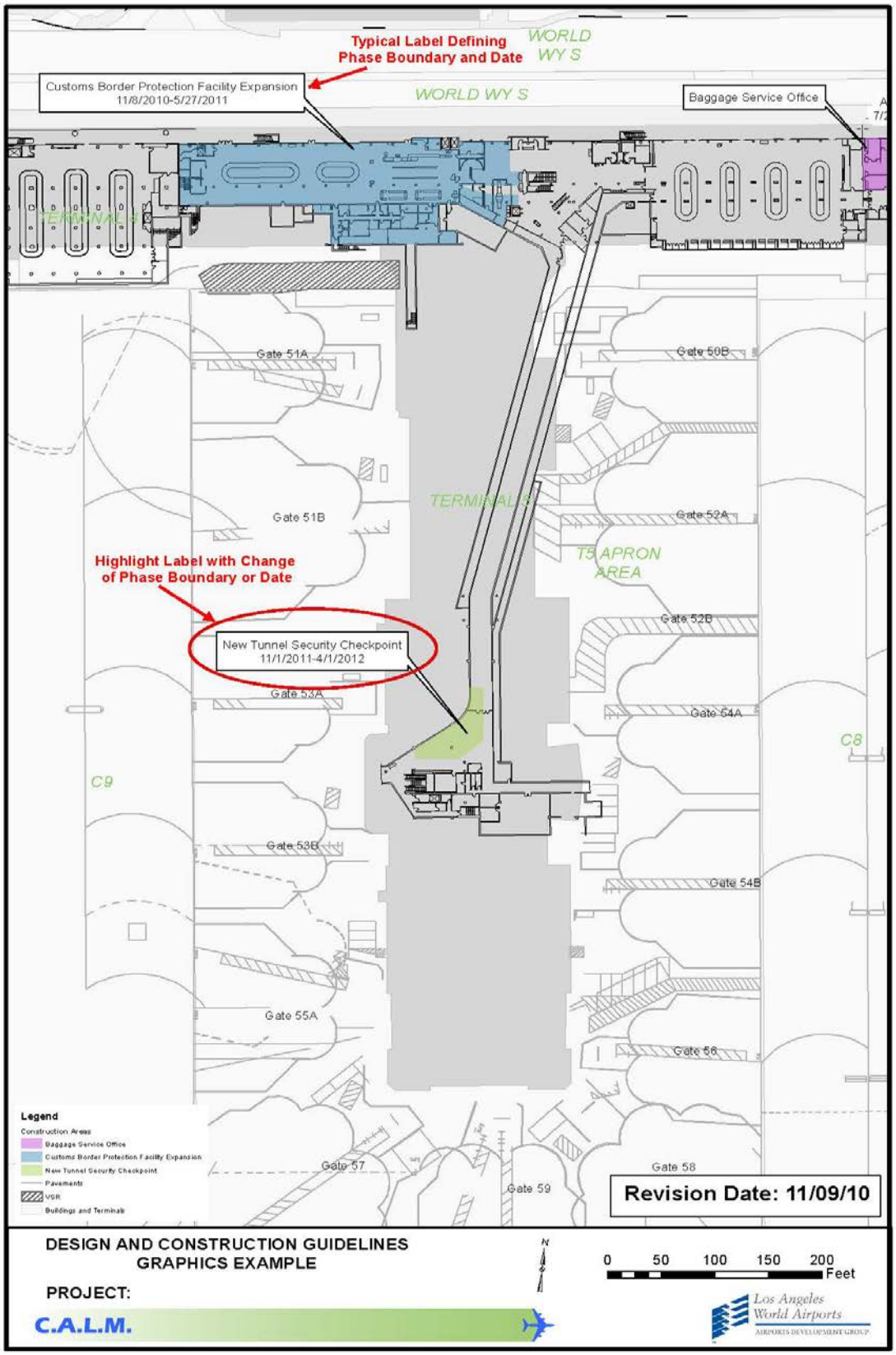
PLEASE NOTE: Fill this form out electronically. In order to "SAVE", ***please PRINT to PDF.***

Impacted Systems (Continued)

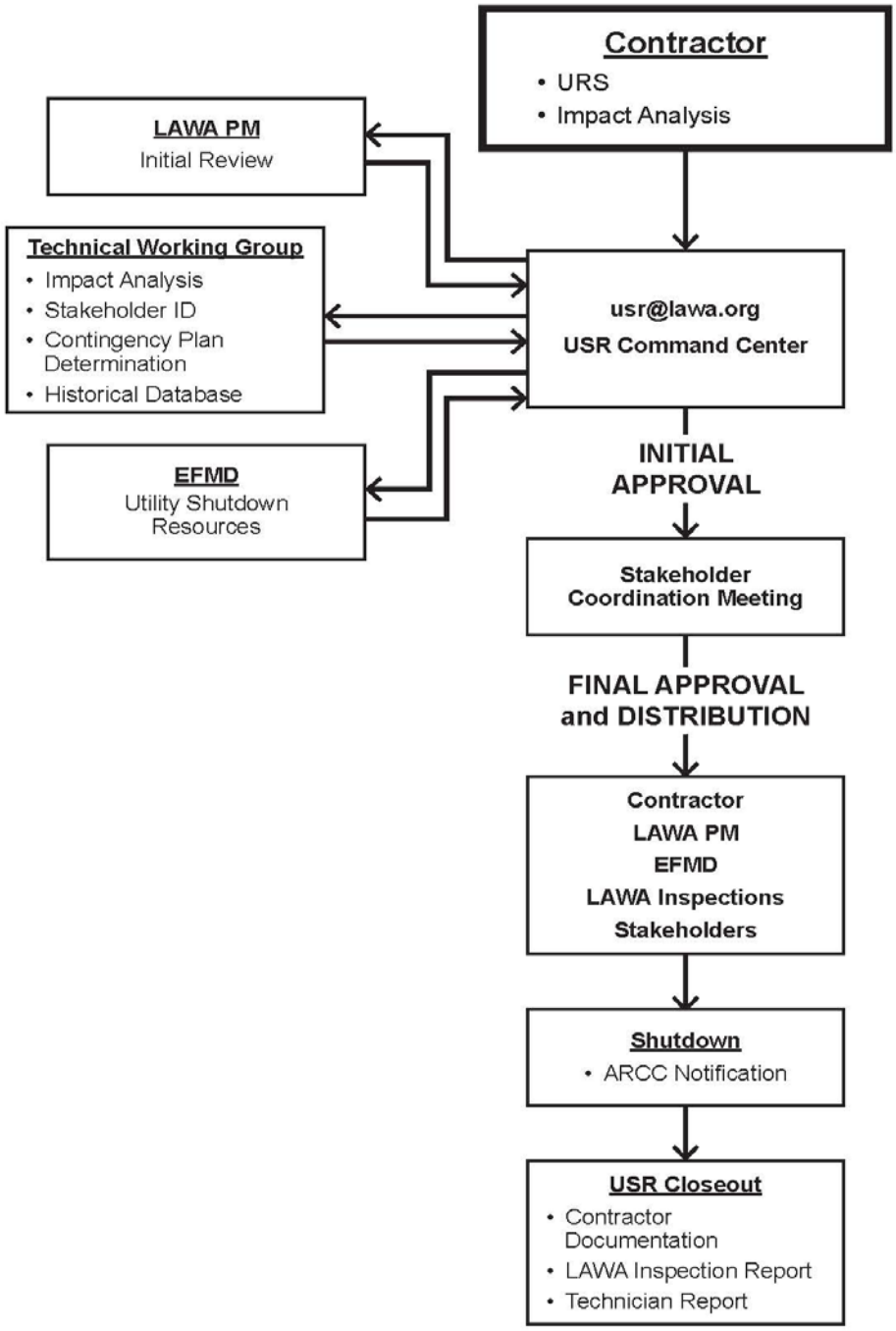
	Yes	No	Description
Communications	☐	☐	
HVAC	☐	☐	
Security/ACAMS	☐	☐	
Other	☐	☐	

Work Plan Requirement

	Yes	No	Description
Electrical Backup)	☐	☐	
Fire Watch	☐	☐	
ACAMS	☐	☐	
Police	☐	☐	
Traffic Control	☐	☐	
Barricades	☐	☐	
Temporary Signage	☐	☐	


Typical Label Defining
Phase Boundary and Date
Customs Border Protection Facility Expansion
11/8/2010-5/27/2011
WORLD WY S
Baggage Service Office
TERMINALS
Gate 51A
Gate 50B
Gate 51B
TERMINAL 5
Gate 52A
T5 APRON
AREA
Highlight Label with Change
of Phase Boundary or Date
Gate 52B
New Tunnel Security Checkpoint
11/1/2011-4/1/2012
Gate 53A
Gate 54A
C8
C9
Gate 53B
Gate 54B
Gate 55A
Gate 56
Legend
Construction Areas
Baggage Service Office
Customs Border Protection Facility Expansion
New Tunnel Security Checkpoint
Pavements
VOR
Buildings and Terminals
Gate 57
Gate 58
Gate 59
Revision Date: 11/09/10
DESIGN AND CONSTRUCTION GUIDELINES
GRAPHICS EXAMPLE
PROJECT:
C.A.L.M.
N
0 50 100 150 200
Feet
Los Angeles
World Airports

Utility Shutdown Process Flow Diagram



F. Disruption of Operation Notification

1. General

- A Disruption of Operation is considered to be shutdown of normal facility operating space for a set period of time that does not include the shutdown of a utility or system. Disruptions of Operations have increased significantly at LAX due to the increase in construction activity and will continue to occur over the life of the facility as future maintenance and construction are performed.

- By nature, Disruption of Operation can affect one or more stakeholders, including tenants, airlines, security personnel, and various departments within LAWA (IT, CDG, Maintenance) as well as the traveling public. Impacts to life safety and security are particularly critical when considering Disruption of Operation. To minimize negative impacts, LAWA has developed procedures and guidelines for contractors to use when requesting a Disruption of Operation.

- Contractor requested Disruption of Operation are discretionary on LAWA's part. Not until LAWA has been fully apprised of the potential risks and impacts, and received necessary contingency plans, will the Disruption of Operation be granted. It shall be the sole responsibility of the Contractor to provide the above information, in accordance with the provisions in this section.

- The procedures and guidelines provided herein may be changed at any time by LAWA for security, safety, and other operational reasons.

- The only Disruption of Operation exempt from this process are those emergency shutdowns identified by ARCC or EFMD.

2. Definitions

- Contingency Plan: Based upon the findings identified in the Impact Analysis a Contingency Plan may be required. It will identify those actions necessary to mitigate disruptions and maintain operational readiness during a shutdown. The Contractor shall provide all necessary management and material to execute the plan.

- Contractor: As used herein, the Contractor is the entity with overall responsibility for executing the scope of work necessitating the shutdown. This could be the General Contractor for a specific capital construction project, a tenant improvement contractor, concessionaire, or LAWA EFMD.

- Disruption of Operations Notice (DON): A DON addresses the shutdown of space for a given length of time when no associated utility shutdown is involved. If a utility shutdown is involved, only a Utility Shutdown Request (USR) is required. For example, shutting down a traffic lane or blocking off a section of concourse walkway

to stage a piece of equipment requires a DON. Blocking the same concourse walkway to shut down a utility requires a USR, not a DON.

- Impact Analysis: The Impact Analysis identifies all operations and parties that will be affected by the proposed shutdown and specifically what that impact is. It shall include sufficient field forensic investigations to verify existing conditions and that all parties affected by the shutdown have been identified. Drawings and work plans shall be developed to convey actual field conditions and affected physical areas and infrastructure of the facility. This research shall also identify the affected stakeholders and the resulting impacts to their operations. This Impact Analysis will be used by LAWA to determine the need for development of a Contingency Plan.

- Utility Shutdown: A utility shutdown is any disruption or disconnect of continuity (including abandonment) of any system for any length of time. This includes, but is not limited to: electrical, water, natural gas, fuel, fire alarm, security/ACAMS, sewer, communications, HVAC, sprinkler, etc. Refer to Section 1.31.6 for Utility Shutdown Request procedures.

3. Protocols

- Disruption of Operation is defined as a singular event; one shutdown of operation /one restoration of operation.

- Generally Disruption of Operation should occur over the shortest period of time required to perform the work necessitating the shutdown. Ideally Disruption of Operation should occur during the hours of 12 am and 5 am within a 24 hour period, unless otherwise approved by LAWA.

- One DOM is required for each 24 hour period, even if the preceding shutdown is being duplicated.

- Disruption of Operation Notice (DON) must be submitted 30 calendar days prior to the proposed shutdown.

- DON's are submitted electronically to the LAWA Project Manager.

- No interruption to Airport Operations will be allowed during periods deemed by LAWA as Holiday Construction Restriction Periods. These periods are typically from the Friday before the week of Thanksgiving through the Monday after Thanksgiving (nine calendar days), and the Friday before the week of the Christmas holiday through the Monday after New Years. The contractor will verify the Holiday Construction Periods with LAWA prior to beginning construction.

- The Impact Analysis and Contingency Plan will identify the LAWA personnel required to be at the shutdown. All other resources necessary for the successful shutdown and restoration are provided by the Contractor.

- A shutdown may be canceled at any time prior to the shutdown for any of the following reasons.

    - All elements identified in contingency plan are not in place
    - Contractor is not ready within 30 minutes of scheduled shutdown
    - Security and operational readiness issues identified by ARCC

- If a shutdown is canceled for any reason, the LAWA Project Manager shall be contacted immediately. The LAWA Project Manager will then notify all stakeholders of the cancelation.

4. LAWA Roles and Responsibilities:

    - LAWA EFMD: LAWA EFMD is a division within the Facilities Management Group (FMG) and shall be made aware of, and may participate in, all operational shutdowns. The role of EFMD at LAX is to provide maintenance of the overall facility.

    - LAWA Inspection (participates on ALL shutdowns): LAWA Inspectors will be present at the beginning and end of all shutdowns. Inspection will certify that operations have been restored satisfactorily and will document the same.

    - LAWA Project Manager (participant in ALL shutdowns): The designated LAWA Project Manager is the single point of contact for the contractor for all shutdowns. The PM is responsible to approve and/or reject the DON and oversees the Contractor in the implementation of the Contingency Plan and execution of the shutdown.

5. Contractor Responsibility:

    - The Contractor is responsible for submitting a DON for every proposed shutdown a minimum of 30 calendar days prior to the requested shutdown date. If the DON requires the filing of FAA Form 7460, the FAA approval process is up to 45 days.

    - Contractor is responsible for performing an Impact Analysis to be included with the DON. The Impact Analysis must include the specific location of the shutdown, documentation of field forensic investigations to verify conditions and all parties affected by the shutdown, and the specific impact to each party affected. Documentation can include written narrative, diagrams, sketches, and photos as appropriate. The Impact Analysis must include a specific work plan for providing contractor personnel and equipment to support the shutdown, including requirements generated by the impacts to other parties. The Impact Analysis must also indentify the need for support from other entities such as LAX Police Department, and LAWA Subcontractors.

    - Development and implementation of a contingency plan, if requested by LAWA, to mitigate specific impacts during the shutdown. Any and all resources, including equipment and manpower, required for the execution of the contingency plan are the

responsibility of the contractor. This includes, but is not limited to, temporary signage, clean-up of collateral damage, operational work-arounds, etc. This may include all areas impacted by the shutdown.

- The Contractor is responsible for issuing a rolling 45 day look ahead calendar that includes the identification of all projected DON's. The calendar shall be submitted weekly to the LAWA PM and shall identify the Disruption Notice number and the date and type of the proposed shutdown. If modifications are needed the schedule shall be submitted to the LAWA PM within 24hrs of identification of the change.

- The Contractor is responsible for implementation of the approved DON including all supporting elements and required contingencies within the designated schedule.

- During the shutdown, the Contractor is responsible for documenting previously unknown conditions and their inclusion on record drawings.

- The Contractor is responsible for contacting ARCC 30 minutes prior to the actual shutdown and immediately following the restoration of operations. If there is any delay in the shutdown or restoration from the approved schedule, the Contractor is responsible for notifying the ARCC as soon as that information is known.

6. Process and Procedures for Submitting DON's

- The Contractor electronically submits the DON, including the Impact Analysis (mandatory) to the LAWA Project Manager (PM). This starts the 30 calendar day period allowed for processing the DON. Any revisions or additions to the submitted DON, necessitating the re-submittal of the DON, will result in the restart of the 30 calendar day period.

- The LAWA PM will review the submitted DON for need, completeness of the DON (including the mandatory Impact Analysis), and compliance with the 30 day notification period. This review will include coordination with stakeholders impacted by the DON and the determination of the need for a Contingency Plan. Any required changes to the DON or Impact Analysis along with any requirement for a contingency plan will be transmitted to the Contractor from the LAWA PM.

- Upon a satisfactory review of the DON, including the Impact Analysis and Contingency Plan, the LAWA PM will schedule a Stakeholder Coordination Meeting. This meeting is chaired by the LAWA PM and includes the Contractor and all applicable stakeholders identified in the DON or as part of the review process. The purpose of the meeting is to review all elements of the shutdown including the review of impacts and applicable contingencies to assure all known elements have been addressed. The DON and applicable Contingency Plan can be modified in this meeting provided all stakeholders are in agreement, the modification does not impact any additional stakeholder not in attendance, and the resulting shutdown in the field can be fully supported.

- Upon satisfactory completion of the Stakeholder Coordination Meeting, the LAWA PM will provide final approval of the DON and distribute copies to all stakeholders identified in the DON.

- Following approval of a DON, if the DON is cancelled for any reason, the LAWA PM will immediately notify all stakeholders.

7. Sample Forms and Checklists

    - Disruption of Operation Notification (DON)

    - DON Impact Analysis

    - DON Impact Analysis Check List

    - Disruption of Operation Notification Process Flow Diagram

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DISRUPTION OF OPERATION NOTIFICATION

IMPACT ANALYSIS CHECK LIST

PLEASE NOTE: Fill this form out electronically. In order to "SAVE", ***please PRINT to PDF.***

Contract No. _____ Contractor DON No. _____ - _____

Construction Project: _____

Description of shutdown: _____ Location: _____

☐ Field Forensic Investigations and Documentation Complete Date: _____

NOTE: CONTRACTOR IS REQUIRED TO COMPLETE AND DOCUMENT FIELD FORENSIC INVESTIGATIONS TO VERIFY EXISTING CONDITIONS

Impacted Facilities

	Yes	No	Description
Terminal	☐	☐	
Parking Structure	☐	☐	
Other Buildings	☐	☐	
Roads	☐	☐	
Airfield	☐	☐	
Other Facilities	☐	☐	

Impacted Parties

	Yes	No	Description
Airlines	☐	☐	
Concessions	☐	☐	
Other Contractors	☐	☐	
FAA	☐	☐	
LAWA	☐	☐	
TSA	☐	☐	
Others (Specify)	☐	☐	

Work Plan Requirement

	Yes	No	Description
Police	☐	☐	
Traffic Control	☐	☐	
Barricades	☐	☐	
Temporary Signage	☐	☐	

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AIRPORTS DEVELOPMENT GROUP

DISRUPTION OF OPERATION NOTIFICATION

PLEASE NOTE: Fill this form out electronically. In order to "SAVE", ***please PRINT to PDF.***

CONTRACTOR

Disruption Notice No: DN - _____ - _____ **Project # / Title:** _____

ADG Attention to: _____ **CC:** _____

Area (s) Affected :

Concourse / All Gates : _____

TIMES REQUESTED

Start: _____ _____ _____ **Complete:** _____ _____ _____
MM / DD /YYYY Day Time MM / DD /YYYY Day Time

Description of work to be performed:

Material and/or Equipment Considerations

Attachments (if required): DN - _____ - _____

☐ Contractor's Impact Analysis _____ ☐ Movement Area Closure Request (email) ☐ Other

☐ Form 7460 (cranes and other tall equipment)
(45 Days for FAA Approval)

_____ _____
CMAR / Contractor's Representative Signature **Date**

Cell: _____ **E-mail:** _____

ADG PROJECT MANAGER

Approval required from:

☐ Airport Police (no TSA)

☐ Airport Police (and TSA)
23 Calendar Day Review Period

Approval received from:

☐ Airport Police (no TSA)

☐ Airport Police (and TSA)

☐ All Stakeholders Contacted

☐ Airport Center to Issue Notice to Airmen (NOTAMS)

☐ Form 7460 (45 Days for FAA Approval)

_____ _____
ADG Project / Construction Manager Representative **Date**

Los Angeles
World Airports

DISRUPTION OF OPERATION NOTIFICATION

IMPACT ANALYSIS

PLEASE NOTE: Fill this form out electronically. In order to "SAVE", ***please PRINT to PDF.***

Contract No. _____ Contractor DON No. _____ - _____

Construction Project: _____

Description of Shutdown

Specific Location

Affected Stakeholders

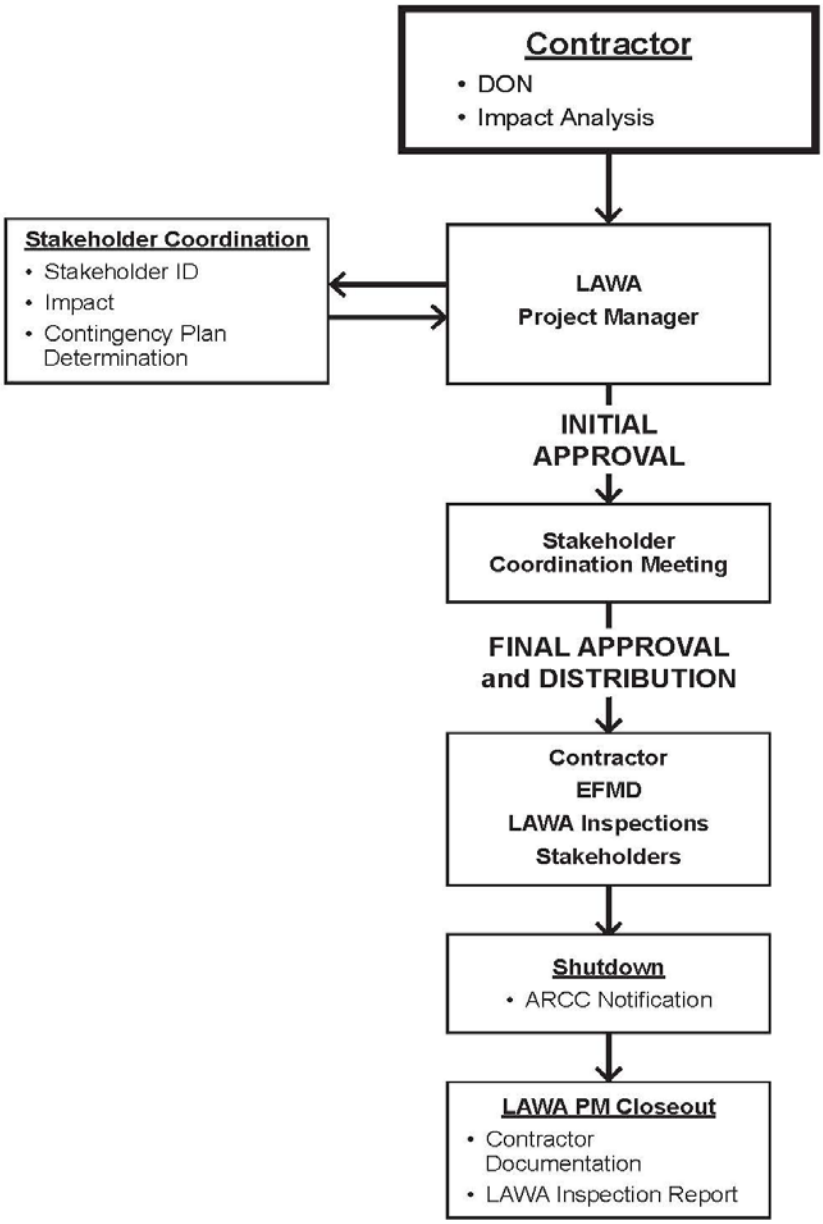
Impact of Work on Stakeholders

Plan to Mitigate Impacts

Proposed Work Plan for Implementing the Shutdown

ATTACH DOCUMENTATION OF FIELD FORENSIC INVESTIGATION, SKETCHES, DIAGRAMS, PHOTOS, AND ADDITIONAL NARRATIVE EXPLANATION AS APPROPRIATE. PROVIDE NAME OF SPECIFIC STAKEHOLDERS IMPACTED.

Disruption of Operation Notification Process Flow Diagram



MH 5/24/11

1.31.8 Submittal Procedures:

This Section includes administrative and procedural requirements of the Contractor for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals. Prepare and submit Submittals for MEP, Communications, Security, etc. Deviations: The Submittals shall clearly identify all deviations from the standards by either highlight, encircle, and/or itemize deviations on submittals.

A. Design Data:

1. Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

B. Site Logistics Plan:

1. The Permittee/Contractor shall submit a proposed Site Logistics Plan, in AutoCAD DWG format, to the Airport Contact for review and approval. An approved Site Logistics Plan must be in place prior to issuance of a Notice to Proceed. At a minimum, the plan shall address the following information:

   a. Point of entrance locations and traffic routes for movement of the contractor's equipment, materials and workers to the work.

   b. Escort provisions including conformance with LAWA and TSA regulations regarding allowable number and handling of un-badged personnel.

   c. Defined alterations to existing facilities/infrastructure

   d. Construction zone accommodation of vehicular and aircraft traffic including signage, traffic stripping, flagging, temporary closures, barricades, and detours

   e. Provisions and plans for worker parking.

   f. Staging/laydown areas for construction equipment, trash/debris receptacles, and material storage and protection

   g. Temporary facilities including trailers, dumpsters, and sanitary facilities

   h. Locations and related work zones for worker/material handling equipment such as cranes, and lifts.

   i. Emergency vehicle access provisions

   j. Emergency evacuation routes

   k. Provisions for protection of private and public properties, including leased properties on site, if applicable

l. Security provisions

m. Fencing and enclosure provisions

n. Location of off-site, project-related facilities

o. Provisions for on-site parking

p. Emergency contacts posted on plan

q. Defined work shifts and corresponding working hours

r. Routes of temporary utility lines and points of tie-ins

s. Provisions for reclamation of areas disturbed by the contractor

t. Plans and actions taken to comply with environmental requirements and permits

u. Dust/dirt/debris mitigation

v. Construction Noise mitigation

w. Coordination and accommodation of stakeholders impacted by the work.

x. Coordination with other contractors impacted by or impacting the work.

C. Project Phasing Documents:

1. That the Applicant/Contractor shall coordinate, phase, sequence, and organize his or her work so as to minimize the inconvenience and disruption to the public, airport stakeholders, and other contractors. The Applicant/Contractor shall submit a Project Phasing Document, in AutoCAD DWG format, defining each specific work area (Phase) into which the overall project is divided. A Project Phasing Document is required for any project with one or more phases of work. An approved Project Phasing Document must be in place prior to issuance of a Notice to Proceed. The document shall be developed in accordance with the following criteria.

   a. Written description of the work to be accomplished within each phase.

   b. Breakdown the physical elements of the project in maximum thirty (30)-day increments, or less if required to accurately reflect the progression of work, sequenced in accordance with the project schedule. .

   c. Include dates for proposed work, daily work hours, and a written work plan for each phase.

   d. The document shall be flexible in its ability to describe real-time updates and shall be updated as required to fully ensure stakeholders are fully informed of revisions as they occur.

e. The document shall be consistent with the overall Project Schedule.

2. The description of each Phase shall address the following as a minimum.

   a. Location of barricades, partitions, covered walkways, stairs, scaffolding, work platforms, etc. which are designed to separate construction activities from ongoing operational areas and mitigate disruptions to passenger and other stakeholder traffic flows. Approval must be obtained for Barricade and Enclosure Plans, temporary signage, and Scaffold and Messaging Concept. Please see “Additional Design Standards and Criteria” for a sample presentation. Full-size mock-ups of these systems may be required and agreed to prior to installation.

   b. Security provisions

   c. Emergency personnel provisions

   d. Emergency evacuation routes

   e. Egress analysis and Occupancy Load calculations for each phase of the construction

   f. Public and worker health and safety protection

   g. Relocation and definition of temporary facilities required to maintain ongoing operations

   h. Maintenance of fire/life safety systems

   i. Construction restrictions during special events and holidays

   j. Material stockpiling and staging

   k. Locations and related work zones for worker/material handling equipment

   l. Plan for rubbish removal, including location of trash bins

   m. Modification and maintenance of existing systems during construction

   n. Temporary signage/way-finding devices

   o. Stakeholder relocations

   p. Routes of temporary utilities, lines, and points of tie-in

   q. Temporary facilities

r. Dust/dirt/debris mitigation

s. Construction Noise mitigation

D. Graphics Standards:

- The Site Logistics Plan and the Project Phasing Document shall be submitted in AutoCAD DWG or shape file ("dwg" or shp") format per LAWA CAD Standards. The Site Logistics Plan and Project Phasing Document shall each be a separate deliverable and not incorporated into the Design Documents. Graphically denote changes by clouding "Labels" only. Reference attached drawing titled "Design and Construction Guidelines Graphics Example" for a graphic representation of these standards.

E. Updates:

- The Site Logistics Plan, the Project Phasing Document and the Project Schedule shall be updated periodically as changes are identified and LAWA shall be notified immediately.

1.31.9 Environmental Mitigation Requirements and Special Construction

General

A. This section covers construction related mitigation requirements that include, but is not limited to, traffic mitigation measures, air quality construction related measures, restrictions on construction material stockpiles, and other miscellaneous items, as included hereafter.

B. The Applicant/Contractor shall implement and comply with these requirements in the performance of the work.

C. Compliance with this Section does not exempt the Contractor from compliance with other applicable permits, approvals, requirements, rules and regulations of other agencies with jurisdiction over the work of this contract.

D. The Applicant/Contractor shall designate a person or persons to ensure the implementation of all components of the construction- related Environmental Mitigation Requirements through direct inspections, records review, and investigations of complaints

E. All construction deliveries requiring lane closures shall receive prior approval from the Engineer. Construction Notification of deliveries requiring lane closures shall be made in writing (a minimum of 72 hours in advance) in order to allow for any modifications to approved traffic detour plans. The Contractor shall obtain delivery permits from all applicable local agencies 30 days prior to any delivery requiring a lane closure.

F. No staging of construction traffic in residential areas will be allowed. Should traffic staging areas be required, the Contractor shall locate these areas away from residential development and shall comply with all local regulations.

G. All Construction deliveries of bulk materials such as aggregate, bulk cement, dirt, etc. to the project site, and hauling of materials from the project site, shall be scheduled during off peak hours to avoid the peak commuter traffic periods on designated haul routes as specified in Section 1350-2. Peak commuter traffic periods are between 7:00 a.m. to 9:00 a.m. and 4:30 p.m. to 6:30 p.m. Any and all deviations to this requirement shall be approved in writing by LAWA prior to actual site deliveries. No staging of construction traffic in residential areas will be allowed.

H. To the extent possible, Contractor shall establish work hours that avoid peak commuter traffic periods as defined herein. Avoidance with peak commuter traffic shall be extended to include weekend and, when applicable, multiple work shifts.

I. The Applicant/Contractor shall ensure that all construction personnel attend a pre-construction orientation meeting to be conducted by the Contractor wherein personnel are advised on topics including the following: where to park, where staging areas are located, construction policies, and the environmental mitigation requirements herein. A copy of the Orientation Meeting Agenda and personnel sign-in sheet shall be submitted to LAWA after each orientation meeting.

1.31.9 A Haul Routes

A. Haul Routes

- The Applicant/Contractor will be required to submit haul routes for all construction traffic, deliveries, and employee travel. Haul routes shall be located away from residential areas. Construction trucks will not be allowed on:
    - o 104th Street between Hawthorne Boulevard and Inglewood Avenue;
    - o Inglewood Avenue between Century Boulevard and Imperial Highway; and
    - o Lennox Boulevard between Hawthorne Boulevard and Inglewood Ave.
    - o Others as required.

The Contractor shall be responsible for maintenance of haul routes.

1.31.9 B <u>Construction Material Stockpiles Locations and Maintenance</u>

Stockpile locations will be off airport property unless otherwise approved by LAWA.

1.31.9 C Air Pollution Control

The Applicant/Contractor shall not discharge smoke, dust equipment exhaust, or any other air contaminants into the atmosphere in such quantity as will violate any Federal, State or local regulations. The Applicant/Contractor shall also abate dust nuisance by cleaning, sweeping and spraying with water or other means as deemed necessary.

1.31.9 D Dust Control

A. The Contractor will be responsible for removing from the Site and other public areas, excavated materials and debris resulting from the Work. Vehicles exiting the Site shall have all dirt clods and mud removed from their tires.

B. The Contractor will contain dust and remove it from the Site at intervals sufficient to prevent contamination outside work limits and as directed by the Engineer. The Contractor shall use adequate watering techniques to alleviate accumulation of construction-generated dust.

- The Contractor will be responsible for containment of dust emission from all construction, transport, storage or handling activities, in accordance with South Coast Air Quality Management District (SCAQMD) Rule 403: Fugitive Dust.
- The Contractor will be responsible for the continuous clean-up of all construction-related dirt on approach routes to the Site.
- The Contractor shall furnish trash bins for all debris resulting from Construction. All debris shall be placed in trash bins daily. Forms or false work that are to be reused shall be stacked neatly as they are being removed. Forms and falsework that are not to be reused shall be disposed of immediately upon their removal.
- The Contractor shall comply with California Vehicle Code 23114 which states in part that "A vehicle may not be driven or moved on any highway unless the vehicle is so constructed, covered, or loaded so as to prevent any of its contents or load other than clear water from dropping, sifting, leaking, blowing, spilling, or otherwise escaping from the vehicle."
- The Contractor shall comply with vehicle speed limits of 15 miles per hour while traveling on unpaved construction sites and maintain at least six (6) inches of freeboard on haul vehicles.

C. When requested by LAWA, the Contractor shall furnish and operate a self-loading motor sweeper with spray nozzles at least once each Working Day for the purpose of keeping paved areas acceptably clean wherever construction, including restoration, is incomplete.

1.31.9 E Air Quality

A. Contractor shall make every effort to reduce air pollutant emissions from construction traffic and equipment both on and off the airport. This includes, but is not limited to, use of construction equipment with "cleaner burning diesel" fuel and exhaust emission controls. The Contractor shall use alternative fuel or low emission vehicles to the maximum extent practicable.

1.31.9 F Non-Road Mobile Source Controls

A. The Contractor shall prohibit staging or parking of construction vehicles (including workers' vehicles) on streets adjacent to schools, daycare centers, and hospitals.

B. The Contractor shall prohibit construction diesel vehicles or equipment from idling in excess of the idling restrictions as defined in CARB Vehicle Idling Rule. The Contractor shall advise drivers and operators of these requirements at the pre-construction orientation meeting, remind them on a daily basis, and post signs in appropriate places indicating the CARB Vehicle Idling Rule. Exemptions may be granted for safety-related and operational reasons, as defined in CARB or as approved by the Engineer. The Contractor and subcontractors shall have policies and procedures in place for compliance with the Vehicle Idling Rule.

1.31.9 G Stationary Point Source Controls

A. The Contractor shall specify a combination of electricity from power poles and electricity from

portable diesel- or gasoline-fueled generators using “cleaner burning diesel” fuel and exhaust emission controls for his electrical energy requirements.

B. The Contractor shall obtain approval of the Engineer for the use of internal combustion engine water pumps, power generators, air compressors and other related construction equipment when an option exists to utilize grid power or electric powered equipment.

1.31.9 H Noise Control

A. Noise generated form the Contractor’s operations shall be controlled as required by LAWA.

B. The Contractor shall comply with local sound control and noise level rules, regulations and ordinances which apply to the Work.

1.31.9 I Spill Prevention and Emergency Response Plan.

A. The Contractor shall prepare and submit a spill prevention and emergency response plan. The plan shall address implementation of measures to prevent sewage spills; procedures for spill control and containment, notifications, emergency response, cleanup, and spill and damage reporting.
B. The plan shall account for all storm drain systems and water courses within the vicinity of the Work which could be affected by a sewage spill. Catch basins that could receive spilled sewage shall be identified. Unless otherwise specified in the Specifications, these catch basins shall be sealed prior to operating the bypass and pumping system. The Contractor shall remove all material used to seal the catch basins when the bypass and pumping system operations are complete.
C. The Contractor shall be fully responsible for containing any sewage spillage, preventing any sewage from reaching a watercourse, recovery and legal disposal of any spilled sewage, any fines or penalties associated with the sewage spill imposed upon by LAWA and/or the Contractor by jurisdictional regulatory agencies, and any other expenses or liabilities related to the sewage spill.

1.31.9 J Water Pollution Control

A. The Contractor shall conform to all applicable local, state and Federal regulations and laws pertaining to water pollution control. The Contractor shall conduct and schedule its operations in such a manner as to prevent water pollution.

- "Water Pollution" shall mean an alteration of the quality of waters by fuels, oils, and other harmful materials. The alteration shall be to a degree that adversely affects such waters for beneficial uses, or facilities that serve such beneficial uses.
- "Beneficial Uses" shall include, but not necessarily be limited to, domestic, municipal, agricultural, and industrial supply; power generation; recreation; esthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.

B. When required, the Contractor shall obtain permits for erosion and water pollution control from the appropriate jurisdictional agency before the start of construction.

C. Wet Weather Erosion Control Plan (WWECP) shall be prepared pursuant to Section 61.02 of the LAMC, whenever it appears that the construction Site will have grading during the rainy

season (from October 15 to April 15). The Contractor shall submit a WWECP to the Engineer for approval within thirty (30) Days after the Notice to Proceed or get approval thirty (30) Days prior to the beginning of the rainy season, whichever is longer.

D. Work shall be in compliance with the requirements of the National Pollutant Discharge Elimination System (NPDES) Permit for the City of Los Angeles (NPDES Permit No. CAS004001), including the Los Angeles Standard Urban Stormwater Mitigation Plan (SUSMP). Guidance on NPDES, SUSMP, and WWECP can be found on the City of Los Angeles' Stormwater website at http://www.lastormwater.org.

E. The Contractor shall conform to the following requirements:
   - Sediments or other surface water quality pollutants shall not be discharged to a storm drain system or receiving waters.
   - Sediments and other surface water quality pollutants generated on the Work site shall be contained on the Work site using appropriate Best Management Practices (BMPs).
   - No construction-related materials, waste, spill, or residue shall be discharged form the Work site to streets, drainage facilities, receiving waters, or adjacent property by wind or runoff.
   - Non-storm water runoff form equipment, vehicle washing, or any other activity shall be contained within the Work site using appropriate BMPs.
   - Erosion shall be prevented. Erosion susceptible slopes, shall be covered, planted or otherwise protected in a way that prevents discharge from the Work site.

1.31.9 K Best Management Practices (BMP)

A. The Contractor shall implement and maintain such BMPs as are relevant to the Work.
B. The Contractor shall be responsible throughout the duration of the Contract for installing, constructing, inspecting, maintaining, removing and disposing of BMPs. Unless otherwise directed by LAWA, the Contractor shall be responsible for BMP implementation and maintenance throughout any temporary suspension of the Work.

C. All projects, regardless of size, shall implement the following good housekeeping BMPs to reduce the discharge of pollutants from construction sites to the maximum extent practicable:
   - Eroded sediments and other pollutants must be retained on Site and may not be transported from the Site via sheet flow, swales, area drains, or natural drainage.
   - Stockpiles of earth and other construction-related materials must be protected from being transported from the Site by water.
   - Fuels, oils, solvents, and other toxic substances originating from the Contractor's operations shall not be allowed to enter the ground water or be placed where they will enter a live stream, channel, drain, or other water conveyance facility. Spills may not be washed into the live streams, channels, drains, or other water conveyance facilities.
   - Such features as drainage gutters, slope protection blankets, and retention basins shall be constructed concurrently with other Work and at the earliest practical time. The Contractor shall exercise care to preserve vegetation beyond the limits of construction.
   - Excess or waste concrete may not be washed into the public way or any drainage

system. Provisions shall be made to retain concrete wastes on-site until it can be appropriately disposed of or recycled.

- Trash and construction-related solid wastes must be deposited into a covered receptacle to prevent contamination of rainwater and dispersal by wind.
- Sediments and other materials may not be tracked from the Site by vehicle traffic. The construction entrance roadways must be stabilized so as to inhibit sediments from being deposited into the public ways. Accidental depositions must be swept up immediately and may not be washed down by rain or by any other means.
- After the completion of the Work, the Site shall be cleared of debris and restored to a condition equal to or better than that existing before construction.

D. The Contractor shall comply with the State Water Resources Control Board Order No. 2009-0009-DWQ (Construction Activities Storm Water General Permit). Contractor is to determine the Risk Level for the Site in accordance with State Water Resources Control Board Order No. 2009-0009-DWQ and determine which requirements are applicable.

E. Compliance with State Water Resources Control Board Order No. 2009-0009-DWQ, may include, but is not limited to the following:
   - Register via the State Water Board's Storm Water Multi-Application & Reporting System (SMARTS) system, as coordinated through LAWA.
   - Prepare all Permit Registration Documents.
   - Have a credentialed preparer, as defined in State Water Resources Control Board Order No. 2009-0009-DWQ, develop a site-specific Storm Water Pollution Prevention Plan (SWPPP).
   - Submit SWPPP to LAWA Environmental Services Division for review and approval.
   - Implement the SWPPP in accordance with State Water Resources Control Board Order No. 2009-0009-DWQ requirements, including, but not limited to necessary and appropriate site monitoring, and filing of required reports and notifications via SMARTS (in consultation with LAWA).
   - Prepare a Notice of Termination (NOT) upon completion of said construction work, fulfill all post-construction requirements under State Water Resources Control Board Order No. 2009-0009-DWQ, and coordinate with LAWA the filing of the NOT via SMARTS.

F. Failure to comply with State Water Resources Control Board Order No. 2009-0009-DWQ may subject discharges to penalties. Dischargers may become liable to pay up to $10,000 a day pursuant to California Water Code section 13385, and another penalty of a minimum of $1,000 pursuant to sections 13399.25-3399.43.

G. Should the Contractor violate any of the provisions of this Subsection, or if pollution occurs in the work area for any reason, the Contractor shall immediately notify LAWA. In addition the Contractor shall, within 10 Days, submit written confirmation to LAWA describing the incident and corrective actions taken. Contractor is to comply with all discharge reporting requirements of Water Resources Control Board Order No. 2009-0009-DWQ. If pollution, for whatever reason, is detected by the Inspector/Engineer before notification by the Contractor, the required written confirmation shall also include any explanation of why the Contractor had not notified the Inspector.

1.31.9 L Drainage Control

The Contractor shall ensure that storm and drainage water does not pond due to the temporary blockage of exiting drainage facilities. To this end, the Contractor shall provide temporary methods that allow for the passage of storm and drainage water in a manner equivalent to the existing drainage system.

1.31.9 M Temporary Light, Power, Water, and Telephone

The Contractor shall obtain a permit to draw water from a public fire hydrant from the Los Angeles Department of Water and Power, Telephone (213) 367-6428, for projects in the City of Los Angeles. If feasible, permission for the use of hydrants located on Airport property may be obtained from the Engineer for hydrants owned and controlled by LAWA. Hydrants will be metered and the cost of water usage will be billed to the Contractor.

The Contractor shall obtain temporary power from the Los Angeles Department of Water and Power, Telephone (213) 367-0364, for projects at Los Angeles International Airport.

The Contractor may inquire about obtaining temporary telephone service from ATT at 1-800-750-2355.

1.31.9 N Public Convenience and Safety

1.31.9 N (1) Traffic and Access:

A. The Contractor shall conduct all operations in a manner that will cause minimal or no interference with normal operation of the Airport. In all operations, the Contractor shall be governed by the regulations and rules of LAWA, comply with FAA AC No. 150/5370-2E, Operational Safety on Airports During Construction, Appendix C, and shall cooperate fully with LAWA Engineers and Airport Manager. All temporary blockages for the movement of construction materials or equipment shall be coordinated with and approved by LAWA at least forty-eight (48) working hours in advance of any closure.

B. As soon as possible, and before moving vehicles onto the Site, the Contractor shall submit to LAWA the proposed Plan for vehicular and pedestrian traffic circulation, including the location and types of signs to be used. Thereafter, and not later than fifteen (15) Days prior to subsequent changes required by the Engineer for said circulation, sign locations and types, the Contractor shall submit revised Plans to LAWA.

C. The Contractor shall provide and install steel plates to bridge any excavation in the public right-of-way. Such bridging shall be in accordance with the provisions of the latest edition of the Work Area Traffic Control Handbook (WATCH), and in addition, shall have a nonskid surface static coefficient of friction of 0.35 per California Test 342 for all steel plates within the traveled roadway of streets and alleys. When required by the Inspector, the Contractor or Applicant shall certify in writing to the Inspector that steel plates to be used in the Work meet the required static coefficient of friction. Also when required by the Inspector, the Contractor or Applicant shall have steel plates to be used in the Work tested in accordance with the above standards for the verification of required static coefficients of friction. Testing shall be done by an independent laboratory approved by the Inspector. The Contractor or

Applicant shall pay for any costs associated with the testing of steel plates.

D. The Contractor's operations shall cause no unnecessary inconvenience. The access rights of the public shall be considered at all times. Unless otherwise authorized, traffic shall be permitted to pass through the Work, or an approved detour shall be provided.

E. Safe and adequate pedestrian and vehicular access shall be provided and maintained to: fire hydrants; commercial and industrial establishments; churches, schools and parking lots; service stations and motels; hospitals; police and fire stations; and establishments of similar nature. Access to these facilities shall be continuous and unobstructed unless otherwise approved by LAWA.

F. Safe and adequate pedestrian zones and public transportation stops, as well as pedestrian crossings of the Work at intervals not exceeding 90 m (300 feet), shall be maintained unless otherwise approved by LAWA.

G. Vehicular access to residential driveways shall be maintained to the property line except when necessary construction precludes such access for reasonable periods of time. If backfill has been completed to the extent that safe access may be provided, and the street is opened to local traffic, the Contractor shall immediately clear the street and driveways and provide and maintain access.

H. The Contractor shall cooperate with the various parties involved in the delivery of mail and the collection and removal of trash and garbage to maintain existing schedules for these services.

I. Grading operations, roadway excavation and fill construction shall be conducted by the Contractor in a manner to provide a reasonably satisfactory surface for traffic. When rough grading is completed, the roadbed surface shall be brought to a smooth, even condition satisfactory for traffic.

J. Unless otherwise authorized, work shall be performed in only one-half the roadway at one time. One shall be kept open and unobstructed until the opposite side is ready for use. If one-half a street only improved, the other half shall be conditioned and maintained as a detour.

1.31.9 N (2) Street Closures, Detours, Barricades

A. There shall be no closure without the express written permission of LAWA.

B. The Contractor shall comply with all applicable State, County and City requirements for closure of streets. The Contractor shall provide barriers, guards, lights signs, temporary bridges, flag persons, and watch persons. The Contractor shall be responsible for compliance with additional public safety requirements which may arise. The Contractor shall furnish and install signs and warning devices and promptly remove them upon completion of the Work.

1.31.9 N (3) Operational Safety on the Airport

In all operations, the Contractor shall be governed by the policies, regulations and rules of LAWA, and shall cooperate fully with LAWA. Should there be a conflict in the requirements listed and any other requirements in the Plans and Specifications, the most restrictive shall govern. Conflicts shall be brought to the attention of the LAWA Engineer or the Engineer's Authorized Representative. The Engineer reserves the right to issue a final determination for conflicts.

A. Operation of Motor Vehicles

- Motor vehicle operations within and on the Airport premises shall be governed generally by the provisions of the California State Motor Vehicle Codes and Traffic Direction procedures and signals for turns. Lights and safe-driving precaution shall be in conformity therewith. In addition, motor vehicles shall conform to all special regulations prescribed by the Los Angeles International Airport or procedures imposed pursuant to Los Angeles International Airport regulations by the Engineer. Refer to "*Operations of Vehicles"* of these specifications.
- All vehicular equipment in the AOA, access road, aircraft parking or storage areas shall at all times comply with any lawful signal or direction of LAWA employees. All traffic signs, lights, and signals shall be obeyed, unless otherwise directed by LAWA employees.
- Every person operating motorized equipment of any character on any area shall operate the same in a careful and prudent manner and at a rate of speed posted or fixed by this section and at no time greater than is reasonable and proper under the conditions existing at the point of operating, taking into account traffic and road conditions, view, obstructions, and shall be consistent with all conditions so as not to endanger the life, limb, or property or the rights of others entitled to the use thereof.

1.31.9 N (4) Operational Procedures - Airports are in operation twenty-four (24) hours a day and construction procedures must provide safe operation during the entire period. In order to provide operating safety, instructions shall be given in the construction documents for turning central chilled water systems, central hot water systems, steam, plumbing or other utility systems on and off to facilitate construction. The designer shall identify all interface valves on the plans or provide for new valves to use for isolation. Prior to isolating or turning off systems, the Contractor shall be required to tag the valve and his representative shall sign it. At the same time, the Airport Contact shall all sign at the same time. Prior to turning the system back on, all representatives shall again sign off on the operation.

1.31.9 N (5) Operational Safety - In order to provide operational safety, the Contractor is to notify at LAX the Airport Response Coordination Center two (2) hours prior to commencement of work and prior to turning fire protection/detection systems on or off. The contractor is expected to give the following information, once in contact with the ARCC:

- Name and phone number of contractor.
- System identification (i.e. sprinkler valve number, fire alarm zoning identification).
- Time the system will be deactivated.
- Time the system will be reactivated.
- Total time the system will be out of service.

1.31.9 O Contractor's Safety Personnel Requirements and Responsibilities
THE CONTRACTOR IS SOLELY RESPONSIBLE FOR ACCIDENT PREVENTION AND JOB SITE SAFETY. This responsibility cannot be delegated to subcontractors, suppliers, LAWA, or other persons.

1.31.9 O (1) Confined Spaces

A. Confined Space Entry Program. The Contractor shall be responsible for implementing, administering and maintaining a confined space entry program (CSEP) in accordance with Sections 5156, 5157 and 5158, Title 8, CCR.

B. Prior to starting the Work, the Contractor shall prepare and submit its comprehensive CSEP to the Engineer. The CSEP shall address all potential physical and environmental hazards and contain procedures for safe entry into confined spaces, including, but not limited to the following:

- Training of personnel
- Purging and cleaning the space of materials and residue
- Potential isolation and control of energy and material inflow
- Controlled access to the space
- Atmospheric testing of the space
- Ventilation of the space
- Special hazards consideration
- Personal protective equipment
- Rescue plan provisions

C. The Contractor's submittal shall include the names of its personnel, including subcontractor personnel, assigned to the project who will have CSEP responsibilities, their CSEP training, and their specific assignment and responsibility in carrying out the CSEP.

Permit-Required Confined Spaces. Entry into permit-required confined spaces as defined in Section 5157, Title 8, CCR may be required as a part of the Work. All manholes, tanks, vaults, pipelines, excavations, or other enclosed or partially enclosed spaces shall be considered permit required confined spaces until the pre-entry procedures demonstrate otherwise. The Contractor shall implement a permit space program prior to performing any work in a permit-required confined space. A copy of the permit shall be available at all times for review by Contractor and LAWA personnel at the Work site.

1.31.9 O (2) Security Requirements

A. Perimeter Fence Security

- Contractor shall not open gates or remove fencing without approval of the Engineer. Adequate precautions shall be taken to prevent entrance of unauthorized persons to Airport-restricted areas or inadvertent entry of dogs or large animals into the AOA.

- Ten Foot Rule: No Contractor will be permitted to store materials, park equipment or erect permanent or semi-permanent structures within ten (10) feet of either side of the AOA perimeter security fence.

1.31.9 O (3) Obstructions to Navigation

A. Penetrations of the imaginary surfaces defined in FAR Part 77 shall not be permitted without advance notification of, and approval by, the Engineer. It will be necessary for the Contractor to file FAA Form 7460-1 with the FAA to obtain approval prior for operation of equipment 15 feet or more in height, including but not limited to vehicles, cranes, or other construction equipment, structures, stockpiled materials, excavated earth, etc. It shall be the Contractor's sole responsibility to file this document. Allow at least 45 days for FAA and review and approval prior to expected use of such equipment.

B. When penetrations more than 15 feet above ground level (AGL) are unavoidable, they shall be brought to the attention of the Engineer, as far in advance as possible to allow NOTAMS to be prepared and distributed to appropriate FAA divisions for publication and dissemination. Contractor shall comply with the provisions of AC 70/7460-1, latest edition, in the marking and lighting of obstacles. The Contractor shall allow at least 45 days for FAA review and approval. No delays will be granted the Contractor for his failure to submit the necessary documents in a timely manner.

C. Depending on the location of the construction site, there may be severe restrictions on the use of equipment that extends skyward, such as cranes and concrete pumping booms. Some of these restrictions include limitations on the height cranes can be extended during times of reduced visibility, e.g., cranes may not be raised unless visibility is 3 miles or greater. Contact the Engineer for further information, prior to submitting a bid, if cranes or other vertically extendable equipment will be used on the project.

1.31.9 P Special Hazardous Substances and Processes

A. Special Hazardous Substances and Processes. Materials that contain hazardous substances or mixtures may be required on the Work. A Material Safety Data Sheet as described in Section 5194 of the California Code of Regulations shall be requested by the Contractor from the manufacturer of any hazardous products used.

B. Except as otherwise permitted, the Contractor agrees to accept sole responsibility for full compliance with any and all applicable present and future rules, regulations, restrictions, ordinances, statutes, laws and/or other orders of any governmental entity regarding the use, storage, handling, distribution, processing and/or disposal of hazardous wastes, extremely hazardous wastes, hazardous substances, hazardous materials, hazardous chemicals, toxic chemicals, toxic substances, pollutants, contaminants, or other similarly regulated substances (hereinafter referred to as "hazardous substances") regardless of whether the obligation for such compliance or responsibility is placed on LAWA of the land, on LAWA of any improvements on the premises, on the user of the land, or on the user of the improvements. Said hazardous substances shall include, but shall not be limited to gasoline, aviation, diesel and jet fuels, lubricating oils and solvents.

C. With the exception of the City's sole negligence, the Contractor agrees that any damages, penalties or fines levied on the City and/or the Contractor as a result of noncompliance with any of the above shall be the sole responsibility of the Contractor and, further, that the Contractor shall indemnify and pay and/or reimburse City for any damages, penalties or fines that City incurs, or pays, as a result of noncompliance with the above requirements.

D. In the case of any hazardous substance spill, leak, discharge or improper storage on the premises, or contamination of same, by any person, the Contractor agrees to make, or cause to be made, any necessary repairs or corrective actions, as well as to clean up and remove any leakage, contamination or contaminated ground. In the case of any hazardous substance spill, leak, discharge or contamination by the Contractor, or by any of its employees, agents, servants, or subcontractors which affects other property of the City, or property (ies) of the City's tenant(s), the Contractor agrees to make, or cause to be made, any necessary repairs, or take corrective actions, to clean-up and remove any such spill, leakage or contamination.

E. If the Contractor fails to repair, clean-up, properly dispose of, or take any other corrective action(s) as required, the City may (but shall not be required to) take all steps it deems reasonably necessary to properly repair, clean-up or otherwise correct the condition(s) resulting from the spill, leak or contamination. Any such repair, clean-up or corrective action(s) taken by the City shall be at Contractor's sole cost and expense, as well as shall any and all costs (including any administrative costs) which City incurs, or pays, as a result of any repair, clean-up or corrective action it takes.

F. Contractor shall promptly supply City with copies of all notices, reports, correspondence and submissions made by the Contractor to any governmental entity regarding any hazardous substance spill, leak, discharge or clean-up, including all tests results.

G. This section and the obligations herein shall survive the expiration or earlier termination of any other contractual relationship.

1.31.10 Quality Assurance

1.31.10 A General

A. The Work is subject to inspection and approval by LAWA.

B. The LAWA Engineer and Inspector shall be permitted access to all parts of the Work, including plants where materials or items are manufactured or fabricated. The presence of the Engineer or the Inspector shall not relieve the Contractor of the responsibility for the proper execution of the Work.

C. The Contractor shall notify the Inspector before noon of the working day before inspection is required. Work shall be done only in the presence of the Inspector, unless otherwise authorized. Any work done without proper inspection will be subject to rejection. The Inspector and any authorized representatives shall at all times have access to the Work during its construction at shops and yards and while in storage, as well as to the Work site. The Contractor shall provide every reasonable facility for ascertaining that the materials and

workmanship are in accordance with these Specifications. Inspection of the Work shall not relieve the Contractor of the obligation to fulfill all requirements of the Contract.

D. The Inspector is authorized to determine the acceptability of materials and the quality of Work. The Inspector is authorized to sample and test all materials to be incorporated into the Work. The Inspector may delegate this authority to sample materials for construction to an approved public or private testing laboratory to perform any necessary tests.

E. No Work shall be backfilled, buried, cast in concrete, hidden or otherwise covered until it has been inspected by the Inspector and other Agencies for which a permit is required. Should the Contractor attempt to cover or conceal any item of Work prior to its approval and acceptance, the Inspector may cause the activity to be stopped and require said Work to be exposed, if determined necessary by the Inspector, so that proper inspection may take place. All costs for exposing such Work, including premium costs resulting from alternate means of inspection, time delays, and impacts resulting on other portions of the Work, shall be borne by the Contractor. All costs of such delays, including its effect upon other portions of the Work, shall be borne by the Contractor. Where Work that was done without inspection cannot be uncovered, such as in concrete cast over reinforcing steel, all such Work shall be subject to demolition, removal, and reconstruction under proper inspection at the expense of the Contractor.

1.31.10 B Faulty and Unauthorized Work

A. Unauthorized work shall be remedied or removed and replaced by the Contractor in an acceptable manner, and no added compensation will be allowed for such removal, replacement, or remedial work. If the contractor chooses to propose repair of non-conforming work, a repair procedure is required for non-conforming work and shall be submitted to the Engineer for review and approval prior to any corrective action taking place. Work done beyond the areas indicated or established by the Engineer, or any “extra work” done without written authority from the Engineer will be considered as unauthorized work. Work shall be remedied, removed or replaced at the Contractor's expense. If the Contractor fails to replace any defective or damaged Work or material after reasonable notice, the Engineer may cause such Work or materials to be remedied, removed, or replaced, and the cost thereof to be deducted from any moneys due or which may become due to the Contractor.

B. Except as set forth in this Subsection or elsewhere in Project Specifications, all non-conforming Work and materials, in place or not, shall be removed immediately from the Site or corrected to conform to all requirements of the Contract Documents, by the Contractor, at the sole expense of the Contractor. If the contractor chooses to propose repair of non-conforming work, a repair procedure is required for non-conforming work and shall be submitted to the Engineer for review and approval prior to any corrective action taking place. If the Contractor fails to remove, replace, or correct any non-conforming Work or materials within seventy-two (72) hours of discovery, the Engineer may cause such Work or materials to be removed and replaced. Such removal and replacement shall be at the sole expense of the Contractor and all such cost shall be deducted from any moneys that are due or may become due to the Contractor. Otherwise the Contractor shall pay LAWA if there remains an insufficient amount or no amount to be paid by LAWA to the Contractor.

C. Any delays or impacts arising on the Work as a result of construction or delivery of non-conforming Work or materials shall be at the Contractor's sole expense.

D. Failure of the Inspector or the Engineer to notify the Contractor of any non-conforming Work shall not constitute acceptance of any non-conforming Work. The Contractor's obligation to remove, replace or correct any non-conforming Work, whenever discovered, shall continue to the end of the warranty period specified in the Contract Documents. LAWA reserves and retains all rights and remedies against the Contractor and their Surety for correction of any and all latent defects discovered after the warranty period.

E. If the Contractor shall join Work with any Work in place, and if such joint is not made in a skillful manner, then such joint or Work shall be deemed and construed to be faulty workmanship and such materials shall be deemed and construed to be defective materials.

F. In case of a dispute between the Contractor and the Inspector, the latter is authorized to reject materials or suspend the Work until any questions at issue can be referred to and decided by the Engineer

1.31.10 C Materials and Workmanship

A. Workers and installers shall be skilled, trained and experienced in the necessary crafts and shall be completely familiar with the specific requirements and methods needed for proper performance and completion of the Work.

B. Fabricators shall be licensed by the City of Los Angeles. All structural welding shall be performed by welders certified and licensed by the City of Los Angeles, Department of Building and Safety.

C. No product containing asbestos shall be used for any purpose. When removing asbestos products, the Contractor shall comply with the requirements of Title 8, CCR, General Industry Safety Orders and Construction Safety Orders.

D. All references to specifications of national organizations and trade associations related to building industry such as, but not limited to, American Society for Testing and Materials, American Institute of Steel Construction, American Concrete Institute, Prestressed Concrete Institute, Post-Tensioning Institute, and the National Board of Fire Underwriters refer to the latest revision of such specifications except as otherwise noted at time of bid opening.

E. All materials, parts, and equipment furnished by the Contractor in the Work shall be new, high grade, and free from defects. Used or secondhand materials, parts, and equipment may be used only if so specified in the contract documents.

F. The quality of materials and workmanship shall be subject to approval by the Inspector. Materials and workmanship of quality not conforming to the requirements of the Specifications shall be considered defective and will be subject to rejection. Defective work or material, whether in place or not, shall be removed immediately form the Work site by the Contractor, at its expenses, when so directed by the Inspector.

G. If the Contractor fails to replace any defective or damaged work or material after reasonable notice, the Engineer may cause such work or materials to be replaced. The replacement expense will be deducted from the amount to be paid to the Contractor.

1.31.10 D Protection of Work and Materials

A. The Contractor shall provide and maintain storage facilities and employ such measures as will preserve the specified quality of materials to be used in the Work. Stored materials shall be reasonably accessible for inspection. The Contractor shall also adequately protect new and existing work and all items of equipment for the duration of the Contract.

B. The Contractor shall not, without LAWA's consent, assign, sell, mortgage, hypothecate, or remove equipment or materials which have been installed or delivered and which may be necessary for the completion of the Work.

C. Access to Work and Materials. The Contractor shall provide access at any time to the Work and materials wherever same are stored, being fabricated, erected or installed, when requested to do so by a representative of the LAWA or other regulatory subdivisions having jurisdiction.

D. Facilities and Labor. The Contractor shall provide sufficient, safe, and proper facilities and labor necessary to move, take and prepare samples for testing of materials, and shall move same for purposes of additional testing when ordered to do so by any of the LAWA's representatives.

1.31.10 E Shop Inspection Requirements

A. When shop inspection is required by the Engineer, a Notification of Fabrication form shall be submitted by the General Contractor or the Quality Control Manager to the Materials Control Coordinator.

B. The General Contractor or the Quality Control Manager shall fax the Notification of Fabrication to the Materials Control Coordinator at 424-646-9327 at least 48 hours in advance when the fabrication will take place within 50 miles of the project.

C. The General Contractor or the Quality Control Manager shall fax the Notification of Fabrication to the Materials Control Coordinator at 424-646-9327 at least 10 working days in advance when the fabrication will take place more than 50 miles from the project.

D. The General Contractor or the Quality Control Manager shall fax the Notification of Fabrication to the Materials Control Coordinator at 424-646-9327 at least 30 days in advance when the fabrication will take place outside of the continental United States.

E. David Jackson is the Material Control Coordinator for all LAWA projects and can be reached at 424 646-5755 or at djackson@lawa.org.

F. Notification of Fabrication form (to be provided).

G. Unless otherwise specified, inspection is required at the sources for asphalt concrete pavement mixtures, structural concrete, metal fabrication, metal casting, welding, concrete pipe manufacture, protective coating application, and similar shop or plant operations. Additional materials and fabricated items which require inspection at the source shall be as specified.

H. Steel pipe in sizes less than 8 inches and vitrified clay and cast iron pipe in all sizes are acceptable upon certification as to compliance with the Specifications, subject to sampling and testing by LAWA. Shelf items mass produced unless noted otherwise in this contract are subject to inspection at the Work site only. Special items of equipment such as designed electrical panel boards, large pumps, sewage plant equipment, etc. are subject to inspection at the source including performance testing. Inspection at the source for other items shall be as specified.

I. All materials and fabricated articles furnished by the Contractor are subject to inspection at their source, and no materials or fabricated articles shall be used in the Work until they have been inspected and accepted by the Materials Control Inspector. The Materials Control Inspector shall be permitted access to all parts of the Work, including shops where materials and fabricated articles are manufactured or fabricated.

J. All materials and fabricated items shall be manufactured or fabricated from Shop Drawings that have been approved by the Engineer. The Contractor shall ensure that legible copies of the approved submittals, shop drawings, approved mix designs, and the corresponding Contract Specifications are provided to its fabricators or suppliers, and that said documents are available to the Materials Control Inspector or Independent Inspection and/or Testing Laboratory (IITL) during the inspection. Shop inspection cannot and will not take place without noted documents.

K. Any material or fabricated item which requires shop inspection and arrives at the Site without inspection by the Materials Control Inspector is subject to rejection by the Inspector and may be required to be removed from the Site by the Contractor at the Contractor's sole expense.

L. Prior to shipment of any material or fabricated item, final inspection shall be performed by the Materials Control Inspector or IITL. Said inspection shall consist of a final visual inspection, identification, and tagging and/or stamping for release to the Project Site. Items received at the Site without the proper identification may be rejected and required to be removed from the Site.

M. See appendix B for typical items requiring Materials Control Inspection—final determination for shop inspection will be made by the Principal Construction Inspector of the project.

1.31.10 F Test of Materials

A. Before incorporation into the Work, the Contractor shall submit samples of materials, as the Engineer may require, at no cost to LAWA. The Contractor, at its expense, shall deliver the materials for testing to the place and at the time designated by the Engineer. Unless otherwise specified, all initial testing and reasonable amount of retesting that is performed under the direction of LAWA, will be at no expense to the Contractor. If the Contractor is to

provide and pay for testing, it will be so specified. For Tenant Projects, the testing expense shall be borne by the Applicant.

B. The Contractor shall notify the Engineer in writing, at least 15 days in advance, of its intention to use materials for which tests are specified, to allow sufficient time to perform the tests. The notice shall name the proposed supplier and source of material.

C. If the notice of intent to use is sent before the materials are available for testing or inspection, or is sent so far in advance that the materials on hand at the time will not last but will be replaced by a new lot prior to use on the Work, it will be the Contractor's responsibility to re-notify the Engineer when samples which are representative may be obtained.

D. Testing by the LAWA. In addition to any other inspection or Quality Assurance provisions that may be specified, the Engineer shall have the right to independently select, test, and analyze, at the expense of the LAWA, additional test specimens of any or all of the materials to be used. Whenever any portion of the Work fails to meet the requirements of the Contract Documents as shown by the results of independent testing or investigation by the Engineer, all costs of such independent inspection and investigation, and all costs of removal, correction, and reconstruction or repair of any such Work shall be borne by the Contractor.

E. Testing by Approved Testing Laboratory. When the manufacturer, fabricator, or supplier provides the results of tests from samples taken at the mill, factory, or warehouse, the Engineer will accept the test reports provided the following conditions are met:

- The Testing Laboratory was approved by the Engineer prior to performing the tests, and that all necessary certifications were valid at the time the tests were performed.
- The tests were performed in conformance with the Contract Documents for the specified material or item.
- The reports are made in the form of an affidavit, as specified below.
- Tests performed by an approved Testing Laboratory are subject to be monitored by LAWA Inspectors.

F. Whenever the approved Testing Laboratory takes samples of materials other than at the Site, the deliveries to the Site of materials represented by such samples shall be identified as specified for the specific material. The results of such tests shall be reported to the Materials Control Inspector in the form of affidavits attested to by the Testing Laboratory. Such affidavits shall furnish the following information with respect to the material sampled:

- Manufacturer's name and brand.
- Place of sampling.
- Sufficient information to identify the lot, group, bin, or silo from which the samples were taken.
- Amount of material in the lot sampled.
- Statement that the material has passed the requirements.
- Signature and title of the person creating the affidavit and the date of execution of the affidavit.

1.31.10 G Certification

A. The Engineer may waive the materials testing requirements and accept the manufacturer's written certificate of compliance that the materials to be supplied meet those requirements. Materials test data may be required by the Engineer to be included with the submittal.

B. A Certificate of Compliance in triplicate shall be furnished prior to the use of materials for which the Contract Documents require that such a certificate be furnished. The Engineer may permit the use of certain materials or assemblies prior to the sampling and testing if accompanied by a Certificate of Compliance. The certificate shall be signed by the manufacturer of the material or the manufacturer of assembled materials and the Contractor, and shall state that the materials involved comply in all respects with the requirements of the specifications. A Certificate of Compliance shall be furnished with each lot of materials delivered to the work, and the lot so certified shall be clearly identified on the certificate. The form of the Certificate of Compliance and its disposition shall be as directed by the Engineer.

C. Materials used on the basis of a Certificate of Compliance may be sampled and tested at any time. The fact that material is used on the basis of a Certificate of Compliance shall not relieve the Contractor of responsibility for incorporating material in the Work which conforms to the requirements of the Contract Documents and such material not conforming to such requirements will be subject to rejection whether in place or not.

D. The Engineer reserves the right to refuse to permit the use of material notwithstanding the submittal of a Certificate of Compliance.

1.31.10 H Trade Names or Equals

A. The Contractor may supply any of the materials specified or offer an equivalent. The Engineer will determine whether the material offered is equivalent to that specified. Adequate time shall be allowed for the Engineer to make this determination.

B. A listing of materials is not intended to be comprehensive, or in order of preference. The Contractor may offer any material, process, or equipment considered to be equivalent to that indicated. The substantiation of offers shall be submitted as provided in the Contract Documents.

C. The Contractor shall, at its expense, furnish data concerning items offered by it as equivalent to those specified. The Contractor shall have the material tested as required by the Engineer to determine that the quality, strength, physical, chemical, or other characteristics, including durability, finish, efficiency, dimensions, service, and suitability are such that the item will fulfill its intended function.

D. Test methods shall be subject to the approval of the Engineer. Test results shall be reported promptly to the Engineer, who will evaluate the results and determine if the substitute item is equivalent. The Engineer's findings shall be final. Installation and use of a substitute item shall not be made until approved by the Engineer.

E. If a substitute offered by the Contractor is not found to be equal to the specified material, the Contractor shall furnish and install the specified material.

F. The specified Contract completion time shall not be affected by any circumstance developing from the provisions of this subsection.

1.31.10 I Weighing and Metering Equipment

A. Scales and metering equipment used for proportioning materials shall be inspected for accuracy and certified within the past 12 months by the State of California Bureau of Weights and Measures, by the County Director or Sealer of Weights and Measures, or by a scale mechanic registered with or licensed by the County

B. The accuracy of the work of a scale service agency, except as stated herein, shall meet the standards of the Business and Professions Code and the Code of Regulations pertaining to weighing devices. A Certificate of Compliance shall be presented, prior to operation, to the Engineer for approval and shall be renewed whenever required by the Engineer at no cost to LAWA.

C. Scales shall be arranged so they may be read easily from the operator's platform or area. They shall indicate the true net weight without the application of any factor. The figures of the scales shall be clearly legible. Scales shall be accurate to within 1 percent when tested with the plant shut down. Weighing equipment shall be so insulated against vibration or moving of other operating equipment in the plant area that the error in weighing with the entire plant running will not exceed 2 percent for any setting nor 1.5 percent for any batch.

1.31.10 J Final Inspection

At the completion of Work, after completion of all corrections, the Inspector, Engineer, Designer, Architect, Construction & Maintenance, and Contractor will make a final inspection, as applicable. The Inspector will provide a Final Inspection Correction List itemizing all Work necessary to complete the Project satisfactorily.

1.31.11 LAWA Furnished Materials

Materials Furnished by LAWA

A. Upon receiving material furnished by the LAWA for storage or installation in the Work, the Contractor shall give a signed receipt to the Airport Contact for the material delivered. Thereafter the Contractor shall be responsible for the care and necessary replacement of such material if damaged.

B. If, as determined by LAWA, the material is not adequately protected by the Contractor, such material may be protected by the LAWA and the cost thereto be charged to the Contractor.

C. Upon receiving such material, the Contractor shall inspect it, and should any damage, defects, or missing equipment or parts be found, the Contractor shall immediately notify

LAWA in writing. By failing to notify LAWA, it shall be deemed that the Contractor has accepted such material as being free from said damage, defects, or missing equipment or parts, except for latent defects.

1.32 Testing and Commissioning

Prior to the time the new system is connected to the main system, detailed testing requirements shall be completely specified by the Design Engineer.

1.32.1 Start-up and Pre-functional Checklist

A. Perform a full pre-functional checkout of each piece of equipment. The pre-functional testing for a given system must be successfully completed prior to formal functional testing.

B. Equipment shall not be “temporarily” started (for heating and cooling) until the Start-Up Plan is completed.

C. The Contractor shall prepare start-up plans for equipment to be commissioned.

D. Subcontractors responsible for pre-functional checklists and startup will be identified at the pre-commissioning meeting. Submit start-up plans to LAWA for review and approval; start-up plans shall consist of, but not be limited to:
   - The manufacturer’s standard written start-up procedures copied from the installation manuals, with check boxes by each procedure and a signature block at the end.
   - Field checkout sheets normally used by the sub-contractor.
   - Forms normally issued by the sub-contractor to document tests required in the specifications.
   - Final pre-functional.
   - Schedule that includes equipment installation, contractor start-up, manufacturer start-up, and other tests required by the specifications. Schedule shall state when documents in the start-up plan will be completed.

E. At least 90 days prior to the start of commissioning, the Contractor shall submit a commissioning package for the equipment to be commissioned. This package shall include the following information:
   - Equipment manufacturer’s operating & maintenance instructions.
   - Equipment manufacturer’s installation and start-up manual.
   - Start-up plans.

1.31.2 Adjustments

A. Adjust operating products, systems, subsystems, and equipment to ensure smooth and unhindered operation.

- The Contractor shall make all repairs and replacements promptly upon receipt of written order from LAWA.

1.33 Protecting Installed Construction

1.33.1 FINAL CLEANING

A. General cleaning is required during construction.

B. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions. Do not use cleaning agents that are potentially hazardous to health or property or which might damage finish surfaces. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with California Code of Regulations maximum allowable VOC levels.

C. In addition to the requirements of the contract documents, complete the following cleaning operations before requesting LAWA Final Inspection.

- Remove labels that are not permanent labels.
- Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
- Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
- Vacuum carpeted and soft surfaces, removing debris and excess nap. Shampoo if visible soil or stains exist.
- Clean equipment and plumbing fixtures to a sanitary condition.
- Clean exposed surfaces of grilles, registers, and diffusers.
- Replace filters of operating mechanical equipment.
- Clean ducts, blowers, and coils if units were operated without filters during construction or display contamination with particulate matter upon inspection.
- Clean light fixtures and replace burned out lamps and bulbs. Replace defective or noisy ballasts and starters in fluorescent fixtures.
- Remove debris and surface dust from limited access spaces, including, but not limited

to the following: roofs, attics, plenums, shafts, trenches, equipment vaults, maintenance holes, gutters, downspouts, and drainage systems.

- Wipe surfaces of mechanical and electrical equipment, elevator, escalator, moving walk, baggage handling, and similar equipment. Remove excess lubrication, paint, mortar droppings, and other foreign substances.

- Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

- Clean the site, including Contractor's Operations and Storage Yard, of rubbish, litter and foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.

- Reinstall any cladding removed for the work.

D. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

E. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on LAWA property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

F. Where extra materials of value, which have become LAWA's property, remain after completion of associated Work arrange for the removal, relocation, and or disposal of these materials as directed by LAWA.

1.33.2 PEST CONTROL

When directed by contract, engage an experienced, licensed exterminator to make final inspection and rid Project of rodents, insects, and other pests. Submit pest-control final inspection report and warranty to LAWA.

1.34 Closeout Procedures

1.34.1 List of Incomplete Items (Punchlist)

Thirty (30) days prior to anticipated Project Completion, submit a list, in an electronic format approved by LAWA, either Microsoft Excel Spreadsheet with PDF or Microsoft Access Database with PDF. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside limits of construction. Use CSI Form 14.1A or other form acceptable to LAWA.

A. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, unless otherwise acceptable to LAWA.

B. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
C. Include following information at top of each page:

- Project name.
- Date.
- Name of Construction Manager and Designer/Architect.
- Name of Contractor.
- Page number.

1.34.2 FINAL INSPECTION

At the completion of Work, after completion of all corrections, the Inspector, Engineer, Designer, Architect, Construction & Maintenance, and Contractor will make a final inspection, as applicable. The Inspector will provide a Final Inspection Correction List itemizing all Work necessary to complete the Project satisfactorily.

Tenant/Contractor is to:

A. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

B. Submit certified copy of LAWA's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by LAWA. Certified copy of list shall state that each item has been completed or otherwise resolved for acceptance.

C. Submit documentation of performance of Closeout Submittals as outlined in Section below.

D. In addition to submittals required in Section below, submit final project photographs, damage or settlement surveys, property surveys, and similar final record information.

Additionally, for those portions to be maintained by LAWA, Tenant/Contractor is to:

A. Advise LAWA of pending insurance changeover requirements.

B. Obtain and submit releases permitting LAWA unrestricted use of Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

C. Advise LAWA of changeover in heat and other utilities

D. Submit changeover information related to LAWA's occupancy, use, operation, and maintenance.

E. Submit final meter readings for utilities, measured record of stored fuel, and similar data as of date of Substantial Completion or when LAWA took possession of and assumed responsibility for corresponding elements of Work.

F. Make ready for landscape maintenance period (if applicable.)

G. Submit any specific testing data, warranties, maintenance agreements, final certifications and similar documents not addressed in Section below."

1.35 Closeout Submittals

1.35.1 PROJECT RECORD DOCUMENTS

A. General: Comply with the requirements of the Contract Documents regarding submittal requirements.

B. Summary: This subsection includes administrative and procedural requirements for Project Record Documents, including, but not limited to, the following:

- Record Drawings
- Record Specifications
- Record Product Data
- Record Samples
- Miscellaneous Record Submittals

C. Store Project Record Documents and samples in the field office, in a secure, fire-resistive location, apart from the documents used for construction. Maintain Project Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for LAWA reference during normal working hours.

1.35.2 Record Drawings

A. Initial Submittal: Thirty days prior to Substantial Completion, submit one paper copy set and PDF electronic files of marked-up (in contrasting color) record prints and one set of plots from corrected record digital files. LAWA will indicate whether general scope of changes, additional information, and quality of drafting are acceptable.

Additional information is to include, but not be limited to, the following:

- Note requests for information, change orders, alternate numbers, and similar information, where applicable.
- Measured horizontal and vertical locations of underground substructures, utilities and appurtenances, referenced to permanent surface improvements.
- Measured locations of substructures, internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
- When substructures are encased in concrete, the outside dimensions of the encasement shall also be given.
- Field changes of dimension and detail.
- Details not on original Contract Drawings.
- Revisions to electrical circuitry and locations of electrical devices and equipment.
- Where the plans are diagrammatic or lacking precise details, the Contractor shall

produce dimensioned full-sized sheets.
- In the case of those Drawings which depict the detail requirements for equipment to be assembled and wired in the factory, the Record Drawings shall be updated by indicating those portions which are superseded by final Shop Drawings.

B. Record Digital Data Files: Immediately before inspection for Substantial Completion, review marked-up (in contrasting color) record prints with LAWA. When authorized, prepare a full set of corrected digital data files of the Contract Drawings as follows:

- Format to be same digital data software program, version, and operating system as the original Contract Drawings.
- LAWA will furnish one digital data set of the original Contract Drawings for use in recording information.
- Annotated, indexed PDF electronic files with comment function enabled.

C. Final Submittal: Upon approval of Initial Submittal, but not less than fifteen days after substantial completion, submit one paper copy set and PDF electronic files of marked-up (in contrasting color) record prints, one set of record digital data files, and three sets of record digital data file plots. Plot each drawing file, whether or not changes and/or additional information were recorded.

D. Identify and date each record drawing; including the designation “PROJECT RECORD DRAWING” in a prominent location.

E. Organize record prints and newly prepared record drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

1.35.3 Record Specifications

A. Mark Specifications in contrasting color to indicate the actual product installation, where installation varies from that indicated in Specifications.

B. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

C. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

D. Record the name of manufacturer, supplier, installer, and other information necessary to provide a record of selections made.

E. Submit one paper copy and a set of annotated, indexed PDF electronic files of Project Specifications, including addenda and contract modifications.

1.35.4 Record Product Data

A. Equipment Summary Data Forms shall be submitted to provide LAWA Construction and Maintenance with sufficient information to catalogue newly purchased equipment items installed. This information is used for inventory purposes as well as for equipment

performance tracking purposes. Each item of equipment installed must be documented on one of two forms; Electrical Summary Data Form, or Equipment Summary Data Form. Examples of each form are attached as Appendix A. Additional requirements regarding submittal format, quantities, etc., are found elsewhere in the Contract Documents.

B. Contractors choosing not to use the Forms may submit a revised Form for LAWA approval. At a minimum the following information must be included:

- Equipment item (included industry-accepted nomenclature).
- LAWA Equipment Identification Number, if applicable
- Manufacturer, including Address, Email, Phone/Fax Numbers)
- Supplier (if different than Manufacturer), including Address, Email Phone/Fax Numbers
- Equipment Serial Number(s)
- Equipment Model Number
- Size
- Capacity
- Rated Output
- Drive Motor Data (as appropriate).

C. Equipment Summary Maintenance Forms shall be submitted to provide LAWA Construction and Maintenance with information sufficient to properly diagnose (troubleshoot, repair, check-out, and return an item of equipment to service. In addition, Maintenance information required to troubleshoot, repair, and return electrical/electronic equipment to service (including set point, derivatives, etc.) shall be included as required. The Maintenance Summary Form attached in intended to serve as a (minimum) guide to the information required per item of equipment. Additional requirements regarding submittal format, quantities, etc. are found elsewhere in this Specification.

D. Contractors choosing not to use the Forms may submit a revised Form for LAWA approval. At a minimum the following information must be included:

- Equipment Item (include industry-accepted nomenclature)
- LAWA Equipment Identification Number, if applicable
- Manufacturer, including Address, Email, Phone/Fax Numbers
- Equipment Serial Number(s)
- Weight of Individual Components (over 100 pounds)
- Nameplate Date (including voltage, horsepower, lubrication requirements, speed, etc.)
- Manufacturer’s Local Representative, including Address, Email, Phone/Fax Numbers
- Maintenance Operation(s) Required. Listing shall include Maintenance Operation to be performed and frequency of said Maintenance Operation based on actual service conditions of installed equipment (i.e., type of duty, environmental factors). Reference shall be made to the appropriate section of the manufacturer’s technical literature.
- Lubricant List. List shall include a primary and two secondary manufacturer-approved lubricants.
- Spare Parts and phone number of the recommended source of spare parts as

detailed below.

E. Submit one paper copy and a set of annotated, indexed PDF electronic files of each Form and/or submittal.

1.35.5 Record Samples

Not more than 30 days prior to the date of Substantial Completion, the Contractor will meet at the Jobsite with LAWA to determine which of the submitted Samples that have been maintained during progress of the Work are to be transmitted to LAWA for record purposes. Comply with delivery to a storage area designated by LAWA.

1.35.6 SPARE PARTS AND TOOLS

A. Submit a Recommended Spare Parts List to LAWA sixty (60) days prior to date certified for substantial Completion. This is to be a list from the manufacturer of the Recommended Spare Parts adequate to ensure two (2) continuous years of normal operation after expiration of the equipment warranty.

B. The Recommended Spare Parts List shall include, but not be limited to, items requiring replacement under the following conditions:
   - Wear, corrosion, or erosion during normal operation.
   - Failure which causes a shutdown of equipment or systems.
   - Damage or breakage during routine maintenance or inspections of equipment.
   - Custom or specially fabricated parts, and
   - Long lead items.

C. Approval of the individual equipment submittal does not constitute authorization to procure the Recommended Spare Parts.

D. The Spare Parts supplier must be the manufacturer or a factory authorized representative of the manufacturer. The manufacturer will be responsible for any default of the representative that is not corrected by the representative in a timely and efficient manner. This responsibility includes replacing incorrect or defective parts, trouble shooting, and correcting problems that are traceable to the manufacturer's parts. The supplier shall provide, along with the Spare Parts List, a formal letter of certification from the manufacturer that the supplier is an authorized representative of the manufacturer.

E. The supplier shall be a stocking facility of the manufacturer of the proposed parts, or the manufacturer must maintain a stocking facility of these parts on the West Coast, or the supplier can guarantee delivery of spare parts within seventy-two (72) hours.

F. The Spare Parts list shall be in addition to any other lists required under any other sections of these Specifications. This list shall include but is not limited to the following:

   - Current prices including delivery to the Jobsite.
   - Original Equipment Manufacturer (OEM) part numbers, which identify interchangeability.

- Make and type of equipment as well as Model number.
- Size.
- Supplier's address and telephone number.
- Address and phone number of local representative.
- Address and phone number of servicing location.
- Letter of certification from the manufacturer.
- Materials.
- Special tools, lubricants, and/or fuels.
- Estimated delivery lead times.
- Warranty: State terms of warranty of spare parts offered.
- Cross-sectional, exploded view or assembly-type drawing with part numbers.
- Manufacturer's price list catalog.

G. Upon approval of the Spare Parts list, and no less than thirty (30) days prior to Substantial Completion, deliver tools, spare parts, extra materials, and similar items to location designated by LAWA.

H. The Contractor shall be responsible for proper storage and protection of the Spare Parts until delivered to LAWA.

I. Spare Parts should be supplied in the manufacturer's original packaging and shall be new and unused. A statement shall be included to clearly indicate that the Spare Parts are new and unused.

1.35.7 TECHNICAL MANUALS

A. This section includes administrative and procedural requirements for preparing technical manuals, including the following:
   - Documentation directory
   - Emergency manuals
   - Operation manuals for systems, subsystems, and equipment
   - Product maintenance manuals
   - Systems and equipment maintenance manuals.

B. Definitions:
   - System: An organized collection of parts, equipment, or subsystems united by regular interaction.
   - Subsystem: A portion of a system with characteristics similar to a system.

C. Submit technical manuals as required in individual Technical Specification Sections and in the following format:
   - PDF electronic file. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to LAWA.
   - Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked directory.
   - Enable inserted reviewer comments on draft submittals.
   - Where scanning of paper documents is required, configure scanned file for minimum

readable file size.

Four paper copies. Include a complete directory. Enclose title pages and directories in clear plastic sleeves. Bind in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2 by 11 inch paper with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversized sheets.

- If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary.
- Identify each binder on front and spine with title, project title, subject matter of contents, and indicate specification section number on bottom of spine. Indicate volume number for multiple volume sets.
- Dividers are to be heavy paper with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components included in the section on each divider, cross-referenced to specification section number and title of project manual.
- Provide protective sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
- If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

D. Timeliness of draft technical manual submittals is detailed in the other subsections. Before final payment, the Contractor shall prepare and deliver to LAWA, four (4) each printed and two (2) each electronic copies on compact discs (CDs) of the final technical manuals. The content of the manuals is detailed in the subsections below.

E. The manuals shall be approved and stamped by the respective Subcontractors.

F. Submit draft copy of each manual at least 30 days before commencing demonstration and training. LAWA will comment on whether general scope and content of manual are acceptable. Correct or modify each manual to comply with LAWA comments.

G. Include a section in the directory for each of the following:

- List of documents
- List of systems – list alphabetically
- List of equipment – list alphabetically
- Table of Contents – include for emergency, operation, and maintenance manuals

H. Where manuals contain manufacturer's standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in tabular format, identify each item using appropriate references from the Contract Documents.

I. Prepare a separate manual that provides an organized reference to all technical manuals. This is called the Documentation Directory.

J. In the Documentation Directory and in each technical manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

K. Enable bookmarking of individual documents based upon file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel upon opening file.

1.35.8 Emergency Instructions

A. Content: Organize manual into separate section for each of the following:
- Type of emergency
- Emergency instructions
- Emergency procedures

B. Type of emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
- Fire
- Flood
- Gas leak
- Water leak
- Power failure
- Water outage
- System, subsystem, or equipment failure
- Chemical release or spill

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of operating personnel for notification of installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:
- Instructions on stopping
- Shutdown instructions for each type of emergency
- Operating instructions for conditions outside normal operating limits
- Required sequences for electric or electronic systems
- Special operating instructions and procedures during emergency

1.35.9 Operational Instructions

A. Content: In addition to requirements of this Section, include operation data required in individual Specification Sections and the following information:
- System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents
- Performance and design criteria if Contractor is designated design responsibility
- Operating standards
- Operating procedures
- Operating logs
- Wiring diagrams
- Control diagrams
- Piped system diagrams
- Precautions against improper use
- License requirements including inspection and renewal dates

B. Descriptions: Include the following:
- Product name and model number. Use designations for products indicated on Contract Documents
- Manufacturer's name
- Equipment identification with serial number of each component
- Equipment function
- Operating characteristics
- Limiting conditions
- Performance curves
- Engineering data and tests
- Manufacturer's recommended tolerances and clearances
- Complete internal and connection wiring diagrams. Circuit diagrams and schematics shall be down to component level
- Complete programming procedures and ladder logic documentation for all computer controlled, programmable logic controllers and automated equipment
- Approved isometric drawings of piping systems
- Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:
- Startup procedures
- Equipment or system break-in procedures
- Routine and normal operating instructions
- Instructions on stopping
- Normal shutdown instructions
- Seasonal and weekend operating instructions
- Instructions regarding load changes
- Recommended "turn-around" cycles
- Required sequences for electric or electronic systems
- All special operating instructions and procedures
- Inspection procedures

D. Systems and Subsystems: Include exploded views and schematics of each assembly.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed and identify color-coding where required for identification.

1.35.10 Maintenance Instructions

A. Product Maintenance Manuals: Include each product, material, and finish

- Include the following as applicable:
  - Product name and model number
  - Manufacturer's name
  - Color, pattern, and texture
  - Material and chemical composition
  - Reordering information for specially manufactured products.
- Include manufacturer's written recommendations and the following:
  - Inspection procedures
  - Types of cleaning agents to be used and methods of cleaning
  - List of cleaning agents and methods of cleaning detrimental to product
  - Schedule for routine cleaning and maintenance
  - Repair instructions – include local sources of materials and related services

B. Systems and Equipment Maintenance Manuals: For each system, subsystem, and piece of equipment not part of a system.

- Include manufacturer's maintenance documentation including the following for each component part or piece of equipment:
  - Standard maintenance instructions and bulletins
  - Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly
  - Identification and nomenclature of parts and components
  - Include service, calibration, and lubrication requirements and standard time allotments
  - Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies
  - Include manufacturer forms for recording maintenance

- List the following information and any items that detail essential maintenance procedures:
  - Test and inspection instructions
  - Trouble-shooting guide
  - Precautions against improper maintenance
  - Disassembly; component removal, repair, and replacement; and reassembly instructions

- Aligning, adjusting, and checking instructions

C. The maintenance manual letters are to be on the front cover of the Maintenance Manuals.

1.35.11 WARRANTY SUBMITTALS

A. Submit written warranties to LAWA thirty (30) days prior to date certified for substantial Completion. If Certificate of Substantial Completion designates commencement date for warranties other than date of Substantial Completion for Work, or designated portion of Work, submit written warranties upon request of LAWA.

When a designated portion of Work is completed and occupied or used by City, by separate agreement with Contractor during construction period, submit properly executed warranties to LAWA within fifteen (15) days of completion of that designated portion of work.

B. When Contract Documents require Contractor, or Contractor and subcontractor, supplier or manufacturer to execute special warranty, prepare written document that contains appropriate terms and identification, ready for execution by required parties. Submit draft to LAWA, for approval prior to final execution.

Refer to other sections for specific content requirements and particular requirements for submitting special warranties.

C. Form of Submittal: At Final Completion compile two (2) copies of each required warranty properly executed by Contractor, or by Contractor, sub-Contractor, supplier, or manufacturer. Organize warranty documents into orderly sequence based on table of contents of Project Manual.

D. Bind warranties in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2 by 11 inch paper.

- Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark tab to identify product or installation. Provide typed description of product or installation, including name of product, and name, address, and telephone number of Installer.
- Identify each binder on front and spine with typed or printed title “WARRANTIES,” project title or name, and name of Contractor.
- When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.
- Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide a table of contents at the beginning of the document.

E. Provide duplicate notarized copies of warranties in operation and maintenance manuals.

F. Execute and assemble documents from subcontractors, suppliers, and manufacturers.

G. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of warranty on the work that incorporates the products.

H. When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

I. When work covered by warranty has failed and has been corrected, reinstate warranty by written endorsement. Reinstated warranty shall be equal to original warranty with equitable adjustment for depreciation.

J. Upon determination that Work covered by warranty has failed, replace or repair Work to an acceptable condition complying with requirements of the Contract Documents.

1.35.12 KEYING SCHEDULE

For those areas to be operated and maintained by LAWA, within 30 days of Substantial Completion, provide key schedule for review. Make final changeover of permanent locks and deliver keys to LAWA. Advise LAWA's personnel of changeover in security provisions."

1.36 DEMONSTRATION AND TRAINING

1.36.1 DEMONSTRATION, TRAINING, AND INSTRUCTIONS

A. This section includes administrative and procedural requirements for instructing LAWA and tenant personnel, including the following:
   - Demonstration of operation of systems, subsystems, and equipment.
   - Development of training programs that will identify skills and knowledge necessary to safely and efficiently operate, adjust, and maintain the project.
   - Training in operation, adjustment, and maintenance of products, equipment and systems.

B. All demonstration, training, and instructional sessions will be monitored and approved by LAWA. Any session or portion thereof deemed unsatisfactory, based on evaluation of the training shall be repeated by the manufacturer or manufacturer's representative at no additional cost to LAWA.

C. When deemed appropriate by LAWA, field instruction to LAWA and/or tenant personnel designated to receive training may be acceptable as a training session. The instruction shall be provided by a field service technician qualified to perform corrective or preventive maintenance, troubleshooting, or related field services.

D. Training shall be conducted so that home study will not be required. The training shall include courses, which combine classroom and field hands-on training that is structured and scheduled to facilitate trainee comprehension of the subject material. Courses shall be continuous, and the field training shall immediately follow the classroom instruction.

E. LAWA reserves the right to videotape any and all training materials and presentations, except for proprietary material, and retain all rights for usage of such recorded material for future training sessions.

F. Refer to Technical Specifications for specific requirements for demonstration, training, and instruction of operation adjustment, and maintenance of products, equipment, and systems as specified in other Sections.

G. In addition to the requirements specified in other Sections, the Contractor must, at a minimum, perform the following tasks:

1.36.2 DEVELOPMENT OF PROGRAM

A. With the exception of safety and overview training, training shall be divided into separate categories for operations training and maintenance training with maintenance training further broken down to specific crafts.

B. No actual operations training of a piece of equipment will be permitted until the equipment is properly installed and is operational.

C. Operations training shall be a prerequisite to the beneficial use of the facility or any portion thereof and be completed a minimum of one week prior to the beneficial use.

D. Maintenance training shall occur after and within thirty (30) days of the beneficial use.

1.36.3 Training Program Submittals

A. The Contractor shall provide the training submittals in the following order for review and approval by LAWA.
- First Draft sixty (60) days prior to proposed instruction date.
- Final Draft thirty (30) days prior to proposed instruction date.

B. The "First Draft" of the training material shall, as a minimum, contain the following:
- Instructional text that details the specific topics of training for the system. These topics are detailed below. All text must be complete. Incomplete sections, paragraphs, etc., shall not be acceptable.
- Power Point, Media Player, and any other type of visual training aid that will be used in conjunction with the training plan.
- Reference materials as detailed in the lesson plan (e.g. handout, manufacturer catalogues, brochures, and pamphlets). All material shall be reviewed by LAWA to determine applicability and functionality. Reference materials that do not pass this review shall be modified and resubmitted within two weeks for approval.
- No actual classroom or field training shall be scheduled unless this material is approved.
- The Contractor shall not proceed to the "Final Draft" stage of training material until LAWA has approved the "First Draft".

C. With the final draft of the training material, the Contractor shall submit a Training Agenda that

provides the following information:

- Company name, address, and telephone number(s) for the vendor.
- Name and telephone number(s) of the vendor training representative.
- Duration of class (total hours).
- Breakdown of class and duration in hours of each training activity.
- Target audience (e.g. operators, maintenance personnel etc.).
- Audiovisual requirements.

D. After the Contractor has received approval of the "Final Draft" of the training material and the training agenda from LAWA, only then can the actual training be scheduled. Contractor shall submit his proposed training schedule to LAWA for approval. The proposed training schedule shall be submitted a minimum of sixty (60) calendar days prior to the start of the training. If the proposed training schedule is approved, then it becomes the final training schedule.

E. Any compensation that is paid to LAWA personnel as a result of class cancellations of classes that begin more than thirty (30) minutes after the scheduled start time shall be reimbursed to LAWA by the Contractor. An exception is when a class is canceled or delayed due to actions by LAWA. LAWA will monitor the starting times of scheduled classes.

F. The review of the training material does not constitute its approval unless specifically stated so. The training material submittal shall contain, but not be limited to, the following:
   - Sufficient background information on each instructor for various sessions shall be provided to allow evaluation of the proposed instructor's qualifications and his capability of training the specific discipline.
   - At the completion of the training, the Contractor shall forward to LAWA one complete electronic set of training materials and support material for each defined training category.

1.36.4 Demonstration

A. Four (4) weeks prior to date of occupancy, submit for LAWA’s approval, a proposed outline of demonstration program including a schedule of proposed dates, times, length. Demonstration shall include, but not limited to, the following procedures:
   - Start-up
   - Shutdown
   - Emergency Operations
   - Noise and vibration adjustments
   - Safety procedures
   - Economy and efficiency adjustments
   - Effective energy utilization

B. Demonstrate products, systems, and equipment to LAWA-specified personnel two (2) weeks prior to date of occupancy.

C. For each demonstration submit list of participants in attendance.

D. Provide two copies of video tape of each demonstration and instructions session.

E. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

F. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

G. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at equipment location.

H. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.36.5 Operational Training

A. Manufacturer supplied (VENDOR) equipment training for all major equipment and subsystems shall be provided.

B. The VENDOR training shall be provided by qualified instructors of the equipment manufacturers, i.e.: equipment field startup technician or their representative, as approved by LAWA and may include both on and off-site training venues. Generally, manufacturer sales representatives will not be acceptable.

C. Classroom training shall be structured to develop a basic understanding of the design, function and capabilities of the equipment and the interrelationship with the process. In addition, routine operational and preventive maintenance, safety considerations, responses to abnormalities and startup, shutdown and troubleshooting will be covered.

D. Field training shall be scheduled to commence immediately following the classroom training and shall stress hands-on, performance based application of the classroom training.

E. Equipment shall be started and relevant systems and components shall be demonstrated.

F. Training schedule: The Contractor shall provide an operation and maintenance training schedule to be conducted immediately following vendor equipment startup of the equipment.

1.36.6 Maintenance Training

A. The maintenance training shall include the function, adjustment, repair, and replacement of all components related to the trainee's trade. Safety aspects shall also be stressed.

B. The training shall include, but not be limited to, the following:
- Preventive and corrective maintenance procedures, including replacement of parts; lubrication quantities, types, frequencies, and application points; and an estimate of time to perform such procedures.
- Special tools, techniques, or procedures required for either preventive or corrective

maintenance of equipment, or its auxiliary or support systems.
- Procedures to perform adjustments required for alignment, wear and calibration for all preventive and corrective maintenance, and an estimate of time required to perform such procedures.
- Assembly and disassembly procedures, including parts lists required for appropriate preventive and/or corrective maintenance.
- Maintenance, overhauls, troubleshooting of equipment, and auxiliary or support systems.

C. Models, "exploded" views, and/or audiovisual materials shall be used for this training. These materials shall be turned over to LAWA upon completion of training.

D. Hands-on field training shall be provided, subject to the approval of LAWA."

1.37 COMMISSIONING

1.37.1 FUNDAMENTAL COMMISSIONING

[NOTE: THE SECTION IS TO BE MODIFIED AS APPROPRIATE, FOR BASIC COMMISSIONING OF ANY SYSTEM OR BUILDING, THESE REQUIREMENTS ARE NOT INTENDED FOR LEED CERTIFICATION or CERTIFICATION UNDER CALGREEN.]

General

A. This section includes administrative and procedural requirements as well as a detailed description of LAWA's basic commissioning process. This section supplements other Division 1 Commissioning Sections and applies to all Contract Sections which specify testing of components and systems.

B. Basic Commissioning is intended to achieve the following objectives:
- Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installation contractors.
- Verify and document proper performance of equipment and systems.
- Verify that Operations and Maintenance (O&M) data is complete.
- Verify that LAWA's operating and maintenance personnel are trained in accordance with the specifications.

1.37.2 Definitions

A. Commissioning Process: A systematic process which verifies that the building systems perform interactively according to the Design Intent Document. The commissioning process coordinates system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training.
B. Commissioning Authority (CA): An entity contracted by the City that plans, schedules, and coordinates the Commissioning Team to implement the Commissioning Process.
C. Commissioning Plan: A document that provides the structure, schedule, and coordination for the commissioning process.

D. Design Intent Document: A written document that details functional requirements of the Project including expectations of how the Project will be used and operated. The Design Intent Document includes design goals, measurable performance criteria, success criteria, and supporting information.
E. Functional Test (FT): A documented test of the dynamic functioning and operation of equipment and systems with the goal of verifying that the Design Intent is met. Test requirements are included in these specifications. Test procedures are developed and results documented by the Commissioning Authority. Test procedures are completed by the Contractor in the presence of LAWA's Facility Activation Team.
F. Pre-functional Checklist (PC): A written checklist that includes checks and tests prerequisite to the equipment's Functional Test. Draft checklists are included in the specifications. The Commissioning Authority assists the Contractor in finalizing the checklists. The Checklists are completed by the Contractor and verified by the Commissioning Authority.
G. LAWA Activation Team: LAWA's Facilities Management Group has identified a specific group of engineers, maintenance, and tenant staff who are responsible for ensuring that LAWA standards are met and that the project can be turned over to the owner for its immediate successful operation and maintenance.
H. LAWA Commissioning Checklists: LAWA's Facilities Management Group utilizes standardized check lists for a variety of building systems and equipment. These check lists will be used by the Commissioning Authority in developing the FT and PC. These lists will also be used by LAWA's Facility Activation Team.

1.37.3 MEETINGS

In order to comply with LAWA Basic Commissioning Requirements, the following meetings are to be held at a minimum. Refer to Contract Specifications for requirements specific to the project.

A. At least one Pre-Commissioning Meeting to be held within 60 days of Construction Notice to Proceed: Conducted by LAWA during which the CA and the LAWA Activation Team reviews the commissioning process with the commissioning team members. Attendance is mandatory for the following team members:
    - Commissioning Authority
    - Contractor's Site Supervisor
    - Contractor's Project Scheduling personnel
    - Mechanical sub-contractor
    - Electrical sub-contractor
    - Air Balance sub-contractor
    - LAWA Construction and Maintenance representative
    - LAWA Activation Team representative
    - Inspector

B. Coordination Meetings: Attend meetings throughout construction, scheduled by LAWA, to plan, coordinate, schedule future activities, and resolve problems.
C. Start-up Plans: Work with the CA and the LAWA Activation Team to develop startup plans and startup documentation formats, including pre-functional checklists.
D. Equipment Start-up: Utilize start-up plans to coordinate equipment start-up, manufacturers'

testing, and other required testing to minimize duplication of work.

E. Testing, Adjusting, and Balancing: Coordinate testing, adjusting, and balancing with the CA and the LAWA Activation Team so that they can witness the processes.
F. Functional Testing: Coordinate functional testing with the CA and the LAWA Activation Team so that they can witness testing.
G. Training: Coordinate training of LAWA and tenant staff with CA and the LAWA Activation Team so that they can verify that training is conducted per commissioning requirements.

1.37.4 SYSTEMS

A. The following systems will be commissioned:

- Irrigation System and Controls
- Building Envelope Systems
- Roofing System, Exterior Insulation, Windows and Doors Installation
- HVAC Systems and all integral equipment controls
- Domestic Hot Water Heaters/Boilers Distribution System
- Plumbing Fixtures Controls
- Packaged Rooftop AC Units and Controls including fans, power exhausters, economizers, dampers, UVC lights, variable speed drives, heaters, humidifiers, CO2 sensors, and controls.
    - Split AC and Heat Pump Units: Including fans, dampers, UVC lights, variable speed drives, heaters, humidifiers, CO2 sensors, and controls.
    - Gas Fired Unit Heaters and Controls
    - HVAC Ducts and Duct Accessories
    - Exhaust Fans and Controls
    - Air Inlets and Outlets
    - Electrical Systems
    - Lighting System and Controls: Including sweep or scheduled lighting controls (weekday, weekend, and holiday schedules); lighting occupancy sensors, photo sensors and controllers (indoors and outdoors).
    - Building Service and Distribution.
    - Automatic Transfer Switches.
    - Fire Alarm and Detection System.
    - Emergency Generator (Generator will be tested with load bank connected at various percentages up to full KVA rating).
    - Uninterrupted power supply (UPS).
    - Automatic roll-up door and control.
    - Automatic door and gate operators and control

1.37.5 Testing

A. Complete the following prior to functional testing:
    - Arrange for commissioning observations to be performed by the Commissioning Authority (CA) and LAWA Activation Team.
    - Complete and approve the Start-up Plan.
    - Correct deficiencies identified during start-up.

- Record pretest set points.

B. Perform functional testing after the test requirements listed above are completed.

C. Perform functional testing under the observation of the CA and LAWA Activation Team who will record the results of the functional test procedures.

D. Perform all specified tests according to approved testing procedures.

E. Verify and test performance using actual conditions whenever possible.

F. Simulate conditions by imposing an artificial load when it is not practical to test under actual conditions and when written approval for simulated conditions is received from LAWA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After test, return settings to normal operating conditions.

G. Alter set points when simulating conditions is not practical and when written approval to do so is received from LAWA.

H. Overwrite sensor values with a signal generator when actual or simulated conditions and altering set points are not practical. Do not use the sensor to act as the signal generator to simulate conditions or overwrite values.

I. The CA and LAWA Activation Team will review and approve functional testing results.

J. Deficiencies found during testing shall be corrected by the Contractor and retested.

K. Where there is a dispute over a deficiency, LAWA shall be the final authority.

L. Problem Solving: The CA will recommend solutions to problems found; however, the burden of responsibility to solve, correct and retest problems is with the contractor and the design team.

M. Costs for retesting beyond one retest will be the responsibility of the Contractor, if LAWA determines that the contractor is responsible for the deficiency. These costs shall include charges for the CA's time, LAWA Activation Team Members, Engineer and Inspector.

N. For a deficiency identified during functional testing but not included in the approved Startup Plan: The CA and LAWA Activation Team will direct the retesting of the equipment once the deficiencies are corrected. Retesting will not be considered a reason for a claim of delay or for a time extension by the contractor.

O. Unforeseen Deferred Tests: Checks or tests not completed due to the building structure, required occupancy condition, or other condition may be delayed upon approval of LAWA. These tests will be conducted in the same manner as the seasonal tests as soon as possible.

P. Seasonal Testing: Complete seasonal testing (tests delayed until weather conditions are closer to the system's design conditions) during the warranty period, as part of this contract. The CA and LAWA Activation Team will coordinate this activity. Tests shall be executed, documented and deficiencies corrected by the appropriate Subs, with LAWA Activation Team and the CA witnessing.

Q. The Contractor shall make adjustments to the Operations and Maintenance Data, as necessary.

1.38 Activation and Turnover

"The Design Engineer shall coordinate all of its efforts under this section with LAWA's designated Facility Activation Team. At a minimum, coordination meetings are to be held monthly for the six months prior to Substantial Completion and increase to weekly during the period two months prior. The activities outlined in Commissioning Sections are to be scheduled in concert with LAWA's Facility Activation Team Scheduler."

---- END OF DESIGN AND CONSTRUCTION HANDBOOK GENERAL REQUIREMENTS

GUIDE SPECIFICATIONS INTRODUCTION

In the following section, guide specifications have been included to provide specific direction to the design teams for a selection of materials and assemblies that are widely used at the Airport.

SECTION 05 70 00 - DECORATIVE METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Decorative wall protection.
2. Metal base.

> **NOTE:** All walls within the public areas are to receive stainless steel wall and corner protection including a 12 inch high stainless steel base. This protection is deemed necessary for the walls of the public areas in order to protect the wall finish from luggage carts and other sources of high impact.

1.2 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for decorative metal.

1. Include plans, elevations, component details, and attachments to other work.
2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

B. Samples for Verification: For each type of exposed finish required.

1. Sections of linear shapes.
2. Samples of welded joints showing quality of workmanship.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

1.5 COORDINATION

A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor

bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. Provide materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.2 STAINLESS STEEL

A. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.

B. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304.

2.3 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Stainless-Steel Items: Type 304 stainless-steel fasteners.

B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.

C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless exposed fasteners are unavoidable.

1. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

2.4 MISCELLANEOUS MATERIALS

A. Laminating Adhesive: Adhesive recommended by metal fabricator that will fully bond metal to metal and that will prevent telegraphing and oil canning and is compatible with substrate and noncombustible after curing.

1. Contact Adhesive: VOC content of not more than 80 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FABRICATION, GENERAL

A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

B. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

D. Form simple and compound curves in bars by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.

E. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

F. Mill joints to a tight, hairline fit.

G. Grind smooth and polish exposed metal edges and corners.

H. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.

I. Comply with AWS for recommended practices in shop welding. Weld behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded joints of flux, and dress exposed and contact surfaces.

   1. Where welding cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 Welds: no evidence of a welded joint.

J. Provide castings that are sound and free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

2.6 DECORATIVE WALL PROTECTION

A. Bumper Rail: Assembly consisting of continuous metal bars and wall brackets; designed to withstand impacts.

   1. Rail: Stainless steel flat bar, in dimensions and profiles indicated on Drawings.

2. Wall Bracket: Cast stainless-steel shape, in dimensions and profiles indicated on Drawings
3. Finish: Directional satin, No. 4.
4. Accessories: Anchors to connect bumper rail to other work.
5. Mounting: Surface mounted directly to wall.

B. Surface-Mounted, Metal Corner Guards: Fabricated from metal bars welded to two mounting brackets. Interconnect corner guard components with full-length, full penetration welds. Use welding method that is appropriate for metal and finish indicated and that develops full strength of members joined. Finish exposed welds and surfaces smooth, flush, and blended to match adjoining surfaces.

1. Material: Stainless steel, Type 304.
2. Bar: 1/2-inch-diameter stainless-steel bar.
3. Mounting Brackets: Fabricated from one-piece, formed or extruded stainless steel with formed edges; with 90- or 135-degree turn to match wall condition

    a. Wing Size: 1-1/2 inches high by 1 inch wide.
    b. Corner Radius: 1/8 inch.
    c. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

2.7 METAL BASE

A. Form metal base from stainless-steel sheet, No. 4 finish, thickness as indicated on Drawings.

2.8 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.9 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.

B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels.

C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.

D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

E. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.

1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.

3.3 DECORATIVE WALL PROTECTION INSTALLATION

A. General: Install decorative wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

1. Install decorative wall protection units in locations and at mounting heights indicated on Drawings.
2. Provide mounting hardware, anchors, and other accessories required for a complete installation.

3.4 METAL BASE INSTALLATION

A. Install metal base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

B. Tightly adhere metal base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

C. On masonry surfaces or other similar irregular substrates, fill voids along top edge of metal base with manufacturer's recommended adhesive filler material.

3.5 CLEANING AND PROTECTION

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

B. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.

C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 70 00

SECTION 05 75 30.13 – COLUMN COVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Column covers with metal and glass finish with LED Light Panel System.

> **NOTE:** LAWA has developed this specification standard for column covers in order to provide a unifying design for the public areas of the terminals while providing long term durability and ease of maintenance.

1.2 PERFORMANCE REQUIREMENTS

A. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include finishing materials.

B. Shop Drawings: Show fabrication and installation details for column covers.

1. Include plans, elevations, component details, and attachments to other work.
2. Indicate materials and profiles of each column cover, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
3. Indicate LED light panel.

C. Samples for Verification:

1. Stainless Steel: For each type of exposed finish required, prepared on 12-inch square Samples of metal of same thickness and material indicated for the Work.
2. Laminated Glass with Colored Interlayer: 18 inches square.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show dimensions of structural columns, fireproofing (if any), attachments, and necessary clearances.

B. Product Certificates: For glass and glazing products, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For stainless-steel finish to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Source Limitations for Glass: Obtain laminated glass from single source from single manufacturer.

C. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Construct one mockup of each type of column cover.
2. Approved mockups may not become part of the completed Work.
3. All mockups shall be constructed at the jobsite.

D. Preinstallation Conference: Conduct conference at Project site.

E. Column Cover installation shall commence only upon receiving written LAWA approval of the Mock Up.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver column covers wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

B. Store products on elevated platforms in a dry location.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with column covers by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION

A. Coordinate installation of anchorages for column covers. Installation of anchors shall not damage the column reinforcement. Furnish setting drawings, templates, and directions for installing anchorages, including concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Coordinate installation of column covers with adjacent construction to ensure that wall assemblies, flashings, trim, and joint sealants, are protected against damage from the effects of weather, age, corrosion, and other causes.

1.10 WARRANTY

A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METAL

A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness.

2.2 GLASS AND GLAZING MATERIALS

A. Bent Laminated Glass: ASTM C 1464, Kind BL, and ASTM C 1172, Kind LA (laminated annealed), Condition A (uncoated), Type I (transparent), Quality-Q3 with two plies of glass and polyvinyl butyral interlayer not less than 0.060 inch thick.

1. Glass Color: Clear.
2. Interlayer Color: White.
3. Glass Plies: 6.0 mm thick, each.

NOTE: The bent glass is comprised of 3/16 inch Starphire / .060 #4640/ 3/16 Starphire, flat polish all edges. Glass shall comply with CPSC CFR 1201 Cat II.

B. Glazing Cement and Accessories for Structural Glazing: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by column cover manufacturer for installing structural glazing.

2.3 ILLUMINATION

A. LED Light Panel System: Molded clear acrylic (PMMA) .3125" thick lens, .125" channel around edge, edges, or perimeter, .0625" x .0625" wire, mesh grid overlay, strings of LEDs in channel around edge, edges, or perimeter with flat metal led covers, flat white plastic sheet on top sides covered with white plastic tape, and low-voltage wire extruding from corner, side, ore rear of panel with barrel connector.

B. Manufacturer:
   1. E Connect: 740 Flower Avenue, Venice, CA 90291, Telephone: 310.616.5055

C. UL Approved.

2.4 MISCELLANEOUS MATERIALS

A. Sealants, Interior: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834; of type and grade required to seal joints in column covers; and as recommended in writing by column covers manufacturer.

   1. Sealants shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.

   1. Provide concealed fasteners for interconnecting column covers items and for attaching them to other work unless otherwise indicated.

C. Nonstructural Anchors: Provide metal expansion sleeve anchors of type, size, and material necessary for type of load and installation indicated, as recommended by manufacturer, unless otherwise indicated.

D. Anchor Materials for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

E. Isolation Coating: Manufacturer's standard bituminous paint.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble column covers items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of column covers items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch and support with concealed stiffeners.

D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.

1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

E. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce column covers items as needed to attach and support other construction.

F. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install column cover items.

2.6 GLAZING PANEL FABRICATION

A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.

1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces
2. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.

B. Glass Column Covers: Factory-bond glass to base and top-rail channels in manufacturer's plant using glazing cement to comply with manufacturer's written specifications.

2.7 COLUMN COVERS

A. Snap-Together Type: Form column covers to shapes indicated from metal of type and minimum thickness indicated below. Return vertical edges and bend to form hook that will engage continuous mounting clips.

1. 304 Stainless-Steel Sheet: 11 gauge

a. Finish: custom decorative/textured.

2. Form returns at vertical joints to provide hairline V-joints.
3. Fabricate column covers with reveals at horizontal joints produced by forming returns on mating ends of metal column cover sections. Provide snap-in metal filler strips at reveals. Locate horizontal joints as indicated.
4. Fabricate base rings, intermediate reveals, and ceiling rings to match column cover metal finish.

B. Glass Column Covers: Factory-bond glass to base and top-rail channels in manufacturer's plant using glazing cement to comply with manufacturer's written specifications.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of column covers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate and place column covers level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces.

C. Form tight joints with exposed connections accurately fitted together.

D. Install concealed gaskets, joint fillers, sealants, and insulation, as the Work progresses, to make interior column covers soundproof and lightproof as applicable to type of fabrication indicated.

E. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.3 ADJUSTING AND CLEANING

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

C. Clean and polish glass as recommended in writing by manufacturer. Wash exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

3.4 PROTECTION

A. Protect finishes of column covers from damage during construction period with temporary protective coverings approved by column cover manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 75 30.13

SECTION 06 40 23 – INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes interior woodwork for the following applications:

1. Wood cabinets.
2. Plastic-laminate cabinets.
3. Solid-surfacing-material countertops.

NOTE: The Architect of Record shall prepare and sign a letter addressed to LAWA certifying that the installed millwork, either stand alone or combined with any equipment that is integrated into the millwork or sitting on top of the millwork, is in compliance with ADA Standards.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Cabinet hardware and accessories.
2. Handrail brackets.
3. Finishing materials and processes.

B. Shop Drawings: Include location of each item, plans and elevations, large-scale details, attachment devices, and other components.

C. Samples:

1. Lumber and panel products for transparent finish, for each species and cut, finished on one side and one edge.
2. Lumber and panel products with shop-applied opaque finish, for each finish system and color, with exposed surface finished.
3. Plastic-laminate-clad panel products, for each type, color, pattern, and surface finish.
4. Thermoset decorative-overlay surfaced panel products, for each type, color, pattern, and surface finish.
5. Solid-surfacing materials.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products or licensee of WI's Certified Compliance Program.

B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.

1. This project has been registered as AWI/QCP Number.
2. Provide AWI certification labels or compliance certificate indicating that woodwork complies with requirements of grades specified.

C. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to the Los Angeles Department of Building and Safety.

D. Forest Certification: Provide interior architectural woodwork produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

E. Mockups: Construct mockups at the jobsite to verify compliance with the construction documents and the written comments issued during the LAWA submittal reviews. Include the following mockups:

a. Functional Mock Up: Fabricate from plywood or particle board in configuration indicated to confirm podium configuration, coordination and integration of all equipment including, but not limited to, computers, ticket spitters, monitors, and dynamic signage displays.

NOTE: Whenever practical, the millwork is to be designed with integral cable raceways with future expansion in mind. Within this millwork, discretely locate any access panels that are to be provided for ease of cable and wiring maintenance. Such millwork installations will require coordination with electrical and communication disciplines. Underlying floor mounted electrical outlets are to be fully recessed with cover plates and smoothly aligned with the adjacent floor finishes.

b. Aesthetic Mock Up: Fabricated from specified and indicated materials; incorporate all requested modifications from the Functional Mock Up.

2. Construct all mock ups at jobsite.
3. Approved mock ups may **not** become part of the completed work.

F. Conduct pre-installation conference at the jobsite.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative

humidity at levels planned for building occupants during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

A. Fabricators: Subject to LAWA review.

2.2 MATERIALS

A. Thermoset Decorative Overlay: Particleboard or medium-density fiberboard with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

B. High-Pressure Decorative Laminate: NEMA LD 3.

1. Manufacturers: Subject to compliance with LAWA requirements, provide products by one of the following:

    a. Formica Corporation.
    b. Laminart.
    c. Wilsonart International; Div. of Premark International, Inc.
    d. Nevamar Company

C. Solid-Surfacing Material (SSM): Provide material that meets or exceeds ISSFA-2-01 performance standards, consisting of reacted monomers and resins, mineral fillers and pigments and manufactured in sheets of specific thicknesses. SSM shall be solid, non-porous, homogeneous, hygienic, renewable, and, when applicable, may feature inconspicuous hygienic seams. SSM shall be free from conspicuous internal strengthening fibers.

1. Products: Subject to compliance with LAWA requirements, provide one of the following:

    a. Avonite, Inc.; Avonite.
    b. DuPont Polymers; Corian.
    c. Wilsonart International, Div. of Premark International, Inc.; Gibraltar.
    d. Nevamar Company
    e. Hanstone
    f. Formica Corporation

D. Stainless Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness..

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials for a complete installation of architectural woodwork.

> **NOTE:** Coordinate all cabinet hardware with the Door Hardware schedule.

B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.

C. Frameless Concealed Hinges (European Type):

1. Provide 170 degree minimum opening capabilities. For end doors perpendicular to walls, provide 90 degree type.

D. Drawer Slides: Unless noted otherwise, provide positive stop, side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings.

E. Door and Drawer Locks:

1. Pin and tumbler slide bolt lock, two keys each.
2. Key all locks inside one room alike and provide masterkey for all locks in project to LAWA.
3. Finish to match adjacent pull, or as selected by LAWA.

F. Exposed Hardware Finishes: Complying with BHMA A156.18 for BHMA finish number indicated.

2.4 MISCELLANEOUS MATERIALS

A. Adhesives, General: Do not use adhesives that contain added urea formaldehyde.

B. Low-Emitting Materials: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. VOC Content for Installation Adhesives and Glues: Comply with the following limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

> **NOTE:** All adhesives shall be compliant with South Coast Air Quality Management District (SCAQMD) requirements.

2.5 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Grade: Premium.

B. Solid-Surfacing-Material Thickness: 3/4 inch.

C. Colors, Patterns, and Finishes: As preselected and indicated in Division 09 Section "Colors and Finishes."

D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate tops with shop-applied edges of materials and configuration indicated.
2. Fabricate tops with indicated backsplash.

E. Install integral sink bowls in countertops in shop.

F. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.6 FABRICATION

A. General: Complete fabrication to maximum extent possible before shipment to Project site. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.

B. Provide Premium grade interior woodwork unless otherwise noted. Subject to LAWA approval.

NOTE: Any grade below premium has been determined not be suitable for the public areas and therefore will not be allowed.

2.7 SHOP FINISHING

A. Finish architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Finishing Materials: Products shall comply with the testing and product requirements of the California Department of Health Services "Standard Practice for the Testing Of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Condition woodwork to average prevailing humidity conditions in installation areas and examine and complete work as required, including removal of packing and backpriming before installation.

B. Quality Standard: Install woodwork to comply with AWI Standards.

C. Install woodwork level, plumb, true, and straight to a tolerance of 1/8 inch in 96 inches. Shim as required with concealed shims.

D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

E. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.

1. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c..

G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Calk space between backsplash and wall with sealant.

END OF SECTION 06 40 23

SECTION 08 11 13 – HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes hollow metal doors and frames.

> **NOTE:** The integration of the existing LAWA Security System into the new steel door and frame may be required. The Contractor shall be responsible for the total and complete coordination of the security system components of the work.

1.2 SUBMITTALS

A. Product Data: Submit product data for each product indicated. Include material descriptions, core descriptions, label compliance, sound and fire-resistance ratings, and finishes for each type of door and frame specified.

B. Shop Drawings: Submit door and frame schedule using same reference designations indicated on Drawings. Include opening size(s), handing of doors, frame throat dimensions, details of each frame type, elevations of door design types, details of construction, location and installation requirements of door hardware and reinforcements, hardware group numbers, details of joints and connections, fire label requirements including fire rating time duration, maximum temperature rise requirements, and smoke label requirements.

> **NOTE:** On the shop drawings, indicate the routing of electrical conduit with related dimensions and locations of required cutouts in doors and frames that are to accept electric hardware devices.

C. Construction Samples: Submit approximately 18 by 24 inches (450 by 600 mm) construction samples, representing the required construction of doors and frames for Project.

1. Doors: Show vertical-edge, top, and bottom construction; insulation; face stiffeners; and hinge and other applied hardware reinforcement. Include glazing stops if applicable.
2. Welded Frames: Show profile, welded corner joint, welded hinge reinforcement, dust-cover boxes, floor and wall anchors, stops, and silencers. Include glazing stops if applicable.
3. Frames: Show profile, corner joint, welded hinge reinforcement, wall anchors, stops, and silencers.

D. Certificate of Compliance for Fire Rated Doors: Provide copies of Certificate of Compliance for all fire rated door assemblies, all smoke and draft control door assemblies, and all temperature rise rated door assemblies.

E. Oversize Construction Certification: For door assemblies required to be fire rated and exceeding limitations of labeled assemblies, submit certification of a testing agency acceptable to authorities having jurisdiction that each door and frame assembly has been constructed to comply with design, materials, and construction equivalent to requirements for labeled construction.

1.3 QUALITY ASSURANCE

A. Hollow Metal Door and Frame Standard: Comply with the applicable provisions and recommendations of the following publications by Hollow Metal Manufacturers Association (HMMA) Div. of National Association of Architectural Metal Manufacturers (NAAMM), unless more stringent requirements are indicated in the Contract Documents:

1. HMMA "Hollow Metal Manual".
2. HMMA 861 "Guide Specifications for Commercial Hollow Metal Doors and Frames".

B. Manufacturer Qualifications: A firm experienced in manufacturing hollow metal doors and frames similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 or UL 10C "Standard for Positive Pressure Fire Tests of Door Assemblies"**.** Fire classification labels at all doors with fire ratings greater than 20 minutes shall indicate the temperature rise developed on the unexposed surface of the door after the first 30 minutes of fire exposure.

1. Provide metal labels permanently fastened on each door which is within the size limitations established by the LADBS.
2. Temperature-Rise Rating: Where indicated, provide doors that have a temperature-rise rating of 450 deg F (250 deg C) maximum in 30 minutes of fire exposure.
3. Positive Pressure Rated Door Assemblies: Where indicated provide positive pressure rated fire rated door assemblies. Sizes and configurations as shown on the drawings. Installed door assemblies shall be in accordance with door manufacturers certified assemblies.

    a. Test Pressure: Test according to NFPA 252 or UL 10C**.** After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1000 mm) or less above the sill**.**
4. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

D. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257 or UL 9.

E. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palleted, wrapped, or crated to provide protection during transit and Project site storage.

B. Inspect doors and frames, on delivery, for damage. Tool marks, rust, blemishes, and other damage on exposed surfaces will not be acceptable. Remove and replace damaged items as directed by Architect. Store doors and frames at building site in a dry location, off the ground, and in such a manner as to prevent deterioration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide doors and frames by one of the following:

1. Hollow Metal Doors and Frames:

a. Ceco Door Products; an Assa Abloy Group Company.
b. Curries Company; an Assa Abloy Group Company.
c. Steelcraft; an Ingersoll-Rand Company.

2.2 MATERIALS

A. Specified Gage Thickness: All specified gauge thicknesses are Manufacturer's Standard Gauge.

B. Hot-Rolled Steel Sheets: ASTM A 1008/A 1008M, CS (commercial steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Cold-Rolled Steel Sheets: ASTM A 1011/A 1011M, CS (commercial steel), Type B, free from scale, pitting, coil breaks, surface blemishes, buckles, waves, or other defects, exposed (matte) dull finish, suitable for exposed applications.

D. Inserts, Bolts, and Fasteners: Galvanized steel.

1. Expansion Bolts and Shields: FS FF-S-325, Group III, Type 1 or 2.
2. Machine Screws: FS FF-S-92, carbon steel, Type III cross recessed, design I or II recess, style 2C flat head.

E. Filler: Sound deadening and heat retarding mineral fiber insulating material.

2.3 DOORS

A. General: Provide flush-design doors, 1-3/4 inches (44 mm) thick, of seamless hollow construction, unless otherwise indicated. Construct doors with sheets joined at their vertical

edges by continuous welding the full height of the door, with no visible seams on their faces or vertical edges, and all welds ground and finished flush.

1. Visible joints or seams around glazed panel inserts are permitted.
2. For single-acting swing doors, bevel both vertical edges 1/8 inch in 2 inches (3 mm in 50 mm).
3. For double-acting swing doors, round vertical edges with 2-1/8-inch (54-mm) radius.

NOTE: For the doors, make provisions for the installation of electrical items specified elsewhere; arrange so wiring can be readily removed and replace. Provide all cutouts and reinforcements required for these steel doors to accept security system components.

B. Interior Door Core Construction: Doors shall be stiffened by continuous vertically formed steel sections which, upon assembly, shall span the full thickness of the interior space between door faces. These stiffeners shall be 0.026-inch (0.6-mm) minimum thickness, spaced so that the vertical interior webs shall be not more than 6 inches (150 mm) apart and spot welded to face sheets a maximum of 5 inches (127 mm) o.c. Place filler between stiffeners for full height of door.

C. Fire Door Cores: A continuous mineral fiberboard core permanently bonded to the inside face of the outer face sheet unless otherwise required to provide fire-protection and temperature-rise ratings indicated.

D. Astragals: As required by NFPA 80 to provide fire ratings indicated.

E. Top and Bottom Channels: Spot weld metal channels, having a thickness of not less than thickness of face sheet, not more than 6 inches (150 mm) o.c. to face sheets.

1. Reinforce tops and bottoms of doors with inverted horizontal channels of same material as face sheet so flanges of channels are even with bottom and top edges of face sheets.

F. Hardware Reinforcement: Fabricate reinforcing from the same material as door to comply with the following. Offset reinforcement so that faces of mortised hardware items are flush with door surfaces.

1. Hinges and Pivots: 7 gauge (0.167 inch) (4.2 mm) thick by 1-1/2 inches (38 mm) wide by 9 inches (229 mm).
2. Lock Front, Strike, and Flushbolt Reinforcements: 12 gauge (0.093 inch) (2.3 mm) thick by size as required by hardware manufacturer.
3. Lock Reinforcement Units: 14 gauge (0.067 inch) (1.7 mm) thick by size as required by hardware manufacturer.
4. Closer Reinforcements: 12 gauge (0.093 inch) (2.3 mm) thick one piece channel by size as required by hardware manufacturer.
5. Other Hardware Reinforcements: As required for adequate strength and anchorage.
6. In lieu of reinforcement specified, hardware manufacturers recommended reinforcing units may be used.

7. Exit Device Reinforcements: 0.250 inch (6.35 mm) thick by 10 inches (245 mm) high by 4 inches (101 mm) wide centered on exit device case body, unless otherwise recommended by exit device manufacturer.

G. Electrical Requirements: Make provisions for installation of electrical items specified elsewhere; arrange so wiring can be readily removed and replaced.

1. Provide all cutouts and reinforcements required for hollow metal doors to accept security system components.
2. Doors with Electric Hinges and Pivots: Provide with metal conduit or raceway to permit wiring from electric hinge or pivot to other electric door hardware.

a. Hinge Location: Center for doors less than 90 inches (2286 mm) tall or second hinge from door bottom for doors greater than 90 inches (2286 mm); top or bottom electric hinge locations shall not be permitted.

H. Interior Hollow Metal Doors:

1. Typical Interior Doors: Flush design with 18 gauge (0.042-inch-) (1.06-mm-) thick cold-rolled stretcher-leveled steel face sheets and other metal components from hot- or cold-rolled steel sheets.
2. Extra Heavy Use Doors: Flush design with 14 gauge (0.067-inch-) (1.7-mm-) thick cold-rolled, stretcher-leveled steel face sheets and other metal components from hot- or cold-rolled steel sheets. Provide only where indicated.

2.4 FRAMES

A. Fabricate hollow metal frames, formed to profiles indicated, with full 5/8 inch (16 mm) stops, and of the following minimum thicknesses.

1. For interior use, form frames from cold- rolled steel sheet of the following thicknesses:

a. Openings up to and Including 48 Inches (1200 mm) Wide: **16 gauge** (0.053 inch) (1.3 mm).
b. Openings More Than 48 Inches (1200 mm) Wide: **14 gauge** (0.067 inch) (1.7 mm).

NOTE: For the frames, make provisions for installation of electrical items specified elsewhere; arrange so wiring can be readily removed and replace. Provide all cutouts and reinforcements required for steel frames to accept security system components. Provide welded sheet metal boxes with metal conduit or raceway to permit wiring from electric hinge to other electric door hardware.

B. Provide frames either saw mitered and full (continuously) profile welded, or machine mitered and full (continuously) profile welded, on back side at frame corners and stops with edges straight and true. Grind welds smooth and flush on exposed surfaces.

C. Hardware Reinforcement: Fabricate reinforcements from same material as frame to comply with the following. Offset reinforcement so that faces of mortised hardware items are flush with surface of the frame.

1. Hinges and Pivots: 7 gauge (0.167 inch) (4.2 mm) thick by 1-1/4 inches (32 mm) wide by 10 inches (254 mm).
2. Strike, Surface Mounted Hold Open Arms, and Flushbolt Reinforcements: 12 gauge (0.093 inch) (2.3 mm) thick by size as required by hardware manufacturer.
3. Closer Reinforcements: 12 gauge (0.093 inch) (2.3 mm) thick one piece channel by size as required by hardware manufacturer.
4. Other Hardware Reinforcements: As required for adequate strength and anchorage.

D. Electrical Requirements: Make provisions for installation of electrical items specified elsewhere; arrange so wiring can be readily removed and replaced.

1. Provide all cutouts and reinforcements required for hollow metal frames to accept security system components.
2. Frames with Electric Hinges and Pivots: Provide welded on UL listed back boxes with metal conduit or raceway to permit wiring from electric hinge or pivot to other electric door hardware.

a. Hinge Location: Center for doors less than 90 inches (2286 mm) tall or second hinge from door bottom for doors greater than 90 inches (2286 mm); top or bottom electric hinge locations shall not be permitted.

E. Mullions and Transom Bars for Sidelights, Transoms, and Borrowed Light Frames: Provide closed or tubular mullions and transom bars where indicated. Fasten mullions and transom bars at crossings and to jambs by butt welding. Reinforce joints between frame members with concealed clip angles or sleeves of same metal and thickness as frame.

F. Jamb Anchors: Locate jamb anchors above hinges and directly opposite on strike jamb as required to secure frames to adjacent construction. At metal stud partitions locate the additional jamb anchor below the top hinge.

1. Masonry Construction: Adjustable, corrugated or perforated, anchors to suit frame size; formed of same material and gauge thickness as frame; at non-rated frames use friction fit T-shaped anchors, at rated frames use anchors consisting of spot welded strap and adjustable anchor; with leg not less than 2 inches (50 mm) wide by 10 inches (250 mm) long. Furnish at least the number of anchors per jamb according to the following frame heights:

a. Two anchors per jamb up to 60 inches (1500 mm) in height.
b. Three anchors per jamb from 60 to 90 inches (1500 to 2250 mm) in height.
c. Four anchors per jamb from 90 to 96 inches (2250 to 2400 mm) in height.
d. One additional anchor per jamb for each 24 inches (600 mm) or fraction thereof more than 96 inches (2400 mm) in height.

2. Metal-Stud Partitions: Metal channel stud zee anchor sized to match stud width, welded to back of frames, formed of same material and gauge thickness as frame. Provide at least the number of anchors for each jamb according to the following heights:

a. Three anchors per jamb up to 60 inches (1500 mm) in height.
b. Four anchors per jamb from 60 to 90 inches (1500 to 2250 mm) in height.
c. Five anchors per jamb from 90 to 96 inches (2250 to 2400 mm) in height.
d. One additional anchor per jamb for each 24 inches (600 mm) or fraction thereof more than 96 inches (2400 mm) in height.

3. In-Place Concrete or Masonry: Anchor frame jambs with minimum 3/8-inch- (9-mm-) diameter countersunk flat head bolts into expansion shields or inserts 6 inches (150 mm) from top and bottom of each jamb with intermediate anchors spaced a maximum of 26 inches (650 mm) o.c. Soffit face of frame shall be punched and dimpled to accept countersunk bolt head. Reinforce frame with spacer to prevent bowing. Bolt head shall be set slightly below soffit face, filled and ground smooth at time of installation.

G. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, formed of same material as frame, 12 gauge (0.093 inch) (2.3 mm) thick, and punched with two holes to receive two (2) 0.375 inch (9.5 mm) fasteners. Where floor fill or setting beds occur support frame by adjustable floor anchors bolted to the structural substrate. Terminate bottom of frames at finish floor surface. Weld floor anchors to frames with at least 4 spot welds per anchor.

H. Head Strut Supports: Provide 3/8-by-2-inch (9-by-50-mm) vertical steel struts extending from top of frame at each jamb to supporting construction above. Bend top of struts to provide flush contact for securing to supporting construction above by bolting, welding, or other suitable anchorage. Provide adjustable wedged or bolted anchorage to frame jamb members to permit height adjustment during installation. Adapt jamb anchors at struts to permit adjustment.

I. Head Reinforcement: For frames more than 48 inches (1200 mm) wide in masonry wall openings, provide continuous steel channel or angle stiffener, 12 gauge (0.093 inch) (2.3 mm) thick for full width of opening, welded to back of frame at head. Head reinforcements shall not be used as a lintel or load bearing member for masonry.

J. Spreader Bars: Provide removable spreader bar across bottom of frames, tack welded to jambs and mullions to serve as bracing during shipment and handling and to hold frames in proper position until anchorage and adjacent construction have been completed.

K. Door Silencer Holes: Drill strike jamb stop to receive three silencers on single door frames and for two silencers on double door frames. Insert plastic plugs in holes to keep holes clear during installation.

L. Plaster Guards and Removable Access Plates: Provide 26 gauge (0.016-inch-) (0.4-mm-) thick plaster guards or dust-cover boxes of same material as frame, welded to frame at back of hardware cutouts to close off interior of openings and prevent mortar or other materials from obstructing hardware operation. Provide removable access plates in the heads of frames to receive overhead concealed door closers.

2.5 STOPS AND MOLDINGS

A. Provide continuous stops and moldings around glazed panels where indicated.

B. Form fixed stops and moldings integral with frame, on the exterior (non-secured) side of the frame.

C. Provide removable stops and moldings formed of 20 gauge (0.032-inch-) (0.8-mm-) thick steel sheets matching hollow metal frames. Secure with countersunk oval head machine screws spaced uniformly not more than 12 inches (300 mm) o.c. Form corners with butted or mitered hairline joints.

D. Coordinate rabbet width between fixed and removable stops with type of glass or panel and type of installation indicated.

2.6 HOLLOW METAL FRAMES

A. Provide hollow metal door frames to be used as both door buck and trim, formed to profiles shown, of minimum **16 gauge** (0.053 inch) (1.3 mm) thick cold rolled steel.

1. Frames shall be splined, tabbed, and miter fit, knockdown type compatible with adjacent construction conditions.
2. Accurately machine, file, and fit exposed connections with hairline joints.
3. Typical Anchorage: Frames shall be provided with concealed mechanical compression anchors at top of each jamb and each jamb shall be prepared and provided with provision for anchorage at floor line of jamb return face.
4. Miter and anchorage type subject to acceptance of Architect.

B. Mortise, reinforce, drill and tap frames for mortise type hardware. Provide internal reinforcement for surface type hardware which is to be field drilled and tapped per requirements hereinbefore specified for welded frames and including silencers. Locate hardware in frames to match location specified and in accordance with the hardware schedule and templates.

2.7 FABRICATION

A. Fabricate doors and frames rigid, neat in appearance, and free of defects, warp, wave, and buckle. Accurately form metal to sizes and profiles indicated. Accurately machine, file, and fit exposed connections with hairline joints. Weld exposed joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

B. Exposed Fasteners: Provide countersunk flat heads for exposed screws and bolts, unless otherwise indicated.

C. Hardware Preparation: Prepare doors and frames to receive hardware, including cutouts, reinforcement, mortising, drilling, and tapping, according to final hardware schedule and templates provided by hardware supplier. Secure reinforcement by spot welding. Comply with applicable requirements of ANSI/BHMA A156.115 and A156.115W specifications for door and frame preparation for hardware. Factory reinforce doors and frames to receive surface-applied

hardware. Factory drill and tap for surface-applied hardware, except at pushplates and kickplates provide reinforcing only.

1. Locate hardware according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames" or otherwise directed by LAWA.

2.8 STEEL SHEET FINISHES

A. General: Clean, treat and prime surfaces of fabricated hollow metal door and frame work, inside and out, whether exposed or concealed in the construction.

B. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale, shavings, filings, and rust, if present, complying with SSPC-SP 3, "Power Tool Cleaning,"

C. Factory Priming for Field-Painted Finish: Apply shop primer immediately after surface preparation and pretreatment. Apply a sufficient number of coats, baked on, to obtain uniformly smooth exposed surfaces. Touch up surfaces having runs, smears, or bare spots.

1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, corrosion-inhibiting, lead- and chromate-free, universal primer complying with ANSI A250.10 acceptance criteria; compatible with substrate and field-applied finish paint system indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install doors and frames according to the referenced standards, the Architect reviewed shop drawings, and manufacturer's written recommendations and installation instructions.

B. Frames: Install frames where indicated. Extend frame anchorages below fills and finishes. Coordinate the installation of built-in anchors for wall and partition construction as required with other work.

1. Frames: Install frames in locations shown, in perfect alignment and elevation, plumb, level, straight and true, and free from rack.
2. Welded Frames:

a. Set masonry anchorage devices where required for securing frames to in-place concrete or masonry construction.

1) Set anchorage devices opposite each anchor location as specified and anchorage device manufacturer's written instructions. Leave drilled holes rough, not reamed, and free of dust and debris.

b. Placing Frames: Set frames accurately in position; plumb; align, and brace securely until permanent anchors are set.

1) At concrete or masonry construction, set frames and secure in place with machine screws and masonry anchorage devices. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
2) Anchor bottom of frames to floors through floor anchors with threaded fasteners.
3) Field splice only at approved locations indicated on the shop drawings. Weld, grind, and finish as required to conceal evidence of splicing on exposed faces.
4) Remove spreader bars only after frames are properly set and secured. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

3. At fire-rated openings, install frames according to NFPA 80.
4. Existing Frames (Salvaged from Alteration Work): Install salvaged existing frames in locations indicated.

C. Doors:

1. Non-Fire Rated Doors: Fit non-fire-rated doors accurately in their respective frames, with the following clearances:

   a. Jambs and Head: 3/32 inch (2 mm).
   b. Meeting Edges, Pairs of Doors: 1/8 inch (3 mm).
   c. Bottom: 3/8 inch (9 mm), if no threshold or carpet.
   d. Bottom: 1/8 inch (3 mm), at threshold or carpet.

2. Fire-Rated Doors: Install with clearances as specified in NFPA 80.
3. Smoke Control Doors: Install according to NFPA 105.
4. Existing Doors (Salvaged from Alteration Work): Install salvaged existing doors in locations indicated.

D. Glazing: Comply with installation requirements in Division 08 Section “Glazing” and with hollow metal manufacturers written instructions.

1. Secure stops with countersunk flat or oval head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.

E. Apply hardware in accordance with hardware manufacturer’s instructions. Drill and tap for machine screws as required. Do not use self tapping sheet metal screws. Adjust door installation to provide uniform clearance at head and jambs, and to contact stops uniformly. Adjust hardware items just prior to final inspection. Leave work in complete and proper operating condition.

1. Field cut existing hollow metal doors and frames indicated to receive new hardware. Field cutting shall be executed in a workmanlike manner and shall not void the existing door and frame labeling.

3.2 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items just before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames that are warped, bowed, or otherwise unacceptable.

B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

C. Remove and replace defective work, including doors or frames that are warped, bowed, or otherwise defective.

D. Institute protective measures required throughout the remainder of the construction period to ensure that hollow metal doors and frames will be without damage or deterioration, at time of substantial completion.

END OF SECTION 08 11 13

SECTION 08 11 19 - STAINLESS-STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless-steel, hollow-metal doors.
2. Stainless-steel, hollow-metal frames.

NOTE: The integration of the existing LAWA Security System into the steel door and frame work may be required. The Contractor shall be responsible for the total and complete coordination of the security system components of the work.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Samples for Verification:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).
2. Doors: Include section of vertical-edge, top, and bottom construction; core construction; glazing; and hinge and other applied hardware reinforcement.
3. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

D. Schedule: Provide a schedule of stainless-steel, hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with a door hardware schedule.

1.3 INFORMATIONAL SUBMITTALS

A. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of stainless-steel, hollow-metal door and frame assembly.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain stainless-steel, hollow-metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

C. Smoke- and Draft-Control Door Assemblies: At corridors, smoke barriers, and smoke partitions, provide assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies that are listed and labeled, by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite. Install in compliance with NFPA 80.

E. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Shipping Spreaders: Deliver welded frames with two removable spreader bars across bottom of frames, tack welded or mechanically attached to jambs and mullions.

C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (100-mm-) high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.

1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for stainless-steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 STAINLESS-STEEL DOORS AND FRAMES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ambico Limited.
2. Ceco Door Products; an ASSA ABLOY Group company.
3. CURRIES Company; an ASSA ABLOY Group company.
4. Steelcraft; an Ingersoll-Rand company.

NOTE: Make provisions for installation of electrical items specified elsewhere; arrange so wiring can be readily removed and replace. Provide all cutouts and reinforcements required for steel doors to accept security system components.

2.2 STAINLESS-STEEL DOORS

A. Description: Stainless-steel doors, not less than 1-3/4 inches (44 mm) thick, of seamless, hollow-metal construction. Construct doors with smooth, flush surfaces without visible joints or seams on faces.

1. Face Sheets: Fabricate from 0.078-inch- (1.98-mm-) thick, stainless-steel sheet.
2. Core Construction: Fabricate doors with core indicated.

a. Welded Steel-Stiffened Core: vertical stiffeners extending full-door height, spaced not more than 6 inches (152 mm) apart, spot welded to face sheets a maximum of 5 inches (127 mm) o.c. Fill spaces between stiffeners with mineral-fiber insulation.
b. Laminated Core: foam-plastic insulation fastened to face sheets with waterproof adhesive.
c. Fire-Rated Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

3. Vertical Edges for Single-Acting Doors: Beveled 1/8 inch in 2 inches (3 mm in 50 mm).
4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.
5. Moldings for Glazed Lites in Doors: 0.038-inch- (0.95-mm-) thick stainless steel.
6. Loose Stops for Glazed Lites in Doors: 0.038-inch- (0.95-mm-) thick stainless steel.
7. Top and Bottom Channels: Closed with continuous channels, 0.062-inch- (1.59-mm-) thick stainless steel.
   a. Securely fastened using adhesive.
8. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 866 with reinforcing plates from stainless steel.
9. Electrical Hardware Enclosures: Provide enclosures and junction boxes within doors for electrically operated door hardware, interconnected with UL-approved, 1/2-inch- (12.7-mm-) diameter conduit and connectors.

   a. Where indicated for installation of wiring, provide access plates to junction boxes, fabricate from same material and thickness as face sheet and fasten with at least four security fasteners spaced not more than 6 inches (152 mm) o.c.

B. Performance: Level A, ANSI A250.4.

C. Materials:

1. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, Type 304 or 316 as indicated.
2. Steel Sheet: ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, Commercial Steel (CS), Type B.
3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
4. Foam-Plastic Insulation: Manufacturer's standard polystyrene board insulation with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within door.
5. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.

D. Stainless-Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

   a. Run grain of directional finishes with long dimension of each piece.

b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

c. Directional Satin Finish: No. 4.

2.3 STAINLESS-STEEL PANELS

A. Provide stainless-steel panels of same construction, materials, and finish as specified for adjoining stainless-steel doors.

NOTE: Make provisions for installation of electrical items specified elsewhere; arrange so wiring can be readily removed and replace. Provide all cutouts and reinforcements required for steel doors to accept security system components. Provide welded on sheet metal boxes with metal conduit or raceway to permit wiring from electric hinge to other electric door hardware.

2.4 STAINLESS-STEEL FRAMES

A. Description: Fabricate stainless-steel frames of construction indicated, with faces of corners mitered and contact edges closed tight.

1. Door Frames: Saw mitered and full (continuously) welded.

   a. Weld frames according to HMMA 820.

2. Sidelight Transom and Borrowed-Light Frames: Saw mitered and full (continuously) welded.
3. Door Frames for Openings 48 Inches (1219 mm) Wide or Less: Fabricate from 0.078-inch- (1.98-mm-) 0.109-inch- (2.78-mm-) thick, stainless-steel sheet.
4. Door Frames for Openings More Than 48 Inches (1219 mm) Wide: Fabricate from 0.109-inch- (2.78-mm-) thick, stainless-steel sheet.
5. Borrowed-Light Frames: Fabricate from 0.078-inch- (1.98-mm-) thick, stainless-steel sheet.
6. Sidelight and Transom Frames: Fabricate from stainless-steel sheet of same thickness as adjacent door frame.
7. Glazing and Panel Stops: Formed integral with stainless-steel frames, minimum 5/8 inch (16 mm) high, unless otherwise indicated.
8. Loose Stops for Glazed Lites and Panels: 0.038-inch- (0.95-mm-) thick stainless steel.
9. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 866 with reinforcing plates from stainless steel.
10. Head Reinforcement: 0.109-inch- (2.78-mm-) thick, stainless-steel channel or angle stiffener for openings widths more than 48 inches (1219 mm).
11. Jamb Anchors:

    a. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.062-inch- (1.59-mm-) thick stainless steel with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.156 inch (4.0 mm) thick.

b. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.050-inch- (1.27-mm-) thick stainless steel.
c. Compression Type for Slip-on Frames: Fabricate adjustable compression anchors from stainless steel.
d. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter, stainless-steel bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

12. Floor Anchors: Not less than 0.078-inch- (1.98-mm-) thick stainless steel, and as follows:

    a. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
    b. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

13. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch- (9.5-mm-thick by 50-mm-) wide from stainless steel.
14. Plaster Guards: Not less than 0.019-inch- (0.48-mm-) thick stainless steel.

B. Performance: Level A, ANSI A250.4.

C. Materials:

1. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, Type 304 or 316 as indicated.
2. Steel Sheet: ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, Commercial Steel (CS), Type B.
3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
4. Frame Anchors: Stainless-steel sheet. Same type as door face.
5. Frame Anchors: Steel sheet, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
6. Inserts, Bolts, and Anchor Fasteners: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Alloy Group 1 or 4) for bolts and nuts.
7. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

D. Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

    a. Run grain of directional finishes with long dimension of each piece.
    b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
    c. Directional Satin Finish: No. 4.

2.5 ACCESSORIES

A. Glazing: Comply with requirements in Section 088000 "Glazing."

B. Grout: Comply with ASTM C 476, with a slump of not more than 4 inches (102 mm) as measured according to ASTM C 143/C 143M.

C. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

D. Mineral Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.

2.6 FABRICATION

A. Stainless-Steel Door Fabrication: Stainless-steel doors to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.

1. Seamed Edge Construction: Both vertical door edges joined by visible, continuous interlocking seam (lock seam) full height of door.
2. Seamed Edge Construction: Both vertical door edges joined by visible seam that is projection, spot, or tack welded on inside edges of door at minimum 6 inches (152 mm) o.c.
3. Seamless Edge Construction: Door face sheets joined at vertical edges by continuous weld extending full height of door; with edges ground and polished, providing smooth, flush surfaces with no visible seams.
4. Exterior Doors: Close top edges flush and seal joints against water penetration. Provide weep-hole openings in bottom of exterior doors to permit moisture to escape.
5. Stops and Moldings: Factory cut openings in doors. Provide stops and moldings around glazed lites. Form corners of stops and moldings with butted or mitered hairline joints.

    a. Glazed Lites: Provide fixed stops and moldings welded on secure side of door.
    b. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

6. Hardware Preparation: Factory prepare stainless-steel doors to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 087100 "Door Hardware."

    a. Reinforce doors to receive nontemplated mortised and surface-mounted door hardware.

7. Locate hardware as indicated, or if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."
8. Tolerances: Fabricate doors to tolerances indicated in ANSI/NAAMM-HMMA 866.

B. Stainless-Steel Frame Fabrication: Fabricate stainless-steel frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
2. Mullions Rails and Transom Bars: Provide closed tubular members with no visible face seams or joints. Fasten members at crossings and to jambs by butt welding according to joint designs in HMMA 820.

    a. Provide false head member to receive lower ceiling where frames extend to finish ceilings of different heights.

3. Provide countersunk, flat-, or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

        1) Two anchors per jamb up to 60 inches (1524 mm) in height.
        2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.
        3) Four anchors per jamb from 90 to 96 inches (2286 to 2438 mm) in height.
        4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof more than 96 inches (2438 mm) in height.

    b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

        1) Three anchors per jamb up to 60 inches (1524 mm) in height.
        2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.
        3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) in height.
        4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof more than 96 inches (2438 mm) in height.
        5) Two anchors per head for frames more than 42 inches (1066 mm) wide and mounted in metal-stud partitions.

    c. Compression Type: Not less than two anchors in each jamb.

d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

6. Head Reinforcement: For frames more than 48 inches (1219 mm) wide, provide continuous head reinforcement for full width of opening, welded to back of frame at head.
7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.

   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

8. Stops and Moldings: Provide stops and moldings around glazed lites and solid panels where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

   a. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of door or frame.
   b. Multiple Glazed Lites: Provide fixed and removable stops and moldings such that each lite is capable of being removed independently.
   c. Coordinate rabbet width between fixed and removable stops with type of glazing or panel and type of installation indicated.

9. Hardware Preparation: Factory prepare stainless-steel frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 087100 "Door Hardware."

   a. Reinforce frames to receive nontemplated mortised and surface-mounted door hardware.
   b. Locate hardware as indicated, or if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

10. Plaster Guards: Weld guards to frame at back of hardware mortises and mounting holes in frames to be grouted.
11. Tolerances: Fabricate frames to tolerances indicated in ANSI/NAAMM-HMMA 866.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stainless-steel doors and frames.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of stainless-steel, door-frame connections before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation and with installation spreaders in place, adjust and securely brace stainless-steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install stainless-steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with ANSI/NAAMM-HMMA 866 and manufacturer's written instructions.

B. Stainless-Steel Frames: Install stainless-steel frames of size and profile indicated.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-protection-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install frames with removable glazing stops located on secure side of opening.
    d. Install door silencers in frames before grouting.
    e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    f. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

g. Apply corrosion-resistant coating to backs of grout-filled frames.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.

   a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors, if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
5. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
6. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
7. Grouted Frames: Solidly fill space between frames and substrate with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
8. Installation Tolerances: Adjust stainless-steel frames for squareness, alignment, twist, and plumb to the following tolerances:

   a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Stainless-Steel Doors: Fit non-fire-rated doors accurately in frames with the following clearances:

1. Non-Fire-Rated Doors:

   a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
   b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
   c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
   d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Install glazing in sidelights, transoms, and borrowed lights to comply with installation requirements in Section 088000 "Glazing."

1. Secure stops with countersunk, flat-, or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c., and not more than 2 inches (50 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work including stainless-steel doors or frames that are warped, bowed, or otherwise unacceptable.

B. Clean grout and other bonding material off stainless-steel doors and frames immediately after installation.

C. Stainless-Steel Touchup: Immediately after erection, smooth any abraded areas of stainless steel and polish to match undamaged finish.

END OF SECTION 08 11 19

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes door hardware.

NOTE: All door hardware for public rest rooms shall be stainless steel.

1.2 SUBMITTALS

A. Product Data: Submit product data including installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: Submit samples of exposed door hardware for each type indicated below, in specified finish. Tag with full description for coordination with the Door Hardware Schedule.

1. Door Hardware: As follows:

   a. Locks and latches.
   b. Operating trim.

2. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

C. Door Hardware Schedule: Submit door hardware schedule prepared by or under the supervision of door hardware supplier. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware. The Architect's review of schedule shall neither be construed as a complete check nor shall it relieve the Contractor of responsibility for errors, deviations, or omissions from the specified requirements to provide complete door hardware for the project.

1. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.

2. Content: Include the following information:

   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.

f. Mounting locations for door hardware. Supply templates to door and frame manufacturer(s) to enable proper and accurate sizing and locations of cutouts for hardware. Detail conditions requiring custom extended lip strikes, or other special or custom conditions.
g. Door and frame sizes and materials.
h. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

1) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.

D. Keying Schedule: Submit keying schedule prepared by or under the supervision of supplier, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

E. Warranties: Submit special warranties specified in this Section.

F. Fire-Rated Door Assembly Testing: Submit a written record of each fire door assembly to LAWA and to the LADBS for future building inspections.

NOTE: Perform a field survey of each opening prior to submitting shop drawings. Verify the appropriateness of the assigned hardware group for the designated opening.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Supplier Qualifications: Door hardware supplier, who has completed a minimum of three (3) projects over the last 5 years which were similar in material, design and extent to that indicated for the project and which have resulted in construction with a record of successful in service performance, and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.

C. Source Limitations: Obtain each type of door hardware from a single manufacturer, unless otherwise indicated.

D. Regulatory Requirements: Comply with the following:

1. Provide hardware items complying with the applicable provisions for accessibility and usability by the disabled and handicapped in compliance with Americans with

Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG),".

2. NFPA 101: Comply with applicable provisions for means of egress doors.
3. Electrified Door Hardware: Listed and classified by Underwriter's Laboratories, Inc. or by a testing agency acceptable to authorities having jurisdiction, as suitable for the purpose indicated.
4. LADBS requirements.

E. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by Underwriter's Laboratories, Inc. for fire ratings indicated, based on testing according to NFPA 252. Provide only door hardware items that are identical to items tested by UL for the types and sizes of doors required. In case of conflict between type of hardware specified and type required for accessibility or fire protection, furnish type required by NFPA and UL. Doors indicated in fire rated partitions and walls shall be positive latching and self-closing, with smoke gaskets where required by applicable codes.

1. Wherever exit device hardware is required on doors, comply with UL 305. Furnish hardware to door manufacturer for installation at factory. Provide supplementary label, "Fire Exit Hardware", on each exit device to certify that panic hardware has been panic load tested with door.

F. Keying Conference: Conduct conference at Project site to comply with LAWA requirements. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
1. The degree of security required,
2. Preliminary key system schematic diagram.
3. LAWA Requirements for key control system.
4. Address for delivery of keys to LAWA.

G. Preinstallation Conference: Conduct conference at Project site to comply with LAWA keying and security requirements. Review methods and procedures related to electrified door hardware including, but not limited to, the following:

1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
2. Review sequence of operation for each type of electrified door hardware.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review required testing, inspecting, and certifying procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

1.5 COORDINATION

A. Templates: Furnish templates and door hardware schedules, coordinated for the application of door hardware items with door and frame details, to door opening fabricators and trades performing door opening work to permit the preparation of doors and frames to receive the specified door hardware. Where the door hardware item scheduled is not adaptable to the finished size of door opening members requiring door hardware, submit an item having a similar operation and quality to the Architect for review. Each door hardware item shall be fabricated to templates.

NOTE: Coordinate the layout and installation of electrified door hardware with connections to power supplies, fire alarms systems and detection devices, access control system, security system and the building control system.

B. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.6 WARRANTY

A. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Faulty operation of door hardware.
2. Deterioration of metals, metal finishes, and other materials beyond normal use.

B. Warranty Period for Electromagnetic Locks: Five years from date of Substantial Completion.

C. Warranty Period for Manual Closers: Ten years from date of Substantial Completion.

D. Warranty Period for Concealed Floor Closers: Five years from date of Substantial Completion.

E. Warranty Period for Exit Devices: Five years from date of Substantial Completion.

F. Warranty Period for Other Hardware: Two years from date of Substantial Completion.

G. Warranty for Mortised Mechanical Lock and Latchsets: Ten years from date of Substantial Completion.

H. Warranty for Heavy Duty Cylindrical Mechanical Lock and Latchsets: Seven years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section, door hardware sets are keyed to each scheduled door in the door and frame schedule, and the Door Hardware Schedule.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturer's products.
2. The hardware supplier shall review each hardware set and compare it with the door types, details, and sizes as shown and verify each hardware item for function, hand, backset, and method of fastening through shop drawing submittals.

ITEM	MANUFACTURER	ACCEPTABLE SUB
Hinges and Electric Hinges	(STN) Stanley	Hager, Zero, Select
Key System	(SCH) Schlage	Owner's Standard
Locks	(SCH) Schlage	Owner's Standard
Exit Devices	(VON) Von Duprin	Owner's Standard
Flush Bolts/Dust Proof Strike	(IVE) Ives	
Coordinator	(IVE) Ives	
Closers	(LCN) LCN	Owner's Standard
Push & Pull Plates	(IVE) Ives	Rockwood, Trimco
Kickplates/Moplates	(IVE) Ives	Rockwood, Trimco
Magnetic Catches	(ROC) Rockwood	
Magnetic Holder	(RIX) Rixson	Or Equal
Stops & Holders	(IVE) Ives	Rockwood, Trimco
Power Supply	(VON) Von Duprin	
Power Transfer	(VON) Von Duprin	
Thresholds	(PEM) Pemko	Zero, NGP,
Astragals/Seals/ Bottoms	(PEM) Pemko	Zero, NGP
Silencers	(IVE) Ives	
Decals	(VON) Von Duprin	
Door Contacts	(GES) General Electric Security	Flair
Electric Strike	(FAS) Folger Adam Security	Von Duprin
Cyberlock Cylinder	(VID) Videx Key System	
Bottom Rail Lock	(ARC) Adams Rite	
Floor Stop & Miscellaneous	(TRM) Trimco	Rockwood

2.2 HINGING METHODS

A. Conventional Hinges: **High strength stainless steel** pins with concealed bearings.

2.3 LOCKS AND LATCHES

A. Mortise Lock and Latch Sets: Heavy duty, commercial, mortise bodies complying with BHMA A156.13 Series 1000, Grade 1, with throughbolted lever trim. Furnish mortise type, field reversible without disassembly, field multifunctional without opening lock cases, lock and latch sets with 1 or 2 piece anti-friction deadlocking stainless steel latchbolts having a minimum 3/4 inch (19 mm) throw, 2-3/4 inches (70 mm) backset, and UL listed for 3 hour doors. All lock and latch sets, to be furnished complete with heavy 0.109 inch (2.77 mm) (12 gage) wrought steel zinc dichromate or chrome plated case, trim, adjustable beveled square cornered armored fronts, cold forged steel or stainless steel hubs, and 6 pin cylinders. Conceal fastenings, washers and bushings. Provide wrought, or black plastic, box strikes for each lock and latch set. Provide brass, bronze or stainless steel strikes with curved lips of sufficient length to protect frames. Provide solid forged or cast levers with wrought roses. Where electro-mechanical locksets are scheduled provide transformers properly sized for conversion of power supply to the power characteristics of the electromechanical locksets. Where electro-mechanical locksets are scheduled provide request to exit (REX) monitoring feature.

1. *Chassis: cold-rolled steel, handing field-changeable without disassembly.*
2. *Latchbolts: 3/4 inch throw stainless steel anti-friction type.*
3. *Lever Trim: through-bolted, accessible design, cast lever or solid extruded bar type levers as scheduled. Filled hollow tube design unacceptable. Provide security design independent breakaway spindles. Breakage of outside lever shall not allow access to inside lever's hubworks to gain wrongful entry.*
4. *Thumbturns: accessible design not requiring pinching or twisting motions to operate.*
5. *Deadbolts: stainless steel 1-inch throw.*
6. *Electric operation: Manufacturer-installed continuous duty solenoid.*
7. *Strikes: 16 gage curved steel, bronze or brass with 1 inch deep box construction, lips of sufficient length to clear trim and protect clothing.*
8. *Scheduled Lock Series and Design: Schlage L series, 03A design.*
9. *Certifications:*
   a) *ANSI A156.13, 1994, Grade 1 Operational, Grade 1 Security.*
   b) *ANSI/ASTM F476-84 Grade 31 UL Listed.*

2.4 EXIT DEVICES

A. Exit Devices: Exit devices and exit device accessories shall conform to BHMA A156.3, Grade 1. Trim shall be wrought construction and commercial plain design with straight, beveled or

smoothly rounded sides, corners and edges. Keyed devices shall be furnished less cylinders. Cylinders shall be as herein specified keyed to building system.

B. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to the LADBS, for panic protection, based on testing according to UL 305.

1. *Independent lab-tested 1,000,000 cycles.*
2. *Push-through push-pad design. No exposed push-pad fasteners, no exposed cavities when operated. Return stroke fluid dampeners and rubber bottoming dampeners, plus anti-rattle devices.*
3. *0.75-inch throw deadlocking latchbolts.*
4. *End caps: impact-resistant, flush-mounted. No raised edges or lips to catch carts or other equipment.*
5. *No exposed screws to show through glass doors.*
6. *Non-handed basic device design with center case interchangeable with all functions, no extra parts required to effect change of function.*
7. *Releasable in normal operation with 15-lb. maximum operating force per UBC Standard 10-4, and with 32 lb. maximum pressure under 250-lb. load to the door.*
8. *Flush end cap design as opposed to typical "bottle-cap" design end cap.*
9. *Comply with CBC Section 1003.3.1.9.*

C. Specific features:

1. *Non-Fire Rated Devices: cylinder dogging.*
2. *Lever Trim: Breakaway type, forged brass or bronze escutcheon min .130" thickness, compression spring drive, match lockset lever design.*
3. *Rod and latch guards with sloped full-width kickplates for doors fitted with surface vertical rod devices with bottom latches.*
4. *Fire-Labeled Devices: UL label indicating "Fire Exit Hardware". Vertical rod devices less bottom rod (LBR) unless otherwise scheduled.*
5. *Delayed Egress Devices: Function achieved within single exit device component, including latch, delayed locking device, request-to-exit switch, nuisance alarm, remote alarm, key switch, indicator lamp, relay, internal horn, door position input, external inhibit input plus fire alarm input. NFPA 101 "Special Locking Arrangement" compliant.*
6. *Electrically Operated Devices: Single manufacturer source for electric latch retraction devices, electrically controlled trim, power transfers, power supplies, monitoring switches and controls.*

2.5 CYLINDERS AND KEYING

A. Cores for Bored Cylindrical Locksets: Provide key-in lever 6 pin cores for all bored cylindrical locksets, keyed into base building system, as manufactured by the bored lockset manufacturer.

B. Cylinders: Full faced cylinders with square shouldered (not tapered) compression rings, 6 pin cylinders, standard threaded, keyed into building system, with cams to suit lock functions. Provide cylinders for installation into all locks.

1. 1100 Series Flexible Head Mortise Cylinder; Corbin Russwin Architectural Hardware (CR).
2. Series 40 Adjustable Front Cylinder; Sargent Manufacturing Company (SGT).
3. 30-001 full-faced mortised cylinder with 36-083 compression rings; Schlage Lock Company (SCH).

C. Keying System: Final keying to determine lock cylinders, keyed alike sets, level of keying, master key groups, grandmaster keying system shall be as directed by the LAWA. Supplier and Contractor shall meet with the LAWA and obtain final instructions in writing. Provide 2 nickel silver keys for each lock, and 6 keys for each grandmaster and masterkey system. Provide 2 blank keys for each lock for the LAWA's convenience in making additional keys.

1. Temporary Cylinders: Provide temporary cylinders in locks during construction and as may be necessary for security or as may be requested by the LAWA. All temporary cylinders shall be individually keyed as required and subject to a single master key.

D. Key Control System: Furnish a key control system with complete accessories including key gathering envelopes, labels, reserve pattern key tags with self-locking key clips, key receipt forms, key receipt holders, 3 way visible card index, temporary key markers and permanent key markers.

2.6 STRIKES

A. Strikes for Locks and Latches: All strikes for locks and latches shall be provided by the lock and latch manufacturer unless otherwise specified or scheduled, refer to Article 'Locks and Latches'.

B. Dustproof Floor Strikes: Complying with BHMA A156.16, Type L04251, L04021 or L14021, one of the following:

1. No. 80; Door Controls International.
2. DP2; H.B. Ives.
3. 3910; Triangle Brass Manufacturing Company, Inc. (TBM).
4. 570; Rockwood Manufacturing Company (RM).

C. Electric Strikes: Complying with BHMA A156.5, Grade 1. Mortised type for devices mounted in hollow metal frames. Unless otherwise required to interphase with the security access system furnish in 24 volt DC continuous voltage for silent operation. Provide each strike with extended lips as required to suit jamb conditions and fail secure function. Remote electrical control from card reader or control panel will unlock strike jaw, releasing latchbolt of the deadlatch, so door can be opened without operating latch by key cylinders from outside of secured room. Electric strikes shall be UL listed for up to 3 hour fire door assemblies.

1. 6200 Series Electric Strikes; Von Duprin.

2.7 CLOSERS

A. Surface-Mounted Closers: Closers shall be certified by ETL laboratories and the manufacturer to a minimum of 8,000,000 cycles and meet BHMA A156.4, Grade 1. Closers used in conjunction with overhead stops and holders shall be templated and coordinated to function properly. Properly detail closers to meet application requirements by providing drop plates, brackets, etc. to meet application and installation requirements as indicated. Comply with manufacturers recommendations for size of door closer depending on size of door, stack pressure conditions, and anticipated frequency of use. Closers shall have adjustable spring power, full rack and pinion, independent closing speed and latch regulating V-slotted valves, fully hydraulic with a high strength cast iron cylinder and solid forged steel arms, bore diameter of 1-1/2 inches (38.1 mm), pinion shaft diameter of 5/8 inches (15.87 mm), adjustable back check, cushion and built-in stop feature where scheduled, hold open arms where scheduled, delayed action where scheduled, arm finish to match closer cover finish scheduled. Provide metal covers of clean line design with plated or primed for paint finish as scheduled and that require removal in order to make adjustments to closer.

1. *Full rack-and-pinion type cylinder with removable non-ferrous cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring.*
2. *ISO 2000 certified. Units stamped with date-of-manufacture code.*
3. *Independent lab-tested 10,000,000 cycles.*
4. *Non-sized, non-handed, and adjustable. Place closer inside building, stairs, and rooms.*
5. *Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.*
6. *Adjustable to open with not more than 5.0lbs pressure to open at exterior doors and 5.0lbs at interior doors. As allowed per California Building Code, Section 1133B.2.5, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15lbs.*
7. *Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.*
8. *Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.*
9. *Exterior door closers: tested to 100 hours of ASTM B117 salt spray test, furnish data on request.*
10. *Exterior doors do not require seasonal adjustments in temperatures from 120^{o} F to –30^{o} F, furnish data on request.*
11. *Non-flaming fluid, will not fuel door or floor covering fires.*
12. *Pressure Relief Valves (PRV): unsafe, not permitted.*

2.8 PROTECTIVE TRIM UNITS

A. Kick and Armor Plates: Fabricate protection plates from minimum 0.050 inch (1.3 mm) thick **stainless steel**, beveled top and 2 sides (B3E), square corners, complying with BHMA A156.6, and fastened with oval head Phillips fasteners countersunk into plate surface.

1. Series 8400; H. B. Ives (IVS).
2. K1050 Doorplate Series; Rockwood Manufacturing Company (RM).
3. KA050-2 Armor Plate and KOO50 for Kickplates; Triangle Brass Manufacturing Company, Inc. (TBM).

B. Size: Furnish kick and armor plates sized 2 inches (51 mm) less than door width. Furnish kickplates 12 inches (305 mm) high, furnish armor plates 48 inches (1219 mm) high unless otherwise indicated. Provide protective plates with cutouts for locks, louvers and windows to the extent indicated. Mount protective plates flush with bottom of door.

2.9 OTHER HARDWARE

A. Automatic Flush Bolts: Low operating force design, “LBR” type where scheduled.

B. Overhead Stops: **Stainless steel** (100 series). Non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.

C. Door Stops: Provide stops to protect walls, casework or other hardware.

1. Unless otherwise noted in Hardware Sets, provide wall type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
2. Locate overhead stops for maximum possible opening. Consult with Owner for furniture locations. Minimum: 90^{o} stop / 95^{o} deadstop. Note degree of opening in submittal.

D. Seals: Finished to match adjacent frame color. Resilient seal material: polypropylene, nylon brush, or solid high-grade neoprene. UL label applied to seals on rated doors. Substitute products: certify that the products equal or exceed specified material’s thickness and durability. Proposed substitutions: submit for approval.

1. Solid neoprene: MIL Spec. R6855-CL III, Grade 40.
2. Non-corroding fasteners at in-swinging exterior doors.
3. Fire-rated Doors, Resilient Seals: UL10C / UBC Standard 7-2 compliant. Coordinate with selected door manufacturers' and selected frame manufacturers' requirements. Where rigid housed resilient seals are scheduled in this section and the selected door manufacturer only requires an adhesive-mounted resilient seal, furnish rigid housed seal at minimum, or both the rigid housed seal plus the adhesive applied seal. Adhesive applied seals alone are deemed insufficient for this project where rigid housed seals are scheduled.

C. Thresholds: Comply with CBC Section 1133B.2.4.1.

1. Exteriors: Seal perimeter to exclude water and vermin. Use butyl-rubber or polyisobutylene sealant complying with requirements in Division 7 "Thermal and Moisture Protection". Non-ferrous 1/4inch fasteners and lead expansion shield anchors, or Red-Head #SFS-1420 (or approved equivalent) Flat Head Sleeve Anchors (SS/FHSL).
2. Fire-rated openings, 90min or less duration: use thresholds to interrupt floor covering material under the door where that material has a critical radiant flux value less than 0.22 watts per square centimeter, per NFPA 253. Use threshold unit as scheduled. If none scheduled, request direction from Architect.
3. Fire-rated openings, 3hour duration: Thresholds, where scheduled, to extend full jamb depth.
4. Plastic plugs with wood or sheet metal screws are not an acceptable substitute for specified fastening methods.

D. Fasteners: Generally, exposed screws to be Phillips or Robertson drive. Pinned TORX drive at high security areas. Flat head sleeve anchors (FHSL) may be slotted drive. Sheet metal and wood screws: full-thread. Sleeve nuts: full length to prevent door compression.

E. Silencers: Interior hollow metal frames, 3 for single doors, 4 for pairs of doors. Omit where adhesive mounted seal occurs. Leave no unfilled/uncovered pre-punched silencer holes.

2.10 FABRICATION

A. Manufacturer's Nameplate: Provide each door hardware item without exposed manufacturers labels, names, or designs.

B. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended. Provide Phillips oval-head screws with finished heads to match surface of door hardware item being attached. Machine screws and expansion shields shall be used for attaching hardware to concrete and masonry. Use throughbolts for renovation work only where existing door blocking and reinforcements are unknown.

1. Concealed Fasteners: All new doors and door frames have been specified with adequate blocking and reinforcement provisions to eliminate exposed throughbolting of hardware items. Doors installed with exposed throughbolts will be rejected and replaced by the Contractor at no cost to the Owner. Where through bolts are used on existing doors provide sleeves for each through bolt.

2.11 FINISHES

A. Designations: The abbreviations used to schedule hardware finishes are generally BHMA (Federal Standards where indicated in parenthesis) designations. Comply with base material and finish requirements indicated by the following:

1. BHMA 600 (USP): Primed for painting.
2. BHMA 626 (US26D): Satin chromium plated.
3. BHMA 630 (US32D): Satin stainless steel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Hardware for fire door assemblies shall be installed in accordance with NFPA 80. Hardware for smoke and draft control door assemblies shall be installed in accordance with NFPA 105. Install hardware for non-labeled and non-smoke and draft door assemblies in accordance with BHMA A156.115 for steel doors and frames, BHMA A156.115-W series for wood doors, and hardware manufacturers installation instructions for doors and frames fabricated from other than steel or wood.

1. All modifications to fire doors and frame for electric and mortised hardware shall be made by the respective door and frame manufacturers.

B. Smoke Seals at S Labeled Door Assemblies: Provide and install smoke seals at S labeled doors in accordance with door manufacturers instructions.

3.2 INSTALLATION

A. Mounting Heights: Mount door hardware units at the following heights, unless specifically indicated on the drawings or required to comply with LADBS regulations:

1. Locate levers, key cylinders, t-turn pieces, touchbars and other operable portions of latching hardware between 30 inches to 44 inches above the finished floor, per CBC Section 1133B.2.5.1.
2. Where new hardware is to be installed near existing doors/hardware scheduled to remain, match locations of existing hardware.

B. Install each door hardware item to comply with manufacturer's written instructions. Install overhead surface closers for maximum degree of opening obtainable. Place on room side of corridor doors, stair side of stair doors, secondary corridor side of doors between corridors. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be finished, coordinate removal, storage, and reinstallation of surface protective trim units. Do not install surface-mounted items until finishes have been completed on substrates involved.

C. Existing frames and doors scheduled to receive new hardware: carefully remove existing hardware, tag and bag, and turn over to LAWA.

1. Metal doors/frames: Weld or fasten with screws: filler pieces in existing hardware cut-outs and mortises not scheduled for re-use by new hardware. Leave surfaces smooth - - no applied patches.
2. Remove unused existing floor closers, fill empty floor closer cavities with concrete.

D. Do not install permanent key cylinders in locks until the time of preliminary acceptance by the Owner. At the time of preliminary acceptance, and in the presence of LAWA, permanent key all lock cylinders. Record and file all keys in the key control system, and turn system over to LAWA for sole possession and control.

E. Key control storage system shall be installed where directed by the LAWA.

3.3 ADJUSTING

A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every hardware component. Replace hardware components that cannot be adjusted to operate as intended. Adjust door control devices to compensate for building stack pressures, final operation of forced air mechanical equipment and to comply with referenced accessibility requirements.

1. Test each electrical hardware item to determine if devices are properly functioning. Wiring shall be tested for correct voltage, current carrying capacity, and proper grounding. Stray voltages in wiring shall be eliminated.
2. Coordinate with electrical installation for interface and connection with life safety and security systems.

B. Fire-Rated Door Assembly Testing: Upon completion of the installation, test each fire door assembly in the project to confirm proper operation of its closing device and that it meets all criteria of a fire door assembly as per NFPA 80 2007 Edition. The inspection of the fire doors is to be performed by individuals with knowledge and understanding of the operation components of the type of door being subjected to testing. A written record shall be maintained and transmitted to LAWA and be made available to the LADBS. The record shall list each fire door assembly throughout the project, and include each door number, an itemized list of hardware set components at each door opening, and each door location in the facility.

3.4 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation. Clean hardware components as necessary to restore proper finish. Provide protection during the progress of the work and maintain conditions that ensure door hardware is in perfect working order and without damage or deterioration at time of Substantial Completion.

END OF SECTION 08 71 00

SECTION 09 22 16 – NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes non-structural metal framing assemblies.

1.2 ASSEMBLY PERFORMANCE REQUIREMENTS

1. Typical Walls: Wall assemblies shall be constructed for deflection not to exceed 1/240 of the wall height when subjected to a positive and negative pressure of 5 psf (239 kPa).

2. Walls with Tile or Stone Finish: Wall assemblies to receive tile finishes shall be constructed for deflection not to exceed 1/360 of the wall height when subjected to a positive and negative pressure of 5 psf (239 kPa). L/600 where supporting stone.

3. Ceilings, bulkheads, soffits, ceiling transitions, ledges, and coves shall be constructed for a deflection not to exceed 1/360 of the distance between supports.

4. Partitions Enclosing Pressurized Mechanical Rooms: Provide metal framing systems of base metal thickness and spacing capable of limiting lateral deflections to L/240 when subjected to a 15 psf uniform lateral load or the desing value induced by the mechanical system, whichever is greater.

1.3 SUBMITTALS

A. Product Data: Submit product data for each product indicated.

B. Evaluation Reports: Provide LARR identification numbers for Metal Studs, Fasteners, and Suspension Ceilings.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For non-structural metal framing assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."

B. Sound Transmission Characteristics: For non-structural metal framing faced with gypsum wallboard materials and having STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

C. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.6 PRE-INSTALLATION MEETING

A. Prior to start of the non-structural metal framing Work, and at the Contractors direction, meet at the site and review the installation procedures and coordination with other Work. Meeting shall include Contractor, Architect and major material manufacturer as well as the Installer and other subcontractors whose Work must be coordinated with the non-structural metal framing and the gypsum wallboard Work.

1.7 PROJECT CONDITIONS

A. Comply with ASTM C754 requirements or wallboard material manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. General: For fire rated assemblies, provide materials, including accessories and fasteners produced by one manufacturer, or, when products of more than one manufacturer are used in a rated system, they shall be acceptable to the Los Angeles Department of Building and Safety.

2.2 STEEL SUSPENDED CEILING FRAMING

A. Components, General: Provide steel framing members sized and spaced as indicated but not less than that required to comply with ASTM C 754 under the maximum deflection conditions specified under Article 'Assembly Performance Requirements'.

B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

C. Hanger Attachments to Overhead Decks: Suitable for application indicated, fabricated from corrosion-resistant materials, with eyepins, clips or other devices for attaching hangers and capable of sustaining, without failure, a load equal to 10 times that imposed by the complete ceiling system.

D. Hangers: As follows:

1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.

2. Rod Hangers: ASTM A 510 (ASTM A 510M), mild carbon steel.

a. Diameter: 1/4-inch (6.34-mm).
b. Protective Coating: ASTM A 153/A 153M, hot-dip galvanized.

3. Flat Hangers: Commercial-steel sheet, ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized.

a. Size: 1 by 3/16 inch (25.4 by 4.76 mm) by length indicated.

E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch (1.37 mm), a minimum 1/2-inch- (12.7-mm-) wide flange, with manufacturer's standard corrosion-resistant zinc coating.

F. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized zinc coating.

1. Cold Rolled Channels: 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flange, 3/4 inch (19.1 mm) deep.

2. Steel Studs: ASTM C 645, 0.0312 inch (0.79 mm) minimum base metal thickness and minimum depth as required to suit deflection criteria.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.

a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).

4. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission.

G. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

2.3 STEEL PARTITION AND SOFFIT FRAMING

A. General: Provide steel framing members sized and spaced as indicated but not less than that required to comply with ASTM C 754 under the maximum deflection conditions specified under Article 'Assembly Performance Requirements'.

1. In areas where top of partitions are dependent on ceiling system for lateral support, coordinate design and installation to comply with the above deflection limitation.
2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized zinc coating.

B. Steel Studs and Runners: ASTM C 645, in minimum depth indicated in partition type details.
1. Minimum Base Metal Thickness:

a. Typical: As required to comply with deflection criteria.
b. Partitions Supporting Wall Mounted Casework: 16 gauge (0.053 inch) (1.3 mm) minimum thickness.

2. Depth: As indicated.

C. Deflection Track: ASTM C645 top runner with custom fabricated flanges with depths sized to accommodate roof and floor deck live and dead load deflections but not less than 2 inch (50.8 mm) deep flanges. Steel sheet top runner manufactured to prevent cracking of gypsum board applied to interior partitions resulting from deflection of structure above; in thickness indicated for studs and in width to accommodate depth of studs; one of the following:

1. CEMCO; CST, slotted Track.
2. Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
3. MBA Building Supplies; Slotted Deflecto Track
4. Steel Network Incl; VertiClip SLD or VertiTrack VTD Series.
5. Superior metal Trim; Superior Flex Track System (SFT)
6. Telling Industries; Vertical Slip Track.

D. Firestop Track: ASTM C645 top runner with custom fabricated flanges with depths sized to accommodate roof and floor deck live and dead load deflections but not less than 2 inch (50.8 mm) deep flanges. Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs; one of the following:

1. CEMCO; FAS Track
2. Fire Trak Corp; Fire Trak System
3. Metal-Lite, Inc; The System
4. The Steel Network, Inc: VertiClip SLD Series or VertiTrack VTD Series, Durham, NC.
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E. Flat Strap and Backing Plate: 36 -inch (914-mm) wide steel sheet for blocking and bracing required for the attachment of surface mounted items and accessories indicated.

1. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).

F. Cold-Rolled Channel Bridging: For channel bridging for fixture attachment or lateral bracing provide 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flange:

1. Depth: 1-1/2 inches (38.1 mm).
2. Clip Angle: 1-1/2 by 1-1/2 inch (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
2. Depth: 7/8 inch (22.2 mm).

H. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep, steel sheet members designed to reduce sound transmission.

I. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members securely to substrates involved; complying with the recommendations of the gypsum board manufacturers for applications indicated.

NOTE: On the drawings, indicate the locations for each type of metal framing, fasteners, furring or suspension system with the required spacing and corresponding thickness with their related LARR number.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which non-structural metal framing attaches or abuts, installed door frames and structural framing with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (600 mm) o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of the non-structural metal framing and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLING STEEL FRAMING, GENERAL

A. General: Install steel framing to comply with ASTM C754, ASTM C840 and the gypsum board manufacturers recommendations, where standards conflict the more stringent shall apply.

B. Install supplementary framing, blocking, backerplates and bracing at locations in gypsum board assemblies which are indicated to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

C. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement.

1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.

    a. Use deep-leg deflection track where indicated.
    b. Use proprietary firestop track where indicated.

3.4 INSTALLING STEEL SUSPENDED CEILING FRAMING

A. Suspended Ceiling Framing:

1. Suspend ceiling hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Attach hangers to structural members. Do not support ceilings from or attach hangers to permanent metal forms, steel deck tabs, steel roof decks, ducts, pipes, or conduit.
4. Secure wire hangers by looping and wire-tying, to eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
5. Secure rod and flat hangers to structure, including intermediate framing members, by attaching to devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member and transversely between parallel members.

C. Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

D. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards unless more stringent spacings are recommended by the gypsum board manufacturer.

E. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.5 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

A. Install continuous runners (tracks) sized to match studs at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction. Secure runners to substrates with fasteners spaced a maximum of 24 inches (600 mm) o.c. unless closer spacing is recommended by the framing manufacturer for the floor and ceiling construction involved. Provide fasteners at all corners and ends of runner tracks.

1. Where studs are installed directly against exterior walls, install foam gasket isolation strip between studs and wall.

B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings and at partial height partitions. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. Cut studs 1/2 inch (13 mm) short of full height to provide perimeter relief.
2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
3. Terminate partition framing at suspended ceilings where indicated.
4. Terminate partial height partition framing as indicated.

D. Install steel studs and furring in sizes and at spacing indicated but not less than that required by the referenced steel framing installation standard to comply with maximum deflection and minimum loading requirements specified, unless more stringent requirements are recommended by the gypsum board manufacturer:

1. Space studs 16 inches (400 mm) o.c., unless otherwise indicated.

E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.

F. Install backerplates for support of wall mounted items.

G. Curved Partitions:

1. Cut top and bottom track (runners) through leg and web at 2-inch (50-mm) intervals for arc length. In cutting lengths of track, allow for uncut straight lengths of not less than 12 inches (300 mm) at ends of arcs.
2. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
3. Support outside (cut) leg of track by clinching steel sheet strip, 1-inch- (25-mm-) high-by-thickness of track metal, to inside of cut legs using metal lock fasteners.
4. Begin and end each arc with a stud, and space intermediate studs equally along arcs at stud spacing recommended in writing by gypsum board manufacturer for radii indicated.

On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches (150 mm) o.c.

H. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

1. Install two studs at each jamb, unless otherwise indicated. Install one additional stud no more than 6 inches (150 mm) from jamb studs at single doors greater than 48 inches (1200 mm) and at all pairs of doors.
2. Install cripple studs at head adjacent to each jamb stud. Provide runner track and typical studs above door openings with studs spaced not more than 24 inches (600 mm) o.c.
3. At all welded frames with fixed anchor clips secure stud reinforcing to jamb anchor clips with not less than two self tapping screws per clip.
4. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

I. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

J. Isolation Strip Attachment: Where partitions abut exterior wall window mullions, and partition filler panels are not indicated, adhesively attach isolation strips to window mullions. Center isolation strips on mullion to form a continuous, sound resistant and lightproof, recessed joint seal for the entire length of the interface between the partition studs and trim members and the vertical window mullions.

3.6 CLEANING AND PROTECTION

A. Clean floors of all non-structural metal framing debris and leave broom clean. Excess material, scaffolding, tools and other equipment are to be removed upon completion of the Work.

B. Provide final protection and maintain conditions that ensures non-structural metal framing Work remains without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 22 16

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes gypsum board assemblies.

1.2 SUBMITTALS

A. Product Data: Submit product data for each product indicated.

B. Samples: Submit full size samples in 12-inch- (300-mm-) long lengths for each exposed trim accessory indicated.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."

B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

C. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."

D. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.

E. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

C. Handle gypsum board to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.5 PRE-INSTALLATION MEETING

A. Prior to start of each type of gypsum wallboard system, and at the Contractors direction, meet at the site and review the installation procedures and coordination with other Work. Meeting shall include Contractor, Architect and major material manufacturer as well as the Installer and other subcontractors whose Work must be coordinated with the gypsum wallboard Work.

1.6 PROJECT CONDITIONS

A. Comply with ASTM C840 requirements or wallboard material manufacturer's written recommendations, whichever are more stringent.

B. Installation of wallboard joint treatments shall not start until the space to receive wall board joint treatments is heated to maintain a continuous and uniform temperature of not less than 55 degrees F, from one week prior to beginning of joint treatment until joint treatment is completed and thoroughly dry. Ventilation, either natural or supplied by fans, circulators or air conditioning systems shall be provided to remove excess moisture during joint treatment. Temperature requirements may be waived only on recommendation of wallboard materials manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. General: For fire rated assemblies, provide materials, including accessories and fasteners produced by one manufacturer, or, when products of more than one manufacturer are used in a rated system, they shall be acceptable to authorities having jurisdiction.

2.2 INTERIOR GYPSUM WALLBOARD

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Gypsum Wallboard: ASTM C 36 or ASTM C1396/C1396M.

1. Regular Type:

    a. Thickness: 5/8 inch (15.9 mm), unless otherwise indicated.
    b. Long Edges: Tapered.
    c. Location: Vertical surfaces, unless otherwise indicated.

2. Type X:

    a. Thickness: 5/8 inch (15.9 mm).
    b. Long Edges: Tapered.
    c. Location: Where required for fire-resistance-rated assembly.

NOTE: On the drawings indicate the locations for each type of gypsum board and tile backing units using the same terminology as in these specifications. On the drawings place UL or LARR numbers for all fire rated gypsum and cementitious backer unit assemblies.

C. Flexible Gypsum Wallboard for Curved Surfaces: ASTM C 36 or ASTM C1396/C1396M, manufactured to bend to fit tight radii and to be more flexible than standard regular-type panels of the same thickness.

1. Thickness: 1/4 inch (6.4 mm).
2. Long Edges: Tapered.
3. Location: Apply in double layer at curved assemblies.

D. Sag-Resistant Gypsum Wallboard for Interior Ceilings: ASTM C 36 or ASTM C1396/C1396M, manufactured to have more sag resistance than regular-type gypsum board.

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.
3. Location: Ceiling surfaces.

NOTE: Use Impact Resistant Gypsum Board in areas susceptible to high abuse and the use of alternative materials is not feasible. Use a minimum of 20 gauge metal framing as support.

2.3 TILE BACKING PANELS

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Water-Resistant Gypsum Backing Board: ASTM C 630/C 630M or ASTM C1396/C1396M.

1. Core: 5/8 inch (15.9 mm).

C. Cementitious Backer Units: ANSI A118.9, in thickness indicated.

1. Thickness: 1/2 inch (12.7 mm).

NOTE: For adhesive applied ceramic tile in rest rooms, use cementitious back units as a sub-strate. When using water-resistant gypsum backing board at tile applications, the metal studs shall be spaced at 16 inches on center.When using water resistant backing board on ceilings spacing of supports shall be 12 inches on center.

2.4 TRIM ACCESSORIES

A. Interior Steel Trim Accessories: ASTM C 1047; formed metal sheet steel zinc coated by hot dipped process. Shapes indicated below by reference to Fig. 1 designations in ASTM C1047.

1. Cornerbead: Use at outside corners.

2. LC-Bead with both face and back flanges to receive joint compound; use at exposed panel edges.
3. U-Bead with face and back flanges; face flange formed to be left without application of joint compound: Use where indicated.
4. Curved-Edge Cornerbead: With notched or flexible flanges; use at curved openings.
5. Expansion (Control) Joint: One-piece control joint formed with V-shaped slot, with removable strip covering slot opening. Use where indicated.

B. Aluminum Trim Accessories: Extruded aluminum trim with 1/4 inch (6.35 mm) diameter holes in fins for attachment to wallboard or studs; longest lengths available in profiles indicated; primed for finish painting; sized for scheduled wallboard thickness shown.

2.5 JOINT TREATMENT MATERIALS

A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of the wallboard products and joint treatment materials for each application indicated.

B. Joint Tape:

1. Interior Gypsum Wallboard over Metal Studs: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, flanges of trim accessories, and fasteners, use setting-type taping compound.
3. Second coat: For filling over tape, beads and fasteners. Use setting-type, sandable topping compound.
4. Third coat: For finishing over tape, beads and fasteners. Use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Use setting-type taping and setting-type, sandable topping compounds.
2. Cementitious Backer Units: As recommended by manufacturer.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 that effectively reduces airborne

sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound Attenuation Blankets, and Fire Resistive Insulation for Installation Within Gypsum Wallboard Partitions: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

NOTE: Sound insulation is required in all rest room walls.

E. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board assemblies attach or abut, installed door frames and structural framing with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS

A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840, GA-216, and the gypsum wallboard manufacturer's recommendations, where standards conflict, the more stringent shall apply.

B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

C. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints or avoid them entirely.

    a. Stagger abutting end joints not less than one framing member in alternate courses of board.
    b. At high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

D. Multilayer Application:

1. On Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

2. On Ceilings: Apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply base layers in same sequence. Apply base layers at right angles to framing members and offset face layer joints 1 framing member, 16 inches minimum, from parallel base joints, unless otherwise indicated or required by fire-resistance-rated assembly.

E. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

F. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.

G. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

H. Curved Partitions:

1. Install panels horizontally and unbroken, to the extent possible, across curved surface plus 12 inches (300 mm) long straight sections at ends of curves and tangent to them.
2. Wet gypsum panels on surfaces that will become compressed where curve radius prevents using dry panels. Comply with gypsum board manufacturer's written recommendations for curve radii, wetting methods, stacking panels after wetting, and other preparations that precede installing wetted gypsum panels.
3. On convex sides of partitions, begin installation at one end of curved surface and fasten gypsum panels to studs as they are wrapped around curve. On concave side, start fastening panels to stud at center of curve and work outward to panel ends. Fasten panels to framing with screws spaced 12 inches (300 mm) o.c.
4. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.
5. Allow wetted gypsum panels to dry before applying joint treatment.

I. Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: For substrates indicated to receive thin-set tile, install water-resistant gypsum backing board panels, unless otherwise indicated. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.
2. Cementitious Backer Unit Application: ANSI A108.11 at showers and where otherwise indicated.

J. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

K. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions.

L. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

M. Attach gypsum panels to framing provided at openings and cutouts.

N. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Fit gypsum panels around ducts, pipes, and conduits.
2. Where partitions intersect open exterior and interior wall kickers, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by the wall kickers and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
3. Where chase walls are shown, provide bracing between parallel rows of studs. Unless otherwise shown, provide gypsum wallboard braces no less than 1/2-inch- (12.7-mm-) thick x 12-inches- (300-mm-) wide and cut to width of chase. Locate at quarter points in wall height between each pair of parallel studs. Fasten with not less than 3 screws at each stud.

O. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

P. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

Q. Cut openings in wallboard for electrical outlets, piping and other penetrations. Maintain close tolerances so that edges will be covered by plates and escutcheons. Cut both face and back paper. Do not install electrical outlets back to back on opposing sides of partitions.

R. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.
2. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.
3. Install fasteners not less than 3/8-inch- (9.5-mm-) from ends or edges of wallboard sheets, spacing fasteners opposite each other on adjacent ends or edges.
4. Begin fastening from center of wallboard and proceed toward edges and corners.
5. Apply pressure on surface of wallboard adjacent to fasteners being driven to ensure that wallboard will be secured tightly to supporting members.

    a. Drive fastener with shank perpendicular to face of board.
    b. Drive screws with a power screwdriver as recommended by wallboard manufacturer. Set heads of screws slightly below surface of paper without cutting paper.

3.3 INSTALLING TRIM ACCESSORIES

A. General: Fasten trim accessories according to manufacturer's written instructions for type, length, and spacing of fasteners.

B. Install corner beads at external corners.

C. Install interior trim accessories where edge of gypsum panels would otherwise be exposed or semiexposed. Provide interior trim accessories with face flange formed to receive joint compound.

D. Install aluminum trim accessories where indicated.

E. Install control joints in locations indicated and where directed by the Architect for visual effect, or if not indicated or directed by the Architect, provide control joints in accordance with ASTM C 840 which is as follows:

1. Where a partition, wall or ceiling traverses a construction joint (expansion, seismic, or building control element) in the base building structure.

2. Where a wall or a partition runs in an uninterrupted straight plane exceeding 30 linear feet (9,100 mm).

3. Control joints in interior ceilings with perimeter relief shall be installed so that linear dimensions between control joints do not exceed 50 feet (15,000 mm) and total area between control joints does not exceed 2500 square feet (230 m^2).

4. Control joints in interior ceilings without perimeter relief shall be installed so that linear dimensions between control joints do not exceed 30 linear feet (9,100 mm) and total area between control joints does not exceed 900 square feet (84 m^2).

5. A control joint or intermediate blocking shall be installed where ceiling framing members change direction.

3.4 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Apply joint treatment at gypsum board joints, flanges of interior trim and aluminum trim accessories, interior angles, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration and levels of gypsum board finish indicated. Produce surfaces free of tool marks and ridges ready for decoration of type indicated. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Cementitious Backer Units: Finish according to manufacturer's written instructions.

E. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.
3. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
4. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface where wallboard is indicated to receive wall coverings, semi-gloss and high gloss paints, and Italian plaster.

3.5 CLEANING AND PROTECTION

A. Clean floors of all wallboard debris and leave broom clean. Excess material, scaffolding, tools and other equipment are to be removed upon completion of the Work.

B. Provide final protection and maintain conditions that ensures gypsum board assemblies remain without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 29 00

SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes ceramic and porcelain tile.

1.2 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.6.
2. Step Treads: Minimum 0.6.
3. Ramp Surfaces: Minimum 0.8.

1.3 SUBMITTALS

A. Product Data: Submit product data for each product used.

B. Samples: Submit samples showing full range of color and texture variations expected.

1. Full size units of each type, composition, color, and finish of tile.
2. Assembled samples with grouted joints for each color grout and for each type, composition, color, and finish of tile.
3. Thresholds in 6-inch (150-mm) lengths, each type.

C. Test Reports: Submit test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile products with requirements specified for slip resistance.

D. Maintenance instructions: Submit maintenance instructions for each type of product installed.

1.4 QUALITY ASSURANCE

A. Installer: Engage an installer, with a minimum of 5 years of successful commercial tile installations similar in material, design, and scope to that indicated.

B. Source Limitations for Tile: Obtain tile from one source or producer, and from same production run and of consistent quality in appearance and physical properties for each contiguous area.

C. Field-Constructed Sample Installations: Before installing tile, erect sample installations for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build sample installations to comply with the following requirements, using materials indicated for final unit of Work.

1. Locate sample installations on site, in locations and size indicated or, if not shown or indicated, as directed by LAWA but not less than 100 sq. ft. (9.29 sq. m) area for floors, and not less than 100 sq. ft. (9.29 sq. m) area for walls.
2. Retain and maintain sample installations during construction in undisturbed condition as a standard for judging completed unit of Work.
3. Approved sample installations may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

B. Maintain temperatures at 50°F or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.7 EXTRA MATERIALS

A. Provide attic stock equal to the following for each type, color, pattern, and size (or fraction thereof) of tile provided for the project. Supply in manufacturer=s unopened containers, identified with name, brand type, grade, class and all other qualifying information, to a location where directed by LAWA.

1. 2% of amount installed but not less than one box.

PART 2 - PRODUCTS

2.1 TILE PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide Standard grade tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

B. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.

C. Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing where applicable.

2.2 ACCESSORY MATERIALS

A. Thresholds: Fabricate to provide transition between adjacent floor finishes. Bevel edges at 1:2 slope, limit height of bevel to 1/2 inch (12.7 mm) or less, and finish bevel to match face of threshold.

1. Marble Thresholds: ASTM C 503 with a minimum abrasion resistance of 12 per ASTM C 1353 or ASTM C 241 and with honed finish.

a. Description: Uniform, fine- to medium-grained white stone with gray veining.

B. Waterproofing for all Wet Areas and <u>Existing Concrete Slabs on Grade.</u>

1. Fabric-Reinforced, Fluid-Applied Product: System consisting of liquid-latex rubber and fabric reinforcement which are compatible with mortar bed specified and complying with ANSI A118.10; one of the following:

a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.

b. LATICRETE International Inc.; Laticrete 9235 Waterproof Membrane.

c. MAPEI Corporation; Mapelastic 400.

NOTE: <u>All</u> wet areas such as but not limited to kitchens and rest rooms and all existing concrete slabs on grade, shall incorporate a waterproofing membrane as part of the floor assembly. Indicate relevant waterproofing details on the drawings. The waterproofing membrane shall extend up the wall, a minimum of 3 feet, behind all wall hung plumbing fixtures and 12 inches high at all walls without plumbing fixtures in accordance with LAWA Rest Room Design Guidelines.

2.3 SETTING AND GROUTING MATERIALS

A. Manufacturers:

1. Custom Building Products.
2. LATICRETE International Inc.
3. MAPEI Corporation.

B. Source Limitations: For each tile installation, obtain compatible formulations of setting and grouting materials containing latex or latex additives from a single manufacturer.

C. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.1A and as specified below:

1. Reinforcing Wire Fabric: Galvanized, flat, welded wire fabric, 2” x 2” x 0.062 inch (50.8 x 50.8 mm x 1.57 mm) diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.

2. Latex Additive: Manufacturer's standard styrene-butadiene-rubber water emulsion, serving as replacement for all gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

D. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4 consisting of the following:

1. Prepackaged dry-mortar mix combined with liquid-latex additive.
2. For wall applications, provide nonsagging mortar.

E. Medium-Bed, Latex-Portland Cement Mortar: ANSI A118.4:

1. Prepackaged dry-mortar mix combined with liquid-latex additive.

F. Polymer-Modified Tile Grout: ANSI A118.7.

1. Polymer Type: Dry, redispersible form, prepackaged with other dry ingredients.
2. Colors: As selected from manufacturers standards to match tile being grouted.

NOTE: Epoxy grout shall be used in all public rest rooms. Latex grout in public rest rooms is not allowed. All grout joints shall be made as small as possible.

2.4 MISCELLANEOUS MATERIALS

A. Sealants: 'Silicone sanitary sealant'.

B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.5 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions. Add materials and liquid latex additives in accurate proportions. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 PREINSTALLATION MEETING

A. Prior to the installation of tile, meet at the project site to review the material selections, substrate preparations, installation procedures, coordination with other trades, special details and conditions, standard of workmanship, and other pertinent topics related to the Work. The meeting shall include LAWA, the Architect of Record, the Contractor, tile installer, tile and setting material manufacturer's representatives, and representatives of other trades or subcontractors affected by the installation.

3.2 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present.

1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds. Grind concrete substrates to remove existing floor adhesive and mortar residues, films, sealing and curing compounds if they are determined to be present on the substrate.
2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with the Architect of Record.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

A. Remove paint, coatings, including curing compounds and other substances that are incompatible with tile-setting materials.

B. Blending: Color blend tiles at Project site before installing.

1. Furnish the same lots, batches, etc. within the same contiguous areas of the site (i.e. corridors on the same floors, common rooms which adjoin each other, etc.).

3.4 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials.

B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation".

C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area beginning at thresholds. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.

F. Movement (Expansion) Joints: Locate sealant filled expansion joints where recommended by the manufacturers of mortar and tile materials but not less than the requirements of TCA EJ171, and as accepted by the Architect of Record. Form movement joints and other sealant-filled joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Locate joints in tile surfaces directly above joints in concrete substrates.
2. Prepare joints and apply sealants.

NOTE: All control joints to be carried to the surface.

3.5 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and waterproofing manufacturer's written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.

1. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.6 FLOOR TILE INSTALLATION

A. Thinset Tile over Concrete Slabs (Typical): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for ANSI setting bed methods, TCA installation methods related to types of subfloor construction, and grout ANSI installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.

1. Mortar: Latex-Portland Cement Mortar: ANSI A108.5.

2. Concrete Subfloors, Interior: TCA F113.

   a. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturers recommendations.
   b. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
   c. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100% coverage to thickness of not less than 1/16-inch (1.5-mm).
   d. Place tiles onto mortar bed, maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using water. Rake out joints to depth required to receive grout as tile units are set.
   e. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.

3. Grout Installation, Latex-portland cement: ANSI A108.10.

B. Thinset Tile over Waterproof Membrane (*Toilet Rooms, Kitchens and any other wet areas, in addition to all concrete slabs on grade*): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for ANSI setting bed methods, TCA installation methods related to types of subfloor construction, and grout ANSI installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.

1. Mortar: Latex-Portland Cement Mortar: ANSI A108.5.

2. Concrete Subfloors, Interior: TCA F122.

   a. Apply the mortar to waterproofed slab with the flat side of the trowel.
   b. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturers recommendations.
   c. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.
   d. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100% coverage to thickness of not less than 1/16-inch (1.5-mm).
   e. Place tiles onto mortar bed, maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using water. Rake out joints to depth required to receive grout as tile units are set.
   f. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.

3. Grout Installation, Latex-portland cement: ANSI A108.10.

C. Mediumset Tile (Only where indicated): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for ANSI setting bed methods, TCA installation methods related to types of subfloor construction, and grout ANSI installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.

1. Mortar: Latex-Portland Cement Mortar: ANSI A108.5.

2. Concrete Subfloors, Interior: TCA F113 except apply medium set bed thickness.

   a. With a trowel, having notches sized as recommended by the mortar manufacturer, comb the surface of the mortar with the notched side of the trowel removing excess mortar. Spread only as much mortar as can be covered in the time limits established by the mortar manufacturers recommendations.
   b. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying mortar to tiles.

c. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile for 100% coverage to thickness of not less than 1/16-inch (1.5-mm).
d. Place tiles onto mortar bed, maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown. Exercise care to quickly remove spillage from faces of tile using water. Rake out joints to depth required to receive grout as tile units are set.
e. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.

3. Grout Installation: Latex-portland cement: ANSI A108.10.

D. Thickset Tile (Only where indicated): Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for ANSI setting bed methods, TCA installation methods related to types of subfloor construction, and grout ANSI installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.

1. Mortar and Bond Coat:

a. Latex-Portland Cement Mortar: ANSI A108.1A (Wet Set Method).

b. Latex-Portland Cement Bond Coat: ANSI A108.5.

2. Concrete Subfloors, Interior: TCA F121.

a. Apply ½ of the mortar bed to slab and place reinforcing wire fabric. After placing mesh, apply balance of mortar bed. The mortar shall be rodded and compacted with a steel trowel.
b. Wipe the back of each tile, with a damp sponge, to remove all dust or dirt immediately before applying bond coat to tiles
c. Immediately after wiping tile backs, but prior to placing tile, the mortar shall be troweled to back of tile sheets for 100% coverage to thickness of not less than 1/16-inch (1.5-mm)
d. Place tile onto the green mortar bed, maintaining 1/8-inch (3-mm) wide joints for typical tile units and 1/4-inch (6.35-mm) wide joints for quarry tile units if any, and true accurate pattern as shown. Tamp tile with wood block and rubber mallet to produce finish levels of tile matching adjacent tile surfaces. Beating shall take place prior to mortar taking and initial set. Exercise care to quickly remove spillage from faces of tile using water. Rake out joints to depth required to receive grout as tile units are set.
e. Prohibit foot and wheel traffic on tiled floors for period of time as recommended by the mortar manufacturer.

3. Grout Installation: Latex-portland cement: ANSI A108.10.

E. Stone Thresholds: Install stone thresholds in one piece, notched to fit neatly at door jambs; set in same type of setting bed as abutting field tile in accordance with TCA Method TR611.

3.7 WALL TILE INSTALLATION

A. Install in accordance with the mortar manufacturer's recommendations and requirements indicated below for ANSI setting bed methods, TCA installation methods related to types of construction, and grout ANSI installation methods and grout types. Where recommendations and methods conflict, the manufacturer's recommendations shall apply.

1. Latex Portland Cement Mortar Installation (using specified latex portland cement mortar material): ANSI A108.5.

2. Gypsum Wallboard, Interior (Latex Portland Cement Mortar) Method: TCA W243, place tiles maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown.

3. Cementitious Backerboard (Latex Portland Cement Mortar) Method: TCA W244, place tiles maintaining 1/8-inch (3-mm) wide joints, and true accurate pattern as shown.

4. Grout Installation: Latex-portland cement: ANSI A108.10.

3.8 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.

C. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

D. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

END OF SECTION 09 30 00

SECTION 09 51 13 – ACOUSTICAL PANEL CEILINGS

1.1 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each product indicated.

B. Coordination Drawings: Drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Ceiling suspension assembly members.
2. Method of attaching hangers and lateral bracing to building structure.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

C. Samples: For each acoustical panel, for each exposed suspension system member, and for each color and texture required.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Research/evaluation reports:

NOTE: Indicate LARR numbers on the drawings as a condition of plan check approval.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory.

B. Fire-Test-Response Characteristics:

1. Fire-Resistance Ratings: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Ratings are indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.

2. Surface-Burning Characteristics: Acoustical panels complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.

C. Seismic Standard: Comply with the following:
1. Los Angeles Department of Building and Safety Document requirements.

NOTE: Refer to LADBS document number P/BC 2008-40: Recommended Standards for Suspended Ceiling Assemblies. This document provides guidelines for designing and installing a suspended ceiling assembly and provides standard support configurations for typical conditions. This document can be found online at www.ladbs.org.

D. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.

1. Approved mockups are not to become part of the completed Work.

NOTE: The ceiling installing shall not installed until the installation mock up has been approved by LAWA.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

B. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Products: Subject to compliance with LAWA selection criteria and requirements,

2.2 GENERAL

C. Acoustical Panel Standard: Comply with ASTM E 1264.

1. Recycled Content: Provide acoustical panels with recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 70Insert number percent by weight.

D. Low-Emitting Materials: Acoustical tile ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the

Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Metal Suspension System Standard: Comply with ASTM C 635.

1. Recycled Content: Provide products made from steel sheet with average recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

F. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.

1. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

NOTE: The use of powder actuated fasteners is by **SPECIAL APPROVAL ONLY**. Prior to the use of these fasteners, the Contractor shall develop and present to LAWA, their procedures and protocol for using such equipment at LAX.

G. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

1. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106 inch diameter wire.

H. Rod Hangers: ASTM A 510, mild carbon steel.

1. Diameter: 1/4 inch.
2. Protective Coating: ASTM A 153/A 153M, hot-dip galvanized.

I. Seismic struts and seismic clips.

J. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch , a minimum 1/2 inch wide flange, and in depth indicated.

K. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.3 ACOUSTICAL PANELS

L. Products: Subject to compliance with requirements, provide one of the following:

1. Armstrong World Industries, Inc.
2. USG Corporation

2.4 METAL SUSPENESION SYSTEM

A. Products: Subject to compliance with requirements, provide one of the following:

1. Chicago Metallic Corporation

2.5 ACOUSTICAL SEALANT

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2.6 INSTALLATION

A. Per manufacturer's instructions and applicable codes.

END OF SECTION 09 51 13

SECTION 09 66 13 - PORTLAND CEMENT TERRAZZO FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Poured-in-place portland cement terrazzo flooring and base.

> **NOTE:** Some of the existing terrazzo installations at the airport are cementitious. In the event that one of these existing installations is required to be repaired or replaced, this guide specification section is to be utilized.

1.2 DEFINITIONS

A. Aggregate: Marble chips or other types of aggregate.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at LAX.

1. Review methods and procedures related to terrazzo including, but not limited to, the following:

   a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
   b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   c. Review special terrazzo designs and patterns.
   d. Review procedures for coping with unfavorable forecasted weather conditions.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:

1. Divider strips.
2. Control-joint strips.
3. Expansion-joint strips.
4. Accessory strips.
5. Abrasive strips.

6. Stair treads, risers, and landings.
7. Terrazzo patterns.

C. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

D. Samples for Initial Selection: NTMA color plates showing the full range of colors and patterns available for each terrazzo type.

E. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in size indicated below:

1. Terrazzo: 6-inch- (150-mm-) square Samples.
2. Accessories: 6-inch- (150-mm-) long Samples of each exposed strip item required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: .Engage an experienced Installer who is a current NTMA member in good standing and who has completed a minimum of 3 terrazzo installations similar in material and extent to that indicated for Project – as determined by LAWA – over the last 5 years and that have resulted in construction with a record of successful in-service performance.

> **NOTE:** A letter from the NTMA dated within 30 days of the bid, stating same, must be submitted with the bid. Any active investigations of contractor's work must be noted in this letter.

B. Material Certificates: For each type of terrazzo material or product, from manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For terrazzo to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An installer who is a contractor member of NTMA.

B. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for terrazzo including accessories.

    a. Size: Minimum 100 sq. ft. (9 sq. m) of typical poured-in-place flooring condition for each color and pattern in locations directed by LAWA.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless LAWA specifically approves such deviations in writing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with terrazzo installation only when forecasted weather conditions permit work to be performed according to NTMA's written recommendations.

B. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.

C. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.

B. FloorScore Compliance: Terrazzo floors shall comply with requirements of FloorScore Standard.

C. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 PORTLAND CEMENT TERRAZZO

A. Portland Cement Terrazzo System: Sand cushion.

1. Underbed: Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo system indicated for component proportions and mixing.
2. Topping: Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo system indicated for matrix and aggregate proportions and mixing.

    a. Terrazzo Topping Thickness: As required.
    b. Formulated Mix Color and Pattern: Insert NTMA color plate designation.
    c. Custom Mix Color and Pattern: Match existing.

B. Materials:

1. Portland Cement: ASTM C 150, Type 1.

    a. Color for Exposed Matrix: As required by mix indicated.

2. Water: Potable.
3. Sand: ASTM C 33/C 33M.
4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.

    a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.
    b. 24-Hour Absorption Rate: Less than 0.75 percent.
    c. Dust Content: Less than 1.0 percent by weight.

5. Matrix Pigments: Pure mineral or synthetic pigments, alkali resistant, durable under exposure to sunlight, and compatible with terrazzo matrix.
6. Bonding Agent: Neat portland cement, or epoxy or acrylic bonding agents formulated for use with topping indicated.
7. Underbed Reinforcement: Galvanized welded-wire reinforcement, wire 2 by 2 inches (51 by 51 mm) by 0.062 inch (1.57 mm) in diameter, complying with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.
8. Isolation Membrane: Polyethylene sheeting, ASTM D 2103, Type 13300, 4 mils (0.1 mm) thick; or unperforated asphalt felt, ASTM D 226, Type I (No. 15).

2.3 STRIP MATERIALS

A. Standard Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in substrate.

B. Heavy-Top Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in substrate.

C. Heavy-Top Angle Divider Strips: One-piece, L-type angle strips with anchoring device and in depth required for topping thickness indicated.

D. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.

E. Expansion-Joint Strips: Brass, with removable zip-strip top for installing sealant; minimum 1/2 inch (12.7 mm) wide.

F. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:

1. Base-bead strips for exposed top edge of terrazzo base.
2. Edge-bead strips for exposed edges of terrazzo.
3. Nosings for terrazzo stair treads and landings.

2.4 MISCELLANEOUS ACCESSORIES

A. Strip Adhesive: Recommended by manufacturer for this use.

1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Anchoring Devices:

1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.

C. Isolation and Expansion-Joint Material: Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, and non-outgassing in unruptured state; butyl rubber; rubber; minimum 1/2 inch (12.7 mm) wide.

D. Portland Cement Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on terrazzo type indicated.

E. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.

1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
2. Acid-Base Properties: With pH factor between 7 and 10.
3. Sealers shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

1. Roughen concrete substrates before installing terrazzo system according to NTMA's written recommendations.

B. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

1. Moisture Testing: Perform tests indicated below.

a. Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.

1) Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform not less than two tests in each installation area and with test areas evenly spaced in installation areas.

b. In-Situ Probe Test: Perform relative-humidity test using in-situ probes per ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative-humidity-level measurement.

c. Test Method: Test for moisture content by method recommended in writing by terrazzo manufacturer. Proceed with installation only after substrates pass testing.

C. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.

1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

3.3 INSTALLATION, GENERAL

A. Comply with NTMA's written recommendations for terrazzo and accessory installation.

B. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet (6.4 mm in 3 m); noncumulative.

C. Underbed:

1. Comply with NTMA's "Terrazzo Specifications and Design Guide" for underbed installation.
2. Cover entire surface to receive terrazzo with dusting of sand.
3. Install isolation membrane over sand, overlapping ends and edges a minimum of 3 inches (75 mm).
4. Install welded-wire reinforcement, overlapping at edges and ends at least two squares. Stop mesh a minimum of 1 inch (25 mm) short of expansion joints.
5. Place underbed and screed to elevation indicated below finished floor elevation.

D. Strip Materials:

1. Divider and Control-Joint Strips:

   a. Locate divider strips directly over control joints, breaks, and saw cuts in concrete slabs.
   b. Install control-joint strips back to back and directly above concrete-slab control joints.
   c. Install control-joint strips with 1/4-inch (6.4-mm) gap between strips, and install sealant in gap.
   d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.

2. Expansion-Joint Strips: Form expansion joints using divider strips and install directly above concrete-slab expansion joints.

> **NOTE:** All expansion and control joints within the existing concrete slab are to be carried through the terrazzo, to the finish surface.

3. Accessory Strips: Install as required to provide a complete installation.
4. Abrasive Strips: Install with surface of abrasive strip positioned 1/16 inch (1.6 mm) higher than terrazzo surface.

3.4 POURED-IN-PLACE TERRAZZO INSTALLATION

A. Pour in place and seed additional aggregates in matrix to uniformly distribute granular material and produce a surface with a minimum of 70 percent aggregate exposure. Cure and finish portland cement terrazzo according to NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.

B. Grinding: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.

3.5 REPAIR

A. Cut out and replace terrazzo areas that evidence lack of bond with substrate or underbed, including areas that emit a "hollow" sound if tapped. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by LAWA.

3.6 CLEANING AND PROTECTION

A. Terrazzo Cleaning:

1. Remove grinding dust from installation and adjacent areas.
2. Wash surfaces with cleaner immediately after final cleaning of terrazzo flooring according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 66 13

SECTION 09 66 23 – RESINOUS MATRIX TERRAZZO FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes resinous matrix (epoxy) terrazzo.

1.2 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For terrazzo installed on walkway surfaces, provide finished installation with the following values as determined by testing per ASTM C 1028:

1. Level Surfaces: Minimum 0.6.
2. Step Treads: Minimum 0.6.
3. Ramp Surfaces: Minimum 0.8.

1.3 SUBMITTALS

A. Product Data: Submit product data for each material indicated.

B. Shop Drawings: Submit shop drawings showing the extent of each terrazzo matrix, type, size and layout of divider strips, control joint strips, and edge strips

1. Indicate layout of abrasive strips at stair nosings.

2. Indicate layout of stair treads, risers and landings.

3. Large scale details of precast terrazzo jointing and edge conditions, including anchorage details.

C. Samples: Submit samples of each of the following items for each type, color, and pattern of terrazzo and accessory required and in size indicated below. Sample submittals shall be for color, pattern and texture only. Compliance with other requirements is the responsibility of the Contractor.

1. Epoxy Terrazzo: 6-inch- (150-mm-) square Samples.
2. Precast Epoxy Terrazzo Base: 12-inch- (300-mm-) long Samples.
3. Precast Epoxy Terrazzo Tread: 12-inch- (300-mm-) long Samples.
4. Precast Epoxy Terrazzo Riser: 12-inch- (300-mm-) long Samples.
5. Accessories: 6-inch- (150-mm-) long Samples of each exposed strip item required.

NOTE: With previous terrazzo installations at the airport, a minimum of three sample runs have been required in order to achieve the approved design.

D. Field Testing: Submit pre-installation relative humidity probe readings and pH testing for information only. Readings shall be prepared in accordance with ASTM F2170.

E. Maintenance Data: Submit copies of instructions for maintenance of each type of terrazzo.

F. Warranty: Submit sample copies of the mvt warranty to verify compliance with specification. Submit executed copies of epoxy terrazzo warranty as specified herein.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who is a current NTMA member in good standing and who has completed a minimum of 3 terrazzo installations similar in material and extent to that indicated for Project – as determined by LAWA – over the last 5 years and that have resulted in construction with a record of successful in-service performance.

> **NOTE:** A letter from the NTMA dated within 30 days of the bid, stating same, must be submitted with the bid. Any active investigations of contractor's work must be noted in this letter.

B. Standard: Except as modified by governing codes and by the Contract Documents, comply with applicable provisions and recommendations of the NTMA Terrazzo Information Guide Specification.

C. Sample Installations:

1. Following acceptance of samples, provide sample installations of the following where directed by the LAWA.

    a. Floors: Cast a typical module (minimum 10' x 10' ft.) of interior flooring including divider strips.

2. Sample installations shall be complete with all bedding, jointing, and sealants as shown in accordance with the final shop drawings. Sample installations shall be reviewed by the Architect for acceptance of terrazzo assemblies including jointing and workmanship. Replace unsatisfactory work as directed. Maintain sample installations during construction as a standard for judging acceptability of terrazzo work. Properly finished and maintained sample installations shall be retained as a portion of the completed work.

1.5 PROJECT CONDITIONS

A. Deliver materials, other than bulk materials, in manufacturer's unopened containers, fully identified with trade name, grade and color.

B. Store materials above grade, protected from the weather, soiling or damage from any source. Store in accordance with manufacturer's instructions.

C. Wrap precast units individually in polyethylene film or other nonstaining protective cover and mark each unit for proper identification of installed location.

1.6 PROTECTION

A. Protect terrazzo work throughout the construction period so that it will be without any indication of use or damage at the time of acceptance by LAWA.

1.7 WARRANTY

A. Manufacturer and installer shall supply to LAWA a three year Joint and Several Warranty from the date of substantial completion stating that the Moisture Vapor Barrier shall protect the epoxy terrazzo installation from moisture related blistering or disbondment and that in the event of defects related to moisture vapor transmission within the stipulated period, the manufacturer and installer shall jointly or severally effect all repairs or replacement necessary to remedy defects at the convenience of, and no cost to LAWA.

PART 2 - PRODUCTS

2.1 EPOXY TERRAZZO

A. Epoxy Terrazzo Material Products and Manufacturers: The epoxy resin terrazzo specifications are based on Terroxy Resin System by Terrazzo and Marble (T & M) Supply Companies.

1. The following terrazzo systems and manufacturers are capable of providing epoxy resin terrazzo flooring complying with the requirements of the Contract Documents.

   a. General Polymers; Thin-Set Epoxy Terrazzo #1100 Flooring System.

   b. Crossfield Products Corp., Dex-O-Tex Division; Dex-O-Tex Cheminert Terrazzo.

   c. Master Terrazzo Technologies, LLC; Morricite.

2. System Performance: The epoxy resin flooring system shall possess the following properties:

Compressive Strength, ASTM D695	10,000 psi
Water Absorption, ASTM D570	0.10 %
Tensile Strength, ASTM D638	3,000 psi
Flexural Strength, ASTM D790	4,500 psi
Adhesion, ACI 503R	350 psi, 100% concrete failure
Hardness, ASTM D2240	65-85 Shore D
Impact Resistance – MIL-D-3134, Sec. 4.7.3	Withstands 16 ft/lbs. no chipping, cracking, spalling or loss of adhesion.
Abrasion Resistance, ASTM D4060, CS 17 Wheel	70-90 milligrams lost
Slip Resistance	Meets ADA Standards

Critical Radiant Flux, ASTM D648	.90
Thermal coefficient of linear expansion, ASTM D696	25 x 10^{-6} in/in/ degree F.

B. Moisture Vapor Barrier: One of the following:

1. Barrier Primer; Terrazzo and Marble (T & M) Supply Companies.

2. FasTop MVT or AquArmorS; General Polymers.

C. Flexible Epoxy Membrane (Crack Bridging Membrane): 100% solids for crack preparation followed by full coverage application.

1. Products: One of the following:

   a. Isocrack Membrane; Terrazzo and Marble (T & M) Supply Companies.

   b. 3556 EPO-FLEX Flexible Epoxy Membrane; General Polymers.

2. System Performance: The flexible epoxy membrane shall possess the following properties:

Tensile Strength, ASTM D412	1,000-1,300 psi
Elongation at Break, ASTM D412	130-145%
Adhesion, ACI 503R	350 psi, 100% concrete failure
Hardness, ASTM D2240	23 Shore D
Thermal Cycling, ASTM C884 (24 hours, -21C to +25C	No Cracking
Flammability	Self-extinguishing over concrete
VOC	zero
The epoxy elastomer must be free of solvent, external plasticizers, coal tar, known carcino-gens, rubber compounds or nitrile butadienes	

D. Fabric Reinforcing: Fiberglass of type and manufacture recommended and acceptable to the matrix manufacturer.

1. FS38-4.4 Fiberglass Scrim; General Polymers.

E. Aggregates: Natural, sound, crushed stone chips, mother of pearl, glass, plastic, and metal filings with colors selected and graded to match Architect's samples, but with maximum size within limits of workability for terrazzo thickness indicated.

1. Sizes shall be **#1's** and **#0's only,** conforming with N.T.M.A. standards.

2. Abrasion and impact resistance shall not exceed 40% loss per ASTM C131.

3. 24 hour absorption rate not to exceed 0.75 percent.

4. Chips shall contain no deleterious or foreign matter.

5. Dust content less than 1% by weight.

6. Obtain and stockpile each aggregate material from a single source of consistent quality in appearance and physical properties for the entire project.

F. Epoxy Fill Mortar: 100% Solids fill mortar system including blended aggregate of a type recommended by the epoxy resin terrazzo manufacturer. One of the following:

1. Terroxy Fill; Terrazzo and Marble (T & M) Supply Companies.

2. 3520 Epoxy Terrazzo Matrix as the binder resin mixed with dry silica sand; General Polymers.

G. Finishing Grout: 100% solids resin-based grout with filler and pigments as recommended by matrix manufacturer. One of the following:

1. Terroxy Grout; Terrazzo and Marble (T & M) Supply Companies.

2. 3520 Epoxy Terrazzo Matrix with 5271 Terrazzo Grout Additive; General Polymers.

H. Substrate Primer: 100% solids, moisture insensitive, two-component resin recommended by matrix manufacturer. No solvent containing primers are allowed.

2.2 MIXES

A. Toppings: Adjust topping mixes as required to obtain LAWA's acceptance for each type, color, pattern and finish. Refer to the drawings and finish schedules for the extent of each topping and finish; the following topping mixes were used to develop the Architect's samples. The samples were prepared by and reflect sample controls numbers of using Terrazzo and Marble (T & M) Supply Companies terrazzo materials. Each precast terrazzo unit shall be composed of a single mix design prepared using the matrices specified, precast units consisting of a face mix and a backup mix shall not be permitted. Adjust Portland cement precast mixes, for bases, treads and riser units, as required to obtain LAWA's acceptance for matching the type, color, pattern and finish of the epoxy matrix type, color pattern and finish indicated on the drawings for the base, tread and riser units.

1. TR-01: Refer to Sample #1 in the Terrazzo Chart below.

2. TR-02: Refer to Sample #2 in the Terrazzo Chart below.

NOTE: A white field with dark aggregate will maintain a clear appearance longer. In a multi color design, a matrix with a repetition of aggregate is helpful in order to create a more unified appearance.

TERRAZZO CHART

Sample #1		**Chip Blend**		
Matrix Color	**Resin Color # & Fanfold**	**Aggregate**	**Size**	**%**
	Resin Color selected to match		0's	90
			0's	10
Sample #2		**Chip Blend**		
Matrix Color	**Color # & Fanfold**	**Aggregate**	**Size**	**%**
	Resin Color selected to match		1's & 0's	90
			1's, & 0's	10

B. Precast Terrazzo Base and Stair Tread/Riser Setting Beds:

1. Cement Setting Bed Mix: 226 Thick Bed Mortar Mix; Laticrete International Inc.

2. Liquid Latex Additives: Laticrete 3701 Liquid Latex Mortar Admix.

3. Mixing: Comply with the manufacturers printed recommendations for either machine or hand mixing of setting bed mixes.

   a. Mix 6 bags of cement setting bed mix to 1 pail (5 gal.) of liquid latex additive. Adjust quantity of liquid latex additive to bring the cement setting bed to the proper consistency for placing.

4. Welded Wire Fabric for Setting Bed Reinforcement at Metal Stair Risers and Treads: ASTM A185, 2 in. x 2 in. x 16 gage, galvanized.

C. Grout for Precast Items: Polymer-modified tile grout composed of ethylene vinyl acetate, in dry, redispersible form, prepackaged with other dry ingredients to which only water must be added at Project site, and complying with ANSI A118.6, custom colored to match adjacent precast terrazzo tile units.

NOTE: the mix design shall consist no more than 40% glass / mirror. Recycled glass is not permitted. All glass/mirror or aggregate shall be no larger than #1, (#0s and #1s only).

The Contractor shall also premix all terrazzo ingredients which are able to be combined prior to installation (Epoxy Part A and B and aggregate mixes). This premix process shall occur in a clean and neat factory or laboratory environment. Quantities should be carefully measured on certified/calibrated scales and mixing shall follow laboratory best practices. The resulting premixed ingredients shall then be packaged in clean, clearly labeled, hard sided containers in ratios whereby labor staff can combine in the field with no need to calculate or measure. LAWA or its authorized third party inspectors shall have continuous and unabated access to witness/inspect the factory/laboratory premix and packaging processes.

2.3 ACCESSORIES

A. Divider and Stop Strips: White alloy zinc, 1/8" in. thick x depth as indicated for terrazzo topping. Angle or "T" - types. Verify compatibility of divider and stop strips with resin supplier prior to ordering.

1. Control Joint Strips: Laminations of 16 gage zinc, back to back strips infilled with Flexible Epoxy Membrane pigmented to match resin color of epoxy terrazzo.

B. Cleaner: A neutral chemical cleaner, specially compounded for cleaning terrazzo of the types indicated, as recommended by the manufacturer of the cleaner with the following minimum characteristics.

1. Ph factor between 7 and 10.

2. Biodegradable and phosphate free.

3. Free form crystallizing salts or water soluble alkaline salts.

C. Floor Sealer: Waterbased, colorless, stain-resistant penetrating sealer with Ph factor between 7 and 10, that does not affect color or physical properties of terrazzo surface, and which will provide an anti-slip coefficient of friction of greater than 0.6.

D. Joint Sealants: Two-Part Polyurethane Sealant (Self Leveling), refer to Section 079200, JOINT SEALANTS.

E. Channels to receive abrasive inserts at Precast Stair Nosings: 16 gauge aluminum channel.

F. Abrasive Inserts: One line composition strips filled with 100 or finer carborundum, aluminum oxide or silicone carbide, black, mixed 4 parts to 1 with a binding material.

G. Reinforcing, Anchors and Fasteners for Precast Units:

1. Reinforcing for Treads and Risers: ASTM A615, grade as selected by fabricator. Reinforcing adjacent to the exposed surface of panels is to be positioned and firmly held in place by hangers, or other means without the use of form-contact bar supports.

2. Welded Wire Fabric for Treads and Risers: ASTM A185, 2 in. x 2 in. x 16 gage, galvanized.

3. Anchors and Fasteners: All anchors, clips, shapes, fasteners, dowels, cramps, and accessories for erecting precast terrazzo units shall be galvanized steel devices of grade, type, size and number required to attach precast terrazzo to supporting stair substrates.

H. Precast Portland Cement Terrazzo Base, Tread and Riser Materials (To be used when proposing Alternate):

1. Portland Cement: ASTM C150, Type I, nonair entraining, nonstaining white and gray as required to match Architect's epoxy terrazzo samples. Obtain cement from a single source for all work of one color.

2. Sand: ASTM C33 for fine aggregates as required to match Architect's epoxy terrazzo samples.

3. Water: Fresh, clean and potable.

4. Aggregates, Glass, Plastic and Shell Materials: As required to match Architect's epoxy terrazzo samples.

5. Pigments: Pure mineral pigments, resistant to alkalies, nonfading and weatherproof, colors as required to match Architect's epoxy terrazzo samples.

NOTE: LAWA is currently using Tesco crystal sealer #2, applied with a diamond pad for existing terrazzo installations.

2.4 PRECAST UNIT FABRICATION

A. Precast Terrazzo Bases: Fabricate precast terrazzo bases from epoxy terrazzo materials to the sizes, shapes and profiles shown and from the terrazzo mix(es) indicated.

1. The minimum thickness of the precast terrazzo base shall be ½".

2. Forms: Construct forms of non-staining metal, fiberglass reinforced polyester, plywood, or other acceptable material. Fabricate and reinforce forms for close control of dimensions and details. Construct forms tightly to prevent leakage of mixes. Form joints will not be permitted on faces exposed to view in the finished work.

3. Mixing and Placing: Mix terrazzo mixes to distribute fine and coarse aggregate evenly throughout. Place terrazzo so as to prevent segregation in the forms.

4. Curing: Allow units to cure.

5. Casting Tolerances: As required to achieve installation tolerances. Units which have bowed, warped, or curled shall not be acceptable.

B. Precast Terrazzo Treads and Risers: Fabricate precast terrazzo treads and risers from epoxy terrazzo materials to the sizes, shapes and profiles shown to match the epoxy terrazzo mix indicated for treads and risers.

1. The minimum thickness of the precast terrazzo stairs and treads shall be 1-1/2". Provide 2 lines of abrasive insert at stair tread nosing.

2. Forms: Construct forms of non-staining metal, fiberglass reinforced polyester, plywood, or other acceptable material. Fabricate and reinforce forms for close control of dimensions and details. Construct forms tightly to prevent leakage of mixes. Form joints will not be permitted on faces exposed to view in the finished work.

3. Reinforcement: Place welded wire and reinforcing bars of size and spacings as required to resist shrinkage, temperature and handling stresses. Support and space reinforcement using devices to ensure that it will remain positioned in the precast terrazzo units as required. Keep reinforcement from the edges and surfaces of the units.

4. Mixing and Placing: Mix terrazzo mixes to distribute fine and coarse aggregate evenly throughout. Place terrazzo so as to prevent segregation in the forms.

5. Curing: Allow units to cure.

6. Casting Tolerances: As required to achieve installation tolerances. Units which have bowed, warped, or curled shall not be acceptable.

C. Surface Treatment:

1. Finish surfaces exposed to view to match accepted samples in all respects. Provide smooth joints and square edges.

2. Finish: Allow terrazzo to obtain sufficient strength prior to grinding and as required to withstand handling stresses and to produce a terrazzo finish consistent with the accepted samples. Protect corners and edges to preserve uniform, straight arrisses and corners. Grind in a continuous operation, using grinding equipment to achieve a uniform appearance. Do not change equipment, materials, procedure or operating personnel during the course of the grinding work for the entire Project. Discard and replace terrazzo units which develop any irregular penetration or appearance, or swirl marks as a result of grinding. Select type of grit gradation(s) and speed of operation to achieve the following:

a. Match finish of cast in place epoxy terrazzo as specified under Part 3 – Execution below.

3. Abrasive Inserts for Stair Treads:

a. Carefully mask terrazzo on either side of abrasive channel to protect finished terrazzo.

b. Clean all foreign matter from channel.

c. Trowel abrasive mix into channel with finished elevation approximately 1/16" above terrazzo tread.

d. After abrasive mix has set, remove masking material and allow to cure.

PART 3 - EXECUTION

3.1 CONDITION OF SURFACES

A. Examine the substrates and adjoining construction and the conditions under which the Work is to be installed. Do not proceed with the Work until unsatisfactory conditions have been corrected. Examine areas to receive terrazzo for:

1. Defects in existing work that affect proper execution of terrazzo work.

2. Deviations beyond allowable tolerances for the concrete slab work. The substrate shall not exceed ¼” in a 10’-0” span. When placing a 10 foot straightedge anywhere on the substrate, at no point shall the gap between the straightedge and the substrate exceed ¼”.

3. Ensure that the building expansion joints in the floor area are raised or lowered to actual finish elevation of terrazzo.

4. Ensure that drains in installation area are functional and raised or lowered to actual finish elevation of terrazzo.

3.2 PREPARATION

A. General: Comply with NTMA specifications and recommendations, unless otherwise shown or specified for preparation of substrate.

B. Substrates to Receive Epoxy Terrazzo: After the removal of existing floor coverings in areas to receive the terrazzo work, and before the terrazzo flooring installation, visit the jobsite to evaluate substrate condition.The evaluation shall include a determination of the suitableness of the substrate to receive the epoxy terrazzo materials and to test for moisture and alkalinity of the substrate. Test for moisture by relative humidity probe and digital meter method according to ASTM F 2170 "Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-situ Probes" and the probe manufactures instructions. Use a minimum of 1 probe for every 5,000 s.f. of surface to receive terrazzo flooring. Proceed with the epoxy floor system installation only after substrates have a maximum relative-humidity-measurement reading of 75 percent in 24 hours. If the pH of the slab is 10 or lower, notify the manufacturer for preparations required to ensure a good bond.

1. Probe Manufacturer: A relative humidity probe kit and manufacturer known to comply with the requirements includes "The Rapid RH Probe" manufactured by Wagner Electronic Products, Inc., Rogue River, OR. (800) 207-2164 (v).

C. Surface Treatment:

1. Prepare slab substrates, (*including any existing cementitious terrazzo*) to "open" surface pores by means of light scarification, medium shot blast or medium scarification with a vacuum unit. Surface preparation results shall achieve a minimum Concrete Surface Profile (CSP) of 5 according to International Concrete Repair Institute Guideline No. 03732. Remove all contaminating or bond breaking substances including but not limited to dust, laitance, curing compounds, coatings, sealers, oil, grease, existing floor covering adhesives and mastics. All oil or grease not removed by scarification or blasting shall be removed by either detergent scrubbing with heavy duty cleaner/degreaser, low pressure water cleaning, steam cleaning, or chemical cleaning methods in accordance with the manufacturers written instructions. All spalled or deteriorated slab surfaces shall be mechanically removed by scabbling or chipping hammers. Acid etching is not acceptable.

NOTE: Many of the existing sub-floor areas of the existing Terminals are not level and require extensive floor prep. All existing finishes such as but not limited to Fritztile are to be removed from the concrete slab.

2. Apply moisture vapor barrier across the entire area to receive the epoxy terrazzo in accordance with the manufacturers recommendations.

3. Repair or level damaged slab surfaces with epoxy fill mortar. Latex fills or self leveling underlayments are not acceptable.

4. Flexible Epoxy Membrane (Crack Bridging Membrane) Placement:

   a. Install flexible epoxy membrane at 40 mils thickness over the moisture vapor barrier and embed fabric reinforcement. Follow the specific recommendations of the flooring manufacturer for detailing at terminations, construction control joints, construction joints, building columns, and base conditions. Thoroughly mix flexible epoxy membrane and apply to prepared moisture vapor coated slab substrates according to manufacturer’s instructions. Allow membrane to level until no ridges are showing.

5. Cracks and non-expansion joints greater than 1/16" wide after surface preparation shall be prepared until sound and treated with membrane materials in accordance with the instructions of the epoxy terrazzo manufacturer and as follows. Allow in base bid for above crack detailing as follows - 5% of lineal footage of total project square footage for combined Type 1 & 2, and 3% of lineal footage of Type 3. (i.e., a 10,000 sq ft project would allow for a combined 500 lineal feet of Type 1 & 2 repairs and 300 lineal feet of Type 3 repairs.

a. Type 1 Crack Detailing: Hairline cracks shall receive detail coat of epoxy primer with 6" fabric reinforcement.

b. Type 2 Crack Detailing Fill cracks greater than hairline but less than 1/16" wide after surface preparation with neat, epoxy membrane. Place detail coat of epoxy membrane over crack and embed 12" fiberglass cloth. Lightly abrade or solvent wipe treated cracks prior to applying primer.

c. Type 3 Crack Detailing Fill cracks greater than 1/16" with flexible epoxy membrane. Place 25-30 mil detail coat so that flexible epoxy membrane extends at least 9" to 12" on each side of crack or joint. After flexible epoxy membrane has leveled, lay precut reinforcing fabric into wet membrane. Smooth cloth with a flat steel trowel, allowing cloth to be encapsulated but remain exposed on the surface of flexible epoxy membrane. Lightly abrade or solvent wipe treated cracks prior to applying primer.

NOTE: For the floor leveling purposes, the Bid cost for Epoxy Terrazzo shall include the price for installing a 5/8" minimum epoxy sand level.

3.3 INSTALLATION

A. General: Comply with NTMA specifications and recommendations, unless otherwise shown or specified for installation of strips, placing, curing, grinding, and finishing of terrazzo. Make provisions for protecting adjacent work from terrazzo placement and finishing.

1. Extend terrazzo work into recesses and under equipment in the spaces shown or scheduled to receive terrazzo. Form a complete covering without interruptions or seams, except provide divider strips where shown. Place and finish terrazzo uniformly and neatly around obstructions so as to achieve continuous color, pattern and finish throughout the Work.

2. Complete terrazzo work prior to contiguous work which might be damaged by water or other materials used.

B. Epoxy Terrazzo:

1. Control Joints, Stop Strips and Divider Strips:

a. Control Joints: Place back to back angle divider strips **directly over concrete control joints** leaving a space appropriate for anticipated movement – typically 1/4" – 3/8". Fill gap between control joints with divider strip joint sealant. If flexible membrane was placed greater than 72 hours before placement of epoxy terrazzo, solvent wipe completely prior to installing epoxy primer and terrazzo.

NOTE: All control joints to be carried to the surface.

b. Stop Strips: Install stop strips at perimeter of epoxy terrazzo flooring fields. Adhere stop strips with substrate primer – do not fasten to concrete. If flexible membrane was placed greater than 72 hours before placement of epoxy terrazzo, solvent wipe completely prior to installing epoxy primer and terrazzo.

c. Divider Strips: Place divider strips directly over concrete where indicated on the drawings. Adhere divider strips with substrate primer – do not fasten to concrete. If flexible membrane was placed greater than 72 hours before placement of epoxy terrazzo, solvent wipe completely prior to installing epoxy primer and terrazzo.

NOTE: All pours to be to the divider strips. Phased pours in areas within the divider strips shall not be allowed unless directed otherwise by LAWA. The leg of the divider strip shall be fully bonded to the slab. When two divider strips are joined, the ends shall touch and align.

2. Placing Epoxy Terrazzo:

a. Clean and prepare substrate to comply with NTMA specifications for type of terrazzo application indicated. Clean substrate of loose chips and foreign matter.

b. Priming: Apply epoxy primer evenly over prepared flexible membrane at the rate of 200-300 square feet per gallon, to thoroughly wet surface, but avoiding "ponding" the material.

c. For thinset terrazzo topping, comply with resin manufacturer's recommendations for proportioning mixes.

d. Comply with NTMA guide specifications previously referenced under "Thin-Set Terrazzo Materials" and with matrix manufacturer's directions for installing thin-set terrazzo. Match Architect's samples and provide total material thickness of not less than 3/8”. Allow cure per manufacturer's recommendations prior to grinding operations.

3. Grinding: Exercise extreme care to ensure fluids from grinding operation do not react with dividers and strips to produce a stain on aggregate. Delay grinding until heavy trade work is completed and construction traffic through the area is restricted.

a. Rough Grinding: Grind with 24 or finer grit stones or with comparable diamond plates.

b. Intermediate Grinding: Follow initial grind with 80 or finer grit stones.

c. Grouting: Cleanse floor with clean water and rinse thoroughly. Remove excess rinse water by wet vacuum and machine until completely dry. Apply epoxy grout to fill voids.

d. Fine Grinding: Grind with **120** or finer grit stones until all grout is removed from surface. Upon completion terrazzo shall show a minimum of 70% to 75% of marble chips.

C. Precast Terrazzo:

1. Preparation: Clean precast terrazzo surfaces which have become dirty or stained prior to setting to remove soil, stains and foreign materials. Clean precast terrazzo by thoroughly scrubbing with fiber brushes followed by a thorough drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh filler or abrasives.

2. Installation, General:

   a. Employ only skilled and experienced workmen to install the precast terrazzo work. Use carborundum or diamond tipped power saws to cut precast terrazzo units which need to be fitted to existing field conditions.

   b. Set precast terrazzo units to comply with requirements indicated on drawings and final shop drawings. Install anchors, supports, fasteners and other attachments indicated or necessary to secure precast terrazzo work in place. Shim and adjust anchors, supports and accessories to set precast terrazzo work accurately in locations indicated with uniform joints of widths indicated and with edges and faces aligned.

   c. Installation Tolerances:

      1) Joint Widths: +/- 1/16".

      2) Variation from Plumb: +/- 1/16".

      3) Variation from Level: +/- 1/8" in 20', non-cumulative.

      4) Piece Alignments (Edge to Edge): +/- 1/32”.

3. Installation of Wall Base: Install base where indicated, after placing floors, and in accordance with NTMA, and the applicable provisions of TCA W243 and ANSI A108.5. Tamp units into setting bed to achieve a full bond without voids. Level units at joints. Grind at joints to remove any minor discrepancies in level of units. Replace warped, stained, damaged and non-matching units as directed. Grout joints, except those shown to receive sealant or divider strips, with a mixture of Portland cement, pigment and water, matching the matrix of the unit being grouted.

4. Installation of Stair Tread/Risers: Place setting bed on steel pan and poured in place concrete type stairs where shown and in accordance with NTMA, and the applicable provisions of TCA S151 Method F111 (for steel pan stairs) and Methods F112 and W211 (for concrete stairs) and ANSI A108.1A. Tamp units into setting bed to achieve a full bond without voids. Level units at joints. Grind at joints to remove any minor discrepancies in level of units. Replace warped, stained, damaged and non-matching units as directed. Grout joints, except those shown to receive sealant or divider strips, with a mixture of Portland cement, pigment and water, matching the matrix of the units being grouted.

3.4 CLEANING, SEALING AND PROTECTION

A. Clean terrazzo after installing and grinding operations are completed by thoroughly washing all terrazzo surfaces with a neutral cleaner. Rinse with clean water and allow surface to dry

thoroughly. Apply sealer in two coats at the coverage rate of 500 square feet per gallon per coat in compliance with sealer manufacturer's instructions. Protect terrazzo from damage and wear during construction operations.

END OF SECTION 09 66 23

SECTION 09 68 13 – TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes carpet tile.

1.2 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. The Carpet and Rug Institute "The Carpet Specifiers' Handbook."

2. The Carpet and Rug Institute "CRI 104 Commercial Carpet Installation Standard."

1.3 SUBMITTALS

A. Product Data: Submit product data, specifications, installation instructions for materials specified herein and other data as may be required to show compliance with the Contract Documents. Include installation recommendations for each type of substrate required.

B. Shop Drawings: Submit shop drawings showing the following:

1. Existing floor materials to be removed.
2. Existing floor materials to remain.
3. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
4. Carpet tile type, color, and dye lot.
5. Type of subfloor.
6. Type of installation.
7. Pattern of installation, carpet locations, direction, and starting points per floor.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Pile direction.
11. Transition and other accessory strips.
12. Transition details to other flooring materials.

C. Samples: Submit samples showing full range of color, texture, and pattern variations expected. Prepare samples from same material to be used for the Work. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules. Submit the following:

1. Carpet Tile: Full-size Samples.
2. Exposed Edge Stripping and Accessory: 12-inch- (300-mm-) long Samples.

D. Maintenance Data: Submit copies of instructions for care, cleaning, maintenance and repair of carpeting.

1. Each carpet manufacturer shall meet with the authorized LAWA personnel, to review the characteristics of his product and to recommend appropriate maintenance procedures, prior to occupancy of the finished spaces.

E. Warranty: Submit special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage a carpet installer, who has completed a minimum of three (3) projects over the last 10 years which were similar in material, design and extent to that indicated for the project - as determined by the LAWA – and which have resulted in construction with a record of successful in service performance.

1. In the case where the Installer is actually a Dealer, it is understood that the terms Installer, Dealer, Carpeting Contractor and Contractor shall be one and the same for purposes of this Contract. He shall assume responsibility for all of the work, including acquisition of the materials from the manufacturers herein specified.

B. Mill Inspection: The carpeting may be inspected to determine compliance with the Contract Documents with respect to manufacture, materials, pattern and colors. Inspection may be made at the mill by a representative of LAWA at any time during the process of manufacture.

C. Sample Installations: Before installing carpet, install sample installation, for each type of carpet installation required to demonstrate aesthetic effects and qualities of materials and execution. Install sample installations to comply with the following requirements, using materials indicated for the completed Work:

1. Size and Location: Provide 250 square foot (23.23 sq.m) sample installation in location as directed by LAWA.

2. Demonstrate the proposed range of aesthetic effects and workmanship.

3. Obtain LAWA's approval of sample installations before starting work.

4. Maintain sample installations during construction in an undisturbed condition as a standard for judging the completed Work.

5. Approved sample installations may become part of the completed Work if undamaged at time of Substantial Completion.

NOTE: The contractor shall not proceed with installation until the required mock up has been approved by LAWA.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver carpeting in original mill protective wrapping with mill register numbers and tags attached.

B. Deliver other materials in manufacturers unopened containers identified with name, brand, type, grade, class, and other qualifying information.

C. Store materials in a dry location, in such a manner as to prevent damage.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install carpet tile until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Do not install carpet tile over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.7 WARRANTY

A. Carpet Manufacturer's Warranty: Written warranty, signed by carpet tile manufacturer agreeing to replace carpet tile that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, wear, static buildup in excess of 3.0 kV when tested under the Standard Shuffle Test at 70 deg. F (21 deg. C) and 20% RH, edge raveling without seam sealers, tuft bind loss, zippering (wet or dry), shrinkage, curling, doming, snags, runs, and delamination. Warrantees shall be full term, not pro-rated for the specified warranty period.

1. Warranty Period: 10 years.

1.8 EXTRA MATERIALS AND ATTIC STOCK

A. Attic Stock: Package and deliver usable remnants of carpet to LAWA at the conclusion of the job. Include any uncut carpet tiles.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Carpet Tile Types: Provide manufacturers commercial grade carpet tile for a 100% glue down installation.

B. Provide carpet tile by one of the following:
1. Interface
2. Lees / Mohawk Industries
3. Milliken
4. Mannington
5. Shaw

C. Fiber Content: **Nylon 6,6.**

D. Pile Characteristics: **No Over-Tufting.**

E. Dye Process: **Solution-dye** or **injection-dye is required.**

F. Density: Greater than 7000.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Portland cement-based formulation provided by or recommended by carpet tile manufacturer. Do not use gypsum based compounds.

B. Carpet Adhesives: Water-resistant, mildew resistant, and nonstaining, high solids, low VOC emitting formulations that are specifically recommended by the carpet manufacturer, as verified through compatibility and adhesion testing for the intended substrate and application, and that comply with flammability requirements for installed carpet.

C. Carpet Edging: Provide rubber composition carpet edging in single lengths wherever possible, keeping the number of joints or splices to a minimum. Provide in quantities and locations as job required based upon the recommended good practice of the industry; include in every location where carpet terminates and other flooring continues. Color to match adjacent carpet types.

D. Floor Sealer: Type as recommended and manufactured by the carpet tile manufacturer for the applications indicated.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION MEETING

A. Prior to the installation, meet at the project site to review the material selections, substrate preparations, installation procedures, coordination with other trades, special details and conditions, standard of workmanship, and other pertinent topics related to the Work. The meeting shall include LAWA, the Architect of Record, the Contractor, the installer, material manufacturer's representatives, and representatives of other trades or subcontractors affected by the installation.

3.2 PREPARATION

A. Coordinate the installation of carpet so as not to delay the occupancy of the site or interfere with the completion of construction.

B. Examine the substrates, adjoining construction and the conditions under which the Work is to be installed. Verify recommended limits for moisture content and alkalinity of concrete substrates with carpet manufacturer.

1. Moisture Content: Verify moisture content using a standard calcium chloride crystal test or a 1 square yard (0.84 sq.m) clear plastic test. Perform testing at a frequency as recommended by the carpet manufacturer. Perform testing at a frequency of not less than once every 1,000 square feet (93 sq.m).

2. Alkalinity Test: Verify alkalinity of concrete substrates by drilling a 3/8 inch (9.5 mm) diameter hole approximately 1/4 inch (6.35 mm) deep, remove all residue; fill with distilled water, allow water to stand 3 minutes and test with a calibrated electronic meter

or Ph paper. Perform testing at a frequency of not less than once every 1,000 square feet (93 sq.m).

3. Alternative test procedures for moisture content and alkalinity may be acceptable subject to the carpet manufacturer's review and written acceptance.

C. Concrete Subfloors: Verify that concrete slabs comply with the following:

1. Remove coatings, including curing compounds, existing floor covering adhesive residues, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by the carpet manufacturer.

2. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the carpet manufacturer.

3. Use leveling and patching compounds recommended by flooring manufacturer for filling cracks, holes and depressions in the substrate. Surface shall be smooth, level and at proper elevation. Remove ridges, roughness and protrusions from concrete surfaces by grinding.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

E. Carpet installation shall not commence until painting and finishing work are complete and ceiling and overhead work is tested, approved, and completed.

F. Proceed with installation only after unsatisfactory conditions have been corrected

3.3 INSTALLATION

A. General: Comply with the manufacturer's instructions, specified industry standards and recommendations, and as required to match the accepted sample installations. Apply adhesive in accordance with adhesive manufacturer's directions.

B. Adhere all full size, perimeter tiles, and cut tiles, with a full spread of adhesive. Dry fit cut tiles and apply adhesive to tile back after tile has been cut. Use full uncut tiles down the center of corridors and, where necessary, cut perimeter tiles to butt walls.

1. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

2. Cut openings in carpet for electrical outlets, piping and other penetrations. Maintain close tolerances so that edges of carpet will be covered by plates and escutcheons.

3. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

C. Butt carpet tile tightly together to form seams without gaps or entrapped pile yarns and aligned with adjoining tiles.

D. Edge Strip Installation: Install edge strip at every location where edge of carpet is exposed to traffic, unless otherwise indicated. Unless otherwise directed by the Architect of Record, install in single lengths and secure in accordance with manufacturer's directions.

E. Traffic over adhesive installations shall be restricted until adhesive has properly cured in accordance with the adhesive manufacturers recommendations.

3.4 CLEANING AND PROTECTION

A. Cleaning: As the carpeting is installed, remove and dispose of all trimmings, excess pieces of carpeting and laying materials from each area as it is completed. Vacuum carpeting with a commercial vacuum, having a cylindrical brush or beater bar and high suction. Remove adhesives, stains, and soil spots in accordance with the carpet manufacturer's recommendations.

B. Protection: Protect carpeting against damage of every kind as damaged carpeting shall be rejected. Use non-staining cover material for protection. Tape joints of protective covering.

1. Plastic and polyethylene sheet protective coverings shall not be permitted.

2. Remove and replace rejected carpeting with new carpeting. At the completion of the work, remove covering, vacuum clean carpeting and remove soiling and stains (if any) to the satisfaction of LAWA.

END OF SECTION 09 68 13

SECTION 09 68 16 – SHEET CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes broadloom carpet.

1.2 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. The Carpet and Rug Institute "The Carpet Specifiers' Handbook."

2. The Carpet and Rug Institute "CRI 104 Commercial Carpet Installation Standard."

1.3 SUBMITTALS

A. Product Data: Submit product data, specifications, installation instructions for materials specified herein and other data as may be required to show compliance with the Contract Documents. Include installation recommendations for each type of substrate required.

B. Shop Drawings: Submit shop drawings showing the following:

1. Existing floor materials to be removed.
2. Existing floor materials to remain.
3. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
4. Dye lots, pattern types, repeats, locations, pile direction, and starting points per floor.
5. Seam locations, types, and methods.
6. Type of installation.
7. Type, color, and location of insets and borders.
8. Type, color, and location of edge, transition, and other accessory strips.
9. Show details of cutouts.
10. Type of cushion.
11. Include on shop drawings dimensions which verify field conditions.
12. Transition, and other accessory strips.
13. Transition details to other flooring materials.

C. Samples: Submit samples showing full range of color, texture, and pattern variations expected. Prepare samples from same material to be used for the Work. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules. Submit the following:

1. Carpet: 24-inch- (600-mm-) square Samples of each carpet required.
2. Exposed Edge Stripping and Accessory: 12-inch- (300-mm-) long Samples.
3. Carpet Cushion: 6-inch- (150-mm-) square Sample.

4. Mitered Carpet Border Seam: 12-inch- (300-mm-) square Sample. Show carpet pattern alignment.

D. Maintenance Data: Submit copies of instructions for care, cleaning, maintenance and repair of carpeting.

1. Each carpet manufacturer shall meet with the authorized LAWA personnel, to review the characteristics of their product and to recommend appropriate maintenance procedures, prior to occupancy of the finished spaces.

E. Warranties: Submit special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage a carpet installer, who has completed a minimum of three (3) projects over the last 10 years which were similar in material, design and extent to that indicated for the project - as determined by LAWA – and which have resulted in construction with a record of successful in service performance.

1. In the case where the Installer is actually a Dealer, it is understood that the terms Installer, Dealer, Carpeting Contractor and Contractor shall be one and the same for purposes of this Contract. He shall assume responsibility for all of the work, including acquisition of the materials from the manufacturers herein specified.

B. Mill Inspection: The carpeting may be inspected to determine compliance with the Contract Documents with respect to manufacture, materials, pattern and colors. Inspection may be made at the mill by a representative of LAWA at any time during the process of manufacture.

C. Sample Installations: Before installing carpet, install sample installations for each type of carpet installation required to demonstrate aesthetic effects and qualities of materials and execution. Install sample installations to comply with the following requirements, using materials indicated for the completed Work:

1. Size and Location: Provide 250 square foot (23.23 sq.m) sample installations in locations as directed by LAWA. Subdivide the sample installation with one continuous seam of the type specified.

2. Demonstrate the proposed range of aesthetic effects and workmanship.

3. Obtain LAWA's approval of sample installations before starting work.

4. Maintain sample installations during construction in an undisturbed condition as a standard for judging the completed Work.

5. Approved sample installations may become part of the completed Work if undamaged at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver carpeting in original mill protective wrapping with mill register numbers and tags attached.

B. Deliver other materials in manufacturers unopened containers identified with name, brand, type, grade, class, and other qualifying information.

C. Store materials in a dry location, in such a manner as to prevent damage.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use. Stack rolls horizontally no higher than two high on a flat surface.

B. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

1.7 WARRANTY

A. Carpet Manufacturer's Warranty: Written warranty, signed by carpet manufacturer agreeing to replace carpet that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, wear, static buildup in excess of 3.0 kV when tested under the Standard Shuffle Test at 70 deg. F (21 deg. C) and 20% RH, edge raveling, tuft bind loss, shrinkage, zippering (wet or dry), and delamination. Warrantees shall be full term, not pro-rated for the specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS AND ATTIC STOCK

A. Attic Stock: Package and deliver usable remnants of carpet to a storage room as directed by LAWA at the conclusion of the job. Include pieces of broadloom 20 square feet (1.86 sq.m) in area or greater.

PART 2 - PRODUCTS

2.1 CARPET

A. Carpet Types: Provide manufacturers commercial grade broadloom carpet for **100% glue down** installation.

B. Provide carpet tile by one of the following:
1. Interface
2. Lees / Mohawk Industries
3. Milliken

4. Mannington
5. Shaw

C. Fiber Content: **Nylon 6,6.**

D. Pile Characteristics: **No Over-Tufting.**

E. Dye Process: **Solution-dye** or **injection-dye is required.**

F. Density: Greater than 7000.

2.2 CARPET CUSHION

A. Product as recommended in writing by the carpet manufacturer for the application indicated and which will not void the specified warranties, (*if required*).

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Portland cement based formulation provided by or recommended by the following. Do not use gypsum based compounds.

1. Carpet manufacturer.
2. Carpet cushion manufacturer.

B. Carpet Adhesives: Water-resistant, mildew resistant, and nonstaining, high solids, low VOC emitting formulations that are specifically recommended by the carpet manufacturer, as verified through compatibility and adhesion testing for the intended substrate and application, and that comply with flammability requirements for installed carpet:

C. Tackless Carpet Stripping (Stretch-In Installations): Water-resistant plywood in minimum 1 inch (25 mm) wide strips, thickness to match cushion thickness, with minimum 3 rows of prenailed angular pins protruding from the top designed to grip and hold stretched carpet at backing.

D. Plastic Coated Fabric Tape (Stretch-In and Double Stick Broadloom Cushion Installations): Woven fabric impregnated with plastic and coated with adhesive having high-tack adhesion forming a secure bond for application to cushion top seams to resist peaking. Provide water-resistant plastic-coated tape which will unwind without adhesive transfer.

E. Seaming Tape: Hot melt adhesive tape, 6" wide, recommended by the carpet mill as suitable for backing specified.

F. Seaming Cement: Water-resistant and flame-resistant carpet adhesive for sealing raw edges, seaming, reinforcing seams and patching. Provide fast drying, easy spreading carpet seaming adhesive having excellent aging characteristics recommended by the carpet manufacturer.

G. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

H. Carpet Edging: Provide rubber composition carpet edging in single lengths wherever possible, keeping the number of joints or splices to a minimum. Provide in quantities and locations as job

required based upon the recommended good practice of the industry; include in every location where carpet terminates and other flooring continues. Color to match adjacent carpet types.

I. Floor Sealer: Type as recommended and manufactured by the carpet manufacturer for the applications indicated.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION MEETING

A. Prior to the installation, meet at the project site to review the material selections, substrate preparations, installation procedures, coordination with other trades, special details and conditions, standard of workmanship, and other pertinent topics related to the Work. The meeting shall include the LAWA, the Architect of Record, the Contractor, the installer, material manufacturer's representatives, and representatives of other trades or subcontractors affected by the installation.

3.2 PREPARATION

A. Coordinate the installation of carpet so as not to delay the occupancy of the site or interfere with the completion of construction.

B. Examine the substrates, adjoining construction and the conditions under which the Work is to be installed. Verify recommended limits for moisture content and alkalinity of concrete substrates with carpet manufacturer.

1. Moisture Content: Verify moisture content using a standard calcium chloride crystal test or a 1 square yard (0.84 sq.m) clear plastic test. Perform testing at a frequency of not less than once every 1,000 square feet (93 sq.m).

2. Alkalinity Test: Verify alkalinity of concrete substrates by drilling a 3/8 inch (9.5 mm) diameter hole approximately 1/4 inch (6.35 mm) deep, remove all residue; fill with distilled water, allow water to stand 3 minutes and test with a calibrated electronic meter or Ph paper. Perform testing at a frequency of not less than once every 1,000 square feet (93 sq.m).

3. Alternative test procedures for moisture content and alkalinity may be acceptable subject to the carpet manufacturer’s review and written acceptance.

C. Concrete Subfloors: Verify that concrete slabs comply with the following:

1. Remove coatings, including curing compounds, existing floor covering adhesive residues, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by the carpet manufacturer.

2. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness

characteristics by performing bond and moisture tests recommended by the carpet manufacturer.

3. Use leveling and patching compounds recommended by flooring manufacturer for filling cracks, holes and depressions in the substrate. Surface shall be smooth, level and at proper elevation. Remove ridges, roughness and protrusions from concrete surfaces by grinding.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

E. Carpet installation shall not commence until painting and finishing work are complete and ceiling and overhead work is tested, approved, and completed.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. 100% Direct Glue Down of Broadloom Carpet: Comply with the manufacturer's instructions, specified industry standards and recommendations, and as required to match the accepted sample installations.

1. Carpet Layout, Cutting and Edge Trim Seaming: Prior to applying adhesives, place seams at locations indicated on accepted shop drawings. All carpet rolls shall be installed in the exact roll number sequence as listed on the carpet rolls. Maintain direction of pattern, texture and lay of pile. Side to end seaming shall not be allowed. All edges of all rolls of carpet shall be finish trimmed prior to laying to assure a perfect seam condition and carpet match. All trimmed edges shall then be treated with latex seaming adhesive to assure that loose and cut yarns are not left to ravel or pull out.

a. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

b. Extend carpet into closets and offsets, and under movable equipment of the rooms and spaces shown or scheduled to receive carpet, including recessed covers within those spaces.

c. Provide cutouts as required for removable access covers in substrates except do not cutout for floor closer cover plates. Bind edges neatly and secure to substrate. Cut only 3 sides wherever it is feasible to provide carpet flap in lieu of fully removable cutout.

d. At doorways, center seams under door in closed position; do not place seams perpendicular to door frame in direction of traffic through doorway.

e. Cut openings in carpet for electrical outlets, piping and other penetrations. Maintain close tolerances so that edges of carpet will be covered by plates and escutcheons.

f. Seams shall be located away from areas subject to pivoting traffic.

2. Apply adhesive in accordance with adhesive manufacturer's directions.

3. Adhere carpet with a full spread of adhesive. Ensure uniform bond over the entire area.

   a. Butt carpet tightly together to form seams without gaps or entrapped pile yarns and aligned with adjoining rolls of carpet. Seams shall be pressed by hand and/or suitable tool to produce the best possible even top pile width-to-width. Adjacent widths of carpet must be installed to finish at exactly the same elevation.

   b. Roll carpet uniformly, removing air pockets and bubbles.

   c. If the pile of the carpet has been compressed while laying in storage, so that there appears to be a difference in color in adjacent widths of material, the Contractor shall neutralize the pile with a steam machine and obtain a uniform pile direction throughout by brushing the carpet while it is still damp, at no additional cost to LAWA.

4. Edge Strip Installation: Install edge strip at every location where edge of carpet is exposed to traffic, unless otherwise indicated. Unless otherwise directed by the Architect of Record, install in single lengths and secure in accordance with manufacturer's directions.

5. Traffic over adhesive installations shall be restricted until adhesive has properly cured in accordance with the adhesive manufacturers recommendations.

B. Stair Carpeting: Comply with the manufacturer's instructions, specified industry standards and recommendations, and as follows:

   1. Glue Down Installation: Tightly secure carpet to treads and risers using carpet adhesive. Stairs with a return nosing shall be cut and installed with the tread and risers being separate pieces.

3.4 CLEANING AND PROTECTION

A. Cleaning: As the carpeting is installed, remove and dispose of all trimmings, excess pieces of carpeting and laying materials from each area as it is completed. Vacuum carpeting with a commercial vacuum, having a cylindrical brush or beater bar and high suction. Remove adhesives, stains, and soil spots in accordance with the carpet manufacturer's recommendations.

B. Protection: Protect carpeting against damage of every kind as damaged carpeting shall be rejected. Use non-staining cover material for protection. Tape joints of protective covering.

   1. Plastic and polyethylene sheet protective coverings shall not be permitted over glue down installations.

   2. Remove and replace rejected carpeting with new carpeting. At the completion of the work and when directed by LAWA, remove covering, vacuum clean carpeting and remove soiling and stains (if any) to the satisfaction of LAWA.

END OF SECTION 09 68 16

SECTION **09 91 23 - INTERIOR PAINTING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems.

1.2 SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product.

C. Product List: For each product indicated.

1.3 EXTRA MATERIALS

A. Furnish extra materials from the same production run as the material applied.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. LAWA will select one surface to represent surfaces and conditions for application of each paint system.
      a. Vertical and Horizontal Surfaces: Provide to LAWA, samples of at least 100 sq. ft..
      b. Other Items: LAWA may designate items or areas required.
   2. Final LAWA approval of paint selections will be based on mockups.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with LAWA requirements:
   1. Benjamin Moore & Co.
   2. Dunn-Edwards Corporation.
   3. Frazee Paint.

4. ICI Paints
5. Kelly-Moore Paints
6. PPG Architectural Finishes, Inc.
7. Sherwin-Williams Company.
8. Vista Paint.

2.2 PAINT, GENERAL

A. Material Compatibility:
   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: Products shall comply with VOC limits of Los Angeles Department of Building and Safety and LAWA requirements.

C. FLOOR COATINGS:
   1. Frazee; Monochem Dex-coat 2600
   2. ICI; Groundworks, 3214 Water-based Clear Acrylic Concrete Sealer
   3. PPG; Perma-Crete Plex-Seal WB Interior/Exterior Clear Sealer 4-6200
   4. Sherwin Williams; H&C Concrete & Masonry Waterproofing Sealer

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: LAWA reserves the right to invoke the following procedure:
   1. LAWA may engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent.
   2. Masonry (Clay and CMU): 12 percent.
   3. Gypsum Board: 12 percent.
   4. Plaster: 12 percent.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

NOTE: When planning, either partial or full removal of existing coatings, regulatory restrictions and procedures shall be followed.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations.

B.

1. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
2. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in LAWA equipment rooms:
    a. Equipment, including panelboards and switch gear.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping
    d. Pipe hangers and support.
    e. Metal conduit.
    f. Plastic conduit.
    g. Tanks that do not have factory-applied final finishes.
    h. Duct, equipment and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    i. Mechanical and electrical equipment that is indicated to have a factory primed finish for field painting.

2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: LAWA may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site as per LAWA direction.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by LAWA, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

Provide interior painting schedule indicating the type of prime coat, intermediate coat and top coat for all substrates applicable to your project.

END OF SECTION 09 91 23

SECTION 10 14 00 – SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY OF WORK INCLUDED

A. CONTRACTOR shall be responsible for securing all sign permits, including payment of fees, required by the Los Angeles Department of Building and Safety for the installation of all interior signage for the Project.

B. Sign Fabrication: Types of signs, messages, and graphics are indicated on the Drawings and herein, and require various materials, finishes, Illumination and fabrication and installation techniques.

C. Shop drawings, layouts, samples, and mock-ups for LAWA approval.

D. Structural design and calculations for all ceiling suspended signage to confirm structural integrity of the designed support connection. All structural connections will require certification by an Engineer licensed in the State of California.

E. Installation of all fabricated signs, including all fasteners and fastenings and related electrical and data connections.

F. Coordination with all trades of this Contract required for the fabrication and installation of the signage, including the approvals by LAWA required in this Section. Fabrication and installation of the Work in accordance with National Electrical Code (NEC); latest edition, Underwriters Laboratory UL); latest edition, National Fire Protection Agency (NFPA); latest edition and National Electrical Manufacturers Association Standards,

G. Verification of all conditions and sign dimensions in the field. Sign Fabricator to coordinate all signage requirements with the architectural, structural, lighting, electrical, and telecommunications drawings to ensure that all proposed signs can be installed, with power and required data connections and structurally supported. Verification of conditions and sign dimensions to be completed prior to sign fabrication and approval of all required submittals.

NOTE: A separate signage and graphics package consisting of drawings, material samples, renderings and any other information that adequately describes the proposed signage scheme shall be submitted to LAWA for review and approval in accordance with the Airport Sign Policy. *LAWA reserves the right to make the final determination on the appropriateness of all proposed signage and graphics.*

1.2 DESIGN CRITERIA

A. Structural design: Details on Drawings indicate a design approach for sign fabrication but do not necessarily include all fabricating details required for the complete structural integrity of the signs, including consideration for static, dynamic, and erection loads during handling, erecting, and service at the installed locations, nor do they necessarily consider the preferred shop practices of the individual Sign Fabricators. Therefore, it shall be the responsibility of the Fabricator to perform the complete structural design of the signs and to incorporate all the reasonable safety factors necessary to protect LAWA , against public liability. Designs which survive rational engineering analysis will be acceptable, provided that shop drawings, including structural design, are approved by LAWA. Signs must meet all applicable local, state, and national codes, as well as testing laboratory listings where required.

NOTE: All signage shall be in English and in compliance with the American with Disabilities Act and any other applicable building codes such as the general signage requirements for an Interior Mall as described in section no. 404.3.7 of the Los Angeles Building Code.

Proposals for the use of blade signs will be reviewed by LAWA on a case by case basis.

1.3 SHOP DRAWINGS

The Drawings presented for pricing are not fabrication drawings. The Signage Contractor is expected to provide all details necessary to effectively explain and specify the fabrication process and the expected performance of the installed product. The Signage Contractor must demonstrate through details and specifications their complete understanding of the desired final product and the method/process by which they are producing said product. The Signage Contractor is responsible to field measure prior to submitting Shop Drawings. Repackaging the supplied Drawings with new title blocks and delivering them as submittals will not be accepted. Although art may be supplied electronically, Signage Contractors must be prepared to create all graphic content from scratch – per instance as requested - to demonstrate and verify the quality and accuracy of the delivered product.

A. The Sign Fabricator is responsible for the proper engineering of all elements of the Work and where applicable, to include a set of wet stamped, signed engineering calculations by a licensed California Structural Engineer. The internal structure, dimensions, and specifications for all items shall be indicated in the shop drawings.

B. Description: Provide shop drawings for all items including, but not limited to the following:

1. Complete fabrication and installation drawings for each sign type. Indicate dimensions, materials, finishes, fastening, anchorage, joining, sealing, backing, utility requirements, rough-in, and adjacent related site conditions.
2. Each sign type with all graphic elements.

3. All letter styles shall be accurately reproduced.
4. Connections and routing for all power and data cabling.

1.4 SUBMITTALS

A. Procedure: Prepare submittals in accordance with the following requirements:

1. Notes on Drawings shall clearly define any actions requiring review by the LAWA.
2. First article of production-run items, both large and small, will be reviewed by LAWA before production run is commenced.
3. It shall be the responsibility of the Contractor to schedule all review meetings with LAWA.

B. Submit physical samples of sufficient size and quantity to illustrate materials, finishes, equipment or workmanship, and to establish standards by which completed work will be judged. Samples must represent the functional characteristics of the product or material, with integrally related parts and attachment devices, colors, and finishes.

C. All samples to have a place for stamp approval.

D. Required samples for review:

1. Full 12" x 12" set of all specified paint colors and finishes.
2. Complete, full-size message in each typeface to demonstrate proper spacing (black text on white background: outline not accepted).
3. Sample of each type of fastener to be used.
4. Each type of exposed metal used for major elements of work with respective finish.
5. Each type of adhesive vinyl film, including computer-cut designs, shown full-size on each of the specified ground colors.
6. Each type of neon.
7. Mock-ups as scheduled in this section. Mock-ups shall become the property of LAWA and are not to be part of the completed work.
8. Other items as may be required by LAWA, or as noted on the Drawings or herein.

E. Extra Materials / Spares: Deliver to LAWA, the manufacturer’s original packaging and store at the Project where directed.

1. Furnish (1) gallon of each finish paint color for touch-up purposes.
2. Furnish (6) lamps of each type and size used in the signage (as applicable).
3. Furnish spare keys to master keyed locks on directory or Kiosk signage

F. Supplementary Product Literature: Submit for information. Furnish within seven (7) days of request, manufacturer’s literature describing the general properties of each product to be used in the Work

NOTE: This signage shop drawing submittal shall include all required power and data requirements and circuiting configurations and have this information coordinated with the corresponding electrical drawings. All illuminated signs within a tenant's lease area shall be circuited to the Tenant's electrical panel board.

1.5 PERMITS BY SIGNAGE CONTRACTOR

A. Signage Contractor shall make all submittals for each permit to LAWA. Signage Contractor shall be responsible for paying all fees, making adjustments as required, or any task necessary for obtaining local building and installation Sign permits for the proper execution of the Work.

1.6 QUALITY ASSURANCE

A. Mock-ups and Prototypes:

1. Provide a mock-up (partial for large Signs; complete for smaller Signs) of each sign type requested at the fabrication facility for review.
2. Utilize the same materials and installation methods in the mock-up as intended for the final Work. Schedule the installation so that the mock-up may be examined, and any necessary adjustments made, prior to commencing fabrication of the final Work. Replace unsatisfactory items as directed.
3. When accepted, mock-up shall serve as the standard for materials, workmanship, and appearance for the Work throughout the project.

B. Work-In-Progress Approvals:

1. Provide work-in-progress sign elements reviews. Scheduled or unscheduled viewings at the Fabrication Facility may be initiated by LAWA as deemed necessary to ensure continued quality control and make any adjustments required during fabrication. Unsatisfactory items are to be corrected by the Signage Contractor as directed by LAWA.

C. Regulatory Requirements:

1. Comply with applicable requirements of the Applicable Laws and Authorities. Obtain necessary approvals and permits from all such Authorities as required.

D. Markings and Labels:

1. Locate markings, labels, manufacturer names and other identifications so as to be concealed from public view and as acceptable by LAWA.
2. No trade name or other identification shall appear on any item where it will be seen by the public except as specifically approved by LAWA in advance.

E. Final Location of Signs:

1. The location of signs as shown on the Location Plans is for general reference only and in some cases is not representative of the exact final location. Final locations of Signs shall be field located in coordination with LAWA.
2. Signage Contractor shall arrange for meetings at the Project to accommodate direction of final locations according to Project Construction Schedule.

F. Lettering:

1. The Signage Contractor shall be responsible for the quality control of all lettering. All letterforms shall be crisp, sharp, free of nicks, ragged edges and discontinuous curves. All lettering shall conform to approved typeface, weight and letter spacing. No substitutions of typeface foundry, brand or version or implementation technique will be accepted without prior approval.
2. Vinyl Die Cut Graphics: All camera-ready artwork shall be anagraph scanned for cutting on a Gerber Sign Maker II or approved equal.
3. All cutting and routing shall be executed in such a manner that all edges and corners of finished letterforms are true and clean. Letterforms with rounded positive or negative corners, nicked, cut, or ragged edges, etc., will not be accepted. All letterforms shall be so aligned as to maintain a baseline parallel to the sign format. Margins must be maintained as specified in drawings.
4. All Work under the Agreement shall be performed by skilled craftsmen under supervision of trained foremen, experienced in the trade of craft required to accomplish the Work and produce a product of high quality.

G. Tactile Sign Messages

1. All tactile sign messages must comply with ADAAG 2006; Sections 703.2-703.4
2. Character spacing shall be measured between the two closest points of adjacent raised characters within a message, excluding word spaces. Where characters have rectangular cross sections, spacing between individual raised characters shall be 1/8 inch (3.2 mm) minimum and 4 times the raised character stroke width maximum. Where characters have other cross sections, spacing between individual raised characters shall be 1/16 inch (1.6 mm) minimum and 4 times the raised character stroke width maximum at the base of the cross sections, and 1/8 inch (3.2 mm) minimum and 4 times the raised character stroke width maximum at the top of the cross sections. Characters shall be separated from raised borders and decorative elements 3/8 inch (9.5 mm) minimum.
3. Braille shall be contracted Braille (Grade 2), domed and maintain a minimum 3/8 inch clear-space from other tactile elements.
4. Proof-reading of Braille messages is to be performed by the sign fabricator prior to fabrication.

H. High Quality of Workmanship:

1. The Signage Contractor shall be responsible for the high quality of all materials and workmanship required for the execution of the Agreement including materials and workmanship of any firm or individual who act as Signage Contractor's Sub-Contractor.
2. Signage Contractor shall be responsible for providing up-to-date drawings, specifications, graphic schedule, etc., to all sub-contractors.

I. Dimensions

1. Written dimensions on drawings shall have precedence over scaled dimensions.
2. Signage Contractor shall verify and be responsible for all dimensions and conditions shown by these drawings. Shop details must be approved by LAWA prior to fabrication.

J. Discrepancies

1. Signage Contractor shall notify LAWA of any discrepancies in the Drawings, Sign Location Plan or Sign Message Schedule, in field dimensions or conditions and/or changes required in construction details.

K. Regulatory Requirements:

1. Comply with applicable portions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
2. References

a. International Building Code - IBC 2006
b. California Building Code – CBC 2007 – Title 24
c. National Association of Architectural Metal Manufacturers (NAAMM) "Metal Finishes Manual."
d. American Welding Society (AWS) – AWS D1.1 "Structural Welding Code, Steel," and AWS D1.2 "Structural Welding Code, Aluminum."
e. Underwriters Laboratories Inc. (UL) – Standards for Safety, UL Publication 48 "Electric Signs."

1.7 WARRANTY

A. Signage Warranty

1. Submit to LAWA a 5-year written warranty (effective the date of final acceptance) covering all Signs, notarized by the Signage Contractor and Installer (if Sub-Contractor is used), agreeing to repair or replace the Defective Signs. Upon notification of such Defective Signs within the warranty period, make necessary repairs or replacement at the convenience of LAWA.

B. Linear Polyurethane Paint Factory Finish Warranty

1. Submit to LAWA a 5 year written warranty, warranting that the factory-applied linear polyurethane finishes will not develop excessive fading or excessive non uniformity of color or shade, and will not crack, peel, pit, corrode or otherwise fail as a result of Defects in materials or workmanship within the following defined limits. Upon notification of such Defects within the Warranty Period, make necessary repairs or replacement at the convenience of LAWA.

C. "Excessive Fading"

1. A change in appearance which is perceptible and objectionable as determined when visually compared with the original color range standards.

D. "Excessive Non-Uniformity"

1. Non-uniform fading to the extent that adjacent panels have a color difference greater than the original acceptable range of color.

E. "Will Not Pit or Otherwise Corrode"

1. No pitting or other type of corrosion, discernible from a distance of 10' (3 m), resulting from the natural elements in the atmosphere at the project site.

1.8 MAINTENANCE

A. Maintenance and Operating Manuals

1. Submit four (4) copies of Maintenance and Operating Manuals to LAWA Representative and 1 copy to the Architect of Record.
2. Furnish complete manuals describing the materials, devices and procedures to be followed in operating, cleaning and maintaining the Work. Include manufacturers' brochures and parts lists describing the actual materials used in the Work, including metal alloys, finishes, electrical components and other major components.
3. Assemble manuals for component parts into single binders identified for each system.

B. Instruction

1. Prior to acceptance, establish an instruction and training program for LAWA personnel.
2. Notify LAWA in writing at least 7 days prior to commencement of the program providing an outline of topics indexed to the Maintenance and Operating Manual.
3. Provide a trained instructor. Provide three (3) consecutive 4-hour periods of training scheduled during the normal 8-hour working day. Instruction and training shall include, but shall not be limited to, procedures to be followed in the normal day-to-day maintenance and operation of the Work.

PART 2 - PRODUCTS

2.1 FABRICATION

A. Signage shall be complete for proper installation

B. Finish work shall be firm, well anchored, in true alignment, properly squared, with smooth clean uniform appearance, without holes, cracks, discoloration, distortion, stains, or marks.

C. Construct all work to eliminate burrs, dents, cutting edges, and sharp corners.

D. Finish welds on exposed surfaces to be imperceptible in the finished work.

E. Except as indicated or directed otherwise, finish all surfaces smooth.

F. Surfaces, which are intended to be flat, shall be without dents, bulges, oil canning, gaps, or other physical deformities.

G. Surfaces, which are intended to be curved, shall be smoothly free-flowing to required shapes.

H. Except where approved otherwise by LAWA, conceal all fasteners.

I. Make access panels tight-fitting, light proof, and flush with adjacent surfaces.

J. Conceal all identification labels and Underwriters Limited labels to conform to Underwriters Limited Codes.

K. Carefully follow manufacturer's recommended fabricating procedures regarding expansion or contraction, fastening, and restraining of acrylic plastic.

L. Exercise care to ensure that painted, polished, and plated surfaces are unblemished in the finished work.

M. Isolate dissimilar materials. Exercise particular care to isolate nonferrous metals from ferrous metals.

N. All illumination shall be even and without hot spots.

O. Ease all exposed metal edges.

P. Provide miscellaneous metal items required for completion of the work even though not shown or specified.

Q. Paint finishes shall be Matthews Acrylic Polyurethane with Matthews Primers and Metal Pre-Treatments.

R. Shop painting to be uniform on and around all sign elements to ensure sign elements will withstand all weather conditions.

S. Mounting: Mounting plates shall be in conformance with manufacturer's written recommendations.

2.2 MATERIALS

A. All Specified Metals

1. Aluminum

a. Aluminum shall be suitable for ornamental, architectural work. Surface finish shall be smooth, free of extrusion marks or imperfections. Alloy shall be selected to meet the structural requirements of the specific application.

2. Stainless Steel

a. Stainless steel shall be suitable for ornamental and architectural work. Surface finish shall be smooth, free of all extrusion marks or imperfections. Alloy shall be selected to meet the structural requirements of specific application. Structural metal for concealed framing shall be of galvanized rolled steel or equal as required to satisfy structural requirements.

B. Aluminum exterior cabinets, spacers, backplates and frames shall be constructed from 0.25 inch aluminum, #4 horizontal brushed and clear anodized finish, unless otherwise specified on Drawings.

C. Aluminum interior plaques shall be constructed from 0.125 inch aluminum, #4 horizontal brushed finish with semi-gloss linear polyurethane clear coat.

D. Aluminum interior fabricated components shall be constructed from 0.125 inch thickness aluminum sheet.

E. Adhesive used for installing Signs shall be manufactured by Dow Corning or equal. Polyfoam or "Isotac" contact adhesive tape manufactured by 3M shall be used in conjunction with silicone adhesives for installation of wall signs, in minimum thicknesses available.

F. Public Art Artist's Plaques

1. Fabricate from aluminum sheet, ¼-inch thickness, 10-inch length, 5-inch width plaques to be installed integral with the resinous terrazzo flooring, flush with finished surface, or as wall mounted installations.

a. Quantity: Ten (10), four (4) of which will be wall mounted.
b. Locations: To be positioned near each Public Art piece and as located by LAWA.
c. Finish: Polished face and edges.
d. Text: Helvetica Font, minimum 36pt., minimum 50 letters, text to be engraved and filled with black enamel.
e. Wall Mounted Installation: Tap back of plaque to receive stainless steel pins for "pin mounting" to wall.

G. Extruded aluminum shapes utilizing 6063-T6 aluminum alloys, unless otherwise specified on Drawings.

H. Concrete Installation of anchoring devices into concrete slab shall be adjusted to avoid penetrating existing reinforcing conduit, etc. contained in the concrete slab. Coordinate with the Architect and Structural Engineer.

I. Stainless steel exterior cabinets, spacers, backplates and frames shall be constructed from 0.125 inch stainless steel, #4 horizontal brushed and clear anodized finish, unless otherwise specified on Drawings.

J. Stainless steel interior plaques shall be constructed from 0.125 inch thickness stainless steel sheet, #4 horizontal brushed finish with semi-gloss linear polyurethane clear coat, unless otherwise specified on Drawings.

K. Stainless steel interior fabricated components shall be constructed from 0.0625 inch stainless steel, unless otherwise specified on Drawings.

L. Stainless steel shall be suitable for ornamental and architectural work. Surface finish shall be smooth, free of all extrusion marks or imperfections. Alloy shall be selected to meet the structural requirements of specific application. Structural metal for concealed framing shall be of galvanized rolled steel or equal as required to satisfy structural requirements.

M. Acrylic intended for non-illuminated use shall be 0.25 inch cast acrylic sheet with non-glare finish, unless otherwise specified on Drawings. Acrylic intended for edge-illuminated use shall be 10mm extruded acrylic sheet with embedded diffuser particles designed specifically for edge-lighting, unless otherwise specified on Drawings.

N. Use Plexiglas II as manufactured by Rohm and Haas Co., or equal quality. Thickness shall be as indicated on Drawings or not less than 1/8" thick. Signage Contractor shall provide color and finish samples of all plastics for approval before fabrication; no substitution in color, thickness, or finish of plastics will be accepted without written approval from LAWA. All plastics shall be of uniform color, translucence and illumination, as supplied by manufacturer. Any exposed edges of acrylic shall be finished so as no saw marks are visible.

O. *Decal or Transfer:* Provide special printed paper or vinyl suitable for reproducing the design onto material indicated, as required. Submit sample to LAWA for approval.

P. Aluminum posts shall be constructed from 2-inch square T52 tubes, 0.1875 wall thickness and #4 brushed and clear anodized finish with capped ends, unless otherwise specified on Drawings.

Q. *Hardware / Hinges:* Provide and install all incidental hardware necessary for the proper functioning of the Signs, including, but not restricted to, materials and products covered in this section. Provide stainless steel hinges for all hinged access panels. Provide pin tumbler locks for all access panels requiring locks. Provide stainless steel fasteners for assembling ferrous and non-ferrous metals.

R. Bolts, nuts, screws, washers, anchors and other devices required to complete the Work. Signage Contractor shall use the same basic metal or alloy as the metal fastened, and finish to match in color and texture. Use stainless steel 300 series alloy where used to join dissimilar materials.

S. All exposed fasteners to be 0.125 inch flathead stainless steel screws painted to match adjoining surfaces unless otherwise specified on drawings.

T. Pin-mount supports shall be 3/16” to 1” diameter painted threaded rods as appropriate.

U. *Insulation /Material Isolation:* Separate all ferrous and non-ferrous metals with non-conductive gaskets to prevent electrolysis. In addition to gaskets, provide stainless steel fasteners for some cases as required.

V. Welding Electrodes and Filler Metal

W. Provide the alloy and type of welding electrodes and filler metal required for strength, workability, compatibility and color match after grinding smooth and finishing the fabricated product.

X. Applied interior vinyl graphics to be High Performance Cast Vinyl Sheeting. Applied exterior vinyl graphics to be High Performance Reflective Vinyl Sheeting, unless otherwise specified on Drawings.

Y. *Additional Material/Processes:* For materials or processes described in the preceding list, the material and/or process as detailed in the design documents shall be used as the meet or exceed equivalent.

2.3 ELECTRICAL COMPONENTS

A. Electrical components must conform to applicable electrical codes and the following:

1. All materials must be approved and listed by Underwriters Laboratories, Inc.
2. Light Emitting Diode (LED) general lighting requirements:

    a. Provide sufficient LED wattage, quantities and spacing to ensure continuous, maximum illumination.
    b. Provide LED lighting prototypes to verify brightness and uniformity of lighting with designer.

3. LED lighting component, color and power requirements:

    a. Edge lighting – fabricated linear white LED’s 24 VAC
    b. Back lighting – fabricated matrix white LED’s 24 VAC

4. LED Dynamic Display resolution, color and power requirements:

    a. 4 mm dot pitch RGB LED character display, 120 VAC
    b. 7.62 mm dot pitch RGA LED character display, 120 VAC
    c. 10 mm dot pitch RGB LED character display, 120 VAC
    d. 7.62 mm dot pitch RGA LED character display, 120 VAC, exterior rated
    e. 12 mm dot pitch RGB LED character display, 120 VAC, exterior rated
    f. All LED Dynamic Displays shall be provided with an interface card.

5. Dynamic Monitor and component requirements: LCD displays are specified in Section 16730 – FIDS Displays. LCD displays include 40-inch diagonal, 57-inch diagonal and 65-inch diagonal displays.

a. .40” diagonal LCD monitor and display driver
b. .50” diagonal Plasma monitor and display driver
c. .52” diagonal LCD monitor and display driver
d. .65” diagonal LCD monitor and display driver

6. Heavy duty, non-keyed, flush mounted, fused or un-fused disconnects. Provide NEMA 1 for dry locations and proper enclosure for others.

B. *Electrical Wiring and Equipment:* Provide and install electrical materials such as ballasts, transformers, lamps, sockets, neon units, connectors, and all other equipment which shall be new and shall be approved by Underwriters Laboratories, Inc. The assembly of all components within the illuminated signs shall conform to all standards of Underwriters Laboratories, Inc. as published in the latest edition of “Standards for Sign Safety” and all illuminated signs shall bear the U.L. label. All wiring and equipment shall be concealed within the Sign structure.

C. *Conduit and Devices:* Provide Rigid steel conduit, junction boxes and associated devices in accordance with applicable codes as required.

D. *Wiring:* Minimum #12 AWG copper shall be used. High tension wiring shall not be less than GTO 15 wire as manufactured by Carol Cable Company or approved equal. All wiring shall be AWM 90 0 centigrade 1000 volt TW/MTW U.L. file no. 18971. Wiring connectors for wire splicing shall be U.L. approved 1000 volt capacity and shall be Scotch Lock type Y or R or equal. All splices should be easily accessible for inspection and should be shown on Shop Drawings.

E. *Ballasts* shall be used as required for internally illuminated cabinet signs, in quantity and arrangement as recommended by ballast manufacturer and accessible for maintenance and shown on Shop Drawings.

F. *Disconnect Switch:* All Signs or Sign components with electrical service shall be equipped with an approved external disconnect switch, flush mounted on the cabinet / Sign, with circuits and capacity to control all primary wiring within the Sign. Location of switch must be shown on Shop Drawings and is subject to approval.

G. *Illumination:* All Signs with fluorescent fixtures shall utilize minimum 800 milliamp T8 output cool white fluorescent lamps at the length and placement necessary to provide even illumination without light leaks. All Signs with LED light sources shall be built to perform as required by the Design Consultant's documentation. Signage Contractor shall provide any specification information required to verify performance. All lamps and ballasts shall be provided by the Signage Contractor. Signage Contractor shall provide waterproof flush access panel(s), which shall be concealed wherever possible. Conduit wiring and electrical equipment from the field electrical connection to any part of the sign and within the sign shall be provided by the Signage Contractor.

H. *Ventilation:* While maintaining a proper weather seal, Signage Contractor shall provide for sufficient ventilation of Sign components to prevent overheating or warping; allowing for color of sign, mounting surface, climate conditions, etc. In providing for ventilation, Signage Contractor shall protect sign from elements (rain, wind, debris, etc.) that might cause

operational or cleaning problems. Signs / cabinets with light leaks will not be accepted. Signage Contractor shall utilize stainless steel bug mesh screen for integration with weep holes or vent / louvers on the Signs to prevent insect migration into illuminated Signs.

I. Neon Sign Lighting

1. *Neon Tubing:* Use concealed Neon and/or Exposed NeoForm neon tubing in the shape of each letter, with tubes individually filled at the optimum pressure required for uniform lighting.
2. *Electrodes:* "Type 8C", Engineering Glass Laboratories, Newark, NJ.
3. *Tube Supports:* Use buttress threaded glass posts, not less than 3/8" (9.5 mm) diameter, adjustable type. Securely attach tubes to supports with pure annealed copper wire ties without strain on tubing.
4. *Transformers:* Use 4030 low power factor type, loaded not in excess of 85% of manufacturer's maximum recommended footage of neon tubing.
5. *Power Distribution:* Use no less than 12 gauge THW rubber covered copper wire for all primary circuit wiring and 15 KV type high tension cable, insulated from metal by non-porous ceramic supports and/or tubes. Provide raceways of 16 ga. (1.6 mm) Zinc-Grip A metal with enamel finish, and 1-1/2" x1-1/2" (38 x 12.5 mm) by 1/4", (6 mm) galvanized steel angles.

2.4 FINISHING MATERIALS

A. Linear Polyurethane Coatings: Provide the following, or other products as acceptable.

1. *Acrylic Linear Polyurethane enamel:* Two components, acrylic aliphatic isocyanate / acrylic polyurethane having ultraviolet (UV) inhibitors and engineered for exterior application by Matthews Paint Company or approved equal.
2. *Primer for Aluminum:* Two part component primer: One-coat Matthews 74-734 and 74-735 Metal Pretreat at. 25 mils dry film thickness or one-coat Matthews 74-793 Spray Bond at .15 to .25 mils dry film thickness or Wyandotte / AKZO Grip-Guard Wash Primer (2Afy-31284) with Grip-Guard Wash Primer Hardener (10AFK-31285) combined and applied per manufacturer's specifications or approved equal (primer) for the application of the pre-approved and pre-formulated paint system.
3. *Primer for Steel:* Two part component primer: One-coat Matthews 74-734 and 74-735 Metal Pretreat at .25 mils dry film thickness or Wyandotte / AKZO Grip-Guard Wash Primer (2Afy-31284) with Grip-Guard Wash Primer Hardener (10AFK-31285) combined and applied per manufacturer's specifications or approved equal (primer) for the application of the pre- approved and pre-formulated paint system.
4. *Clear Sealers:* Crystal clear matte polyurethane sealers By Matthews Paint Co. or approved equal. Sealers are to resist rust and corrosion associated with exposure to salt air. As required and of highest quality available, applied per manufacturer's specifications.

B. *Anodized Aluminum Components / Panels:* If required, Signage Contractor shall provide anodized (application of aluminum oxide film coating in clear or colored dye finish) aluminum panels or parts to match Executive Architect's color, grain, finish and specifications.

C. *Silk Screening Materials:* Provide photo processed screening, arranged to furnish sharp and solid images without edge build up or bleeding of the coating. Pattern-cut screens may be used for non-repeat copy, provided that final image copy is equal to photoscreen quality. Provide only weather-resistant coating materials, compatible with the intended substrates. All silk-screened graphics are to be done with the finest screen size feasible for sharp, even reproduction.

D. *Vinyl Die-Cut and Pattern Cut-out Graphics:* Use Scotchcal Opaque and Translucent film and Scotchcal Diamond Grade VIP Reflective film manufactured by 3M where specified. Use pressure-sensitive, non-yellowing, non-peeling and weather resistant vinyl as specified. Use approved fonts and equipment as specified.

2.5 FABRICATION OF SIGNS AND SUPPORTS

A. *General:* Provide custom manufactured Sign assemblies, components completely fabricated and finished at factory before delivery to Project. Construct to accurate detail and dimensions as shown and as review on approved Shop Drawings. Fit and assemble the Work at the shop and mark the components as required to facilitate assembly during installation. Exposed fasteners on finished faces will not be allowed, unless specifically indicated. Waviness and oil canning of surfaces is not acceptable. Minimum material thickness is to be 0.090 inches. Conceal wiring, conduct and other electrical items within sign enclosures.

B. *Lettering:* Cut and rout in a manner to produce true and clean edges and corners of finished letterforms. Letterforms having rounded positive or negative corners, nicked, cut, or ragged edges are not acceptable. Align letter forms to maintain a baseline parallel to the sign format. Maintain margins as indicated on the Drawings.

C. *Seams and Joints:* The Signage Contractor shall cut walls and floors carefully and neatly repair them in an acceptable manner. Signage Contractor shall consult the Architect of Record in cases where cutting into a structural portion of the building is required so that satisfactory reinforcement may be provided. Added joints shall be ground filled and finished flush and smooth with adjacent work. Such seams shall be invisible after final finish has been applied. Spot welded joints shall not be visible on exterior of signs after final finish has been applied. No gaps, light leaks, waves, or oil canning will be permitted in Work. If any of these are evident, the Signage Contractor will be required to correct its Work or construct a new Sign at its own expense.

D. *Metal Signs and Supports:* Fabricate exposed surfaces uniformly flat and smooth, without distortion, pitting, or other blemishes. Form exposed metal edges to a smooth radius. Permanently bond the laminated metal components and honeycomb core with adhesive or sealant in accordance with product manufacturer's recommendations. Grind exposed welds and rough areas to make flush with adjacent smooth surfaces.

E. *Welding:* Make welds continuous. Comply with American Welding Society, Aluminum Association, and Copper Development Association standards for the type of metal used.

F. *Fasteners:* Use exposed fasteners only if shown on the Construction Documents. Perform drilling and tapping at shop.

G. *Dissimilar Materials:* Where metal surfaces will be in contact with dissimilar materials, coat the surfaces with epoxy paint or plate with zinc chromate, or provide other means of dielectric separation as recommended by manufacturer to prevent galvanic corrosion (i.e. Neoprene gasket as an isolation membrane)

H. *Castings:* Exposed surfaces shall be uniformly free from porosity and roughness. Edges shall be filled and ground smooth. Faces shall be chemically etched and mechanically polished for specified finish.

I. *Galvanizing:* Provide for steel components in exterior construction, and where noted in Drawings shall be galvanized. Complete the shop fabrication prior to application of the zinc coating. Remove mill scale and rust, clean and pickle the units as required for proper pretreatment of the surfaces.

J. *Hardware:* Provide all incidental hardware necessary for the proper functioning of signs. External hardware shall conform to the external appearance of the Sign.

K. *Supports and Backing in Walls:* Signage Contractor shall provide engineered Sign supports anchored to building structure where required and to meet requirements of applicable building codes. Support or backing requiring installation within the building wall construction shall be immediately relayed to the Architect of Record and LAWA for field coordination. Signage Contractor shall meet with the Contractor to review all requirements.

L. *Access Doors and Frames:* Access doors and frames shall be flush with the material in which they occur, unless otherwise specified. Access doors and frames shall be provided upon prior written approval of the Architect. Each trade providing access doors and frames shall verify the need for fire rated doors on the Construction Drawings. Access doors in walls, partitions or ceilings shall bear UL fire rated labels of same fire rating. If access doors and frames are required to be exposed to view, they shall be chrome, brass, stainless steel, or other finish to match other finishes in the spaces in which they are to be installed, unless otherwise specified. Obtain LAWA approval for location of each access door prior to placement.

M. *Acoustical Requirements:* Certain partition, floor and ceiling assemblies are required to have sound absorption and sound transmission loss characteristics as required in the Specification sections or as indicated on the Construction Drawings. The Signage Contractor shall coordinate his work in constructing these assemblies and that of other contractors whose work adjoins, connects to, or penetrates these assemblies to assure that such work does not reduce acoustical characteristics of the assemblies.

2.6 SHOP APPLICATION OF SIGN FINISHES

A. *Sign Graphics:* Provide the letters, numerals, symbols, and other graphics markings, using the finish materials shown. Apply the graphics neatly, uniformly proportioned and spaced, and accurate within the dimensions indicated. Prepare the substrate surfaces and apply finish materials in accordance with manufacturers' instructions.

B. *Metal Finishes:* Remove scratches, abrasions, dents and other blemishes before applying finish. Apply the following to the fabricated Work, with texture and reflectivity as required to match the Architect's sample.

C. *Linear Polyurethane Finishes:* Clean the surfaces as required for proper adhesion of coatings. Use 3M Co. “Scotch Brite” pads with cleanser and water, and/or chemically treat as recommended by paint manufacturer to remove deleterious film or residue.

D. *Linear Polyurethane Paint:* Provide pretreatment and primer in accordance with manufacturer’s recommendation. Add ultra violet inhibitors to paint subject to sunlight exposure.

E. *Clear Linear Polyurethane Finish:* Provide pretreatment, primer, and matte or semi-gloss finish coatings in accordance with manufacturer’s recommendations. Apply 1.5 to 2.0 mils (0.0375 to 0.050 mm) dry film thickness.

2.7 GRAPHIC APPLICATION

A. *Preparation:* Surfaces to receive the graphic markings shall be clean, dry, and otherwise made ready for application of the materials. Accurately measure and lay out the required marking configurations as indicated on drawings.

B. *Vinyl Die-cut and Pattern-cut Graphics:* Use pressure sensitive, non-yellowing, non-peeling and weather resistant vinyl adhesive letters or images, custom flood coated as required, die cut from ScotchCal or ScotchLite as manufactured by 3M Company. Apply in strict accordance with manufacturer’s instructions. Make uniformly smooth and free from bubbles, wrinkles, stretching and blemishes.

C. *Painted or Silk-screened Graphics:* All graphics shall be applied using photo processed screens from camera ready art, arranged to furnish sharp and solid images without build-up or bleeding of the coating. Comply with coating manufacturer’s application instructions. Provide proper type of primer to suit each substrate and obtain a permanent bond. Verify compatibility of each substrate with the coatings to be used in the Work. Apply the markings with neat edges, minimum 3 mils (0.075 mm) dry film thickness and as required to obtain solid markings without voids.

D. *Acid-Etched Graphics and Typography:* Acid-etched typography and graphic imagery must be an average of 1/16” deep, with clean, crisp, sharp edges; ragged or soft (polished out) edges will be rejected. Acid baths used for etching should be fresh and used in an environment and temperature that will provide the highest quality etched images. Colorfill as indicated by the S/P color and finish schedule, keeping inks and fills true to the edges of letterforms / graphics.

2.8 BASIS OF DESIGN PRODUCTS

A. Edge lighting process and electrical components to be provided by the following manufacturer or LAWA approved equivalent product:

1. AD/S - Architectural Design & Sign - LUMIPANE

a. 2950 Palisades Drive
b. Corona, CA 92880
c. www.ad-s.com

2. Fluoresco Lighting & Signs

a. 5505 Nogales Highway
b. Tuscon, AZ. 85706
c. www.fluoresco.com

B. LED Dynamic Displays to be provided by the following manufacturer or LAWA approved equivalent product:

1. Daktronics
331 32nd Ave.
Brookings, S.D. 57006
www.daktronics.com

PART 3 - EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Inspect all surfaces to receive signage and report all defects which would interfere with signage installation.

B. Starting Work implies acceptance of surfaces as satisfactory

C. Verify all conditions and sign dimensions in field. Contractor to review and study architectural, landscape, lighting, electrical and related plans to insure that all proposed signs can be installed and supported. Verification of conditions and sign dimensions to be completed prior to sign fabrication and reviewed with the architect.

3.2 INSTALLATION

A. Install signage upon acceptance by LAWA of material and substantial completion of job site area to receive such materials.

B. Special Precautions: Guard against damaging existing pavements and planting where signage is to be installed.

C. Footings beneath topping surface shall be installed and located prior to top surface installation.

D. Prior to installation, check all components, nuts, bolts, and other connections for proper alignment, fit and any damage. Replace damaged or defective components.

E. Prior to installation, confirm all electrical locations and requirements with LAWA.

3.3 CLEAN UP

A. Keep areas of work clean, neat and orderly at all times. Clean surfaces, inside and out. Use approved cleaners if necessary to remove dirt.

B. Protective coverings and strippable films shall be removed at a time that will afford the greatest protection of the furniture. Surfaces shall be cleaned to remove excess glazing and sealant compounds, dirt, and other substances.

C. Upon completion of work and before final acceptance, remove tools, surplus materials, apparatus, and debris from the site. Leave the site in a neat, clean condition, acceptable to the Engineer. Wash, clean, and leave paved areas without stains.

3.4 FINAL INSPECTION AND ACCEPTANCE

A. Upon completion of work, a final inspection for acceptance will be performed by LAWA.

B. All mock-ups and unused submittals shall be removed from site prior to final acceptance.

C. Submit operation manuals, tools, and keys as specified in this Section.

END OF SECTION 10 14 00

SECTION 10 21 13 – TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes toilet compartments and screens as follows:
   1. Type: Stainless steel.
   2. Compartment Style: Ceiling hung with intermittent floor support.
   3. Screen Style: Wall hung.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Include plans, elevations, sections, details of installation, and attachments to other work and hardware.

> **NOTE:** These shop drawings shall accurately indicate existing field conditions. Perform a dimensional field survey of as-built conditions prior to submitting shop drawings.

C. Samples: For each exposed finish and for each color and pattern required.

D. Maintenance manuals

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's Americans with Disabilities Act (ADA) and Architectural Barriers Act and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities and the City of Los Angeles Building Code.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to approval by LAWA, provide products the following:

B.
   1. **Bobrick Washroom Equipment, Inc**.

2.2 MATERIALS

A. Panel, Pilaster, and Door Material:
   1. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled flatness, patterned.

2.3 FABRICATION

A. Toilet Compartments: Ceiling hung with intermittent floor support.

B. Urinal Screens: Wall hung.

C. Metal Units: Internally reinforce metal panels for hardware, accessories, and grab bars.

D. Doors: Unless otherwise indicated, 24 inch wide in-swinging doors for standard toilet compartments and 36 inch wide out-swinging doors with a minimum 32 inch wide clear opening for compartments indicated to be accessible to people with disabilities.

E. Door Hardware: Stainless steel. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units rigid, straight, level, and plumb, with not more than 1/4 inch between pilasters and panels and not more than 3/4 inch between panels and walls. Provide brackets, pilaster shoes, bracing, and other components required for a complete installation. Use theft-resistant exposed fasteners finished to match hardware. Use sex-type bolts for through-bolt applications.

NOTE: Partition Pilasters supporting adjacent partitions with accessible grab bars shall extend to the floor with a stainless steel shoe. Floor to ceiling pilasters shall be located at all corners of toilet stall partition that are not supported by adjacent wall.

Locked partition doors shall be removable by lifting the door up and off the hinges with special tools. Doors at unoccupied stalls shall be held partially open (30 degrees) in a consistent and uniform position and shall open into the stall, except at accessible stalls, where the doors shall swing out.

Coat hooks shall be installed inside of each compartment wall at centerline and 6 inches below top of door except at accessible stalls where the maximum is 48" above finish floor. Coat hooks shall bear at least 15 lbs.

Coordinate with the structural specification for the steel member that support ceiling hung toilet compartments. Indicate this steel support on the drawings.

END OF SECTION 10 21 13

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Corner guards.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain corner guards from single source from single manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F for not less than 72 hours before beginning installation and for the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M.

B. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and with a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.2 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards: Fabricated from one-piece, formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Arden Architectural Specialties, Inc.
      b. Balco, Inc.
      c. Construction Specialties, Inc.
      d. Korogard Wall Protection Systems; a division of RJF International Corporation.

   2. Material: Stainless steel, Type 304.
      a. Thickness: Minimum 0.0625 inch.
      b. Finish: Directional satin, No. 4.

   3. Wing Size: Nominal 3-1/2 by 3-1/2 inches.
   4. Corner Radius: 1/8 inch.
   5. Mounting: Adhesive.

2.3 END-WALL GUARDS

A. Surface-Mounted, Metal, End-Wall Guards: Fabricated from one-piece, formed or extruded metal that covers entire end of wall; with formed edges.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Arden Architectural Specialties, Inc.
      b. Balco, Inc.
      c. Construction Specialties, Inc.
      d. Korogard Wall Protection Systems; a division of RJF International Corporation.
   2. Material: Stainless steel, Type 304.
      a. Thickness: Minimum 0.0625 inch.
      b. Finish: Directional satin, No. 4.
   3. Wing Size: Nominal 3-1/2 by 3-1/2 inches.
   4. Corner Radius: 1/8 inch.
   5. Mounting: Adhesive.

2.4 FABRICATION

A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.

B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.5 METAL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Remove tool and die marks and stretch lines, or blend into finish.
   2. Grind and polish surfaces to produce uniform finish, free of cross scratches.
   3. Run grain of directional finishes with long dimension of each piece.
   4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
   1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
   1. Install impact-resistant wall protection units in locations indicated

2. Provide full height units. Do not splice.

3.4 CLEANING

A. Immediately after completion of installation, clean corner guards.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 26 00

SECTION 10 28 00 – TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Warm-air dryers.
3. Childcare accessories.
4. Underlavatory guards.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

D. Warranty: Sample of special warranty.

E. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.4 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

NOTE: Indicate all accessories on drawings with an accessory schedule. Verify wall thickness for all recessed accessories.

1.5 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Basis-of-Design Product: Subject to LAWA approval, provide and indicate on the drawings the following products:

1. Bobrick Washroom Equipment, Inc.
2. Georgia Pacific
3. Bradley

B. Toilet Tissue (Jumbo-Roll) Dispenser:

1. Basis-of-Design Product: Bobrick 2892.
2. Description: Stainless Steel Twin – Jumbo Roll Toilet tissue dispenser.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

C. Paper Towel Dispenser:

1. Basis-of-Design Product: Georgia Pacific 59466.
2. Material and Finish: Stainless steel, No. 4 finish (satin).

D. Recessed Waste Receptacle:

1. Basis-of-Design Product: Bobrick B-3644.
2. Mounting: Recessed.
3. Material and Finish: Stainless steel.

E. Semi Recessed Waste Receptacle:

1. Basis-of-Design Product: Bradley 334-10
2. Mounting: Semi Recessed.
3. Material and Finish: Stainless steel.

F. Waste Receptacle Large Capacity, Stand Alone:

1. Basis-of-Design Product: Bobrick B-2280
2. Mounting: Stand Alone.
3. Material and Finish: Stainless steel.

G. Liquid-Soap Dispenser:

1. Basis-of-Design Product: Bobrick B-830.
2. Description: Sureflo Soap Dispensing System.

H. Grab Bar (corner):

1. Basis-of-Design Product: Bobrick B-68137.

2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
4. Outside Diameter: 1-1/4 inches.
5. Configuration and Length: Corner, 36" x 54".

I. Grab Bar (straight):

1. Basis-of-Design Product: Bobrick B-6806 x 36.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
4. Outside Diameter: 1-1/4 inches.
5. Configuration and Length: Straight Bar – 36" long.

J. Vendor:

1. Basis-of-Design Product: Bobrick B-352 25.
2. Type: Sanitary napkin and tampon.
3. Mounting: Fully recessed.
4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).

K. Vendor (alternate):

1. Basis-of-Design Product: Bobrick B-3500 25.
2. Type: Sanitary napkin and tampon.
3. Mounting: Fully recessed.
4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).

L. Seat-Cover Dispenser:

1. Basis-of-Design Product: Bobrick B – 4221, Contura Series
2. Mounting: Surface mounted.
3. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).

M. Seat-Cover Dispenser (alternate):

1. Basis-of-Design Product: Bobrick B – 221
2. Mounting:
3. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).

N. Mirror Unit:

1. Basis-of-Design Product: Bobrick B-290.
2. Frame: Stainless-steel angle.

O. Air Freshener:

1. Basis-of-Design Product: Technical Concepts – Model no. 401375.
2. Description: Automatic Air Freshener.

2.3 WARM-AIR DRYERS

A. Hand Dryer:

1. Basis-of-Design Product: Dyson, Airblade A02 (LAWA Standard)

2.4 CHILDCARE ACCESSORIES

A. Manufacturers: Subject to LAWA approval, provide products by one of the following:

B. Diaper-Changing Station:

1. Basis-of-Design Product: Koala Bear Kare – KB110SSRE.
2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
3. Mounting: Recessed.
4. Operation: concealed pneumatic cylinder with hinge structure.
5. Material and Finish: Stainless steel, No. 4 finish (satin), exterior shell with high density grey polyethylene interior.

2.5 UNDERLAVATORY GUARDS

A. Manufacturers: Subject to LAWA approval, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Plumberex Specialty Products, Inc.
2. Truebro by IPS Corporation.

C. Underlavatory Guard:

1. Basis-of-Design Product: Truebro Lav Guard 2 E-Z.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.6 CUSTODIAL ACCESSORIES

2.7 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. The total number of keys for each accessory shall be determined by LAWA.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf , when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 28 00

SECTION 10 43 13 - DEFIBRILLATOR CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Custom fabricated automated external defibrillator (AED) cabinets.

2. Automated external defibrillators (AED's).

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for AED cabinets.

1. Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

2. Automated External Defibrillator

B. Shop Drawings: For AED cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For each type of fire protection cabinet indicated.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Size: 6 by 6 inches square.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For AED cabinets and AED's.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to AED cabinets including, but not limited to, the following:

    a. Schedules and coordination requirements.

1.5 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of AED cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Stainless-Steel Sheet: ASTM A 666, Type 304.

C. Tempered Float Glass: ASTM C 1048, Kind KT, Condition A, Type I, Quality q3, 1/8 inch, Class I (clear).

2.2 AED CABINET

A. Cabinet Type: Suitable for mounting AED with emergency telephone and alarm; match existing AED cabinets;

1. Basis of Design Product: Potter Roemer LLC; Model HSSS7063-D-LAWA-modified as described herein or a comparable product by one of the following:

    a. J. L. Industries, Inc., a division of Activar Construction Products Group;.
    b. Larsen's Manufacturing Company;.

B. Cabinet Construction: Nonrated.

C. Cabinet Interior Size: 14 inches wide by 22 inches high by 6 inches deep, as required to incorporate AED and specified features. All cabinet components and equipment shall be accessible, removable and replaceable with the cabinet door in a 90 degree position.

D. Cabinet Material: Stainless-steel sheet.

E. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim.

F. Cabinet Trim Material: Stainless-steel sheet.

G. Door Material: Stainless-steel sheet.

H. Door Style: Provide limited visibility window to match existing.

I. Door Glazing: Tempered float glass.

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide manufacturer's standard.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

K. Accessories:
1. Identification: Manufacturer's standard.

L. Finishes:

1. Manufacturer's standard baked-enamel paint for the interior of cabinet.
2. Stainless Steel: No. 4.

M. Cabinet Interior Features:
1. Emergency Phone Box.
2. Cable Access Box
3. Raceway

N. Alarm:
1. Circuitry Board.
2. Alarm Circuitry
3. Alarm Key Switch and Key:
4. Control for Visual Alarm, Audio Alarm and Relay Cloasures:

O. Power Requirements for Alarm Board, Siren and LED:

2.3 AUTOMATED EXTERNAL DEFIBRILLATOR (AEDS)

A. Provide the following:
1. Philips Heartstart OnSite (HS1) Defibrillator

2.4 FABRICATION

A. AED Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
1. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install AED cabinets in locations and at mounting heights, at heights acceptable to the Los Angeles Fire Department.

B. AED Cabinets: Fasten cabinets to structure, square and plumb.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust cabinet doors to operate easily without binding.

C. On completion of cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by AED cabinet and mounting bracket manufacturers.

E. Replace AED cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 13

SECTION 10 44 13 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:

a. Portable fire extinguishers.

NOTE: Indicate on the drawings a fire extinguisher in a cabinet within a 75 foot travel distance to all portions of the building on each floor. Keep in mind that additional fire extinguishers and cabinets may be required as dictated by the Fire Department Field Inspector.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For each type of fire protection cabinet indicated.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Size: 6 by 6 inches square.

E. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire protection cabinets including, but not limited to, the following:

a. Schedules and coordination requirements.

1.5 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Stainless-Steel Sheet: ASTM A 666, Type 304.

C. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 1/4 inch-thick, mm thick, with Finish 1 (smooth or polished).

2.2 FIRE PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Products: Subject to compliance with requirements, provide one of the following:

a. J. L. Industries, Inc., a division of Activar Construction Products Group;.
b. Larsen's Manufacturing Company;.
c. Potter Roemer LLC;

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Stainless-steel sheet.

1. Shelf: Same metal and finish as cabinet.

D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim.

E. Cabinet Trim Material: Stainless-steel sheet.

F. Door Material: Stainless-steel sheet.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Acrylic sheet.

1. Acrylic Sheet Color: Clear transparent acrylic sheet.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide manufacturer's standard.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Comply with the Los Angeles Fire Department Requirements.

a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door.
2) Application Process: Engraved.
3) Lettering Color: Black.
4) Orientation: Vertical.

K. Finishes:

1. Manufacturer's standard baked-enamel paint for the interior of cabinet.
2. Stainless Steel: No. 4.

2.3 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.

4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
1. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights, at heights acceptable to the Los Angeles Fire Department.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 13

SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to the Los Angeles Fire Department.

1.6 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. J. L. Industries, Inc.; a division of Activar Construction Products Group.
b. Larsen's Manufacturing Company.
c. Potter Roemer LLC.

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. J. L. Industries, Inc.; a division of Activar Construction Products Group.
b. Larsen's Manufacturing Company.

c. Potter Roemer LLC.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10 44 16

SECTION 12 24 13 - ROLLER SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes roller shades with manual and electrical shade operators.

> **NOTE:** Any window treatment is optional. Window treatment is used primarily to reduce heat gain into the building and to improve the readability of electronic signage during certain times of the day.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, operating instructions, and typical wiring diagrams including integration of motor controllers with building management system, audiovisual and lighting control systems as applicable.

B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension system members and attachment to building structure.
2. Ceiling-mounted or penetrating items including light fixtures, air outlets and inlets, speakers, sprinklers, recessed shades, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
3. Shade mounting assembly and attachment.
4. Size and location of access to shade operator, chain locations, motor, and adjustable components.
5. Minimum Drawing Scale: 1/4 inch = 1 foot (1:48).

D. Samples for Initial Selection: For each colored component of each type of shade indicated.

1. Include similar Samples of accessories involving color selection.

E. Samples for Verification:

1. Complete, full-size operating unit not less than 16 inches (400 mm) wide for each type of roller shade indicated.

2. For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. Shadecloth sample and aluminum finish sample as selected. Mark face of material to indicate interior faces.

3. For the following products:

    a. Shade Material: Not less than 3 inches (76 mm) square, with specified treatments applied. Mark face of material.

    b. Window Treatment Schedule: For roller shades. Use same designations indicated on Drawings.

F. Product Certificates: For each type of roller shade, signed by product manufacturer.

G. Qualification Data: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.

H. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:

1. Methods for maintaining roller shades and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
3. Operating hardware.
4. Motorized shade operator.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years experience in manufacturing products comparable to those specified in this section.

B. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

C. Flame-Resistance Ratings: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

D. Product Standard: Provide roller shades complying with WCMA A 100.1.

E. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing.

F. Shade cloth to “pass” indoor air quality / VOC testing as per ASTM D 5116-97 ASTM D 6670-01, USEPA-ETV (U.S. Environmental Protection Agency’s Environmental Technology Verification Protocol).

G. Shade Cloth: Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC9644, ATCC9645.

H. Shade Cloth to be constructed of a woven screen material consisting of yarns comprised of extruded vinyl coated Polyester core yarn as a composite Thermoplastic shade cloth that shall be sealed at the edges, assuring binding the core yarn to the coating at the cut edge to assure a sealed edge to substantially minimize raveling. Screen cloths to have inert core yarns: i.e. Fiberglass yarns shall not be acceptable.

I. Use only injection-molded Delrin engineered plastics by Dupont for all plastic components of shade hardware. Styrene based, PVC, or glass reinforced polyester thermo polymer plastics are not acceptable.

J. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

2. Locate mock-up in window designated by LAWA.

3. Do not proceed with remaining work until mock-up is accepted by LAWA.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in a window treatment schedule.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 WARRANTY

A. Roller Shade Hardware, Chain and Shadecloth; Manufacturer's standard fit-for-use, including normal wear & tear,, non-depreciating, Limited Lifetime twenty-five year warranty. Warranty to transfer to owner upon completion of installation.

B. Roller Shade Motors and Motor Control Systems: Manufacturer's standard non-depreciating eight-year warranty.

PART 2 - PRODUCTS

2.1 ROLLER SHADES

A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated in Drawings or a comparable product by one of the following:

1. MechoShade Systems, Inc (MechoShade), as basis of design, performance and warranties, or equal.

B. Shade Band Material: The selection of density and color of sunscreen shadecloth shall be based on the relationship with the specified glass, in accordance with the specific project requirements for reducing heat loads and glare.

1. Fabric Width: As per manufacturer's standard.
2. Pattern: As per manufacturer's standard.
3. Colors: As per manufacturer's standard.
4. Material Openness Factor: As per manufacturer's recommendation for specified glass type and applicable conditions.
5. Bottom Hem: Fabric wrapped and electronically sealed at ends. **Sewn hems and open hem pockets are not acceptable.**

C. Rollers: Extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" snap-off" spline mounting, without having to remove shade roller from shade brackets. Mounting spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.

D. Provide shade hardware system that allows multi-banded shades to be capable of smooth operation when the axis is offset a maximum of 6 degrees on each side of the plane perpendicular to the radial line of the curve, for a 12 degrees total offset.

E. Direction of Roll: Reverse or regular roll, as required. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all manual shade drive end brackets. Universal offset shall be adjustable for future change.

F. Mounting Brackets: Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel or heavier as required to support 150 percent of the full weight of each shade.

1. Bracket shall be fully integrated with all accessories, including, but not limited to: fascia, room darkening side / sill channels, center supports and connectors for multi-banded shades.
2. Drive sprocket and brake assembly shall rotate and be supported on a welded 3/8 inch (9.525 mm) steel pin.
3. The brake shall be an over - running clutch design which disengages to 90 percent during the raising and lowering of a shade. The brake shall withstand a pull force of 50 lbs. (22 kg) in the stopped position.

4. The braking mechanism shall be applied to an oil-impregnated hub on to which the brake system is mounted. The assembly shall be permanently lubricated. Products that require externally applied lubrication and or not permanently lubricated are not acceptable. The entire assembly shall be fully mounted on the steel support bracket, and fully independent of the shade tube assembly, which may be removed and reinstalled without effecting the roller shade limit adjustments.

G. Drive Chain: #10 qualified stainless steel chain rated to 90 lb. (41 kg) minimum breaking strength. **Nickel plated steel chain shall not be accepted.**

H. Roller Shade Pocket for recessed mounting in acoustical tile, or drywall ceilings.
1. Provide either extruded aluminum and or formed steel shade pocket, sized to accommodate roller shades, with exposed extruded removable closure panel to provide access to shades.
2. For open return air plenum, provide "Vented Pocket" such that there will be a minimum of four 1 inch (25.4 mm) diameter holes per foot allowing the solar gain to flow above the ceiling line.
3. Provide pocket end caps where required.

I. Fascia:
1. Continuous removable extruded aluminum fascia that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners. Fascia shall be able to be installed across two or more shade bands in one piece. Fascia shall fully conceal brackets, shade roller and fabric on the tube. Provide bracket / fascia end caps where mounting conditions expose outside of roller shade brackets. Notching of Fascia for manual chain shall not be acceptable.
a. Color: Selected from manufacturer's standard colors.

~~J.~~ Manual Operation: Chain locations to be on right hand side of user.

2.2 ROLLER SHADE FABRICATION

A. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise. Fabricate shadecloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8 inch (3.18 mm) in either direction per 8 feet (2438 mm) of shade height due to warp distortion or weave design.

B. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting roller, and operating hardware and for hardware position and shade mounting method indicated.

C. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

D. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

E. Colors of Metal and Plastic Components Exposed to View: As selected by Architect from manufacturer's full range, unless otherwise indicated.

2.3 MOTORIZED SHADE HARDWARE AND SHADE BRACKETS

A. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade.

B. Provide shade hardware system that allows for field adjustment of motor or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).

C. Provide shade hardware system that allows for operation of multiple shade bands offset by a maximum of 8-45 degrees from the motor axis between shade bands (4-22.5 degrees) on each side of the radial line, by a single shade motor (multi-banded shade, subject to manufacturer's design criteria).

2.4 SHADE MOTOR DRIVE SYSTEM

A. Shade Motors: Tubular, asynchronous (non-synchronous) motors, with built-in reversible capacitor operating at 110v AC (60hz), single phase, temperature Class A, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each motor. Conceal motors inside shade roller tube. Maximum current draw for each shade motor of 2.3 amps. Use motors rated at the same nominal speed for all shades in the same room. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of the shade motor and tube assembly.

2.5 MOTOR CONTROL SYSTEMS

A. Specifications and design of shade motors and motor control system are based on a motor logic control system that provides all of the following performance capabilities. Motor logic control systems not in complete compliance with these performance criteria shall not be accepted as equal systems.
   1. Motor Control System:
      a. Provide power to each shade motor via individual 3 conductor line voltage circuits connecting each motor to the relay based motor logic controllers.
      b. Control system components shall provide appropriate (spike and brown out) over-current protection (+/- 10 percent of line voltage) for each of the four individual motor circuits and shall be rated by UL or ETL as a recognized component of this system and tested as an integrated system.
      c. Motor control system shall allow each group of four shade motors in any combination to be controlled by each of four local switch ports, with up to fourteen possible "sub-group" combinations via local 3 button wall switches and all at once via a master 3 button switch. System shall allow for overlapping switch combinations from two or more local switches.

d. Multiple "sub-groups" from different motor control components shall be capable of being combined to form "groups" operated by a single 3 button wall switch, from either the master port or in series from a local switch port.
e. Each shade motor shall be accessible (for control purposes) from up to four local switches and one master switch.
f. Control system shall allow for automatic alignment of shade hem bars in stopped position at 25 percent, 50 percent, and 75 percent of opening heights, and up to three user-defined intermediate stopping positions in addition to all up / all down, regardless of shade height, for a total of five positions. Control system shall allow shades to be stopped at any point in the opening height noting that shades may not be in alignment at these non-defined positions).
g. Control system shall have two standard operating modes: Normal mode allowing the shades to be stopped anywhere in the window's opening height and uniform mode, allowing the shades to only be stopped at the predefined intermediate stop positions. Both modes shall allow for all up / all down positioning.
h. Control system components shall allow for interface with both audiovisual system components and building fire and life safety system via a dry contact terminal block.
i. Control system components shall allow for interface with external analog input control devices such as solar activated controllers, 24 hour timers, and similar items; via a dry contact terminal block.
j. Reconfiguration of switch groups shall not require rewiring of the hardwired line voltage motor power supply wiring, or the low voltage control wiring. Reconfiguration of switch groups shall be accomplished within the motor control device.

2. Wall Switches:
   a. Three-button architectural flush mounted switches with metal cover plate and no exposed fasteners.
   b. Connect local wall switches to control system components via low voltage (12V DC) 4-conductor modular cable equipped with RJ-11 type connectors supplied, installed and certified.
   c. Connect master wall switches to control system components via low voltage (12V DC) 6-conductor modular cable equipped with RJ-12 type connectors supplied, installed and certified.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions. Allow clearances for window operation hardware.

B. Installer shall train LAWA's maintenance personnel to adjust, operate and maintain roller shade systems.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by LAWA, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train LAWA's maintenance personnel to adjust, operate, and maintain roller shades.

END OF SECTION 12 24 13

SECTION 14 20 00 – VERTICAL TRANSPORTATION, GENERAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes vertical transportation for the entire project. The vertical transportation work includes, but is not limited to the, following:

1. All elevator work.
2. All escalator work.
3. All moving walk work.
4. Anchors, embedments, shims, fasteners, inserts, hoisting equipment, fall protection/prevention tie-offs, expansion devices, accessories, support brackets, hoist beams, temporary work platforms, backing and attachments for the above.
5. All testing for the above.
6. CCTV, security system, and BMS components will be incorporated into the vertical transportation work. Coordinate with the CCTV, security system, and BMS component contractors to incorporate CCTV, security system, and BMS components and interface requirements during the course of the Work.

NOTE: During any retrofit, LAWA is to be provided the opportunity to identify any parts they deem beneficial for use at another LAWA location. The Design Professional and Contractor shall work directly with LAWA staff, to identify any salvageable parts and their respective handling requirements.

B. Related work specified elsewhere includes, but is not limited to, the following:
1. Elevator Hoistway and Pit:

a. Clear, plumb, substantially flush hoistway with variations not to exceed 1" at any point.
b. Bevel cants not less than 75° from the horizontal on any rear or side wall ledges and beams that project or recess 2" or more into the hoistway. Not required on hoistway divider beams.
c. Divider beams between adjacent elevators at each floor, pit, and overhead. Supports at each floor for car and counterweight guide rail fastening including supports for car guide rail fastening above top landing. Intermediate car guide rail support when floor heights exceed 14'-0" or as designated on contract drawings. Intermediate counterweight guide rail supports where floor heights exceed 16'-0". Provide rail bracket supports as required to meet Code required bracket spacing and/or Installer needs. Building supports not to deflect in excess of 1/8" under normal conditions, 1/4" under applicable seismic conditions.
d. Continuous vertical car and counterweight guide rail support between floors shown on Contract documents full height of hoistway.

e. Installation of guide rail bracket supports in concrete. Inserts or embeds, if used, will be furnished under Division 14.
f. Hoist machine supports including two (2) additional horizontal supports above the top terminal landing on the machine side of the hoistway. Locate as required for selected providers' equipment.
g. Wall blockouts and fire rated closure for control and signal fixture boxes which penetrate walls.
h. Cutting and patching walls and floors.
i. Concrete wall pockets and/or structural steel beams for support of hoist machine, rope sheaves, and dead-end hitch beams. Support deflection shall not exceed 1/1666 of span under static load.
j. Erect front hoistway wall after elevator entrances are installed.
k. Grout floor up to hoistway sills and around hoistway entrances.
l. Lockable, self-closing, fire-rated pit door, if pit depth exceeds 10'-0" (3.048 m).
m. Pit access ladder for each elevator and pit divider screens.
n. Structural support at pit floor for buffer impact loads, guide rail loads.
o. Waterproof pit. Indirect waste drain or sump with flush grate and pump. Locate sump pump outside of hoistway/pit.
p. Protect open hoistways and entrances during construction per OSHA Regulations.
q. Protect car enclosure, hoistway entrance assemblies, and special metal finishes from damage.
r. Hoistway smoke relief venting or hoistway pressurization for smoke control.
s. Hoist machine ventilation, heating and/or cooling. Maintain minimum temperature of 55°F, maximum 90°F at the location of the hoist machine.
t. Seal fireproofing to prevent flaking.
u. Glass enclosed hoistways. Laminated glass to meet the requirements of ANSI Z97.1. Interior ledges created by glass mullions not to exceed 4".
v. Access ladders and platform to governor(s), if required.

2. Elevator Control Room and Machinery Spaces:

a. Enclosure with access. Provide ships ladder or stair with guard railing. Include similar access to overhead machinery space.
b. Self-closing and locking access door.
c. Ventilation and heating. Maintain minimum temperature of 55° F, maximum 90° F. Maintain maximum 80% relative humidity, non-condensing.
d. Paint walls and ceiling.
e. Class "ABC" fire extinguisher in each elevator controller space.
f. Seal fireproofing to prevent flaking.
g. Self-closing and locking governor access door and access means.
h. Fire sprinklers.

3. Elevator Electrical Service, Conductors and Devices:

a. Lighting and GFCI convenience outlets in pit, controller space, and overhead machinery spaces. Provide one additional non-GFCI convenience outlet in pit for sump pump.
b. Three-phase mainline copper power feeder to terminals of each elevator controller in the controller space with protected, lockable "open," disconnecting means.

c. Single-phase copper power feeder to each elevator controller for car lighting and exhaust blower with individual protected, lockable "open," disconnecting means located in the controller space.

d. Emergency telephone line to each individual elevator control panel in elevator controller space.Fire alarm initiating devices in each elevator lobby, for each group of elevators or single elevator and each controller space to initiate firefighters' return feature. Device at top of hoistway if sprinklered. Provide alarm initiating signal wiring from hoistway or controller space connection point to elevator controller terminals. Device in machine room and at top of hoistway to provide signal for general alarm and discrete signal for Phase II firefighters' operation.
e. Temporary power and illumination to install, test, and adjust elevator equipment.
f. Category 6 (distance≤300 feet) or Fibre Optic (distance >300 feet) Ethernet connection and junction box in each elevator machine room space.
g. Firefighters' telephone jack and announcement speaker in car with connection to individual elevator control panels in the controller space and elevator control panel in firefighters' control room.
h. Conduit from the closest hoistway of each elevator group or single elevator to the firefighters' control room and/or main control console. Coordinate size, number, and location of conduits and junction boxes with Elevator Contractor.
i. Means to automatically disconnect power to affected elevator drive unit and controller prior to activation of the controller space fire sprinkler system, and/or hoistway fire sprinkler system. Manual shut-off means shall be located outside bounds of the controller space.
j. When sprinklers are provided in the hoistway all electrical equipment, located less than 4'-0" above the pit floor shall be identified for use in wet locations. Exception, seismic protection devices.
k. Single-phase power feeders to main control console and firefighters' control panel.
l. Single-phase power feeder to elevator intercom amplifier in the elevator controller space.
m. Single-phase power feeders to controller(s) for CCTV with lockable "open" disconnecting means.
n. 10 footcandles illumination level in elevator lobbies of elevator threshold.

4. Elevator Standby Power Provision:

a. Standby power of normal voltage characteristics via normal electrical feeders to run one elevator at a time in each elevator group and/or single elevator unit at full-contract car speed and capacity.
b. Conductor from auxiliary form "C" dry contacts, located in the standby power transfer switch to a designated elevator control panel in each elevator group and/or single elevator unit. Provide a time delay of 30 - 45 seconds for pre-transfer signal in either direction.
c. Standby single-phase power to group controller, and each elevator controller for car lighting, exhaust blower, emergency signaling device, intercom amplifier and hoist machine cooling fan.
d. Means for absorbing regenerated power during an overhauling load condition per NEC 620.91. Elevator(s) will employ IGBT drive, presenting a non-linear active load.
e. Standby power to hoist machine and control room ventilation or air conditioning.
f. Standby power to emergency communications device(s).

5. Escalator Wellway and Pit

a. Clear, plumb, wellway with variations not to exceed 1" at any point.
b. Floor pockets and/or structural beams for support of escalator truss at each end and at intermediate locations as shown on Architect's drawings. Steel supports, if used, shall meet deflection requirements of AISC Specifications for Design, Fabrication, and Erection of Structural Steel for Buildings.
c. Fire rated enclosure of escalator truss including ends, sides and bottom in ceiling plenum.
d. Patching and finishing around escalator landing plates after installation.
e. Cladding and finishing of exposed truss surfaces.
f. Waterproof pit. Sump pit with flush grate and pump or indirect waste drain with oil separator for outdoor units.
g. Protect exposed exterior escalators with weatherproof canopy entire length of truss per Code.
h. Protect open wellways during construction per OSHA Regulations.
i. Protect escalator truss, steps, landing plates, balustrades, handrails, and special metal finishes from damage.
j. Venting or other means to prevent accumulation of smoke and gas in escalator truss as required by Local Building Code.
k. Fire sprinklers per local Code requirement with protective guards.
l. Finished flooring surrounding floor landing plates. All patching of flooring including floor covering adjacent to the escalators. Any damage caused by the Contractor shall be replaced at no additional cost to LAWA. Expansion joint treatment at the lower escalator support to accommodate sliding escalator attachment.
m. Well way railing at top openings, pit edge angles and pit drains.

6. Escalator Electrical Service, Conductors and Devices

a. Light with guard and GFCI convenience outlet in each pit and machine room space.
b. Three phase mainline copper power feeder to terminals of each escalator controller in the machine room space with protected, lockable "open", disconnect switch. Auxiliary disconnect, as required, for multiple drive units.
c. Telephone and/or CATV Ethernet line to each individual escalator control panel in escalator machine space.
d. Supports, conduit and wall blockouts for remote controller installations.
e. Fire alarm initiating devices in each escalator pit. Provide alarm initiating signal wiring from connection point to escalator controller terminals. Device to provide signal for general alarm and interruption of escalator operation.
f. Temporary power and illumination to install, test, and adjust escalator equipment.
g. Category 6 (distance≤300 feet) or Fibre Optic (distance >300 feet) Ethernet connection and junction box in each escalator machine room space.
h. Conduit from the closest wellway of each escalator group or single escalator to the firefighters' control room and/or the control console. Coordinate size, number and location of conduits and junction boxes with escalator contractor.
i. Single phase copper power feeder to each lower end intermediate location, and upper end escalator pit for under handrail lighting with individual protected, lockable "open", disconnect switch located in machine room space.

7. Moving Walk Wellway and Pit

    a. Clear, plumb, wellway with variations not to exceed 1" at any point.
    b. Floor pockets and/or structural beams for support of moving walk truss at each end and at intermediate locations as shown on drawings. Steel supports, if used, shall meet deflection requirements of AISC Specifications for Design, Fabrication, and Erection of Structural Steel for Buildings.
    c. Fire rated enclosure of moving walk truss including ends, sides and bottom in ceiling plenum.
    d. Patching and finishing around moving walk landing plates after installation.
    e. Cladding and finishing of exposed truss surfaces.
    f. Waterproof pit. Sump pit with flush grate and pump or indirect waste drain with oil separator for outdoor installations.
    g. Protect exposed exterior moving walks with weatherproof canopy entire length of truss per Code.
    h. Protect open wellways during construction per OSHA Regulations.
    i. Protect moving walk truss, pallets, landing plates, balustrades, handrails, and special metal finishes from damage.
    j. Venting or other means to prevent accumulation of smoke and gas in moving walk truss as required by Local Building Code.
    k. Fire sprinklers per local Code requirement with protective guards.
    l. Finished flooring surrounding floor landing plates. All patching of flooring including floor covering adjacent to the moving walks. Any damage caused by the Contractor shall be replaced at no additional cost to LAWA.

8. Moving Walk Electrical Service, Conductors and Devices

    a. Light with guard and GFCI convenience outlet in each pit and machine room space.
    b. Three phase mainline copper power feeder to terminals of each moving walk controller in the machine room space with protected, lockable "open", disconnect switch. Auxiliary disconnect, as required, for multiple drive units.
    c. Telephone and/or CATV Ethernet line to each individual moving walk control panel in moving walk machine space.
    d. Supports, conduit and wall blockouts for remote controller installations.
    e. 10 footcandles minimum illumination escalator landings and along the entire escalator run.
    f. Fire alarm initiating devices in each moving walk pit. Provide alarm initiating signal wiring from connection point to moving walk controller terminals. Device to provide signal for general alarm and interruption of moving walk operation.
    g. Temporary power and illumination to install, test, and adjust moving walk equipment.
    h. Category 6 (distance≤300 feet) or Fibre Optic (distance >300 feet) Ethernet connection and junction box in each moving walk machine room space.
    i. Conduit from the closest wellway of each moving walk group or single moving walk to the firefighters' control room and/or the control console. Coordinate size, number and location of conduits and junction boxes with moving walk contractor.

j. Single phase copper power feeder to each lower end intermediate location, and upper end moving walk pit for under handrail lighting with individual protected, lockable "open", disconnect switch located in machine room space.

1.2 QUALITY REQUIREMENTS

A. Manufacturer Qualifications: Award the fabrication of the vertical transportation work to one of the following firms who are specialized in the fabrication of vertical transportation equipment and who have successfully produced work similar in design and extent to that required for the project:

1. Schindler Elevator Corporation
2. Otis Elevator Company.
3. KONE Inc.
4. Substitutions: Other manufacturer's products may be incorporated into the Work if approved by LAWA.

B. Installer Qualifications: Engage the vertical transportation manufacturer or an experienced Installer approved by the vertical transportation manufacturer who has completed not less than 3 elevator, escalator, and moving walk installations similar in material, design, and extent to that indicated for this Project, as determined by LAWA, for a period of 5 years and with a record of successful in-service performance and who is acceptable to LAWA.

C. Contractor's Statement: The Contractor shall furnish a statement giving a complete description of all parts wherein the vertical transportation systems that he proposes to furnish do not comply with these specifications, or are in conflict with the Contract Documents. Failure to furnish such a statement will be interpreted to mean that the Contractor agrees to meet all requirements of this specification, and any conflicts with the work of other trades brought about by the use of the selected manufacturer's equipment will not result in any added cost to LAWA.

D. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of California and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of elevators and escalators that are similar to those indicated for this Project in material, design, and extent.

E. Standards: The following standards shall govern the vertical transportation work. Where standards conflict, that standard with the more stringent requirements shall be applicable.

1. Elevator, Escalator and Moving Walk Code: In addition to requirements of authorities having jurisdiction, comply with the latest edition of ASME A17.1, "Safety Code for Elevators and Escalators", ASME A17.2 “Guide for Inspection of Elevators, Escalators and Moving Walks”, and ASME A17.5 “Requirements for Elevator and Escalator Electrical Equipment”, including supplements, as published by the American Society of Mechanical Engineers. Wherever “Code” is referred to in the vertical transportation specifications, the ASME A17.1 Code shall be implied.

a. The vertical transportation systems shall be designed to resist the seismic loads required under the 2007 California Building Code taking into account IBC Seismic Design Category, IBC Design Spectral Response Acceleration (SDS), IBC Importance Factory and Seismic Story Drift. Conform to the applicable portions of Section 8.4 'Elevator Safety Requirements for Seismic Risk Zone 2 or Greater' of ASME A17.1 and Section 8.5, "Escalator and Moving Walk Safety Requirement for Seismic Risk Zone 2 or greater" of ASME A17.1 also comply with CCR Title 8, Rules 3137(a) and 3137(d).

2. Electrical Code: For electrical Work included in the vertical transportation Work, comply with "National Electrical Code" (ANSI C1), by NFPA, all applicable local codes, and the Authorities having jurisdiction.
3. Welding: Comply with AWS standards.
4. Americans with Disabilities Act (ADA).
5. Local fire Jurisdiction.
6. Requirements of IBC and all other Codes, Ordinances and Laws applicable within the governing jurisdictions.
7. Life Safety Code, NFPA 101 and CCR Title 19.
8. California Code of Regulations Title 8 and California Building Code Title 24.
9. City of Los Angeles Elevator Code.

F. Electrical Devices and Equipment:

1. Elevators:

a. Furnish and install all necessary wiring for proper operation of the equipment including conduit and fittings for machine rooms beginning at the light and power outlets furnished under Division 26 ELECTRICAL sections. Include all wiring and connections required to elevator devices remote from hoistway and between elevator machine rooms. Provide additional components and wiring to suit machine room layout.
b. Provide grounded metal shielded GFCI receptacles for work lights on the underside of each platform and the crosshead of each car.

2. Escalators/Moving Walk:

a. Furnish and install all necessary wiring for proper operation of the equipment including all wiring, conduit and fittings beginning from the disconnect switch in the escalator machine space to all electrified escalator equipment.
b. Install all conductors, except control panel wiring, in rigid conduit except short connections where equipment may require shifting for adjustments. Conduit shall be liquid tight on outdoor installations. Such wiring shall be installed in liquid tight flexible metal conduit not exceeding 6' in length.
c. Provide flame retardant panel wiring.
d. Provide grounded metal shielded GFCI receptacles for work lights in the upper and lower pit areas.

3. All electrical and wiring interconnections shall comply with the governing codes, ASME A17.1, ASME A17.5 and NFPA 70.

    a. Conductors: Copper throughout with individual wires coded and all connections at accessible, numbered terminal blocks and connected with lugs and pressure connectors. Use no splices or similar connections in wiring except at terminal blocks, control cabinets, junction boxes and conduits. Provide 10% spare conductors throughout.
    b. Elevator Traveling Cables: All wiring shall be insulated with a moisture-proof, flame retardant, outer covering. Non-traveling cable hoistway wiring shall be run in tubing, conduit, or electrical wireways. Provide flexible traveling cables which are properly suspended to relieve stress on individual cables. Provide six (6) pairs of 18 ga. shielded wire in the traveling cables for telephone or other electronic equipment in the car. Provide 10% spare conductors. Provide four space pair of shielded communication wires. Terminate them to barrier-type terminal strip behind each elevator return panel at one end of cable and within a machine room security junction box. Provide two RG-6 traveling coax cables for CCTV equipment in the car. Provide two pair 14 gauge wires for CCTV power. Prevent traveling cables from rubbing or chafing against hoistway or car items.
    c. Conduit and Fittings: Galvanized steel conduit. Minimum conduit size shall be 3/4" diameter unless larger size is required per NFPA 70 for use intended. Fittings may be steel compression type unless otherwise permitted or required by NFPA 70.

G. Testing and Inspections: Advise LAWA in advance of dates and times that tests and inspections are to be performed.

1. Regulatory Testing and Inspections: Upon nominal completion of each elevator, escalator, and moving walk installation, and before permitting use of the same (either temporary or permanent), perform tests as required and recommended by the "Code" and applicable law. Verification that such tests have been completed, all corrective work accomplished and installation approved for issuance of a permit or certificate to operate, shall be required before acceptance of each unit.

    a. Before final acceptance, the Contractor shall furnish permits, or certificates, by the Building Department or other City, County or State departments having legal jurisdiction, as required to allow the use of each unit. All certificates shall be furnished to LAWA through the Contractor.

2. Acceptance Testing: Upon completion of each elevator, escalator and moving walk installation and before final acceptance, make a contract load test of each in the presence of the local authorities having jurisdiction with full maximum load, (or in accordance with local code requirements) to determine whether the equipment as installed meets the speed, capacity and all other requirements of the specifications.

H. Manufacturer Labeling: Names, trademarks and other identifying symbols shall not be permitted on surfaces visible to the public.

I. Obtain and pay for permits, fees, licenses, and inspections necessary to complete the vertical transportation installations.

1.3 SUBMITTALS

A. Submit shop drawings and required material samples for review in accordance with Section SPECIAL CONDITIONS, Submittals. Include certification or other data verifying compliance with required characteristics. Indicate by transmittal form that copy of each has been distributed to the installer.

1. Scaled Fully Dimensioned Layout: Plan of pit, hoistway, wellway and machine room indicating equipment arrangement, elevation section of hoistway, and wellway, details of car enclosures, hoistway entrances, car/hall signal fixtures, and seismic attachments.
2. Design Information: Indicate equipment lists, reactions, and design information on layouts.
3. Power Confirmation Information: Design for existing conditions for Elevators, Escalators and Moving Walks. Provide complete power data submittals including heat emission data.
4. Fixtures: Cuts, samples, or shop drawings.
5. Finish Material: Submit 3" x 12" samples of actual finished material for review of color, pattern, and texture. Compliance with other requirements is the exclusive responsibility of the Provider. Include, if requested, signal fixtures, lights, graphics, Braille plates, and detail of mounting provisions.
6. Design Information: Provide calculations verifying the following;

    a. Adequacy of existing electrical provisions.
    b. Adequacy of retained equipment relative to Code requirements if car weight increased by more than 5%.
    c. Machine room heat emissions in B.T.U.' s.
    d. Adequacy of existing retained elevator machine beams and escalator supports.
    e. Adequacy of existing car platform structure for intended loading.

B. Senate Bill 1886 Submittals: Provide copies of all Code Authority/Permit submittals to the Architect.

C. Submittal review shall not be construed as an indication that submittal is correct or suitable, nor that the work represented by submittal complies with the Contract Documents. Compliance with Contract Documents, Code requirements, dimensions, fit, and interface with other work is Provider's responsibility.

D. Acknowledge and/or respond to review comments. Promptly incorporate required changes due to inaccurate data or incomplete definition so that delivery and installation schedules are not affected. Identify and cloud drawing revisions, including Provider elective revisions on each re-submittal. Revision response time is not justification for equipment delivery or installation delay.

E. Perform review and evaluation of all aspects of its work prior to requesting Design Consultant's final review. Work shall be considered ready for Consultant's final contract compliance review

when copies of Provider's test and review sheets are available for Design Consultant's review and all elements of work or a designated portion thereof are in place and a unit or group are deemed ready for service as intended.

F. Documents required prior to final payment:

1. Provide three sets of neatly bound written information necessary for proper maintenance and adjustment of equipment within 30 days following final acceptance of the project. Final retention will be withheld until data is received, accepted, and approved by Engineer and reviewed by Design Consultant. Include the following as minimums:

    a. Straight line wiring diagram of "as installed" circuits, with index of location and function of components. Provide one reproducible master set. Mount one set wiring diagrams on panels, racked, or similarly protected, in machine room. Provide remaining set rolled and in a protective drawing tube. Maintain machine room set with addition of all subsequent field changes. These diagrams are LAWA's property.
    b. Lubricating instructions, including recommended grade of lubricants.
    c. Parts catalogs for all replaceable parts including ordering forms and instructions.
    d. Four sets of neatly tagged keys for all switches and control features properly tagged and marked.
    e. Neatly bound instructions explaining all operating features including all apparatus in the car, exterior escalator and moving walk switches and remote control panels.
    f. Neatly bound maintenance and adjustment instructions explaining areas to be addressed, methods and procedures to be used and specified tolerances to be maintained for all equipment.
    g. Diagnostic test device complete with access codes, adjusters manuals and set-up manuals for adjustment, diagnosis and troubleshooting of elevator system and performance of routine safety tests.

2. Preventive Maintenance Contract: Furnish properly executed contract for continuing, preventive maintenance. Utilize contract form provided, by LAWA.
3. Acceptance of such records by LAWA/Design Consultant shall not be a waiver of any Provider deviation from Contract Documents or shop drawings or in any way relieve Provider from his responsibility to perform work in accordance with Contract Documents.

G. Materials, And Tools: General: Within sixty days following initial acceptance of the elevator/escalator/moving walk installation, provide written information and diagnostic tools necessary for proper maintenance and adjustment of the equipment, as follows:

1. Provide two copies and one mylar reproducible of all wiring diagrams, including straight-line wiring diagrams of all "as built and installed" elevator electrical circuits with index of location and function of all components. Provide logic diagram for all microprocessors. NOTE: Leave one complete set of corrected installation diagrams and wiring dope sheets on the job for each unit.
2. Provide two copies of all "final" construction and installation drawings.
3. Provide three neatly bound and indexed sets of the following:

a. Sequence of operation and/or floor charts of the motion control and supervisory control panels, and related operating equipment, including individual and group microprocessors.
b. Operating instructions and complete, detailed adjustment and application data and instructions for all equipment components including controller, microprocessor, selectors, motors, drives, valves, switches, etc.
c. Lubricating instructions, including recommended grade of lubricants.
d. Parts catalogs for all replaceable parts, including ordering forms and instruction. If a given component is made up of smaller parts, the smaller parts shall also be clearly identified by number.
e. Provide a summary of contract data for each type of equipment furnished, including quantity and part number.
f. Supplemental data required or requested by LAWA to facilitate equipment maintenance and adjustment.

4. Provide all special tools, including top-level solid-state diagnostic equipment, which the Manufacturer and Installer supplies to his adjusters and service personnel for proper maintenance and adjustment of all equipment. Special tools shall become the property of LAWA. NOTE: If solid-state microprocessor or group supervisory diagnostic equipment and/or tools are not available for sale Elevator Contractor shall quote LAWA on lease or rental of this equipment, including acceptable terms. Quote as a separate item.
5. The following supplemental information will be required by LAWA for this project.

a. Step-by-step adjusting procedures, as used by elevator Manufacturer's/Installer's field adjustor, for each type of equipment used in this specific installation. This shall include, but not be limited to the following:

1) Selectors / encoders.
2) Brakes: Shoe clearance, core clearance, brake switch, brake torque and all other adjustments necessary to give a satisfactory functioning brake.
3) Controllers: Relay air gaps, current operated relays, timed circuits, set-reset relays, and all other necessary adjustments and settings.
4) Electronic devices and circuits.
5) Dispatching controller: Timed circuits, etc.
6) Computer type dispatcher: Data and procedure to change settings.
7) Overload relays: Current settings upon tripping, testing and maintenance procedures.
8) Acceleration and deceleration patterns, including time and slow-down settings.
9) Governor: Over-speed switch. Jaw pull-through in pounds.
10) Hydraulic elevators: Pump flow and leveling control valves, relief valves, and jack packing gland.
11) Hoistway switches and cams.
12) Terminal landing slow down device.
13) Leveling and re-leveling units in hoistway.
14) Load compensation: Load weighing device settings and load compensation adjustments.

15) Safeties: Clearance to rails and pull out in pounds for the releasing carrier. Setting of safety operated switch.
16) Door protective devices: Focusing, testing, maintenance, and adjusting procedures.
17) Roller guides: Spring tension and stop settings.
18) Motors: Air gap, compounding, neutral setting and all other necessary adjustments.
19) Door operator and doors: Door operator control switches, door operator control potentiometers or resistances, door motor, door checks, door closers, door and gate locks, clutches/bayonets, door unlocking cams, encoders, and door restrictors.
20) Communications, annunciating, and security systems.
21) Escalator Safety devices
22) Escalator Code clearances

b. List of necessary tools, instruments, and other equipment used in the adjusting procedure, including method for incorporating them in procedures.
c. Final adjusting data for each elevator/escalator/moving walk, including, but not limited to, settings for the following:

1) Load compensation sensing device in voltage or current for empty fully loaded car.
2) Selectors/encoders.
3) Brakes: Shoe running clearance and brake coil current. Escalator brake torque settings.
4) Hatch switches and devices.
5) Door operator control switch settings.
6) Safety device: Full-load, full-speed, test data.
7) Full-load starting and running current.
8) Current settings or current operated relays.
9) Motor field resistance settings.
10) Timers: Time delay settings, including method and equipment needed to program microprocessor.
11) Electronic power supply voltages necessary for correct functioning of equipment and from where measured.
12) Skirt/Step clearance settings.
13) Safety switch settings.

6. Warranty: Submit a copy of the following written warranty for the vertical transportation work. The Contractor will correct defects and non-compliant work which develop or become known within one year from the date of acceptance by LAWA to the satisfaction of LAWA at no additional cost. Make modifications, adjustments, improvements, etc., to meet the specified performance requirements. No earlier than 1 month prior to the conclusion of the warranty period each elevator, escalator, and moving walk, will be inspected jointly by LAWA, and the Contractor. All maintenance and warranty deficiencies requiring correction by the Contractor shall be mutually agreed to at this time. A written report shall be provided by LAWA detailing the required actions.

a. The warranty shall not deprive LAWA of other rights LAWA may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.Elevator/Escalator Maintenance Agreement: Provide full preventative maintenance service of the elevator equipment for a period of 12-months from the date of acceptance by LAWA. This service shall include a monthly examination of not less than 1 hour per examination per hydraulic elevator, a semi-monthly (twice per month) examination of each traction elevator, of not less than 1 hour and a weekly examination of each escalator/moving walk of not less than 1 hour by competent and trained personnel and shall include all necessary adjustments, greasing, oiling, cleaning, supplies, and replacements of parts to keep the equipment in perfect operation, except such parts made necessary by negligence not caused by this Contractor. Use parts and supplies as used in the manufacture and installation of original equipment. All costs in connection with such maintenance shall be included in the agreement price.

b. Include 24 hour per day, 7 day per week emergency Call Back Service for all elevators, escalators and moving walks should operational problems or shut downs develop between service periods.

    1) Response Time: Two hours or less.

c. Take equipment out of service for scheduled routine preventative maintenance during non-peak usage of the equipment, as approved by LAWA.
d. Perform preventative maintenance during regular working hours.
e. Require service and emergency personnel to report to the LAWA representative on site upon arrival at the building and again on completion of the required work. Furnish a copy of the work ticket containing a complete description of the work performed to the County's representative.
f. Maintain a preventative maintenance checklist in the machine room to itemize individual component parts, as determined by the original equipment manufacturer, which require weekly, monthly, quarterly or yearly inspection. Include on the checklist the building name, elevator/escalator serial numbers, examination or service frequency, examination hours, individual elevator/escalator components examined or serviced.
g. Maintain an inventory at all times and available for immediate delivery and installation, a sufficient supply of emergency parts for repair of each unit. Provide materials or parts to be used which are genuine original manufacturer’s renewal parts.
h. Regularly and systematically examine, inspect, properly adjust, clean, lubricate, and if conditions warrant, repair or replace, all mechanical, structural and electrical elevator and escalator/moving walk equipment components, including, but not limited to, the following:

    1) Controller, selector, dispatching equipment, solid state drive units and all related equipment, including but not limited to relays, solid state components, resistors, condensers, transformers, contacts, leads, overloads, dash pots, timing devices, computer devices, selectors components, cables,

safety devices and tapes and all switches in the machine rooms, hoistways, wellways and pits.

2) Motors, including but not limited to, windings, rotating elements, bearings, brakes and gear boxes.
3) Door operating equipment, including but not limited to, operators, interlocks, gate switches, hangers, tracks, rollers, door gibs and closers.
4) Bull gears, sheaves and pulleys including bearings and shafts.
5) Car guide rails, guide rail brackets and backing, guide rail lubricators, buffers, buffer supports, guide shoes, guide shoe mounts, guide shoe rollers and guide shoe gibs.
6) Car frame, platform and sill, including all related components.
7) Car and corridor operating and signal fixtures components, including light bulbs.
8) Car fan and emergency lighting units.
9) Electric wiring and traveling cables necessary for the operation of the elevators equipment and associated accessory equipment.
10) Hydraulic cylinders, plungers, packing, and related components.
11) Pump unit and all related components, including but not limited to tank, filters, strainers, pumps, motors, belts, pipe, valves and all component parts thereof, muffler and scavenger pump.
12) Hydraulic oil.
13) All hydraulic piping, valves, and fittings.
14) Governor, including but not limited to governor sheave and shaft assembly, bearings, contacts, governor jaws and governor tension sheave assembly.
15) Escalator/Moving Walk tracks, chains, chain and step/pallet rollers, handrails, steps, pallets and safety devices.
16) Repair and replacement coverage is intended to be full and complete, and to include the cost of providing all elevator replacement components, including those not mentioned above.

i. Provide fireman's recall tests as required by the governing code.
j. Maintain the efficiency, safety and speeds of the equipment at all times, including acceleration, retardation, contract speed, with or without full load, floor to floor time, door opening and closing time. Maintain escalator hand rail speed within 2 fpm of step tread. Maintain the vertical transportation system monitoring system at all times.
k. Housekeeping: Provide and maintain industry standard parts cabinets for the orderly storage of replacement parts. Keep the premises free of accumulation of waste material or rubbish. Store combustible materials in closed metal containers. Regularly brush lint and dirt from the guiderails, car tops, bottom of platform and remove dirt, excess lubricant and accumulated rubbish from pits, and machine room floors. Take necessary actions to prevent oil and grease from creating unsightly appearances on the equipment and/or accumulating on the floor of equipment room, elevator pit, escalator pits, escalator steps, moving walk pits or pallets.

l. Clean all of the elevator/escalator/moving walk equipment. Cleaning of the equipment shall occur at regular intervals sufficient in frequency to maintain a professional appearance and preserve the life of the equipment. Perform complete clean down of escalator/moving walk interiors and elevator hoistways during the 11th month of Warranty Maintenance. Report to LAWA the need for cleaning and/or janitorial services for all items not covered by the Contract.Lubricate all moving parts of the equipment requiring lubrication. Apply lubricants at intervals recommended by the equipment manufacturer. Provide lubrication more frequently, if dictated through use of the equipment. Utilize lubricants suitable for the purpose intended that meet or exceed the minimum requirements specified by the manufacturer of the equipment to which the lubricant is applied. Remove and properly dispose of used and oily wiping materials from the building on the same day that they are used.

m. Adjust the equipment as necessary in accordance with the check list and when the operation of the equipment varies from its normal or originally designed performance standards. Utilize qualified individuals properly equipped with tools and instruments, employed by the installer for adjustments. Parts or assemblies which have worn (or otherwise deteriorated) beyond "normal" adjustment limits shall be replaced as provided for under the following paragraphs titled "Replace" and "Repair".

1) Replace: Replace items during the course of scheduled preventative maintenance, when such replacement will prevent an unscheduled equipment shutdown and/or ensure the continued safe normal operation of the equipment or which otherwise will extend the useful life of the equipment. Make all replacements using original manufacturer's parts or LAWA approved equals.

2) Repair:

a) Repairs which are the Responsibility of the Installer: Make (or cause to made) all repairs stipulated herein, made necessary due to normal wear and use of the elevator or escalator/moving walk system. All costs for labor, materials, expanses, and supplies which occur as a result of the stated repair.

n. Periodic Tests: Perform periodic safety tests of the elevator and escalator/moving walk components, as required by Code. The periodic tests shall be conducted as indicated in the code. Test results shall be witnessed as required and recorded on forms supplied by or acceptable to LAWA. Provide certified copies of the completed test forms to LAWA. Coordinate the periodic testing with LAWA Inspection/Clean Down Procedure which is required once annually by LAWA.

7. Elevator/Escalator/Moving Walk Extended Preventative Maintenance Agreement: Quote monthly cost for a five year preventative maintenance agreement commencing upon completion of the warranty maintenance. Price adjustment will be made at Agreement commencement date and thereafter as provided in the Agreement. Use competent personnel, acceptable to LAWA, employed by and supervised by the equipment installer.
8. Escalator/Moving Walk Maintenance Agreement: Provide full preventative maintenance service of the equipment for a period of 12-months from the date of acceptance by

LAWA. This service shall include weekly examinations of not less than 1 hour per examination per escalator/moving walk by competent and trained personnel and shall include all necessary adjustments, greasing, oiling, cleaning, supplies, and replacements of parts to keep the equipment in perfect operation, except such parts made necessary by negligence not caused by this Contractor. Use parts and supplies as used in the manufacture and installation of original equipment. All costs in connection with such maintenance shall be included in the agreement price.

a. Include 24 hour per day, 7 day per week emergency Call Back Service for all escalators, and moving walks should operational problems or shut downs develop between service periods.

    1) Response Time: Two hours or less.

b. Take equipment out of service for scheduled routine preventative maintenance during non-peak usage of the equipment, as approved by LAWA.
c. Perform preventative maintenance service during regular working hours.
d. Require service and emergency personnel to report to LAWA's representative on site upon arrival at the building and again on completion of the required work. Furnish a copy of the work ticket containing a complete description of the work performed to the LAWA representative.
e. Maintain a preventative maintenance checklist in the machinery space to itemize individual component parts, as determined by the original equipment manufacturer, which require weekly, monthly, quarterly or yearly inspection. Include on the checklist the building name, equipment serial numbers, examination or service frequency, examination hours, individual escalator components examined or serviced. Make check list adjustment intervals frequent enough to maintain the escalators and moving walks in optimum operating condition.
f. Maintain an inventory at all times and available for immediate delivery and installation, a sufficient supply of emergency parts for repair of each unit. Provide materials or parts to be used which are genuine original manufacturers renewal parts.
g. Regularly and systematically examine, inspect, properly adjust, clean, lubricate, and if conditions warrant, repair or replace, all mechanical, structural and electrical escalator/moving walk equipment components, including, but not limited to, the following:

    1) Machine and related components including but not limited to thrust bearings, sprockets, gears, shafts, bearings, brake and component parts, motors, and chains.
    2) Controller and all related equipment, including but not limited to relays, solid state components, resistors, condensers, transformers, contacts, leads, overloads, dash pots, timing devices, computer devices, and mechanical and electrical driving equipment, including all switches.
    3) Motors, including but not limited to, windings, rotating elements and bearings.
    4) Handrails, brush guards, guide rollers, and alignment devices.
    5) Stop switches and related components.
    6) Conductor cables and wiring.

7) Truss, steps, step treads, pallets, wheels, rollers, axle bushings, comb plates and tracks.
8) All sprockets, chains and bearings.
9) Demarcation lighting.
10) Safety switches.
11) Step Demarcation
12) Repair and replacement coverage is intended to be full and complete, and to include the cost of providing all escalator and moving walk replacement components, including those not mentioned above.

h. Maintain the efficiency, safety and speeds of the equipment at all times. Maintain the vertical transportation system monitoring system at all times.

i. Housekeeping: Provide and maintain industry standard parts cabinets for the orderly storage of replacement parts. Keep the premises free of accumulation of waste material or rubbish. Store combustible materials in closed metal containers. Clean step treads, pallets, and comb plates on a monthly basis. Regularly brush lint and dirt from the units and remove dirt, excess lubricant and accumulated rubbish from pans, pits, and machine spaces. Take necessary actions to prevent oil and grease from creating unsightly appearances on the equipment and/or accumulating on pans in escalator, and moving walk pits.

j. Conduct weekly evaluations of equipment performance, including smoothness of ride, unusual vibration or noise, condition of handrails. Inspect comb plates at both ends of escalators for broken teeth and check for proper clearance between combs and step treads. Inspect comb plates at both ends of moving walks for broken teeth and check for proper clearance between combs and pallets. Check for broken step treads and check clearance between steps and skirt panel. Check for broken pallets and check clearance between pallets and skirt panel. Look for anything (loose trim, screws or bolts) that could snag or damage clothing and luggage, or cause injury. Check condition of handrail brushes. Proceed immediately to make, or cause to be made, replacements, repairs and corrections found as a result of the weekly evaluations.

k. Clean all of the escalator equipment. Cleaning of the equipment shall occur at regular intervals sufficient in frequency to maintain a professional appearance and preserve the life of the equipment. Report to LAWA the need for cleaning and/or janitorial services for all items not covered by the Contract.

l. Lubricate all moving parts of the equipment requiring lubrication. Apply lubricants at intervals recommended by the equipment manufacturer. Provide lubrication more frequently, if dictated through use of the equipment. Utilize lubricants suitable for the purpose intended that meet or exceed the minimum requirements specified by the manufacturer of the equipment to which the lubricant is applied. Remove and properly dispose of used and oily wiping materials from the building on the same day that they are used.

m. Adjust the equipment as necessary in accordance with the check list and when the operation of the equipment varies from its normal or originally designed performance standards. Utilize qualified individuals properly equipped with tools and instruments, employed by the installer for adjustments. Parts or assemblies which have worn (or otherwise deteriorated) beyond “normal” adjustment limits shall be replaced as provided for under the following paragraphs titled “Replace” and “Repair”.

1) Replace: Replace items during the course of scheduled preventative maintenance, when such replacement will prevent an unscheduled equipment shutdown and/or ensure the continued safe normal operation of the equipment or which otherwise will extend the useful life of the equipment. Make all replacements using original manufacturer's parts or LAWA approved equals.Repair:Repairs which are the Responsibility of the Installer: Make (or cause to made) all repairs stipulated herein, made necessary due to normal wear and use of the escalators, and moving walks. Absorb all costs for labor, materials, expanses, and supplies which occur as a result of the stated repair.

n. Periodic Tests: Perform periodic safety tests of the escalator, and moving walk components, as required by Code. The periodic tests shall be conducted as indicated in the code. Test results shall be witnessed as required and recorded on forms supplied by or acceptable to LAWA. Provide certified copies of the completed test forms to LAWA. Coordinate the periodic testing with LAWA.

9. Escalator/Moving Walk Extended Preventative Maintenance Agreement: Quote monthly cost for a five year preventative maintenance agreement commencing upon completion of the warranty maintenance. Price adjustment will be made at Agreement commencement date and thereafter as provided in the Agreement. Use competent personnel, acceptable to LAWA, employed by and supervised by the escalator installer.
10. Test Reports: Submit test results to governing authorities and to LAWA. Include computer generated events and results.
11. Maintenance and Operating Instructions: Submit six (6) sets of maintenance manuals. Each maintenance manual shall include operation and maintenance instructions, parts listing with sources indicated; recommended parts inventory listing, emergency instructions for elevators, escalators, and moving walks. Include diagnostic and repair information for disassembly, inspection/gaging/torque requirements, reassembly, testing and other related information. Detailed lubrication and cleaning schedule indicating weekly, monthly, quarterly, semiannual, and annual lubrication; and a description of each lubrication point, lubrication type, and specification. Provide exploded view drawings to facilitate repair and maintenance functions. Assemble manuals for component parts into a single binder. In addition provide the following for escalators and moving walks:

    a. Procedures for adjusting brake, handrail tension, handrail chain drive tension, step and pallet chain tension, track system, and mechanical components, including pictorials.
    b. Instructions for removing floor plate, replacing comb segments, and removing and installing steps and pallets.

12. Maintenance Log: Upon completion of the installation submit and provide 1 copy of the following in each machine room:

    a. Maintenance log and Maintenance Control Program for each unit, indicating the various items requiring examination, the procedure to be followed, the frequency of the examination and place to record compliance with the recommended procedure. The log shall cover a period of at least 1 year.

b. Call back log, indicating permanent record of visits. The log shall indicate the date of the visit, person making the visit, unit involved, reason for the visit and work accomplished.
c. Fire firefighters service test log for each elevator to comply with the requirements of the code.
d. Hydraulic elevator oil usage log, to record all hydraulic oil added to the system. Log to include reason for loss of hydraulic oil.
e. Replace maintenance logs when available space within the maintenance log is filled. Furnish to LAWA a copy of the maintenance log that is being replaced.

13. All 'as-built' record drawings, wiring diagrams, parts manuals, catalogs, instructions, keys, etc. shall be submitted before final payment.
14. Submit copies of Installer qualifications.

H. Certificates and Permits: Submit inspection and acceptance certificates and operating permits as required by authorities having jurisdiction for normal, unrestricted use of vertical transportation systems.

1.4 JOB CONDITIONS

A. Temporary Use: Do not use vertical transportation components during construction period, unless permitted in writing by LAWA.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect vertical transportation work components during delivery storage, handling, erection and construction period against damage and stains.

B. Do not deliver the vertical transportation components to Project site until they can be placed in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

1.6 COORDINATION

A. Coordinate fabrication and installation of vertical transportation systems with HVAC, EMS, security, telephone/data, audio/visual, CCTV, and fire alarm systems.

B. Coordinate start up and testing of vertical transportation systems with other Work required for complete installation and operation.

C. Field verify all conditions affecting the work of this section.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. Refer to the specification sections for materials, components and fabrication criteria for the vertical transportation systems:

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the spaces and areas to receive the vertical transportation work, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the vertical transportation work. Examine wellways, hoistways, hoistway openings, pits, terminal end truss pits, and machine rooms, as constructed; verify critical dimensions; and examine supporting structure and other conditions under which vertical transportation work is to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Verify dimensions of supporting structure from the working drawings and shop drawings so that the vertical transportation work will be accurately fabricated and fitted to the structure. The Contractor shall satisfy himself by review of the working drawings that the clearances and the alignments are proper for the installation of his equipment.

B. Coordinate vertical transportation work with the work of other trades and provide items to be placed during the installation of other work at the proper time so as to avoid delays in the overall work. Place such items, including inserts and anchors, accurately in relation to the final location of vertical transportation components. Use Contractor's bench marks.

3.3 INSTALLATION

A. General: Install component parts of the vertical transportation work in accordance with referenced standards and the manufacturers printed instructions and recommendations, unless otherwise shown or specified. Keep work areas orderly and free from debris during progress of the work. Remove all loose materials and filings resulting from this work from wellway and hoistway surfaces.

B. Elevator Hoistway Entrances: Coordinate the installation of hoistway entrances with the installation of elevator guide rails, for accurate alignment of entrances with cars. Wherever possible, delay the final adjustment of sills and doors until the car is operable in the shaft. Set sills flush with finished floor surface at landings. Reduce clearances between hoistway entrance sill and car sill to minimum, safe, workable dimension at each landing. Hanger supports shall be erected in perfect alignment, with edges of the sills, sill grooves and head jambs to insure smooth operation of the doors. Guide grooves in the thresholds shall be cleaned and free of debris.

C. Elevator Guide Rails: Erect guide rails plumb and parallel and secure guide rail joints without gaps and file any irregularities to a smooth surface. Fasten guide rail brackets to concrete structures with proper inserts and insert bolts, through bolts, or adhesive anchors. Fasten guide rail brackets to structural steel with through bolts and attach guide rails to brackets with throughbolts or steel clips. Compensate for expansion and contraction movement of guide rails. Balance cars to equalize pressure of roller guide shoes on rails.

D. Escalators: Set escalators true to line and level, or to indicated slope, properly supported, and anchored to building structure. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.

E. Machine Room and Machine Space Equipment: Install machine room and machine space equipment with clearances complying with the referenced codes and standards. Install items so that they may be removed by portable hoists or other means for maintenance and/or repair. Install items so that access for maintenance is safe and readily available. Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby, eliminate sources of structure-borne noise from vertical transportation equipment.

1. Pack wall openings thru which oil lines and conduit pass with fire resistant, sound isolating, mineral wool insulation and fire stopping material.

F. Lubrication and Adjustment: Adjust installed components for smooth, efficient operation, complying with required tolerances and free of hazardous conditions.

1. Traction Elevators: Lubricate operating parts of system. Adjust motors, brakes, controllers, leveling switches, limit switches, stopping switches, door operators, interlocks and safety devices to achieve required performance levels.
2. Hydraulic Elevators: Lubricate operating parts of system. Adjust pumps, valves, motors, brakes, controllers, leveling switches, limit switches, stopping switches, door operators, interlocks and safety devices to achieve required performance levels.
3. Escalators and Moving Walks: Lubricate operating parts, including bearings, tracks, chains, guides, and hardware. Test operating devices, equipment, signals, controls, and safety devices. Install oil drip pans and verify that no oil drips outside of pans.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to the vertical transportation Installer, that ensure vertical transportation equipment is without damage or deterioration at the time of acceptance by LAWA.

B. Repair damaged finishes so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 FIELD QUALITY VERIFICATION

A. General: On completion of each type of vertical transportation equipment installation and before permitting use thereof, perform acceptance tests as required and recommended by ASME A17.1, procedures with the following additions or adaptations, and by authorities having jurisdiction.

1. Traction Elevators/Hydraulic Elevators, Escalators and Moving Walks: Comply with ASME 17.2 "Inspectors Manual for Traction Elevators, Hydraulic Elevators, Escalators and Moving Walks" procedures:

   a. Contractor shall perform the following tests on each escalator without load:

      1) Comb impact device shall be tested and calibrated with an appropriate scale at both ends of the escalator in both the horizontal and vertical direction.
      2) Brakes: Measure deceleration rate with no load over 5 consecutive stops in the down direction using test equipment designed to obtain this information.
      3) Skirt/Step Index test.

   b. Contractor shall perform the following tests on each escalator under full load:

      1) Brake test. The stopping distance in the down direction shall meet all requirements of ASME A17.1.
      2) Twenty Four Hour Test: Each escalator shall be operated continuously for 24 hours after the acceptance test with no faults. If any fault occurs that shuts the escalator down, the fault shall be corrected. Run additional 24 hour tests until all faults are corrected.

B. Perform testing during times approved by LAWA. Perform tests that are disruptive to normal building operations, as determined by LAWA, after normal building occupancy hours.

1. Supply all required labor, material, supervision, material, tools, test weights and test instruments for all required tests, inspections and reviews.
2. In all elevator test conditions, obtain specified speed, performance times, floor accuracy without re-leveling, and ride quality.
3. In all escalator test conditions, obtain specified speed, and ride quality.
4. Label each device with calibration sticker indicating test results and date of test.
5. Provide permanently affixed escalator brake torque tag.
6. Affix mental safety, buffer and governor test tags.

C. Performance Guarantee: Should these tests indicate defects or poor workmanship, variance or noncompliance with the requirements of the specified codes and/or ordinances or variance or noncompliance with the requirements of these specifications, the following work and/or repairs shall be completed at no expense to LAWA.

1. Replace all equipment that does not meet Code or specification requirements.
2. Perform all work and furnish all materials and equipment necessary to complete the specified operation and/or performance.
3. Perform all retesting required by the governing Code Authority and LAWA to verify the specified operation and/or performance.

3.6 DEMONSTRATE, INSTRUCT

A. Instruct LAWA personnel in proper use, operations, and daily maintenance of elevators, escalators and moving walks. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train LAWA personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with LAWA on requirements for a complete vertical transportation maintenance program.

B. Make a final check of each type of vertical transportation equipment with LAWA personnel present and before date of acceptance by LAWA. Determine that operation systems and devices are functioning properly.

3.7 VERTICAL TRANSPORTATION SCHEDULES

END OF SECTION 14 20 00

Guide Specification
Los Angeles World Airports

SECTION 14 21 00 - HEAVY DUTY TRANSIT TYPE MACHINE ROOM-LESS ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes heavy duty machine-room-less electric traction passenger and service elevators. Conventional geared or gearless equipment should be employed where passenger capacity needs or material movement needs exceed those offered within machine room-less product lines.

1.2 DEFINITIONS

A. Definitions in the latest version of ASME A17.1 apply to work of this Section.

B. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

C. Service Elevator: A passenger elevator that is also used to carry freight.

D. Reference to a device or a part of the equipment applies to the number of devices or parts required to complete the installation.

1.3 SUBMITTALS

A. Refer to Section 14 20 00, 3.7.2.

B. Product Data

1. Submit manufacturer's product data for each product and material.
2. Indicate manufacturer, trade names, and model numbers, components, arrangement, optional and accessories being provided.
3. Include applicable literature, catalog material or technical brochures.
4. Include material and equipment specifications, sizes, types, dimensions, weights, rated capacities, and performance curves.
5. Include utility requirements for wiring, piping, and service connection data, motor sizes complete with electrical characteristics.

C. Shop Drawings

1. Six (6) copies of the layout and shop drawings shall be provided by the contractor for review within three weeks of notice to proceed.
2. All drawings, views and details shall be developed and presented in accordance with ANSI Y14.3 Multi and Sectional View Drawings.
3. Drawings shall clearly reflect dimensional data for elevator hoistways including cross references to building column lines and finish elevations depicted in the Contract Drawings.
4. Elevator layout shall be shown in three orthogonal views and shall include key dimensions, support details, power connection locations and power connection terminal points.
5. Shop drawings: Six (6) copies of the shop drawings shall be provided by the Installer. Submit approval layout drawings to scale. Drawings shall include, but not be limited to the following:

    a. Car, guide rails, buffers and other components in hoistway.
    b. Maximum rail bracket spacing.
    c. Maximum loads imposed on guide rails requiring load transfer to the building structure.
    d. Loads on hoisting beams.
    e. Clearances and travel of car and counterweight run-by.
    f. Clear inside hoistway and pit dimensions.
    g. Location and sizes of access doors, hoistway entrances and frames.
    h. Car & Hall signal and operating fixtures.
    i. Remote wiring layouts for each elevator.
    j. Refuge space on top of car and pit.
    k. Control room, machine area, pit and hoistway layout.
    l. Cab design, dimensions and layout.
    m. Hoistway-door and frame details.

6. Complete assembly detail of machine, machine mounting, machine beam assembly, dead end hitch and beam assemblies, governors, safeties, counterweights, with all load calculations.
7. Shop drawings shall include complete schematic and connection diagrams for the controller and all electrical devices including a legend for components.
8. Controller information should include complete I/O list.
9. All drawings shall be provided on CD-ROM in AutoCAD 2008 format.

D. Samples

1. Submit six (6) samples minimum 4” by 4” in size of all finish materials including but not limited to the following:

    a. Cab Flooring.
    b. Ceiling, including surface material, supporting frame and light fixture.
    c. Cab Interior including car door, front return, wall finish etc.
    d. Fixture faceplate.

2. Samples shall be clearly labeled to reflect:

    a. Project Name
    b. Contract Number
    c. Description of Sample

E. Maintenance Control Programs: within sixty (60) days after notice to proceed, and prior to installation, Installer shall submit detailed equipment specific interim and revenue service Maintenance Control Programs, showing functions to be performed and their scheduled frequency.

F. Operating and Maintenance manuals: Prior to installation, Installer shall submit six (6) complete sets of Operation and Maintenance manuals for approval. After LAWA approval and prior to the beginning of acceptance testing, six (6) sets of the approved manuals shall be provided by the Installer. Provide all material on CD-ROM in a format approved by LAWA. The manuals shall include the following:

1. Complete table of contents.
2. Complete instructions regarding operation and maintenance of equipment, including complete illustrated, exploded views of all assemblies, and a complete, illustrated, exploded view for identifying all system parts.
3. Complete nomenclature of replaceable parts, part numbers, current cost, and warehouse location. If product source is another vendor, Installer shall include name and address of other vendor.
4. Sample copies of a preventive maintenance chart.
5. Descriptions of safety devices.
6. Safety rules, tests, and procedures, including testing of all systems and subsystems.
7. Procedures for adjusting all elevator equipment, including pictorials.
8. Troubleshooting techniques.
9. Detailed lubrication and cleaning schedule indicating weekly, monthly, quarterly, semiannual, and annual lubrication; and a description of each lubrication point, lubrication type, and specification.
10. Control and schematic electrical wiring diagrams of controller, including wiring of safety devices to connections with remote indication and control panels for each elevator or group of elevators.
11. Electrical layout showing placement of lighting, light switches, receptacles, light fixtures, disconnect switches, and convenience outlets in machinery/control room spaces and pits.
12. Complete detailed drawings and wiring diagram of elevator system fault-finding device and connection to annunciator panel.
13. As built drawings for final elevator installation, controller and truss wiring. Also provide As-built drawings on CD-ROM in AutoCAD 2008 format.

G. Certification

1. The elevator manufacturer shall provide copies of all documents related to maintenance, safety, operations, design changes, modifications, retrofits, etc., which relate to any part, component, equipment, system, subsystem, or material and services applicable to the elevators provided.
2. All of the above referenced shall be provided as it pertains to the original installation and for a period of ten (10) years after final acceptance of the last elevators provided under any contract.
3. The referenced material shall be provided within thirty (30) days of publication or internal distribution by the elevator manufacturer. The material, even if labeled PROPRIETARY, shall be delivered without prejudice or delay and at no additional cost.
4. Provide all material on CD-ROM in a format approved by the Owner.

H. MSDS and product data sheets: Shall be submitted with an index listing each product, along with the application method of the product, approximate quantity of product per elevator and the component the product is applied to or associated with. The Installer shall allow 6 (six) weeks for review of MSDS.

I. Senate Bill 1886 Submittals: Provide copies of all Code Authority/permit submittals.

1.4 QUALITY ASSURANCE

A. Regulatory agencies: elevator design, materials, construction clearances, workmanship, and tests shall conform to the requirements of the codes and regulations listed in Part 1.5.

B. Welding: Welding shall be performed in accordance with the requirements of AWS or CWB. Welders shall produce evidence of current certification by AWS or CWB.

C. Requirements of Regulatory Agencies

1. Installer shall obtain and pay for all necessary permits, and perform such tests as may be required for acceptance and approval of elevators by jurisdictional agencies.
2. Installer shall notify the proper inspectors to witness required testing.

D. Factory Visit

1. The Installer shall provide for the costs of up to three of LAWA's representatives to visit the factory where the elevators are being manufactured, per contract, per unit type.
2. Installer shall not ship the elevator without the approval of LAWA's representative after the conclusion of the factory visit.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping Packing, Shipping, Handling, and Unloading

1. Accept equipment, materials, and other Products on site in factory containers, bundles, and shipping skids.

B. Delivery and Acceptance at Site

1. Deliver material in original packages, containers, skid loads, or bundles bearing brand names and identification of source of manufacture or supply.
2. Inspect deliveries for damage.

C. Storage and Protection

1. Store materials inside under cover and in a dry location.
2. Protect from weather, direct sunlight, surface damage, corrosion, and construction traffic and activity.
3. Installer shall make necessary provisions to protect systems from damage, deterioration, and environmental conditions during installations and until elevator systems are fully operative.

D. Handling

1. Handle material to prevent damage to edges, ends, surfaces, and finishes.

1.6 INSTALLATION CONTRACT ACCEPTANCE, WARRANTY, INTERIM SERVICE AGREEMENT AND SERVICE AGREEMENT

A. Warranty: The Contractor shall warrant in writing that all equipment manufactured and installed under this Contract be free of defects in design, materials, and workmanship, under normal use and service ("Warranty") for a period of twelve (12) months. Defects in design, materials, and workmanship shall be repaired or replaced with all materials and labor at no additional cost to LAWA ("Warranty Work"). (Defects shall include, but not be limited to, noisy, rough, or substandard operation; failures; loose, damaged, and missing parts; and fluid leaks.)

B. In addition to the Warranty

1. Contractor shall provide, concurrently with each Warranty Period, a 1-Year Preventative Maintenance ("PM") service for all units.
2. Beginning one year after the Contract Completion Date, the Contractor shall provide a 5-Year Extended Preventative and Routine Maintenance Service Agreement ("SA"), per Section 14 20 00, 3.7.2 and Exhibit A, for all units installed in this Contract.
3. The 5-year SA period shall be executed in strict compliance with all of the terms and conditions set forth in Exhibit A ("Exhibit A"). Upon conclusion of the SA, the parties

may mutually agree to extend the SA for an additional sixty (60) months, via a renewable option ("Option").

C. The Contract/Warranty, PM, Interim and SA services shall include all services necessary to maintain the equipment in proper working order for use at a major international airport including, but not limited to.

1. "Tasks":

a. Inspection of completed installation and periodic testing to maintain elevators in completely operable, like new condition.
b. Provide preventative maintenance on elevators for a minimum of four (4) hours each month (Total On-Site Time). Provide monthly documentation of the same to LAWA.
c. Periodic lubrication of parts and equipment components as per OEM's recommendation. Charts are to be provided for each elevator indicating when services are provided.
d. Perform work without removing elevators from service during peak traffic periods determined by LAWA as 7:00 a.m. to 10:30 p.m. daily.
e. Provide twenty (24) hour emergency service during the maintenance period consisting of a prompt response (within 30 minutes) to emergency request by telephone or otherwise from LAWA or designated representative if an elevator is inoperable or in case of injury, entrapment, or potential injury to persons.
f. Unlimited regular time callbacks are included with a required response time of one (1) hour. Regular time will be Monday through Friday, 8:00am to 4:30pm, exclusive of holidays. Overtime\Premium time call backs originating from an operational error related to the performance requirements of the equipment shall be borne by the Contractor.
g. All other services as required by Section 14 20 00, 3.7.2 and Exhibit A.

1.7 EXTENDED PREVENTATIVE AND ROUTINE MAINTENANCE SERVICE AGREEMENT

A. The Contractor shall perform the SA (including all tasks listed herein and in Exhibit A) for a period of sixty (60) months from the date of Elevator Warranty expiration, or one year after the Contract Completion Date, whichever is later. A Faithful Performance Bond and a Payment Bond ("SA Bonds"), each for 100 percent of the contract price for the SA shall be submitted for LAWA approval no less than 30 days prior to Contract Completion Date. The SA Bonds shall be submitted to the City Attorney for approval as to form.

B. Optional Second 5-year SA: No less than six (6) months prior to the conclusion of the 60 month SA, the parties may mutually agree to extend the SA ("Extended SA") for a single, additional 60 month period at a cost no greater than 9percent more than the amount of the initial SA. Should the parties mutually agree, a Faithful Performance Bond and a Payment Bond, each for 100 percent of the contract price for the Extended SA shall be submitted for LAWA approval no less than one (1) month prior to the conclusion of the initial 60 month SA.

C. All Contract Provisions, Appendices and Addenda, as well as the Conditions of Section 14 20 00, 3.7.2 and Exhibit A shall govern the SA and the Extended SA.

1.8 GUARANTEES

A. Notwithstanding the Specifications forming a part of this Contract, any inspection or approval of the Work, or the existence of any patent or trade name, the Installer nevertheless unconditionally guarantees that the equipment furnished and installed hereunder shall be of the best quality, shall be fully fit for the purpose for which it is intended, and shall be of the heavy duty transit type in compliance with APTA guidelines unless augmented per these contract documents.

1.9 LAWA INSTRUCTION/DEMONSTRATION AND COORDINATION

A. The manufacturer shall provide eight (8) hours of onsite demonstration and instructions to LAWA and existing service personnel upon completion of the elevator installation. Instructions are to include safety procedures, proper operation of all equipment, and routine maintenance procedures. All instructions and demonstrations are to be video recorded and remain the property of LAWA.

B. Check operation of the elevators with LAWA's personnel or designated representative present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

PART 2 - PRODUCTS:

2.1 GENERAL:

A. Installer shall furnish and install elevators that shall comply with the following requirements:

1. All elevators supplied under this contract shall be the product of a single manufacturer.

B. Subject to compliance with the requirements of the Section, Elevator Cab design shall be per Contract Drawings.

2.2 MATERIALS:

A. Except where product conformance to specific standards is indicated on the Contract Drawings and in ASME/ANSI A17.1, OEM's standard materials and equipment may be used in elevator construction, subject to approval. Materials cited below are intended to establish the standard of quality for comparable materials used by the manufacturer.

B. Structural Shapes, Plates, Sheets, and Tubing: ASTM A36 Steel.

C. Sheet Steel: ASNI/ASTM A446, Grade B.

D. Stainless Steel: ASTM A167, Type 316L

1. Stainless steel with embossed texture to be rolled into exposed surface.
2. Type 304 or 316L, match specified color/finish in drawings.
3. No. 4: Directional polish (satin finish). Graining directions as shown or, if shown, in longest dimension.
4. No. 8: Reflective polish (mirror finish).
5. Textured: 5WL or 4LB as manufactured by Rigidized Metals or Windsor pattern 5-SM as manufactured by Rimex Metals or approved equal with .050 inches mean pattern depth with bright directional polish (satin finish).
6. Burnished: Non-directional, random abrasion pattern.

E. Aluminum: ASTM B211 or ASTM B221, Alloy 6061, T6.

F. Flooring: as specified.

G. Plastic Laminate: ASTM E84 Class A and NEMA LD3.1, Fire-Rated Grade (GP-50), Type 7, 0.050" plus or minus.005" thick, color and texture as follows:

1. Exposed Surfaces: Color and texture selected by Architect.
2. Concealed Surfaces: Provider's standard color and finish.

H. Fire-Retardant Treated Particle Board Panels: Minimum 3/4 inch thick backup for natural finished wood and plastic laminate veneered panels, edged and faced as shown, provided with suitable anti-warp backing; meet ASTM E84 Class "I" rating with a flame-spread rating of 25 or less, registered with Local Authorities for elevator finish materials.

I. Natural Finish Wood Veneer: Standard thickness, 1/40-inch thoroughly dried conforming to ASME/HPMA HP-1983, Premium Grade. Place veneer, tapeless spliced with grain running in direction shown, belt and polish sanded, book-matched. Species and finish designated and approved by Architect.

J. Paint: Clean exposed metal parts and assemblies of oil, grease, scale, and other foreign matter and factory paint one shop coat of standard rust-resistant primer. After erection, provide one finish coat of industrial enamel paint. Galvanized metal need not be painted.

K. Prime Finish: Clean all metal surfaces receiving a baked enamel paint finish of oil, grease, and scale. Apply one coat of rust-resistant primer followed by a filler coat over uneven surfaces. Sand smooth and apply final coat of primer.

L. Baked Enamel Finish: Prime finish per above. Unless specified "prime finish" only, apply and bake three (3) additional coats of enamel in the selected solid color.

M. Glass: Laminated safety glass, minimum 9/16-inch thick, conforming to ANSI Z97.1 and CPSC 16 CFR Part 1201.

2.3 SPECIAL FEATURES:

A. General

1. Elevator size, arrangement and capacity shall be justified via thorough analysis of passenger and material transport needs and shall comply with design criteria specified in this Section 3.7.1 and 3.7.2. Elevators shall be provided in accordance with the requirements of CCR Title 8 and the ASME A17.1-Safety Code for Elevators and Escalators, hereinafter in this Section the "Code".
2. Provide all material and equipment necessary for the complete execution of all elevator work as specified in this Section and as shown on the Contract Drawings.
3. Provide hoistway guards for protecting hoistway during construction. In existing terminals, hoistway protection shall include high solid panels surrounding each hoistway opening at each floor.
4. All electric equipment, conduit, fittings and wiring shall conform to the requirements of ANSI/NFPA No. 70 National Electric Code.
5. Provide concrete inserts and other similar anchoring devices for the installation of guide rails, machinery and other elevator components. Epoxy ceiling anchors or epoxy side wall anchors shall not be permitted.
6. Clearance around equipment located in each elevator control room and machine area shall comply with the applicable provisions of ANSI/NFPA No. 70 National Electrical Code.

2.4 SUMMARY OF FEATURES:

A. Machine Room-Less Passenger Elevators

Elevator Use	Passenger C-3 Loading
Contract Load, in Pounds	4000 minimum
Contract Speed, in FPM	350 for travel distances of 20'-0" or more. 200 for travel distances of less than 20'-0"
Machine Location	Overhead in hoistway
Machine Type	Gearless
Type of Control	AC variable voltage, variable frequency
Operation	Simplex selective collective or Group automatic

Platform Size	8'-0" wide by 6'-2" deep
Clear Car Inside	7'-8" wide by 5'-5" deep
Car and Hoistway Door Size	4'-0" wide by 7'-0" high
Car and Hoistway Door Type	Single speed, side slide center opening
Car and Hoistway Door Operation	Power operated. High-speed, heavy-duty (minimum opening speed 3.0 FPS)
Hoistway Entrance	As specified
Cab Enclosure	As specified
Car Operating Station	Dual
Direction Indicator	Hall
Hall Call Stations	Single riser
Special Features:	Fire Control Panel, Machine Room Monitor, Load Weighing Device, Communication System, Security Features, Handicap Features, Standby Power, Monitoring Features

B. A. Machine Room-Less Service Elevators

Elevator Use	Service C-3 Loading
Contract Load, in Pounds	5000 minimum
Contract Speed, in FPM	350 for travel distances of 20'-0" or more. 200 for travel distances of less than 20'-0"
Machine Location	Overhead in hoistway
Machine Type	Gearless
Type of Control	AC variable voltage, variable frequency
Operation	Simplex selective collective or Group automatic
Platform Size	6'-0" wide by 9'-4" deep
Clear Car Inside	5'-8" wide by 8'-4" deep
Car and Hoistway Door Size	4'-6" wide by 7'-0" high
Car and Hoistway Door Type	Two speed, side slide

Car and Hoistway Door Operation	Power operated. High-speed, heavy-duty (minimum opening speed 3.0 FPS)
Hoistway Entrance	As specified
Cab Enclosure	As specified
Car Operating Station	Single (Dual with front and rear entrances)
Direction Indicator	Hall
Hall Call Stations	Single riser
Special Features:	Fire Control Panel, Machine Room Monitor, Load Weighing Device, Communication System, Security Features, Handicap Features, Standby Power, Door Hold Button, Monitoring Features

2.5 CAR PERFORMANCE:

A. Car Speed: ±3% of contract speed under any loading condition.

B. Car Capacity: Safely lower, stop and hold 125% of rated load.

C. Car Leveling Zone: ±1/4" under any loading condition.

D. Door Opening Time:

1. Passenger Elevators: 1.8 seconds.
2. Service Elevators: 3.0 seconds.

E. Door Closing Time:

1. Passenger Elevators: 2.7 seconds.
2. Service Elevators: 5.1 seconds.

F. Car Floor-to-Floor Performance Time: Seconds from start of doors closing until doors are -3/4 open and car level and stopped at next successive floor under any loading condition or travel direction. (Based on a floor height of 16'-0". Adjust .3 seconds per foot of travel for 200 fpm elevators and .2 seconds for 350 fpm elevators.)

G. Car Ride Quality

1. All elevators shall have a maximum decibel reading of 65 dBA with the doors closed during a run in the up direction, measured 5 feet above the floor in the center of the cab.
2. All elevators shall have a maximum vibration of 15 milligrams in the X, Y and Z axis measured with an A95 filter.
3. Acceleration and Deceleration: Smooth constant and not more than 3 feet/second^2 with initial ramp between 0.5 and 0.75 second.
4. Sustained Jerk: Not more than 8 feet/second^3.

2.6 DOOR OPERATOR EQUIPMENT

A. Provide GAL's MOVFRW-HSL door operator with encoder-less VVVF drive or approved equal. Closed loop door operator designed to operate car and hoistway doors simultaneously at the speed specified. Door shall open automatically when car stops at landing to discharge passengers or to answer valid calls and close automatically after predetermined time interval has elapsed. The doors shall be capable of smooth and quiet operation without slam or shock. Door operator to have the following features.

1. 1/2 hp motor and heavy duty sprocket, chain, belt, and sheaves.
2. Closed loop regulated speed performance.
3. Hand-held keypad programming.
4. Adjustments can be stored in the keypad and downloaded to another operator.
5. Adjustable door obstruction reversal unit.
6. Optical cams with LED indicators.
7. Test switches for open, close, nudging and speed zone set up.
8. Universal inputs for open, close, and nudging.
9. Reversing switch to back up the door reversal device.

B. Cab Door Interlock. The doors on cab doors shall be equipped with approved cab door interlocks of the cab unit system type tested as required by the Code.

1. Interlock shall prevent operation of the car away from a landing until doors are locked in the closed position. Interlock shall prevent doors from opening at any position within the hoistway and or landing from the cab side unless car is at rest at that landing, or is in the leveling zone and stopping at that landing.
2. Provide an electric contact mounted on the car that will prevent the car from moving away from landing unless car doors are closed.

C. Door Control Device

1. Door Protection – Electronic Entrance Detector Screen: Provide an electronic door detector device and or approved equal, which projects a three dimensional infrared curtain of light guarding the door opening. Arrange to reopen doors if one beam of the curtain is penetrated. Unit shall have transmitters and receivers spaced at a minimum distance to provide the maximum amount of protection within the height of the doorway. Systems, which have the availability to turn Off or On individual zones within the curtain, will not be allowed.
2. Nudging Operation: After beams of door control device are obstructed for a predetermined time interval (minimum 20.0 – 25.0 seconds), a warning signal shall sound and doors shall attempt to close with a minimum of 2.5 foot pounds kinetic energy. Activation of the door open button shall override nudging operation and reopen doors.
3. Interrupted Beam Time: When beams are interrupted during initial door opening, hold door open a minimum of 3.0 seconds. When beams are interrupted after the initial 3.0 second hold time, reduce time doors remain open to an adjustable time of approximately 1.0 – 1.5 seconds after beams are reestablished.
4. Differential Door Time: Provide separately adjustable timers to vary time that doors remain open after stopping in response to calls.

    a. Car Call: Hold open time adjustable between 3.0 and 5.0 seconds.
    b. Hall Call: Hold open time adjustable between 5.0 and 8.0 seconds.

2.7 HOISTWAY EQUIPMENT

A. Guide Rails

1. Guides shall be steel T-section rails. Rail surfaces shall be machined smooth to ensure proper operation of guides. Rail ends shall be accurately machined with tongue and matching groove centrally located on web. Non wearing rail surfaces are to be painted in color selected by the Architect/LAWA.
2. Guides shall be joined and installed in accordance with Section 2.23 of the Code.
3. Guide rails are not to be in view from within the elevator cab.

B. Car Buffers: Oil type with blocking and support for car contract speeds exceeding 200 fpm. Spring type for speeds of 200 fpm or less.

C. Counterweight Buffers: Oil type with blocking and support for contract speeds exceeding 200 fpm. Spring type for speeds of 200 fpm or less.

D. Roller Guides: Roller guides shall be mounted on top and bottom of the car and counterweight frames to engage the guide rails. Provide slide guides with renewable oil less inserts where C3 loading is required.

E. Suspension Means: If steel core ropes are supplied, a means to provide constant lubrication shall be provided.

F. Machine: AC gearless machine, with permanent magnet synchronous motor, direct current electromechanical disc brakes and integral traction drive sheave. Machine to be mounted to the car guide rail or support beam mounted at the top of the hoistway.

G. Deflector Sheaves: Provide machined and grooved sheave for diameter of ropes. All bearings are to be shielded or sealed.

H. Stop Switch: An enclosed stop switch, mounted in the pit of each elevator in accordance with the Code, shall prevent operation of elevator when switch is activated. Switch shall be of the type described in Rule 2.2.6 of the Code.

I. Emergency Auxiliary Stop Switch: An enclosed stop switch, mounted in the over-head machine area and/or on the machine of each elevator in accordance with Rule 2.7 of the Code, shall prevent operation of elevator when switch is activated. Switch shall be of the type described in Rule 2.7 of the Code.

J. Dead End Hitch Assemblies: Provide dead end hitch assemblies in accordance with engineered loading requirements.

K. Counterweight: Counterweights shall consist of a steel frame welded or bolted together and necessary steel weight sections. These weight sections shall be held securely in place within the frame. A minimum of two (2) tie rods shall pass through the holes in all weight sections. Paint color as selected.

1. A required counterweight screen where no compensation is used.
2. The bottom of the counterweight shall have a buffer striking plate and means to attach knock-off blocks during rope stretch.

L. Idler Sheave: To be located directly above the counterweight frame and integral with counterweight frame. The sheave material shall be accurately machined of semi-steel of hardness BHN 220-250 or as per manufacturer's requirements.

M. Governor: Friction type over-speed self-resetting governor rated for the duty of the elevator specified and to operate the car safety. The finish of pit tension sheave shall be factory paint.

1. Locate the governor where the car or the counterweight in case of over-travel cannot strike it, and where there is adequate space for full movement of governor parts.
2. An electrical governor overspeed protective switch that, where operated, shall remove from the driving machine motor and brake before or at the time of application of the safety.
3. Seal and tag the governor with the running speed, tripping speed, and date last tested as required by Code.
4. Operation/rest of the governor shall not require the installation of an overhead access panel. Status of the governor shall be capable of being monitored remotely at the elevator controller.

N. Tension Sheave: Provide tension sheave in accordance with OEM's governor and car safety loading requirements.

O. Terminal Limits: Limit switches shall slowdown and stop the car at the terminals if the primary automatic stopping system fails.

P. Life Safety Provisions: Life safety hooks and/or other life safety devices for fall protection or prevention to be in accordance with OSHA standards/guidelines. Life safety hook, and/or other life safety devices locations to be coordinated and installed by the Installer.

2.8 MACHNE COMPONENTS

A. Motor

1. The motors shall be of the alternating current reversible asynchronous or synchronous type of a design adapted to the severe requirements of elevator service. Motor shall be capable of developing the torque required to meet or exceed an acceleration rate of 2 ft/sec^2 for the elevator car.
2. A means to protect the windings and bearings from airborne dust shall be provided.
3. Insulation of all windings shall be impregnated and baked to prevent absorption of moisture and oil. The insulation resistance between motor frame and windings shall not be less than one meg-ohm. The motor windings shall stand a dielectric test of twice the normal voltage plus 1000 RMS volts of 60 Hertz, alternating current for one minute.
4. Motor leads in the conduit box shall have the same insulation class as the windings. Motor lead wire shall be rated 125 C and shall be sized for 105 C at the motor nameplate amperes at 1.0. Power Factor per Electrical Apparatus Service Association (EASA) recommendations. Leads are to be numbered for clockwise rotation when facing opposite the shaft end.
5. The motor shall be designed to stand the severe loads encountered in elevator service and the windings shall have a minimum insulation temperature rating two ratings higher than the actual temperature rise of the motor, with a minimum rating of NEMA class F.
6. The motor shall be designed to the ASME A17.1 rated load requirements.

B. Brake

1. Provide dual brakes that shall be of the self-adjusting fail-safe (spring applied and electrically released) type provided with a remotely operated, in the controller room, manual brake release and designed to meet the service factor demand of its intended use. Access panels at the top of hoistway shall not be required. Dual brakes shall operate independent of each other for ascending car over speed and unintended car movement. Provide operation to prevent the elevator from striking the hoistway overhead or unintended car movement per the requirements of Code.

C. Gearless Machine

1. Sheave: The sheave material shall be accurately machined of semi-steel of hardness BHN 220-250.
2. Anti-vibration Mounts: For machines that are support beam mounted, anti-vibration mounting pads are to be provided.

2.9 CONTROLLER

A. General

1. The elevator control equipment shall contain diagnostic capabilities as required for the ease of complete maintenance. The diagnostic system shall be an integral part of the controller and provide user-friendly interaction between the service person and the controls. All such systems shall be free from decaying circuits that must be periodically reprogrammed by the manufacturer.
2. Switch gear shall be mounted in cabinets and labeled terminal strips.
3. The Main controller shall be a non-proprietary programmable automation controller (PAC) based on SCADA compliant Allen Bradley CompactLogic™ 1769-L32E, or equal, to control and monitor the status of the elevator. The PAC shall be designed to communicate in TCP/IP format over Ethernet or approved equal.
4. The controller shall store the last 99 faults, accessible via laptop connection, panel view or remote communications.
5. Provide a copy of all working programs on approved computer medium as well as a printed program listing.
6. The Controller shall have one dedicated serial port, which supports RS-232-C signals. It must be usable for programming purposes or for access to remote programmers via modems.
7. Provide Lift-Net, or equal, ready serial port and signals. Elevator monitoring system shall be building monitoring system compatible and capable of monitoring various elevator control systems.

2.10 OPERATION

A. Simplex Selective Collective

1. Momentary pressure of car or hall button, other than landing at which car is parked, shall automatically start the car and dispatch the car to the corresponding floor for which that call was registered. If a call is registered at the floor when the car is idle, the doors shall automatically open.
2. When the direction of travel has been established, the car shall answer all calls corresponding to the direction of travel and shall not reverse direction until all car and hall calls, in that direction, have been answered.
3. Calls registered for the opposite direction of car travel shall remain registered and shall be answered after car has completed its calls in the direction of travel.
4. If no car buttons are pressed, and car starts up in response to several down calls, the car shall answer highest down call first and then reverse to collect other down calls.
5. The car shall remain at the arrival floor for an adjustable interval to permit passenger transfer. Doors shall close after a predetermined interval after opening unless closing is interrupted by car door reversal device or door open button in car.

B. Group Automatic – Groups of Two or More Elevators:

1. Approved microprocessor-based, group dispatch, car and motion control systems as follows.

2. Include as a minimum, the following features:

    a. Operate cars as a group, capable of balancing service and providing continuity of group operation with one or more cars removed from the system.
    b. Register service calls from pushbuttons located at each floor and in each car. Slow cars and stop automatically at floors corresponding to registered calls. Make stops at successive floors for each direction of travel irrespective of order in which calls are registered except when bypassing hall calls to balance and improve overall service; stop only one car in response to a particular hall call. Assign hall calls to specific cars and continually review and modify those assignments to improve service. Simultaneous to initiation of slow-down of a car for a hall call, cancel that call. Render hall pushbutton ineffective until car doors begin to close after passenger transfer. Cancel car calls in the same manner. Give priority to coincidental car and hall calls in car assignment.
    c. Operate system to meet changing traffic conditions on a service demand basis. Include provisions for handling traffic which may be heavier in either direction, intermittent or very light. As traffic demands change, automatically and continually modify group and individual car assignment to provide the most-effective means to handle current traffic conditions. Provide means to sense long-wait hall calls and preferentially serve them. Give priority to coincidental car and hall calls in hall call assignment. Accomplish car direction reversal without closing and reopening doors.
    d. Use easily reprogrammable system software. Design basic algorithm to optimize service based on equalizing system response to registered hall calls and equalizing passenger trip time to shortest possible time.
    e. Serve floors below main floor in a manner which logically minimizes delay in passing or stopping at main floor in both directions of travel. Provide manual means to force a stop at the main floor when passing to or from lower levels.
    f. Required Features:

        1) Dispatch Protection: Backup dispatching shall function in the same manner as the primary dispatching.
        2) Delayed Car Removal: Automatically remove delayed car from group operation.
        3) Position Sensing: Update car position when passing or stopping at each landing.
        4) Hall Pushbutton Failure: Provide multiple power sources and separate fusing for pushbutton risers.
        5) Communication link: Provide serial or duplicate communication link for all group and individual car computers.

C. Independent Service: Provide controls to remove elevator from normal operation and provide control of the elevator from car buttons only. Car shall travel at contract speed and shall not respond to corridor calls.

D. Car Top Operation: Provide per Code requirements.

E. Emergency Recall Operation (Fire Service): Provide operation and equipment per Code requirements. Contractor shall provide relays, wiring, and terminal strips to receive signals from the fire alarm system.

F. Earthquake Operation: Provide operation and equipment per Code.

G. Load Weighing: Provide automatic load weighing device set at approximately 80% of full load. The device when activated shall cause the elevator to bypass corridor calls and shall initiate dispatch of car at main terminal prior to elapse of normal dispatching interval. Provide adjustable setting from 50 to 80 percent of full load.

H. Load Weighing Security Operation: Provide load weighing device to notify ACAMS Controller of weight status in elevator cab when in security mode of operation.

I. Fan and Light Output Timer: Provide an adjustable timer (Range 1 to 10-minutes) that when activated will turn off the fan and light within the car. The time will start when the car becomes inactive.

J. Door Hold Operation: Provide controls and a button within operating panel that shall hold the doors open for an adjustable period of 30 to 90 seconds. The following shall resume normal door operation.

1. Activation of door close button.
2. Expiration of time period.

K. Standby Power Panel and Operation – Contractor shall provide operation as follows: When standby power is detected by an input, one elevator at a time in each group, and single elevators, shall be returned to the main lobby one elevator at a time, and remain there with the doors open. Once all cars have been returned to the lobby, one elevator in each group, and single elevators may be selected to run under standby power. Selection of the cars shall be done automatically. This automatic selection may be overridden through manual selection. Provide necessary wiring and contacts to allow elevator systems to sequence under standby operation. Provide group selection switches in the fire control panel. Provide standby power indicators in the fire control panel and main floor hall station.

L. Tenant Security Operation

1. The Elevator Contractor shall coordinate with the Sections 28 13 00 - ACCESS CONTROL and ALARM MONITORING SYSTEM (ACAMS) and SECTION 28 23 00 VIDEO SURVEILLANCE SYSTEM (VSS) to provide elevator controls as described below:

   a. Card readers shall be installed as directed adjacent to, and interfaced with the elevator call button. The call button will be enabled by an authorized card read of the ACAMS system.
   b. Card readers with keypads shall be installed in each elevator cab and interfaced with the car buttons for as directed.
   c. Access to and from secured floors shall be by card reader only.

d. Elevator departing unsecured floors shall require an authorized card read/PIN to enable the registration of a car call to access secured floors, as programmed in the ACAMS system through access permissions and levels.
e. Provide strobe in car transom that illuminates upon notification from ACAMS Controller that weight or motion is detected in elevator cab.
f. Fire Service Operation overrides the Security Service Operation.

2.11 HOISTWAY ENTRANCES

A. Hoistway Frames and Doors
1. Entrance frames shall be of welded and mitered construction for complete one-piece unit assembly. All frames shall be sound deadened and securely fastened to fixing angles mounted in the hoistway. Finish shall be 420 ferritic stainless steel per ASTM A 240/240M.
2. Entrance frames shall be provided with an extended sill floor plate the full width and depth of each entrance frame assembly.
3. Hoistway doors shall be reinforced and provided with operating mechanisms and door hangers. Door panels shall be hollow metal flush door construction, 16-gauge furniture steel. Fill with fireproof, sound deadening material. Provide reinforcement by formed vertical sections running full height of door. Doors shall be provided with two removable, non-metallic gibs with fire tabs, located at the leading and trailing edge of the door panel. There shall be no visible exposed or protruding fasteners.
4. Provide die cast jamb markings (2 per entrance) mounted at 5'-0". Secure with adhesive and unexposed fasteners.
5. Hoistway door hangers and door operator shall be as specified herein.

B. Struts and Closer Support Angles: Hoistway entrances adjacent to non-load bearing walls (gypsum dry wall, gypsum block, etc.) shall have hanger housing and door closers supported by steel angles of adequate size. Angles shall be continuous between sill and building beams above and shall be bolted to the hanger support. For load bearing walls (masonry, concrete block), submit for approval Shop Drawings of the method to be used to support hanger housing and door closers on the wall.

C. Landing Sills: Landing sills shall be designed for Class C-3 loading and shall conform to Section 2.11 of the Code and shall be extruded stainless steel sills supplied with grooves and trash slots for door guides and machine planed for minimum clearance. Mount sills on combination of concrete/grout and steel supports anchored to floor construction.

D. Hanger Supports and Cover Plates: Hanger supports shall be T bolted to strut angles and closer support angles. Hanger cover plates shall be nominal 0.078 inch thick stainless minimum and shall extend, as indicated in the contact drawings. Covers shall be made in sections for convenient access when servicing hangers. Hanger sections above door openings shall be removable from within elevator car.

E. Dust Cover: Dust cover shall be reinforced as necessary to ensure a flat even surface throughout. Dust cover shall extend at least the full width of door opening on each side and fastened to hanger housings. Dust cover shall extend above entrance opening as indicated on Contract drawings.

F. Interlocks and Contacts:

1. The doors at each hoistway entrance shall be equipped with approved hoistway door interlocks of the hoistway unit system type tested as required by the Code.
2. Interlock shall prevent operation of the car away from a landing until doors are locked in the closed position. Interlock shall prevent doors from opening at any landing from the corridor side unless car is at rest at that landing, or is in the leveling zone and stopping at that landing.
3. Hoistway door unlocking devices shall conform to the requirements of the Code and shall be provided to permit authorized persons to gain access to hoistway when car is away from landing. Ferrules shall be supplied for all hoistway unlocking device keyholes to protect elevator hoistway doors.
4. Provide an electric contact mounted on the car that will prevent the car from moving away from landing unless car doors are closed.

2.12 CAB ENCLOSURE COMPONENTS

A. General

1. Elevator car and car components shall meet the applicable requirements of the Code. Car control station(s) and position indicator(s) shall be per Contract drawings.
2. Entire car assembly, including car frame and platform, shall be free from warps, buckles, and squeaks and rattles. Joints shall be lightproof.

B. Car Frame and Platform

1. Loading Classification and Requirements: The elevator shall be designed for Class A C-3 freight elevator loading following the design data and formulas identified in the Code, including, but not limited to, the car frame, platform, sills and guides.
2. Car frame and platform shall be welded galvanized steel units designed and fabricated in accordance with applicable requirements herein and Rule 2.14 of the Code.

3. Protect car platform with fire retardant material. The platform shall be recessed as required to accept floor finish.
4. Sub floor shall be suitably reinforced to support live loads of the elevator cab.

C. Car Guides: Car guides shall be designed for C3 loading. Provide spring dampened roller guides or swivel type oil less slide guides with renewable inserts.

D. Sills: Car sills shall be extruded stainless steel sills supplied with grooves and trash slots for door guides and machine planed for minimum clearance. Provide with matching sill extensions to face of front return(s).

E. Car Enclosures:

1. General: The enclosure shall be adequately reinforced and ventilated to meet Code requirements. Provide sound-deadening mastic to exterior.
2. Shell:

    a. Passenger Elevators: Sides and back shall be 14-gauge sheet steel with baked enamel interior finish as selected by the Architect. Arrange shell to accept interior panels as indicated in drawings.
    b. Service Elevators: Sides and back shall be 14-gauge, rigidized stainless steel sheet steel. Pattern 5WL or as selected by the Architect. Provide sample.

3. Canopy: Provide minimum 8'-0" clear height under canopy. Reinforced 14-gauge stainless steel No. 4 brushed finish. Arrange for hinged top emergency exit including lock and electrical contact as required by Code.
4. Suspended Ceiling and Lighting:

    a. Provide as shown in Architect's drawings.
    b. Provide clear access to the emergency exit per Code requirements.

5. Floor Covering:

    a. Passenger Elevators: Floor by others Wt/Ft = 10#.
    b. Service Elevators: 1/4" checker plate stainless steel.

6. Front Return Panels and Entrance Columns: 14-gauge sheet steel. Return panel shall be stationary type applied type. Provide faceplate to allow access to car station wiring and fixtures. Provide cabinets for special operating features and flush mounted speaker grills for the "Hands Free" telephone and intercom. Finish shall be stainless steel No. 4 brushed finish.
7. Transoms: 14-gauge sheet steel finishes matching front return panels and entrance columns.
8. Car Door Panels: Same construction as hoistway door panel. Finish shall be stainless steel No. 4 brushed finish.
9. Handrails: Provide a 1 1/2" diameter stainless steel tubular handrail at the rear of each passenger elevator. Return ends to wall. Provide adequate mounting. Top of handrail to be 32" above the finished floor. Provide service elevators with side and rear wall

mounted handrails and bumper rails. Return ends. Bolt handrails and bumper rails through car shell. Provide backing plates and captive nuts.

10. Bases: Provide a 4" high base. Finish as shown in Architect's drawings.
11. Pads and Hooks: Provide pad hooks and pads. Pad hooks shall be conspicuous type (buttons) at all walls. Mount pad hooks at sides and rear above suspended ceiling line. Pads shall cover all walls and front return panels and include cutouts for access to the operating fixtures.
12. Ventilation: Two-speed exhaust blower. Provide OE type in passenger elevators and AA type in service elevators.

F. Emergency Car Lighting and Alarm System: Unit shall provide emergency light in car upon failure or interruption of normal car lighting. Emergency lighting unit shall provide a minimum illumination of 0.2 footcandles at 4' above car floor approximately 1' in front of main car operating panel for not less than 4 hours. Battery shall be 6 volt minimum, sealed rechargeable lead acid or equal. Battery charger shall be capable of restoring battery to full charge within 16 hours after resumption of normal power. Provide means within the car service panel for testing battery, lamps, and alarm bell. When multiple units are provided in a car all units shall illuminate. Illuminate a portion of normal car lighting.

2.13 SAFETIES

A. General: Provide a governor actuated mechanical safety device mounted under the car platform and securely bolted to the car sling.

1. When tripped, the safety mechanism shall engage the rails with sufficient force to stop a fully loaded car with an average rate of retardation within the limits given by the ASME A17.1 Code for the capacity
2. Make provisions to release the car safety. In no event shall the safety be released by downward motion of the car. Raising the car to reset the safety shall be allowed.
3. Include an electrical safety plank switch that will interrupt the power to the hoist machine when the safety is set. Resetting the plank switch shall be separate from resetting the safety jaws.
4. Install a car safety marking plate of corrosion resistant metal showing the data required by the Code.

2.14 SIGNAL DEVICES AND FIXTURES

A. General: Provide vandal resistant signal fixtures and control devices for each elevator. Buttons and signals shall be tamper resistant of the illuminated type that light-up when activated and remain lit until call or other function has been fulfilled. All signal fixture and control device faceplates shall be nominal 0.135 inch thick, unless otherwise shown on the Contract Drawings.

B. Car Operating Station

1. Provide car operating stations with faceplates flush with front returns. Station shall have illuminating pushbuttons numbered to conform to floors served. Buttons shall light to show registration and extinguish when car stops in response to a call. Buttons shall have

a minimum dimension of 3/4", be raised 1/8" ±1/32" above the surrounding surface, be of square shouldered design, and have a detectable mechanical motion. A minimum clear space of 3/8" of other suitable means of separation shall be provided. Panel shall include an alarm bell button, Door Open and Door Close buttons. Provide an extended Door Hold button in each service elevator. All operating controls shall be located no higher than 48" above the car floor, the keyed in car stop switch and alarm button shall be located no lower than 35" above finished floor height. Provide in main car station a fire emergency service cabinet containing. Phase II emergency fire service switch, fire jewel, fireman's phone jack, fire operating instructions, Call Cancel button and Door Open and Door Close buttons. Provide second fire jewel outside of Phase II cabinet. Provide in the return panel an intercom grill and flush mounted speaker grill for the "Hands-free" telephone.

a. Braille/Arabic designations shall be identified by a minimum of 5/8" Arabic numeral, standard alphabet character, or standard symbol immediately to the left of the control button. Braille shall be located immediately below the numeral, character or symbol. Controls and emergency equipment shall be identified by raised symbols, including but not limited to, door open, door close, alarm bell, emergency stop and telephone. The call button for the main entry floor shall be designated by a raised star at the left of the floor designations. Braille and Arabic designations shall be flush with inconspicuous mechanical mounting. The plaques shall have raised white colored numerals on a black background.

2. Provide a lockable service cabinet with concealed hinges. Cabinet door shall be flush with the faceplate with hairline joints. Door shall include a flush integral certificate frame for viewing the operating permit. The window shall be constructed of durable Plexiglas or similar material and be accessible from backside of locked door. Minimum window size to be 7" wide by 3" high.

   a. Cabinet shall contain the following type controls:

      1) A light switch.
      2) Two speed fan switch.
      3) Inspection keyswitch, conforming to the ASME Code.
      4) Independent service keyswitch.
      5) Emergency light test button.
      6) Keyed stop switch.
      7) A duplex 120-volt, A.C. G.F.C.I convenience outlet.

3. Provide black paint filled (except as noted), engraved signage as follows with approved size and font.

   a. Phase II firefighters' operating instructions on rear of locked Phase II compartment door.
   b. Car number over main and auxiliary car operating panel.
   c. "No Smoking" over main car operating panel. Include reference to Los Angeles Municipal Code.
   d. Car capacity in pounds on main car operating panel. Include reference to Los Angeles Municipal Code.

e. 3/16" “Push for Alarm” and telephone usage instructions.
f. 1/8" City of Los Angeles Elevator Code anti-panic signage.

C. Car Position Indicators: Provide segmented digital readout type with 2" high (minimum) indications. Locate at top of each car operating panel at a height no lower than 6'-6" above the finished floor. Indicator shall provide car position and direction of travel and include an adjustable electronic floor passing chime. As the car passes or stops at a floor served by the elevator, the corresponding designation shall illuminate, and an audible signal will sound. The audible signal shall be no less than 20-decibles with a frequency no higher than 1500.

D. Floor Annunciator: Provide digitized voice annunciator providing both male and female voices in a system capable of up to 5-minutes of speech. Messages shall include the following announcements:

1. Floor number.
2. Notice of doors closing prior to nudging operation.
3. Emergency operation announcements:

a. Firefighter’s Service, “Elevator returning to lobby.”
b. Seismic operation, “Elevator proceeding to next floor.”
c. Car has exceeded it rated load, reduce load to resume operation.
d. Standby power activated, “Elevator returning to lobby,” upon sequencing.
e. Security operation, “Elevator in Secure Operation, Exit Elevator Immediately”, upon notification from ACAMS Controller.
f. Contractor/Installer to submit messages for Owner approval prior to fabrication.

E. Hall Buttons

1. Provide one riser of vandal resistant hall pushbuttons. Station shall include flush mounted faceplate. Centerline of riser to be at 3'-6" above the finished floor. Buttons shall have a minimum dimension of 3/4", be raised 1/8" ±1/32" above the surrounding surface, be of square shouldered design, and have a detectable mechanical motion. A minimum clear space of 3/8" or other suitable means of separation shall be provided. Button design shall match those used on the car operating panel. Provide red and/or green LED illumination. Provide 3-position Code required Phase I key switch and operational instructions engraved minimum 1/8" high on the faceplate, at the main lobby. Incorporate fire service jewel and standby power jewels. Faceplate edges shall be relieved. Finish shall be stainless steel No. 4 brushed finish. Backfill for engraving shall be epoxy filled. Integral signs shall be as follows:

a. Fire Operational Instructions. Minimum 1/8" high lettering.
b. Fire Service Jewel. Minimum 1/8" high lettering.
c. Standby Power Indicators. Minimum 1/8" high lettering.

2. Provide spanner type security fasteners. Finish matching faceplate.
3. No objects adjacent to, and below, the hall push button station shall project more than 4-inches from the wall.

F. Hall Lanterns: Provide UP and DOWN lanterns at intermediate landings, single lantern at terminal landings. Electronic chimes for each lantern shall sound once for up and twice for the down direction of travel. The lantern shall illuminate for corresponding direction of car travel and the chime shall sound when the elevator is at a predetermined distance from the scheduled floor stop. The design and location of the hall lanterns shall be as selected. Faceplate finish matching hall buttons.

G. Hoistway Access Switches: Provide without faceplate in entrance frame side jamb at all top and bottom terminals.

H. Fire Control Station: Provide a common control panel for all elevators, locate as directed. Panel to contain a digital readout type position and direction indicator per elevator; fireman's return switch per group or individual elevator as required; a jewel to indicate if doors are open at the fire egress floor per elevator; in car fire service jewel per elevator; space for fireman's phone jack; a cabinet containing fire service keys; engraved instructions for fire service operation; and emergency power selector switches and status indicators.

I. Machine Room Monitors: Provide a monitor in each machine room capable of displaying status, position and critical items for trouble shooting the equipment.

2.15 COMMUNICATION SYSTEM

A. Telephone System: Provide automatic dial “Hands-Free” telephone station located in the car station. A button shall suitably identify activation of auto dialer for the visually impaired. Speaker shall be mounted without faceplate or visible fasteners and located either behind the control station or within the telephone box. Communication shall be capable of being heard from any location within the car enclosure.

1. Provide a telephone symbol minimum 2" high, and raised ±1/32" with Braille indications adjacent to a separate activation button mounted on the control panel.
2. Provide engraved emergency instructions above the activation button. Instructions shall read: “To use emergency telephone, press button below. Dialing will occur automatically.”
3. Provide a visual indication, approximately 3/4" in diameter, or a jewel that illuminates once a call has been received by the master station. Instructions under the visual indicator or within the lighted jewel shall read: “Assistance is on the way”.

B. Provide wiring from car to telephone terminal box in elevator machine room.

C. Provide permanent means of communication between the elevator car and the machine room if required by Code.

D. Provide installation of Life Safety speaker provided by others within the elevator cab. Provide wiring from car to Life Safety junction box in machine room.

E. Bell Alarm System: Bell alarm system for each elevator shall be properly located within building and audible outside hoistway when activated by the Alarm call button on each car control station.

2.16 CENTRAL MONITORING SYSTEM

A. Vertical Transportation Central Monitoring/Control System: Provide central monitoring and control system to monitor and record all the building's elevators, escalators and moving walks and their respective operations simultaneously. System shall be compatible with other building monitoring systems. Systems shall be capable of accommodating multiple elevator control systems from various manufacturers.

B. General: In the event of an elevator shutdown or any other designated emergency, the elevator system shall automatically initiate a call to the Elevator Command Center (ECC). The ECC shall be capable of receiving the call, processing the data and routing the received data to the proper storage or output device, i.e., monitor, hard drive, printer, etc. The system shall have the ability to page designated personnel to notify them of an emergency event. The ECC shall store a chronological listing of the emergency reports received from each elevator. The user shall be able to view or print these reports. The following system hardware shall be provided:

1. Pentium based processor, 1.6GHz or faster.
2. 512 MB RAM.
3. 80 GB hard drive.
4. Parallel port.
5. CD-ROM drive.
6. SVGA card and monitor.
7. Parallel printer.
8. Ethernet connectivity.
9. Provide minimum 17-inch LCD monitor displaying real time activity of each group and each escalator and their respective operations status.

C. Provide a Graphical User Interface Central Monitoring System (CMS) with, but not limited to the following features:

1. Simulated hoistway and car configuration.
2. Individual elevator position.
3. Individual elevator car calls.
4. Individual elevator direction.
5. Individual elevator door position.
6. Individual elevator status of operation.
7. Individual elevator communication status.
8. Registered up and down hall calls.
9. Controller real-time clock date and time.
10. Group mode of operation.
11. Remote registration of car and hall calls. Send a car to any floor at any time, regardless of operation mode, i.e. normal operation, independent service, swing car operation, floor lockout, etc.
12. Floor lockout (hall and car).
13. Independent service to remove car from group to respond to car calls only.
14. VIP operation to send a car to any floor and remain there for a predetermined time reassigning all other calls to different cars automatically.
15. Car to lobby feature to call any car to the main lobby. Return car nonstop after answering preregistered car calls, and park with doors open for an adjustable time period of 60-90-

seconds. Upon expiration of time, the car shall automatically resume to normal operation.

16. Standby power operation and selection.

D. As a minimum, the following reports shall be available from the CMS:

1. Average wait time for each hall call, in each direction of travel.
2. Number of hall calls registered per event or time period selected.
3. Emergency faults and events for the selected time period.
4. Number of hall calls answered per elevator.
5. Door dwell times.
6. Calculated car times including: door open times, door close time, floor-to-floor time.

2.17 WIRING AND ELECTRICAL INSTALLATION

A. Conduit and Wiring

1. Unless otherwise specified, all electrical conductors in the pits and hoistways, except traveling cable connections to the car shall be provided in rigid zinc-coated steel conduit with steel outlet boxes, except that a small amount of flexible conduit may be used where conduit is not subject to moisture or embedded in concrete. Terminal boxes and other similar items shall be of approved construction, thoroughly reinforced, and in no case less than number 12 USSG. All electrical boxes exceeding 150 cubic inches shall be supported independently of the conduits. The rigid conduit shall conform to the specifications here in before specified. All raceway shall be threaded rigid steel conduit. Flexible heavy-duty service cord, type SO, may be used between fixed car wiring and switches on car doors for door reversal devices.
2. All conduit terminating in steel cabinets, junction boxes, wire-ways, switch boxes, outlet boxes and similar locations shall have approved insulation bushings. If the bushings are constructed completely of insulation material, a steel locknut shall be installed under the bushing. At ends of conduits not terminating in steel cabinets or boxes, the conductors shall be protected by terminal fittings having an insulated opening for the conductors.
3. Conduit fittings and connections using set screws or indentations as a means of attachment are not permitted.
4. Connect motors and other components subject to movement or vibration, to the conduit systems with flexible conduit.
5. The Contractor shall furnish all materials and completely wire all parts of the electrical equipment of the elevators including electrical devices on hatch doors.
6. The conduits shall be of such size that the wires or cables can be readily installed and replaced, if necessary. No conduit or raceway shall be less than 3/4" trade size, except that for small devices such as door switches, interlocks, etc., 1/2" conduit may be used. The total overall cross sectional area of the wires contained in any conduit shall not exceed 40 percent of the internal area of the conduit.
7. Conduits shall be neatly and systematically run. All exposed conduit and boxes shall be supported by approved and substantial straps, hangers or clamps to the structural steel, reinforced concrete, or other approved supports. Riser conduits in hoistway shall be supported at each floor level.

8. All screws used for terminal connections of all wiring (control room, machine area, hoistway and pit) shall be provided with "star washers" of proper size and type.

B. Conductors

1. No joints or splices shall be permitted in wiring except at outlets. Tap connectors may be used in wire-ways provided they meet all UL requirements.
2. All wiring shall test free from short circuits or grounds. Insulation resistance between individual external conductors and between conductors and ground shall be not less than one meg-ohm.
3. Provide all necessary conduit and wiring between all remote control rooms, machine areas and hoistway.

C. Traveling Cables

1. Shall be Type EO, rated for a maximum of 300 volts, and shall comply with the requirements of UL Standard #62 and Articles 400 and 620 of ANSI/NFPA No.72
2. Travel cables shall include separate coaxial cable shielded for the communications system.
3. Provide 10 percent spares, but not less than 6 spare conductors in each traveling cable.
4. Provide four pairs of CAT 6A cables for communication, CCTV and security.
5. Provide separate traveling cables for car lighting and fan control circuits.
6. Provide traveling cable for telephone in the elevator car. Cable shall extend from junction box in hoistway to telephone box in car.
7. Provide traveling cable for car work lights.
8. All insulated wiring, control wiring and wiring in traveling cables shall be tag coded at their terminals in the motor room or controller location and hoistway junction box, elevator cab junction box, and push-button stations within the cab, and shall agree with the approved wiring diagrams.

9. All cabinets containing motor drives, filter boxes, transformers and power reactors shall be supported on rails and isolated from the base building structure with elastomer pads having a minimum static deflection of 3/8" (Mason Type N, or equivalent). All connections to and from the cabinetry shall be flexible in order not to compromise the isolation system. Use non-rigid conduit for the final electrical connection, with all other conduit supports and clamps provided on a neoprene sponge insert.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to commencing with the installation of elevator equipment, examine the following and verify that no irregularities exist that would affect the quality of execution of work specified.

1. Hoistway size and Plumbness
2. Anchor brackets
3. Sill Support
4. Pit depth
5. Overhead clearance

3.2 INSTALLATION

A. Install elevator in accordance with the OEM's installation procedures and approved Shop Drawings. Install equipment so it may be easily removed for maintenance and repair. Install all equipment to afford maximum accessibility, safety, and continuity of operation.

B. Verify that electrical wiring installation is in accordance with the OEM's submittal.

C. Erect all items square, plumb, straight and accurately fitted with tight joints and intersections.

D. Coordinate with the General Contractor to ensure that the installation of the elevators is not in conflict with the work performed of other trades.

E. Isolate non-compatible, dissimilar materials from each other by providing vibration isolation, gaskets or insulating compounds.

F. Provide protective coverings for finished surfaces.

G. Upon completion, touch up and restore damaged or defaced factory finished surfaces. Touch up any marred finishes and replace as directed.

H. Remove protective coverings and clean exposed surfaces after completion.

I. Welding shall comply with AWS D1.1. Identify field welds with welder's identification stamp.

3.3 FIELD TESTING

A. General: After installation, the Installer shall inspect and test each elevator and related equipment to Owner's satisfaction that operation of every part of the equipment complies with this specification and with applicable requirements of ANSI A17.1 including sound level criteria specified herein. Elevator will be inspected in accordance with the following:

1. Installer shall notify Owner seven (7) days prior to each scheduled test Installer shall perform testing in the presence of the Owner's representative. This test is in addition to those performed by The City of Los Angeles Elevator Inspector.
2. Installer shall notify the appropriate local authorities having jurisdiction a minimum of seven (7) days in advance of final acceptance tests.
3. Installer shall provide all instruments, materials, and labor required for tests specified herein.

B. Acceptance Testing:

1. Inspect and test the elevator and related equipment to the Owner's satisfaction that operation of every part of equipment complies with applicable requirements of ASME/ANSI A17.1 and local codes.
2. Notification Requirements: Notify Owner a minimum of five (5) working days prior to each scheduled test.
3. Full Load Run Test: Run elevator continuously a minimum of four (4) hours with full specified rated load, during which time car shall be stopped at top and bottom landings with a minimum standing period of 10 seconds at each landing.
4. Speed Test: Make tests before and after full load tests. Using a tachometer on guide rail, determine actual speed of car in both directions of travel, both with full-specified rated load and no load in car. Tolerances for determining if car speeds meet the specified requirements are as follows:

    a. Ascending and Descending Car Speed not more than 10 percent above or more than 10 percent below required speed.
    b. Car Leveling Test: Determine accuracy of floor landing tests both before and after full load run tests. Minimum of 1/4 inch leveling must be maintained. Test accuracy of landing at all floors with full load and no load in car, in both directions of travel.
    c. Electrical Tests: Ensure elevator wiring system is free of short circuits and accidental grounds. Test ground resistance of elevator structure, equipment, and raceways for continuity. Using meg ohm-meter, determine that insulation resistance of each circuit is more than one (1) meg ohm or higher as required by the cable manufacturer. Insulation resistance for motors shall be determined under actual conditions after installation.

5. Acceptance: Elevator acceptance will be based upon elevators meeting requirements of Contract Documents and upon evidence of passing specified acceptance tests and inspections. Final testing will be after elevators are connected to permanent power.
6. Test Reports: Within five (5) days after completion of a test, submit a test report stating type of test, test requirements, failures, or problems, and name of certifying Engineer and

Title. Safety device failure or defective equipment shall be identified, with description of cause and corrective action taken.

7. Failures for any reasons shall be identified with cause(s) and corrective action taken.

C. Re-Inspection: If any equipment is found to be damaged or defective, or if the performance of the escalators does not conform to the requirements of the contract specifications or the Safety Code, no approval or acceptance of escalators shall be issued until all defects have been corrected. When the repairs and adjustments have been completed and the discrepancies corrected, the Owner and Owner's representative shall be notified and the escalators will be re-inspected. Rejected escalators shall not be used until they have been re-inspected and approved.

D. The certificate of inspection for operational use will be issued to LAWA by the enforcing inspection agency. The certificate shall be posted in the elevator control room and in the car operating station.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train LAWA's maintenance personnel to operate, adjust, and maintain escalators.

B. Check operation of escalators with LAWA's personnel present and before date of Completion. Determine that operation systems and devices are functioning properly.

C. Check operation of escalators with LAWA personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 14 21 00

SECTION 14 31 00 - ESCALATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes high-traffic, transit type interior escalators.

1.2 DEFINITIONS

A. Definitions in the latest version of ASME A17.1 apply to work of this Section.

B. High-Traffic Escalators: Escalators designed specifically for use where high-traffic volumes produce dense occupancy resulting in structural, machinery, and brake loads much higher than normal.

C. Defective Escalator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; shipping damage; and similar unusual, unexpected, and unsatisfactory conditions.

D. C.D. Reference to a device or a part of the equipment applies to the number of devices or parts required to complete the installation.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design escalators including attachment to structure, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Operational Requirements: The escalator systems shall:

1. Be capable of operating under full load conditions, at full contract speed, in either direction, and designed to operate quietly and smoothly without bounce.
2. Have a rated nominal speedof 100 ft./min. (.50 m/s) or metric equivalent. The no load to full load speed shall not vary by more than 4% of the contract speed.
3. Hours of operation shall be considered as twenty-four (24) hours per day, seven (7) days per week, 365 days a year.
4. Direction of travel shall be considered as either direction and unit shall be up and down reversible.
5. Handrail speed shall be consistent with step speed.

C. Braking Performance: Provide brakes that stop escalator in up-running mode at a rate no greater than 3 ft./s^2.

D. Step/Skirt Performance Index: Not more than 0.15.

E. Structural and Mechanical Performance for High-Traffic Escalators: For the purpose of structural design, driving machine and power transmission calculations, and brake calculations, design high-traffic escalators for loads not less than 2 times the design loads required by ASME A17.1.

F. Structural Performance of Balustrades, Deck Barricades, and Handrails: Provide components and assemblies capable of withstanding the effects of loads indicated in ASCE 7 for handrail assemblies and guardrail systems.

G. Regulatory Requirements: Comply with ASME A17.1, CCR Title 8, and escalator design requirements for earthquake loads in ASCE 7.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Refer to Section 14 20 00, Vertical Transportation, General.

B. Installer Qualifications: Refer to Section 14 20 00, Vertical Transportation, General.

C. Professional Engineer Qualifications: Professional Engineer Qualifications: Refer to Section 14 20 00, Vertical Transportation, General.

D. Standards: The following standards shall govern the moving walk work. Where standards conflict, the standard with the more stringent requirements shall be applicable.

1. Escalator Code: In addition to requirements of authorities having jurisdiction, comply with the latest edition of ASME A17.1, "Safety Code for Elevators and Escalators", ASME A17.2 "Guide for Inspection of Elevators, Escalators and Moving Walks", and ASME A17.5 "Requirements for Elevator and Escalator Electrical Equipment", including supplements, as published by the American Society of Mechanical Engineers. Wherever "Code" is referred to in the moving walk specification, the ASME A17.1 Code shall be implied.
2. Electrical Code: For electrical work included in the escalator work, comply with the National Electric Code (NFPA 70), ASME A17.5, all applicable local codes, and the authorities having jurisdiction.
3. Welding: Comply with AWS standards.
4. Americans with Disabilities Act (ADA).
5. Building Code of the City of Los Angeles and the following:

    a. California Code of Regulations (CCR), Title 8.

E. Electrical Devices and Equipment: Refer to Section 14 20 00, Vertical Transportation, General.

F. Manufacturer: Provide all moving walks components from a single source. Where equipment or operation varies from those described, the manufacturer shall provide a complete description of those variations as required under Section 14 20 00, VERTICAL TRANSPORTATION, GENERAL, Article QUALITY ASSURANCE, paragraph 'Contractor Statement'.

G. Testing and Inspections: Refer to Section 14 20 00, Vertical Transportation, General.

1.5 SUBMITTALS

A. Scaled Layouts: Fixtures, barricades, etc.

B. Design Information: Indicate equipment lists, reactions and design information on layouts.

C. Product Data: Include capacities, sizes, performances, safety features, finishes, and similar information.

D. Delegated-design Submittal: for installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Shop Drawings: Show plans, elevations, sections, and details indicating coordination with building structure and relationships with other construction. Indicate variations from specified requirements, maximum loads imposed on building structure at points of support, and power requirements. Indicate access and ventilation for escalator machine space. Provide at scale of 1/4" = 1'-0".

1. Load assumptions for maximum loads imposed on trusses requiring load transfer to building structural framing, individual weight of principal components and their dead and live load reactions at points of support, electrical characteristics and connection requirements, loading imposed by truss cladding and any other information requested by the Architect.

    a. Structural Calculations: Submit, for information only, copies of structural calculations indicating load assumptions. Calculations shall be signed, and sealed by the qualified Professional Engineer responsible for their preparation and who is licensed in the State of California.
    b. Power Confirmation Sheets: Include motor horsepower, code letter, starting current, full-load running current, and demand factor for applicable motors.

F. Glass Treatment Certificates: Submit glass treatment certificates signed by manufacturer of the heat soaked glass products certifying that products furnished comply with requirements.

G. Samples: For exposed finishes, 3-inch- square Samples of sheet materials, and 4-inch lengths of running trim members.

H. Fixtures: Cuts, samples or shop drawings.

I. Manufacturer Certificates: Signed by manufacturer certifying that escalator layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for escalator system being provided.

J. Qualification Data: For Installer.

K. Operation and Maintenance Data: For escalators to include emergency, operation, and maintenance manuals.

1. Include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

L. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted escalator use.

M. Rigging: Installer shall submit a rigging plan for approval. Any use of existing building structures shall be reviewed and approved by a structural engineer.

N. Operating and Maintenance Manuals: Prior to completion of the installation, contractor shall submit six complete sets of Operation and Maintenance manuals for approval. After LAWA approval and prior to the beginning of acceptance testing, six (6) sets of the approved manuals shall be provided by the Contractor. The manuals shall include the following:

1. Complete table of contents.
2. Complete instructions regarding operation and maintenance of equipment, including disassembly and assembly of drive system, handrail drive assembly, and track system. Included will be complete and illustrated exploded views of all assemblies as well as a complete and illustrated exploded view for identifying all system parts.
3. Complete nomenclature of replaceable parts, part numbers, current cost, and warehouse location. If product source is another vendor, contractor shall include name and address of the other vendor.
4. Sample copies of a preventive maintenance chart.
5. Descriptions of safety devices.
6. Safety rules, tests, and procedures, including testing of all systems and subsystems.
7. Procedures for adjusting brake, handrail tension, handrail chain drive tension, step chain tension, track system, and mechanical components, including pictorials.
8. Instructions for removing floor plate, replacing comb segments, and removing and installing steps, and interior panels.
9. Troubleshooting techniques.
10. Detailed lubrication and cleaning schedule indicating weekly, monthly, quarterly, semiannual, and annual lubrication; and a description of each lubrication point, lubrication type, and specification.
11. Control and schematic electrical wiring diagrams of controller, including wiring of safety devices to connections with remote indication and control panels for each escalator and group of escalators.
12. Electrical layout showing placement of lighting, light switches, receptacles, light fixtures, disconnect switches, and convenience outlets in machinery room, truss envelope, and pits.
13. Complete detailed drawings and wiring diagram of escalator fault finding device and connection to annunciator panel.

O. Certification:The escalator manufacturer shall provide certification that the purchaser of the escalators shall be provided with copies of all documents related to maintenance, safety, operations, design changes, modifications, retrofits, etc.; which relate to any part, component, equipment, system subsystem, or material and services applicable to the escalator provided.All of the above referenced shall be provided as it pertains to the original installation and for a period of twenty (20) years after final acceptance of the last escalator provided under any contract.The referenced material shall be provided within thirty days of publication or internal distribution by the escalator manufacturer. The material, even if labeled PROPRIETARY, shall be delivered to the Authority without prejudice or delay and at no additional cost.

1. Provide all material on CD-ROM in a format approved by the Authority.

P. Material Safety Data Sheets (MSDS): MSDS and product data sheets shall be submitted with an index listing each product, along with the application method of the product, approximate quantity of product per escalator, and the component the product is applied to or associated with. The contractor shall allow six (6) weeks for review of MSDS.

Q. Spare parts and replacement parts list - Contractor shall maintain, at a minimum, a local on site parts inventory for use solely on this Contract. Parts not listed below, including balustrades, decks, skirt panels, handrails and signage shall be available via overnight air delivery. Inventory shall include lubricants, light bulbs, etc. necessary to maintain equipment in original operating condition. The parts listed below shall be made available for inspection by LAWA or its designee. Part storage shall be as directed by LAWA.

1. Parts required for equipment listed under Section 14 31 00: Parts inventory shall be maintained throughout the Warranty Maintenance period and five year contract maintenance period after which parts will become the property of LAWA.

a. Escalators

5 Complete Steps
10 each – Left, Right and Center Step Treads Inserts
15 Comb plate Segments – each kind
17 Step Rollers and Flanges
7 Step Axel Sets
1 Matched Pair Step Chains (Longest Unit)
2 Sets Gear Box Gaskets and Shims
1 Automatic Lubrication Reservoir
2 Sets Skirt and Emergency Switches
2 Sets Start Contacts, each size
3 Stop Switches
10 10' Sections skirt deflection brushes
4 Stop Switch Covers with hardware
2 Key Switches – each kind
1 Motor Starters, each size
2 LH Electric Interlocks, each size
2 RH Electric Interlocks, each size
1 Circuit Breakers, each size
1 Reverse Phase Relays
1 Transformers
2 Step Chain Oilers
2 Handrail Inlet Brushes
7 Handrail Tension Rollers

1.6 QUALITY REQUIREMENTS

A. Installer Qualifications: Escalator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain escalators and elevators/moving walks specified in other sections through one source from a single manufacturer.

C. Regulatory Requirements: Comply with ASME A17.1, CCR Title 8, and seismic criteria listed above.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.

B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's recommendations to prevent damage, deterioration, or soiling. Step chains exhibiting rust shall be replaced prior to final acceptance.

1.8 COORDINATION

A. Coordinate installation of, escalator equipment with integral anchors, and other items that are embedded in concrete or masonry for escalator equipment. Furnish templates, sleeves, escalator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Coordinate sequence of escalator installation with other work to avoid delaying the Work.

C. Coordinate locations and dimensions of other work relating to escalators including sumps and floor drains in pits, electrical service, and electrical outlets, lights, and switches in pits.

D. Coordinate and provide hoisting related to escalator installation.

E. Coordinate installation of truss cladding and all other work related to the escalator installations.

F. Coordinate seismic attachment with structural design.

1.9 INSTALLATION CONTRACT ACCEPTANCE, WARRANTY, INTERIM SERVICE AGREEMENT AND SERVICE AGREEMENT

A. Warranty: The Contractor shall warrant in writing that all equipment manufactured and installed under this Contract be free of defects in design, materials, and workmanship, under normal use and service (“Warranty”) for a period of twelve (12) months. Defects in design, materials, and workmanship shall be repaired or replaced with all materials and labor at no additional cost to LAWA (“Warranty Work”). (Defects shall include, but not be limited to, noisy, rough, or substandard operation; failures; loose, damaged, and missing parts; and fluid leaks.)

B. In addition to the Warranty

1. Contractor shall provide, concurrently with each Warranty Period, a 1-Year Preventative Maintenance ("PM") service for all units.
2. Beginning one year after the Contract Completion Date, the Contractor shall provide a 5-Year Extended Preventative and Routine Maintenance Service Agreement ("SA"), per Section 14 20 00, 3.7.2 and Exhibit A, for all units installed in this Contract.
3. The 5-year SA period shall be executed in strict compliance with all of the terms and conditions set forth in Exhibit A ("Exhibit A"). Upon conclusion of the SA, the parties may mutually agree to extend the SA for an additional sixty (60) months, via a renewable option ("Option").

C. The Contract/Warranty, PM, Interim and SA services shall include all services necessary to maintain the equipment in proper working order for use at a major international airport including, but not limited to.

1. "Tasks":

a. Inspection of completed installation and periodic testing to maintain elevators in completely operable, like new condition.
b. Provide preventative maintenance on escalators for a minimum of four (4) hours each month (Total On-Site Time). Provide monthly documentation of the same to LAWA.
c. Periodic lubrication of parts and equipment components as per OEM's recommendation. Charts are to be provided for each escalator indicating when services are provided.
d. Perform work without removing escalators from service during peak traffic periods determined by LAWA as 7:00 a.m. to 10:30 p.m. daily.
e. Provide twenty (24) hour emergency service during the maintenance period consisting of a prompt response (within 30 minutes) to emergency request by telephone or otherwise from LAWA or designated representative if an escalator is inoperable or in case of injury, entrapment, or potential injury to persons.
f. Unlimited regular time callbacks are included with a required response time of one (1) hour. Regular time will be Monday through Friday, 8:00am to 4:30pm, exclusive of holidays. Overtime\Premium time call backs originating from an operational error related to the performance requirements of the equipment shall be borne by the Contractor.
g. All other services as required by Section 14 20 00, 3.7.2 and Exhibit A.

1.10 MAINTENANCE SERVICE

A. Comply with requirements in Section 14 20 00, 3.7.2;"Vertical Transportation, General, Section 14 21 00 and Exhibit A."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Comply with requirements in Section 14 20 00, 3.7.2; "Vertical Transportation, General."

2.2 MATERIALS

A. Structural Steel:

1. Rolled Steel Sections, Shapes and Rods: ASTM A36.
2. Tubing:

   a. Cold Formed: ASTM A500.
   b. Hot Formed: ASTM A501.

3. Sheet Steel: ASTM A446, grade B, zinc coated.

B. Stainless Steel: ASTM A 240/A 240M, Type 304.

1. Satin Finish: No. 4 directional satin.

C. Aluminum Castings and Extrusions:

1. Castings: ASTM B108 alloy and temper as required to meet the strength and performance requirements.

2. Extruded Aluminum: ASTM B221, Alloy 6061 or 6063, T6.

3. Finish: Commercial mill finish.

D. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 1 (clear), Quality q3 (glazing, select), Kind FT (fully tempered), 12.0 mm thick. After tempering, heat soak 100% of all fabricated glass units to European Union Standard EN14179 to eliminate inclusion related glass breakage. Statistical heat soaking shall not be permitted. Comply with ASME A17.1, Section 6.1, Rules 6.1.3.3.2 and 6.1.3.3.3.

E. Fasteners: Provide bolts, nuts, washers, screws, rivets, and other fasteners necessary for the proper erection and assembly of the moving walk work. Fasteners shall be compatible with materials being fastened.

F. Welding Materials: Comply with AWS D1.1.

G. Sealants, Joint Fillers and Primers: Sealants, joint fillers and primers internal to the moving walk systems shall be as selected by the moving walk manufacturer. Perimeter sealants, joint fillers and primers are specified under Section 07920, JOINT SEALANTS.

H. Paint and Corrosion Protection: Each moving walk shall have the following minimum corrosion protection.

2.3 COMPONENTS

A. General: Provide high-traffic transit type escalators complying with requirements. Unless otherwise indicated, provide heavy-duty components required by the American Public Transportation Association (APTA) Guidelines and as required for a complete escalator.

B. Performance

1. Step Speed: Unit shall be capable of operating at contract speed under any loading condition in either direction of travel. The no-load-to-full-load speed shall not vary in excess of 4% of the rated speed.
2. Handrail Speed: Consistent with step speed.

C. Operation

1. Each unit shall be capable of operating smoothly and quietly at rated speed with synchronized step and handrail operation and speed in either direction of travel. Units shall be designed to operate twenty-four hours per day, seven days per week.

D. Machine Room Equipment

1. Drive Motor: The driving motors shall be AC induction motors with solid state closed transition starting starters. Voltage 480 V.A.C., 3 phase, Frequency 60 Hertz.
   a. The motors shall be totally enclosed with external cooling fins.
   b. The motor protection class shall be equivalent to IP 55 Insulation group: F.
   c. Driving motors and motor switch gear shall provide a smooth start.
   d. The motor shall be designed for continuous operations under a load as follows:

      1) 1000m wide step with a load of 300 lbs. per step on the incline.

2. Controls and Safety Devices

   a. Operating Controls:

      1) Escalators shall have key operated switches, accessible at both upper and lower landings, located on the exterior deck above the newel base. Alternate locations may be used subject to approval by the Authority.
      2) Each keyed switch shall be clearly and permanently labeled, including starting and direction selection.
      3) Interlocks shall be provided to bring the escalator to a smooth stop, in either direction of travel, before a change of direction may be made.

   b. Safety Devices:

      1) Safety devices include but are not limited to those which are required by the latest edition of ASME A17.1.
      2) A lockable stop switch or disconnect shall be provided in both pits of escalators.
      3) Provide skirt deflection devices (brushes). Provide dual profile brushes with anodized aluminum receptacles. Align joints with skirt panel joints.

   c. A fault-finding device shall be provided in the newels, capable of producing indications of the following data:

      1) Date, time, and cause of escalator stoppages.
      2) The fault indication shall remain visible until reset by an authorized person.
      3) Data shall be transmitted to a remote monitoring location.

3. Brake Operation: Safely decelerate, stop and hold rated load per Code requirements. Brakes shall stop escalator operating in the down direction at a rate not greater than three feet/second/second.
4. Controller: Wire to identified terminal block studs. Identifying symbols or letters identical to those on wiring diagrams permanently marked adjacent to each component on the controller. Enclose all components in steel cabinet removable from machine room for ease of access to switches and wiring. Provide mainline circuit breaker and means to protect against overload and single phasing. Controller shall be labeled with rated load and speed, braking torque, manufacturer serial number and LAWA numbers. Locate controller remote if available space is not sufficient in upper or lower pit.
5. Controller

    a. The escalator control equipment shall contain diagnostic capabilities as required for the ease of complete maintenance. The diagnostic system shall be an integral part of the controller and provide user-friendly interaction between the service person and the controls. All such systems shall be free from decaying circuits that must be periodically reprogrammed by the manufacturer.
    b. Switch gear shall be mounted in NEMA 4X cabinets with labeled terminal strips.
    c. The main controller shall use an Allen Bradley SLC5/03 Programmable Logic Controller (PLC) or approved equal, to control and monitor the status of the escalator. The PLC shall be designed to communicate over Ethernet or approved equal.
    d. The PLC racks shall provide space for two future single-slot modules.
    e. The PLC in the remote control panel shall also have hardware and firmware provisions to communicate with interactive operator interface (monitor).
    f. The PLC shall store the last 99 faults, accessible via laptop connection, panel view or remote communications.
    g. Provide a copy of all working programs on approved computer medium as well as a printed program listing.
    h. The Programmable Controller shall have one dedicated serial port, which supports RS-232-C signals. It shall be accessible in ladder logic and provide support for Point to Point and Lift-Net/Slave SCADA communication protocol systems. Alternatively, it must be usable for programming purposes or for access to remote programmers via modems.
    i. The main control switchgear of an escalator shall contain at least the following devices:

        1) Lockable main switch thermal and magnetic motor protection starter for up and down travel, hour counter, auxiliary contactors, phase failure device, phase sequence monitor, and ground fault monitor.
        2) The controller cabinet shall contain a permanently mounted fault indicator board with indicator lights. Fault data shall also be displayed at the newel. Each group of safety devices shall be connected to one signal lamp.
        3) The indication shall be locked automatically. Reset shall be done by a separate switch installed in the controller. The emergency stop shall not be locked.
        4) All terminals shall have identification markings and all cables shall be provided with cable markers.

5) The controller shall be equipped with an AC induction motor reduced voltage starter; installed in line between the standard type contactor and the drive motor. The starter shall be solid state, capable of starting motors smoothly and gradually, reducing inrush current and mechanical shock upon start up. Adjustable settings for accelerating time and starting torque shall be provided. The starter shall also contain auxiliary contacts and a thermal overload relay for motor protection.
6) Maintenance Receptacles: Electric power receptacles shall be furnished and installed in the upper and lower pits. Each receptacle shall be of the GFCI duplex type, waterproof, grounded, and rated for one hundred and twenty volts at twenty amperes. The receptacles in the pits shall be surface mounted on the walls, not less than thirty inches from the floor.
7) Relays shall be provided with visual indication that they are energized.
8) Adjustable settings for accelerating time and starting torque shall be provided. The starter shall also contain auxiliary contacts and a thermal overload relay for motor protection.

j. Monitoring System Interface: Provide controller with serial data link through RJ 45 Ethernet connection and install all devices necessary to monitor items outlined in Section 2.15. Escalator Contractor responsible to connect monitoring system interface to machine room monitoring compartment and LAN. Wiring from LAN to the machine room monitoring compartment by others.
k. Remote Monitoring and Diagnostics: Equip each controller with standard ports, interface boards, and drivers to accept maintenance, data logging, fault finding diagnostic, and monitoring system computers, keyboards, modems, and programming tools. The system shall be capable of driving remote color CRT monitors that continually scan and display the status of each escalator. System shall be Lift-Net, or equal, ready/compatible. System shall be compatible with other building management systems. Monitoring system shall not be proprietary to any individual control.

6. Maintenance Drive Unit: Means shall be provided for reduced speed maintenance operation that shall be controlled by a manual handset. When operated, the escalator shall run in the direction selected, at a speed of not more than 25% of rated speed. This speed shall be maintained when steps are removed for servicing. Escalator operation shall be continuous so long as an up or down button on the handset is being pressed. The handset shall be a ten foot retractable type cord with a plug connector. When plugged into receptacle, there shall be no means of operating or running the escalator except by the service handset. Receptacles shall be located in both the upper and lower pits.
7. Step Drive Assembly: Direct or indirect drive. Machine sprockets at each side over which step chains or step chain rollers shall pass and transmit motion from machine to steps. If indirect chain drive is used between machine and drive sprocket, provide emergency brake on drive assembly to automatically set if drive chain fails. Provide roller-type sealed bearings.
8. Stop Switch: Per Code.

E. ESCALATOR POWER SAVING CONTROL

1. CERTIFICATIONS

a. The motor controlling device shall be certified to meet US elevator / escalator code (ASME-A A17.5 and CSA B44.1) standard for industrial control equipment as well as CE for the European Standard.

2. PERFORMANCE

a. The supplier shall provide documented proof that the motor controlling device has been tested on an escalator by at least one electric utility in the United States of America and shown positive energy savings test results. Furthermore, the supplier shall provide documented proof that the electric utility approved the motor controlling device for an energy efficiency rebate (if applicable).
b. The motor controlling device shall continually monitor motor and be able correct energy requirement within 8ms and be able to respond to a 50% change in load within 1 second without changing the speed of the motor by over 0.5%. The motor controlling device shall be able to provide full power to a motor without using more than 0.5% more energy that an electrical mechanical motor starter.

3. EQUIPMENT MANUFACURER ACCEPTANCE

a. The supplier shall show broad industry acceptance of the motor control device by documenting that all major escalator service providers, including Otis Elevator, KONE Inc. Schindler, ThyssenKrupp, and Mitsubishi Electric, have experience installing such device on an escalator.

4. FUNCTIONS

a. The motor controlling device must include the following functions:
b. Overload Current Protection
c. Over Voltage Protection
d. Under voltage Protection
e. Over Current
f. Under Current
g. Phase Loss
h. Reverse Direction
i. S.C.R. Failure
j. Fault logging capability
k. Remote monitoring capability

5. MOUNTING HARDWARE

a. The mounting hardware and enclosure shall be rated NEMA - 1 for indoor installations and NEMA 4 for exterior installations rated and specifically designed for ease of installation in escalator applications.

6. CONTROL VOLATAGE CONNECTION

a. The motor controlling device shall not require an external dedicated power source to operate and shall operate based on existing line serving the escalator.

7. DISCRETE INPUTS AND OUTPUTS

    a. The motor controlling device shall have one input connection that controls the starting and stopping of the motor. The motor controlling device shall have two output contacts to provide the run and fault status of the motor controlling device.

8. MOTOR CONTROL FUNCTIONALITY

    a. The motor controlling device shall provide a timed soft start with a start up time range of 0 to 10 seconds or more, to appropriately integrate with other motor starters and reduce the mechanical stress on the escalator system during the starting of the motor.

9. HEAT SINK MATERIAL

    a. The motor controlling device shall utilize a metal heat sink material to dissipate operating heat without requiring external cooling devices.

10. SUBMITTAL REQUIREMENTS

    a. The supplier shall provide motor controlling device drawings including schematic wiring diagram and mounting dimensions.

11. DELIVERABLES

    a. The supplier shall provide an installation and user's manual.

12. WARRANTY

    a. The supplier shall warrant the motor controlling device for a period of two years from the date of sale.

F. Wellway Equipment

1. Truss: Steel truss to safely carry entire load of escalator, including all components, full-capacity load and weight of exterior truss and balustrade covering material; (not to exceed 10 lb. p.s.f.). Provide factor of safety per Code. Provide clearly identified exterior cladding support attachment locations on exposed sides and bottom of the entire length of truss. Escalator intermediate support points shall be provided by installer where required. Submit details and calculations. Provide mounting angles. Truss shall be designed to be accommodated by the existing wellway dimensions.
2. Truss Extensions: Provide truss extensions at upper and/or lower landings as required and/or as shown contract drawings.
3. Noise and Vibration Control: Provide sound isolation within truss as required to limit noise levels relating to escalator equipment and its operation to no more than 60 dBA, measured 3'-0" above escalator at any point of its length.
4. Drip Pans: Oil-tight, steel pans with sufficient strength to withstand weight of workmen, entire width and length of truss. Fabricate all oil pans, chutes, etc. shall be fabricated of galvanized steel.

5. Step Tracks: Construct from steel. Tracks shall be bolted sections including transitions to facilitate maintenance and replacement if required. Track sections, including transitions, shall be factory installed and aligned to insure smooth, quiet operation of running gear under all conditions. The individual track section, together with transition section, step chain tension carriage, main drive shaft and handrail drive shaft shall form a fully independent assembly. The rolling surface of the track be a minimum thickness of 3 mm.
6. Guiding System: The guiding system for the step chains and step wheels shall be of zinc plated or galvanized steel profiles with smooth and even running surfaces and with the joints cut diagonally to the running direction. The guide profiles shall not be welded together at the joints. A second, continuous guiding profile shall be provided above the step chain rollers so that the step chains are positively guided in the area of the escalator open to passengers.
7. Electrical Wiring

    a. Conductors: Copper throughout with individual wires coded and all connections identified on studs or terminal blocks. Type SO cable may be utilized for wiring conducting 30 volts or less, per NEC 620-21.
    b. Conductors: 31 Volt RMS or greater. Provide conduit, junction boxes, connections and mounting means per requirements of Division 16. Provide painted or galvanized steel or aluminum conduit. Conduit size minimum 3/8". Flexible conduit exceeding 18" in length shall not be used.

8. Step Chains: Steel links with hardened pins connecting adjacent steps and engaging drive sprockets. Pins shall have a minimum diameter of 5/8". Provide polyurethane roller assemblies with sealed bearings. A shielding device shall be provided to protect chain, track guides and rollers against water, dirt, and debris. Escalator design shall permit chain inspection and operation while unit is running with steps removed. Roller shall be a minimum of 4" in diameter.
9. Step Chain Tension Carriage: Spring tensioning device to take up chain slack and maintain constant tension.
10. Step Assembly: Single piece die-cast aluminum, fastened to the step chain axles. Step rollers shall have sealed bearings and be tired with synthetic composition material. Treads and riser shall be cleated. Steps shall be covered on the underside with sound-deadening material. Steps shall be removable from unit without disassembly of balustrade or decking. Provide renewable step demarcation inserts on rear edge of each step tread and both sides of each step tread. Paint step tread and riser black between machined surfaces of cleats.
11. Fire Protection

    a. Escalators shall be constructed of noncombustible materials as defined in ASTM A136 throughout, with the exception of handrails, handrail rollers, chain step wheels, and electrical equipment.
    b. Handrails shall have a flame spread rating of seventy-six to two hundred when tested in accordance with ASTME 84.
    c. Bearings shall be rated for an AFBMA L10 life as specified, under a fluctuating bearing load. All bearings shall have basic dynamic load ratings.

G. Handrails

1. Construction: Laminated canvas and rubber running on brass, bronze or steel guides. Handrail shall be spliced and vulcanized with smooth joint. Handrail shall be driven at the same speed as the steps. Provide tensioning device and slack-tension switch.

H. Balustrade

1. Interior Panel: Reinforced 14 gauge stainless steel.
2. Skirt Panels: Reinforced 14 gauge metal. Install to maintain clearance of step treads to skirt of not more than 3/16". Extend skirt panel beyond combplates to meet front plates.
3. Deck Boards: Reinforced 14 gauge metal. All deck section joints shall abut to provide a smooth surface to surface connection with curved transition, top and bottom, horizontal to incline sections.
4. Finishes

    a. Interior Panels: No. 4 stainless steel reinforced vertical panels with section joints vertical to horizontal.
    b. Skirt Panels
        1) Black, low friction material applied to metal panels.
    c. Inner and Outer Deck
        1) No. 4 stainless steel.

5. Trim and Moldings: Match deck finish.
6. Anti-Slide Knobs: Provide outer high deck configuration of immediately adjacent units with anti-slide knobs. Finish of knobs to match deck finish.
7. Floor Intersection Guards: Provide clear plexiglass intersection guards at floor penetrations as required per Code.

NOTE: In areas where luggage carts are used, glass balustrades are not permitted.

I. Landings

1. Flat Steps: Provide upper and lower landings with a minimum two flat steps on vertical travel distances of 15 feet or less. For travel distance above 15 feet, provide three flat steps.
2. Comb plates: Non-corrosive metal provided with non-slip surface. Provide removable comb sections. Apply yellow powder coat finish. Provide comb plate lighting in skirt panel on both sides of units at both upper and lower landings. Comb teeth shall be designed to withstand a load of two hundred and fifty pounds applied in an upward direction at the tip of any one tooth.
3. Landing Plates: Aluminum or other alloy with non-slip surface. Plate shall extend from combplates to equipment access plates at upper and lower ends. Plates shall extend full width of truss. Plates shall be supported by Type 316 stainless steel frames.
4. Equipment Access Plates: Aluminum or other alloy with non-slip surface. Provide removable access plates to provide for entry into equipment spaces at upper and lower

ends. Plates shall cover entire truss openings. Access plates shall match material and finish of adjacent landing plates. Provide landing plate and access floor plate without visible manufacturers name or logo.

J. Signal and Control Fixtures

1. Provide upper and lower newel or stanchion mounted operating stations. Mount on right side when facing unit. Match deck finish. Function and operating positions of switches and buttons shall be identified with engraved characters which are readily visible from a standing position. Each station shall contain the following:

    a. Red "emergency stop" button. The button shall be covered with a transparent cover which can be readily lifted or pushed aside. When the cover is moved, an audible warning signal shall be activated. The signal shall have a minimum sound intensity of 80 dBA at the button location.
    b. The cover shall be engraved "EMERGENCY STOP"; "MOVE COVER" or equivalent legend (i.e. "LIFT COVER," "SLIDE COVER," etc.); and "PUSH BUTTON." "EMERGENCY STOP" shall be in letters not less than 1/2" (13mm) high. Other required wording shall be in letters not less than 3/16" (4.8mm) high. The cover shall be self-resetting.
    c. Key switch to "start" unit.
    d. Key directional control switch.
    e. Speed selection switch.

K. Signs

1. Landing Signs: Provide caution signs at top and bottom landings per Code. Provide engraved stainless steel plate with material and finish to match decking and comply with Code coloring requirements.

L. Environmental Requirements

1. General: Escalators shall be capable of operating with full-specified performance capability while exposed to the following climatic and environmental conditions.

    a. Interior installations: Escalators shall be designed to operate in a temperature range of plus five to plus one hundred and twenty degrees Fahrenheit, dry bulb; and all conditions of relative humidity while exposed to airborne dust and debris.
    b. Exterior installations: Escalators shall be designed to operate while exposed to the natural elements of weather including sunlight, rain, slush, snow and ice; all conditions of relative humidity while exposed to salt, de-icing chemicals, airborne dust, and debris, and corrosive elements; and in a drybulb temperature range of minus ten to plus one hundred and five degrees Fahrenheit. Exterior installations shall follow APTA Guidelines for material selection/protection water diversion and environmental protection.

M. Monitoring System

1. General: Provide an interactive system to monitor and manage the escalator equipment ("units"), hereinafter called "system". Data collection, data storage and real-time monitoring portion of the system shall be based on Microsoft Windows and be able to run

on Windows 2000 Pro, XP Pro, or later operating systems. Provide the following features:

a. Network based, capable of interfacing with control systems via either serial data link or hardwired interface connections.
b. Operate on any TCP/IP based network system including but not limited to an Ethernet, Token Ring, Arc-Net, Lift-Net, etc.
c. Expansion capability to add unlimited number of monitoring terminals on the network.
d. Monitoring terminals shall operate "peer" to peer" or with a single client server. Failure of a single network device shall not affect the operation of the remainder of the system.
e. Complete backup of system data shall be accomplished at any single terminal/server location.
f. Display multiple banks, including multiple buildings, on a single monitoring terminal screen.

2. Monitoring Display: The system shall be capable of simultaneous monitoring of at least five hundred units on a single monitoring station utilizing a graphical representation of a plan view of the facility. Each escalator shown on the plan view shall be individually displayed and shall be visible on the monitoring system display terminal without the need to scroll. Each individual unit, when operating "normally," shall be displayed in green. In the event of a malfunction of any individual unit, the unit shall be displayed by a red blinking light on the monitoring system display. Units which are intentionally placed out of service shall be shown as yellow in the display mode. When malfunctioning units, or units intentionally placed out of service, are returned to normal operation the graphical representation for that unit(s) shall automatically return to green. The user shall have the ability to display additional information, such as the cause of fault/alarm, for all units by selecting the unit with a "mouse click" from the plan view of the facility. All monitored units shall be visible from any monitoring terminal on the network. Entry into the network shall be multi-level password protected.
3. System Capabilities:

a. The system shall be capable of real time display of all monitored status points on all monitored equipment. Fault and event notification screens and audible alarms shall be immediately displayed on selected monitoring stations. Different fault and event tables shall be defined on a per-bank basis. The system shall collect and store all status, fault and event information for later reporting and analysis. The system shall provide statistical analysis of hall call response times, traffic patterns, fault conditions, service logs and security usage in graphical and tabular format.
b. The system shall maintain a record of every status point change occurring on the monitored equipment, and provide the ability to replay these events in a simulation at a later time in real time, slow speed, and single pallet, reverse or fast forward. This information shall be retained for a period of at least twenty-six weeks and a mechanism shall be provided whereby this information may be archived.
c. The system shall store traffic fault and statistical data for a period of at least three years. The system shall log error type, car number, floor position and major system status points whenever a fault or logged event occurs.
d. The system shall provide interactive control of certain features provided in the escalator control system. These features may be revised as the requirements of the

building change. Some of these interactive controls may include, but are not limited to, tandem operation, individual safety switches, remote start/stop feature, etc.

e. In the case of a power failure the system shall be capable of connecting to emergency power back-up unit. The loss of power shall not affect any stored data. The system shall have the capability to detect the loss (disconnect) of any individual unit from the monitoring system by periodically polling all units to ensure that normal communications between the unit(s) and the terminals/server are maintained.

f. The system will automatically re-boot the program and continue to operate after a power loss or other system malfunction.

4. Monitoring Equipment: The monitoring equipment shall have these minimum characteristics:

a. Monitoring Station Hardware: Provide a minimum of two Monitoring Stations.

1) Central processing unit - IBM compatible microcomputer - desk top or mini-tower (multiple machine rooms or lobby displays)
2) Type - Pentium or most current high-performance processor
3) Speed - most current high-performance
4) Internal hard drive - adequate storage for three years data for entire system
5) Modem - most current high-performance
6) Display monitor (19" - 20" LCD flat panel) - color, capable of simultaneous display of all monitored units
7) Printer - current HP Color Desk Jet Series
8) Keyboard - MS Windows compatible
9) Mouse - MS Windows compatible
10) Power requirements - 90 - 230 Volts AC 50 - 60Hz @ 8A

b. Machine Room Hardware (Retained Control):

1) Controller interface panels shall utilize high quality printed circuit boards
2) Input voltage range - 5 - 250V AC/DC
3) Compatible with all types and makes of controllers
4) Operating temperature range - 45 - 112 degrees Fahrenheit
5) Humidity range - 10% - 85% non-condensing
6) Modular design - capable of future expansion
7) Power requirements - 90 - 230 VAC 50 - 60Hz @ 3A
8) The following electrical specifications for interface circuitry shall apply:

a) Input circuit loading: < 2 ma
b) Input impedance: > 1.5 Megohm @ 100VDC
c) Inputs - Optical isolation: > 3500 VRMS @ 1 sec.
d) Outputs - Relay form "C" contact rated 1/3 HP inductive, 3A, 250VDC

c. Monitoring Station Operating System Software

1) MS Windows 2000 Pro, XP Pro, or later

2) MS Windows 2000 Server, or later

5. Network requirements:
   a. Maximum local network rated distance (2-20 gauge shielded TP): > 10 miles
   b. Maximum number of nodes (combined PC, inputs/outputs): 500
   c. Maximum I/O points per node (input or output): 2040
   d. Access time to status bit change (typical 6-car bank): < 25ms
   e. Must be capable of operating on RS485, RS422, Ethernet, Token Ring, Arc-net, Lift-Net, Fiber-Optic and mixed WAN TCPIP Networks

6. Monitoring Requirements: The system shall display and record the following information for each monitored unit. Serial data links may include many more points. Items listed below are minimum requirements.

   a. Escalators:

      1) Power on/off
      2) Emergency stop switch, lower
      3) Emergency stop switch, upper
      4) Travel up
      5) Travel down
      6) Broken pallet chain device #L
      7) Broken pallet chain device #R
      8) Comb-pallet impact device, horizontal switch #TL, TR
      9) Comb-pallet impact device, horizontal switch #BL, BR
      10) Comb-pallet impact device, vertical switch #TL, TR
      11) Comb-pallet impact device, vertical switch #BL, BR
      12) Handrail entry device #TL
      13) Handrail entry device #TR
      14) Handrail entry device #BL
      15) Handrail entry device #BR
      16) Handrail-speed monitoring device #L
      17) Handrail-speed monitoring device #R
      18) Pallet level device #T
      19) Pallet level device #B
      20) Broken pallet device #1
      21) Broken pallet device #2
      22) Broken pallet device #3
      23) Broken pallet device #4
      24) Skirt obstruction device (landing) #TL
      25) Skirt obstruction device (landing) #TR
      26) Skirt obstruction device (landing) #BL
      27) Skirt obstruction device (landing) #BR
      28) Missing bridge (if applicable)
      29) Disconnected motor safety device
      30) Pit stop switch #T
      31) Pit stop switch #B
      32) Pallet lateral displacement (if applicable)
      33) Tandem operation
      34) Cumulative run time

35) Pit high water level (Pit Float Switch)
36) Drive machine oil temperature
37) Overspeed shutdown at greater than 20% over rated speed
38) Underspeed shutdown at less than 20% under rated speed
39) Truss heater/air conditioner

7. Reporting Requirements: System shall provide reports in color graphical format both on-screen and in printed form capability to conveniently switch from one report type to another and from one bank to another using minimal mouse clicks and key strokes. Reports shall be displayed after minimal waiting time. Data for all reports shall be continuously recorded and stored. Reports shall be displayed by simply selecting a date and time range, bank of equipment and report type. Date and time range selections shall carry forward from one report selection to the next. Reporting functions shall be sub-divided into the following categories:

   a. Events recorded (all status changes in a selected period)
   b. Faults recorded (all selected faults in a selected period)
   c. Faults per day/week/month (fault distribution on a per unit basis)
   d. Run time Vs. Down time

8. Interface to Third Party Building Management Systems: The escalator monitoring system shall be capable of interfacing and exchanging data with a variety of third party building management systems such as Siemans, Landis & Staefa, Johnson Controls, SCADA, and others. Information shall be exchanged by Modbus protocol, open protocol or other suitable methods as required. Integration to FMS:

   a. Provide one summary alarm point to the FMS for each escalator and escalator being monitored. Coordinate with LAWA to identify which functions monitored by the system for each escalator and escalator will activate the summary alarm message
   b. Coordinate message format with LAWA and the FMS contractor. The message shall include the escalator and escalator number and location at a minimum.
   c. Communications from the escalator and escalator MDS server/workstation to the FMS server/workstation shall be over the LAWA IT Infrastructure IP network.
   d. Coordinate message protocols with the FMS contractor. Provide software programming to communicate messages to the FMS.

9. Paging Feature: The monitoring system shall be capable of paging a service technician or other personnel based on pre-defined parameters of escalator faults or conditions. The paging system shall provide the ability to page multiple numbers determined by the type of event triggering the notification and shall be able to page different numbers based on preset times of day (i.e. different shifts). The system shall be capable of sending text messages to full text pagers in addition to supporting standard DTMF pagers.
10. Remote Access Feature: The monitoring system shall be capable of allowing approved individuals under multi-level password control, to access all system features via the local area network, internet, or via modem over the public telephone network to review the performance of the equipment or to evaluate a fault condition. The remote access feature shall be integrated into the monitoring system and shall not use third party "remote control" software products.

11. Data Transmission to Central Support Location: The system shall be capable where desired of transmitting fault, car usage and other data to a remote service desk or other office location for further processing, technician dispatch or other purposes. The data may be transmitted via the local area network, internet, or via modem over the public telephone network.

N. Seismic

1. Provide per ASME A17.1-2004 and CCR Title 8, Group IV requirements. Provide all conduit and wiring for seismic switches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine escalator areas, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance. Examine supporting structure, machine spaces, and pits; verify critical dimensions; and examine conditions under which escalators are to be installed.

1. Proceed with installation only after unsatisfactory conditions have been corrected.
2. For the record, prepare written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions.

B. Set escalators true to line and level, properly supported, and anchored to building structure. Use established benchmarks, lines, and levels to ensure dimensional coordination of the Work.

C. Adjust installed components for smooth, efficient operation, complying with required tolerances and free of hazardous conditions. Lubricate operating parts, including bearings, tracks, chains, guides, and hardware. Test operating devices, equipment, signals, controls, and safety devices. Install oil drip pans and verify that no oil drips outside of pans.

D. Repair damaged finishes so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.3 FIELD QUALITY VERIFICATION

A. Comply with requirements in Division 14 Section "Vertical Transportation, General."

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train LAWA's maintenance personnel to operate, adjust, and maintain escalators.

B. Check operation of escalators with LAWA's personnel present and before date of Completion. Determine that operation systems and devices are functioning properly.

C. Check operation of escalators with LAWA personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.5 ESCALATOR SCHEDULE

A. Number Required:

B. Unit Numbers:

C. Location:

D. Vertical Rise:

E. Lengths: As required by the escalator manufacturer.

1. Provide two flat steps at top and bottom for each escalator.

F. Step Width: 40” (1000 m).

G. Maximum Speed: 100 feet/minute (.50 m/s).

H. Power Characteristics: 480 Volts, 3 Phase, 60 Hertz.

END OF SECTION 14 31 00

SECTION 14 32 00 - MOVING WALKS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes moving walks.

1. BMS components will be incorporated into the moving walk work. Coordinate with the BMS component contractors to incorporate BMS components during the course of the Work.

B. Single Subcontract Responsibilities: Refer to Section 14 20 00 Vertical Transportation, General for the requirements of single subcontract responsibilities for moving walks.

1.2 DEFINITIONS

A. Definitions in the latest version of ASME A17.1 apply to work of this Section.

B. Defective Moving Walk Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

C. Reference to a device or a part of the equipment applies to the number of devices or parts required to complete the installation.

1.3 PERFORMANCE REQUIREMENTS

A. Operational Requirements: The moving walk systems shall:

1. Be capable of operating under full load conditions, at full contract speed, in either direction, and designed to operate quietly and smoothly without bounce.
2. Have a rated speed of 100 ft./min. (0.51 m/s) or the metric equivalent. The no load to full load speed shall not vary more than 4% from the contract speed.
3. Hours of operation shall be considered as twenty-four (24) hours per day, seven (7) days per week.
4. Handrail speed shall be consistent with pallet speed.

B. Structural Performance of Balustrades: Per ASME A17.1-2004. Provide balustrades designed to resist the simultaneous application of a static lateral force of 40 lbf/ft and a vertical load of 50 lbf/ft, both applied at the top of the handrail stand.

C. Environmental Requirements: Moving walks shall be capable of operating with full-specified performance capability while exposed to the design climatic and environmental conditions: Climatic and environmental design conditions are available from the mechanical engineer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Refer to Section 14 20 00, Vertical Transportation, General.

B. Installer Qualifications: Refer to Section 14 20 00, Vertical Transportation, General.

C. Professional Engineer Qualifications: Professional Engineer Qualifications: Refer to Section 14 20 00, Vertical Transportation, General.

D. Standards: The following standards shall govern the moving walk work. Where standards conflict, the standard with the more stringent requirements shall be applicable.

1. Moving Walk Code: In addition to requirements of authorities having jurisdiction, comply with the latest edition of ASME A17.1, "Safety Code for Elevators and Escalators", ASME A17.2 “Guide for Inspection of Elevators, Escalators and Moving Walks”, and ASME A17.5 “Requirements for Elevator and Escalator Electrical Equipment”, including supplements, as published by the American Society of Mechanical Engineers. Wherever “Code” is referred to in the moving walk specification, the ASME A17.1 Code shall be implied.
2. Electrical Code: For electrical work included in the moving walk work, comply with the National Electric Code (NFPA 70), ASME A17.5, all applicable local codes, and the authorities having jurisdiction.
3. Welding: Comply with AWS standards.
4. Americans with Disabilities Act (ADA).
5. Building Code of the City of Los Angeles and the following:

    a. California Code of Regulations (CCR), Title 8.
    b. City of Los Angeles Elevator Code.

E. Electrical Devices and Equipment: Refer to Section 14 20 00, Vertical Transportation, General.

F. Manufacturer: Provide all moving walks components from a single source. Where equipment or operation varies from those described, the manufacturer shall provide a complete description of those variations as required under Section 14 20 00, VERTICAL TRANSPORTATION, GENERAL, Article QUALITY ASSURANCE, paragraph 'Contractor Statement'.

G. Testing and Inspections: Refer to Section 14 20 00, Vertical Transportation, General.

NOTE: The intent of this Guide Specification is to specify the robust equipment with the maintainability features required by APTA. Compliance with other APTA Guideline requirements that do not apply to escalators in an interior airport environment is not necessary.

1.5 SUBMITTALS

A. General: Refer to Section 14 20 00, VERTICAL TRANSPORTATION, GENERAL.

B. Warranty and Maintenance Agreement: Warranties and maintenance agreements are required, refer to Section 14 20 00, VERTICAL TRANSPORTATION, GENERAL and Exhibit A.

C. Maintenance and Operating Manuals: Maintenance and operating manuals are required, refer to Section 14 20 00, VERTICAL TRANSPORTATION, GENERAL.

D. Shop Drawings: Submit complete information for all components for review prior to the fabrication of the moving walk work. Items which shall be detailed shall include the following:

1. Fully dimensioned layout for moving walks in plan, elevation, and section at a scale of ¼" = 1'-0". Indicate component locations, structural supports, access spaces, and points of entry. Indicate the interface of the moving walk work with adjacent work, including but not limited to, the following:

    a. Finished flooring surrounding landing plates.

2. Load assumptions for maximum loads imposed on trusses requiring load transfer to building structural framing, individual weight of principal components and their dead and live load reactions at points of support, electrical characteristics and connection requirements, and any other information requested by the Architect.

    a. Structural Calculations: Submit, for information only, copies of structural calculations indicating load assumptions. Calculations shall be signed, and sealed by the qualified Professional Engineer responsible for their preparation.

3. Pallet linkage details for material, configuration, arrangement, and lubrication requirements.
4. Drive motor, controller, safety devices, and switches including brakes.
5. Complete layout of electrical system including motor, control panel; disconnect switches; panelboards, truss lighting, light fixtures and light switches; receptacles; and safety, surveillance and control devices.
6. Complete single line wiring diagrams of all circuits in the moving walk systems. Show component location within each system, terminals with numbers, connection between components, conductor identification, interface connections with remote surveillance and control system, include an explanation of basic operation.

    a. Provide a record set of drawings with all changes made during the installation of the work. At the completion of the job, submit to the Owner for the Owner's use a complete set of "AS INSTALLED" plans and wiring diagrams.

E. Product Data: Submit manufacturers design data, material specifications, installation instructions, and other data pertinent to the components used in the moving walk work.

1. Provide the Owner with special tools, solid state microprocessor tools, including appropriate programs relative to the specific type of microprocessor or computer controls installed on this project, necessary to trouble shoot, service, test and maintain the moving walks. Special tools become the property of the Owner. Tools provided shall be useable throughout the life of the equipment.

a. Tools may be hand held or built into the control system and may be factory programmed to operate only with this project's equipment.

F. Samples: Submit samples as follows:

1. For exposed finishes, 3-inch- (75-mm-) square samples of sheet materials, and 4-inch (100-mm) lengths of running trim members. Acceptable low and high range of variation in color and finish shall be governed by the control samples in the Architect's office.

G. Certificates and Permits: Refer to Section 14 20 00, VERTICAL TRANSPORTATION, GENERAL.

H. Rigging: Installer shall submit a rigging plan for approval. Any use of existing building structures shall be reviewed and approved by a structural engineer.

I. Operating and Maintenance Manuals: Prior to completion of the installation, contractor shall submit six complete sets of Operation and Maintenance manuals for approval. After LAWA approval and prior to the beginning of acceptance testing, six (6) sets of the approved manuals shall be provided by the Contractor. The manuals shall include the following:

1. Complete table of contents.
2. Complete instructions regarding operation and maintenance of equipment, including disassembly and assembly of drive system, handrail drive assembly, and track system. Included will be complete and illustrated exploded views of all assemblies as well as a complete and illustrated exploded view for identifying all system parts.
3. Complete nomenclature of replaceable parts, part numbers, current cost, and warehouse location. If product source is another vendor, contractor shall include name and address of the other vendor.
4. Sample copies of a preventive maintenance chart.
5. Descriptions of safety devices.
6. Safety rules, tests, and procedures, including testing of all systems and subsystems.
7. Procedures for adjusting brake, handrail tension, handrail chain drive tension, pallet chain tension, track system, and mechanical components, including pictorials.
8. Instructions for removing floor plate, replacing comb segments, and removing and installing pallets, and interior panels.
9. Troubleshooting techniques.
10. Detailed lubrication and cleaning schedule indicating weekly, monthly, quarterly, semiannual, and annual lubrication; and a description of each lubrication point, lubrication type, and specification.
11. Control and schematic electrical wiring diagrams of controller, including wiring of safety devices to connections with remote indication and control panels for each moving walk and group of moving walks.
12. Electrical layout showing placement of lighting, light switches, receptacles, light fixtures, disconnect switches, and convenience outlets in machinery room, truss envelope, and pits.
13. Complete detailed drawings and wiring diagram of moving walk fault finding device and connection to annunciator panel.

J. Certification:

1. The moving walk manufacturer shall provide certification that the purchaser of the moving walks shall be provided with copies of all documents related to maintenance, safety, operations, design changes, modifications, retrofits, etc.; which relate to any part, component, equipment, system subsystem, or material and services applicable to the moving walk provided.
2. All of the above referenced shall be provided as it pertains to the original installation and for a period of twenty (20) years after final acceptance of the last moving walk provided under any contract.
3. The referenced material shall be provided within thirty days of publication or internal distribution by the moving walk manufacturer. The material, even if labeled PROPRIETARY, shall be delivered to the Authority without prejudice or delay and at no additional cost.
4. Provide all material on CD-ROM in a format approved by the Authority.

K. Material Safety Data Sheets (MSDS): MSDS and product data sheets shall be submitted with an index listing each product, along with the application method of the product, approximate quantity of product per moving walk, and the component the product is applied to or associated with. The contractor shall allow six (6) weeks for review of MSDS.

L. Spare parts and replacement parts list - Contractor shall maintain, at a minimum, a local on site parts inventory for use solely on this Contract. Parts not listed below, including balustrades, decks, skirt panels, handrails and signage shall be available via overnight air delivery. Inventory shall include lubricants, light bulbs, etc. necessary to maintain equipment in original operating condition. The parts listed below shall be made available for inspection by LAWA or its designee. Part storage shall be as directed by LAWA.

1. Parts required for equipment listed under Section 14 31 00: Parts inventory shall be maintained throughout the Warranty Maintenance period and five year contract maintenance period after which parts will become the property of LAWA.

a. Moving Walks

5 Complete Pallets	4 Stop Switch Covers with hardware
10 each – Left, Right and Center Pallets Treads Inserts	2 Key Switches – each kind
15 Comb plate Segments – each kind	1 Motor Starters, each size
17 Pallets Rollers and Flanges	2 LH Electric Interlocks, each size
7 Pallets Axel Sets	2 RH Electric Interlocks, each size
1 Matched Pair Pallets Chains (Longest Unit)	1 Circuit Breakers, each size
2 Sets Gear Box Gaskets and Shims	1 Reverse Phase Relays
1 Automatic Lubrication Reservoir	1 Transformers
2 Sets Skirt and Emergency Switches	2 Pallets Chain Oilers
2 Sets Start Contacts, each size	2 Handrail Inlet Brushes
3 Stop Switches	7 Handrail Tension Rollers

1.6 JOB CONDITIONS

A. General: Refer to Section 14 20 00, Vertical Transportation, General, Section 14 21 00 and Exhibit A.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Refer to Section 14 20 00, Vertical Transportation, General and 14 31 00, Escalators.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Comply with requirements in Section 14 20 00, 3.7.2, Vertical Transportation, General.

2.2 MATERIALS

A. Structural Steel:

1. Rolled Steel Sections, Shapes and Rods: ASTM A36.
2. Tubing:

    a. Cold Formed: ASTM A500.
    b. Hot Formed: ASTM A501.

3. Sheet Steel: ASTM A446, grade B, zinc coated.

B. Stainless Steel:

1. Sheet, Plate and Strip: ASTM A 666 or ASTM A240, Type 304.
2. Shapes and Bars: ASTM A276, Type 304.
3. Finish: No. 4 satin finish. Brush marks shall run parallel with the moving walk travel.

C. Aluminum Castings and Extrusions:

1. Castings: ASTM B108 alloy and temper as required to meet the strength and performance requirements.
2. Extruded Aluminum: ASTM B221, Alloy 6061 or 6063, T6.
3. Finish: Commercial mill finish:

D. Clear Tempered Glass: ASTM C 1048, Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 1 (clear), Quality q3 (glazing, select), Kind FT (fully tempered), 12.0 mm thick. After tempering, heat soak 100% of all fabricated glass units to European Union Standard EN14179 to eliminate inclusion related glass breakage. Statistical heat soaking shall not be permitted. Comply with ASME A17.1, Section 6.1, Rules 6.1.3.3.2 and 6.1.3.3.3.

E. Fasteners: Provide bolts, nuts, washers, screws, rivets, and other fasteners necessary for the proper erection and assembly of the moving walk work. Fasteners shall be compatible with materials being fastened.

F. Welding Materials: Comply with AWS D1.1.

G. Sealants, Joint Fillers and Primers: Sealants, joint fillers and primers internal to the moving walk systems shall be as selected by the moving walk manufacturer. Perimeter sealants, joint fillers and primers are specified under Section 07920, JOINT SEALANTS.

H. Paint and Corrosion Protection: Each moving walk shall have the following minimum corrosion protection.

1. Cast metal parts such as gear housings, chain sprockets, shall be painted with a rust inhibitive primer coat after preparation by sandblasting.
2. Steel parts which are not specified to be galvanized shall be painted as follows:

    a. Primer coat two (2) mil (dry film thickness), minimum thickness.
    b. Second finish coat two (2) mil (dry film thickness), minimum thickness.

3. Bright or uncoated axles, shafts, etc. Shall be protected by zinc chromate, or chrome plating.
4. Oil drip pans shall be fabricated of factory primed carbon steel.

2.3 COMPONENTS

A. General: Provide moving walks complying with requirements. Each moving walk shall be a self-contained unit consisting of trusses, center supports, tracks, pallet drive units, pallets, pallet chains, comb plates, handrails, driving machine, controller, safety device, balustrades, and all other parts required to provide a complete operating moving walk or ramp.

B. Trusses: The moving walk trusses shall be fabricated of welded structural steel components and be designed and constructed so as to safely carry the passenger capacity load and machinery components, including the weight of the balustrade. A drive machine shall be located in the terminal end truss pit at one end of the wellway and the reversing station shall be located in the terminal end truss pit at the opposite end of the wellway. Provide a machinery space covered with removable landing plates all within the outline of the trusses in the terminal end truss pits. The trusses shall have a factor of safety in accordance with the requirements of the ASME Code. The trusses shall come in sections in sizes that can be installed without disturbing the building structure as detailed.

1. The center supports of each walkway shall be constructed using stanchions typically spaced 36” apart. Each stanchion shall be designed to carry a portion of the weight of the passenger load, pallets, and track system, and balustrades. The center supports shall rest on and be firmly secured to supporting framing members provided in the wellway structure. Center supports shall be ample strength to rigidly maintain the alignment of moving parts. All center supports, including bolts, angles, shims, and bearing pads shall be provided and installed for a complete installation.
2. Provide isolation, designed of rubber and steel, at all moving walk support locations.

C. Oil Drip Pan: Provide factory primed, 3mm thick, steel drip pans under full width and length of moving walks to collect and hold oil and grease drippings from lubricated components. Design and fabricate drip pan to sustain a load of 250 lbf (1.1 kN) on a 1.0-sq. ft. (0.9-sq. m) area at any location.

1. Drip pans shall be of a sufficient size to collect and maintain, within the truss area, all oil, water and grease droppings from the pallet linkage and all forms of loose debris that may be deposited in the drip pans from the pallets in the turn around point at the terminal portions of the moving walks. An access shall be provided to the drip pans at the lower landings of all moving walks for cleaning the drain catch basin. The drip pans in the wellways shall be removable for cleaning, or otherwise be accessible for easy cleaning.

D. Balustrades: Profile as indicated and arranged with moving handrails on guide rail that is supported by 12 mm thick clear tempered glass panels without mullions between panels, with stainless steel deck covers, skirts, trim, and accessories.

1. Handrails:

a. The handrail drive shall be of the traction type and provided with tension device. The handrails shall receive their motion through gear or chain, from the treadway chain drive mechanism to obtain the same ratio of speed and direction of travel as the moving pallets on the treadway.
b. All handrail rollers shall be provided with sealed ball or roller bearings rated at L10, 100,000 hours and have provision for retention of lubricant to ensure satisfactory lubrication and operation. The color of handrails shall be black.
c. Friction drive sheaves and idlers shall be designed and positioned so that lubricant cannot reach surface of handrail. Marking and spotting of handrail by drive equipment shall not be permitted. Provide sealed bearings rated at L10, 100,000 hours.
d. The handrails shall be constructed of laminated, steel, wire mesh, or steel cable reinforced, flexible elastomer material vulcanized into an integral, seamless, smooth handrail resistant to environmental conditions. Each handrail shall operate on formed guides except when in contact with the driving sheaves. A specially coated finish to minimize frictional wear on the underside of the handrail shall be provided. The formed guides shall be fabricated from a material not subject to corrosion or pitting and having a polished or specially coated permanent finish to minimize the frictional wear on the under surface of the handrail.
e. The handrail rollers and guides shall be so arranged that the handrail cannot be easily thrown off or` disengaged while running. Handrails shall be provided with substantially square edges at points of contact with the balustrading.
f. The extending newels shall be so designed and built that the handrails will disappear into the balustrading at a point difficult to reach.

NOTE: In areas, such as, but not limited to Ticketing, glass balustrades are susceptible to breakage from luggage carts and therefore are not permitted.

2. Deck Covers, Skirts, and Trim: Minimum 3 mm thick, satin stainless steel or black with clear Teflon coating at skirt panels. Skirts shall be fastened to the truss with hidden fastenings. Skirt panels shall be installed without overlapping joints or requiring trim pieces to cover where two skirt panels meet. Inner decks shall attach to the upper edge of the skirt and shall extend to the glass inner surface. The inner deck shall be attached to the skirt with oval head stainless steel screws. Outer decks shall be attached with concealed fasteners and shall extend outward from the outer glass surface with a turn down at the finished width and either capture the adjacent wall finish or be concealed behind it as accepted on the shop drawings.
3. During construction, exposed metal finishes shall be protected as recommended by the moving walk manufacturer. Upon completion of the balustrades, the exposed work shall be cleaned and polished.

E. Comb Plates: Fabricate comb plate assemblies from wear resisting, non-corrosive metal material, with exposed anti slip surfaces. Plastic comb plates will not be acceptable. Provide comb plate sections at the end truss landings of moving walks and at the top and bottom landings of ramps and meeting the following requirements:

1. Removable to permit ease of replacement.
2. Yellow in color for safety/demarcation.
3. Have not less than three (3), nor more than seven (7), comb plate sections per comb plate assembly.
4. Provisions for lateral and vertical fine adjustments shall be provided so that cleats of pallet treads pass between comb teeth with minimum clearances.
5. Comb teeth shall be designed so as to withstand a load of two hundred and fifty (250) pounds applied in an upward direction at the tip of any one (1) tooth.

F. Pallet Treads: One-piece, unpainted, die-cast aluminum with demarcation grooves at front and rear of tread surface. The pallet treads shall be cleat type, designed to insure a secure foothold and comfortable tread surface; the cleats shall be fabricated to meet code requirements.

1. Cleats shall be so spaced that the ends are flush with the side of the pallet treads. The tread surface shall be adjacent to adjustable skirt guards on each side of the pallet tread and the overall width of the pallet tread shall be machined to accurate limits to maintain a minimum clearance between the skirt guards and the pallet tread.
2. Pallet treads and their various attachments shall permit removal of pallet treads without disturbing balustrades or dismantling any part of the chains.
3. The design shall permit the running of the drive without pallet treads for convenience in cleaning and inspection.
4. Pallet Rollers: Pallet rollers shall have polyurethane tires on a sealed hub and bearing and be manufactured for quiet operation. Bearings shall be of the ball or roller type, be factory sealed. Rollers shall not require any additional lubrication and must be rated for severe, heavy-duty service. Rollers shall be mounted so as to prevent tilting and rocking of the pallet treads.
5. Pallet treads shall be constructed so as to be driven by chain linkages.

G. Landing Floor Plates and Frames: Landing floor plates shall be provided to cover the full width of the truss at each terminal end truss pit, extending from the comb plate and the floor line of the balustrade, to the end of the truss. Exposed portions of the landing floor plates shall be of finish metal matching pallet and comb plate. Plates shall be die cast aluminum in a ribbed pattern transverse to the moving walk axis. Ribs shall be designed to provide maximum traction, and shall be finished in the same manner as the comb plates. Landing plates shall be removable. Plates shall be reinforced, as necessary, to be rigid and able to withstand a live load of two hundred and fifty (250) pounds per square foot with zero permanent deformation. Landing plates shall be installed flush with the elevation of the finished floor. Provide a frame around the floor openings to receive the landing floor plates fabricated from metal matching the plates. The upper edge of the frames shall be flush with the elevation of the finished floor.

1. In cases where two moving walks are installed side by side, landing plates shall be designed to allow the adjacent moving walk to remain operational while work is being performed on the in-operable moving walk.

H. Pallet Chains:

1. Chain shall be endless, roller type chains specifically designed for moving walk application; one (1) on each side of pallet. The chains shall be made of high grade, heat treated, flat steel links with hardened pins and accurate rollers designed to accurately engage the drive sprockets to insure smooth operation. Each pair of pallet chains shall be a matched set.
2. Provisions shall be made to prevent sagging or buckling of the linkages, to prevent the pallets from coming in physical contact with one another, and to maintain a constant distance between the pallet axles. Automatic tensioning devices shall be provided to maintain tension under load and to compensate for wear.
3. A means for individual fine adjustment of tension for each linkage shall be provided.
4. Pallet chains shall be constructed to permit removal of segments as may be required for replacement purposes.
5. Support rollers shall be spaced to distribute load and to guide linkage throughout run. Rollers shall be constructed of polyurethane material, with diameter sufficient to provide reliability, maintainability, smoothness of motion, and to operate within noise level requirements specified. Rollers shall be affixed in a manner that ensures positive roller retention but allows for replacement.
6. Pallet chain and chain pins shall have a minimal diameter of at least five-eighths (5/8) of an inch and have a tensile strength suitable for the application. The chains shall have a factor of safety of not less than six (6).
7. A test certificate for the chain breaking load shall be provided.

I. Tracks: The tracks shall be constructed of continuous structural steel sheet, strip or plate throughout the truss, incline and transition curves at the landings in order to restrain the lateral displacement of the pallets, ensure the rollers are retained in their proper position on the track and to provide a smooth ride without discernible vibration.

1. Design and fabrication of tracks shall retain pallets, rollers, and running gear safely under load requirements and at the highest speed specified.
2. Contractor shall assemble and secure sections of track together for easy removal and replacement of defective sections. The system shall be adjustable, and welding of the track sections is not acceptable.
3. Design of the mechanical components shall provide for easy installation and removal without the dismantling of parts of the truss or building structure.
4. Tracks shall be properly supported on trusses to provide correct alignment and smooth, even operation of running gear. The rolling surface of the track shall be a minimum thickness of 3 mm.
5. The guiding system for the chains and rollers shall be fabricated from zinc plated or galvanized steel profiles with smooth and even running surfaces. The guide profiles shall not be welded together at the joints.

J. Pallet Driving Machines: The driving machines shall be of the electric motor driven, worm gear type, especially designed for moving walk service, provided with precision cut and matched ground steel worms and worm gears; ball thrust bearings and roller shaft bearings and driven by single speed motors. Run gearing in oil bath in an oil tight housing with appropriate shaft seals. Mount the driving machine within and to the truss and connect the main drive shaft to the pallet drive sprocket assembly, with a gear and chain driven by the driving machine. Design driving motor and motor switch gear to provide a smooth start, and prevent undue strain on drive components. The motor shall be of sufficient size, to operate the moving walk at full rated capacity, per Code without exceeding the rated horsepower. The motor shall be AC, polyphase, induction type continuous rated with a temperature rise not exceeding those in the NEMA and IEEE Standards.

1. A reservoir with a low oil signal to the controller, and a minimum capacity of two and one half (21/2) gallons shall be provided.
2. Reservoir level indications shall be provided where lubricants are contained within housings, supply tanks and larger filler cups.
3. Provide a sight glass or dipstick method of determining oil level in the case. The case shall provide a convenient method of draining the oil.
4. The sprockets shall be precision machined to distribute the load evenly on the sprocket teeth and on the chain rollers and shall be designed for smooth operation.
5. Shafts shall be designed for ease of assembly or disassembly.
6. Main drive bearings shall be rated for L10, 200,000 hours

K. Sprocket Assemblies:

1. Attach the main sprocket assembly rigidly to the truss, at both sides, to ensure and maintain proper alignment.
2. Mount the take up sprocket assembly on rollers, operating on tracks, rigidly attached to the truss at both sides, to automatically maintain proper tension on the pallet chains, by means of weights or compression springs.
3. Provide roller type main drive shaft bearings.
4. Design chain sprockets to accurately distribute the load evenly on the sprocket teeth and chain rollers.

L. Brake:

1. Provide each moving walk with a permanent magnet ceramic brake, located on the high speed shaft which, when activated, shall stop the moving walk or ramp in the event of a normal stop control, activation of stop button, activation of any safety device, o upon loss of power.
2. Provide a load compensating brake system capable of automatically stopping a moving walk or ramp quickly but gradually, and able to hold the moving walk or ramp stationary under full load whenever the power is interrupted. The brake shall be "fail safe" and electrically released. When a stop is initiated, the system shall maintain a relatively constant deceleration independent of the load. The brake shall not cause the moving walk or ramp to come to an abrupt stop. It shall be designed to meet ASME A17.1 Code for deceleration requirements without adjustment. Design of brake shall provide ease of access for inspection.
3. Controller: Wire to identified terminal block studs. Identifying symbols or letters identical to those on wiring diagrams permanently marked adjacent to each component on the controller. Enclose all components in steel cabinet removable from machine room for ease of access to switches and wiring. Provide mainline circuit breaker and means to protect against overload and single phasing. Controller shall be labeled with rated load and speed, braking torque, manufacturer serial number and LAWA numbers. Locate controller remove if available space is not sufficient in upper and lower ot.
    a. The moving walk control equipment shall contain diagnostic capabilities as required for the ease of complete maintenance. The diagnostic system shall be an integral part of the controller and provide user-friendly interaction between the service person and the controls. All such systems shall be free from decaying circuits that must be periodically reprogrammed by the manufacturer.
    b. Switch gear shall be mounted in NEMA 4X cabinets with labeled terminal strips.
    c. The main controller shall use an Allen Bradley SLC5/03 Programmable Logic Controller (PLC) or approved equal, to control and monitor the status of the moving walk. The PLC shall be designed to communicate over Ethernet or approved equal.
    d. The PLC racks shall provide space for two future single-slot modules.
    e. The PLC in the remote control panel shall also have hardware and firmware provisions to communicate with interactive operator interface (monitor).
    f. The PLC shall store the last 99 faults, accessible via laptop connection, panel view or remote communications.
    g. Provide a copy of all working programs on approved computer medium as well as a printed program listing.
    h. The Programmable Controller shall have one dedicated serial port, which supports RS-232-C signals. It shall be accessible in ladder logic and provide support for Point to Point and Life-Net/Slave SCADA communication protocol systems. Alternatively, it must be usable for programming purposes or for access to remote programmers via modems.
    i. The main control switchgear of an moving walk shall contain at least the following devices:

        1) Lockable main switch thermal and magnetic motor protection starter, hour counter, auxiliary contactors, phase failure device, phase sequence monitor, and ground fault monitor.
        2) The controller cabinet shall contain a permanently mounted fault indicator board with indicator lights. Fault data shall also be displayed in the newel. Each group of safety devices shall be connected to one signal lamp.

3) The indication shall be locked automatically. Reset shall be done by a separate switch installed in the controller. The emergency stop shall not be locked.
4) All terminals shall have identification markings and all cables shall be provided with cable markers.
5) The controller shall be equipped with an AC induction motor reduced voltage starter; installed in line between the standard type contactor and the drive motor. The starter shall be solid state, capable of starting motors smoothly and gradually, reducing inrush current and mechanical shock upon start up. Adjustable settings for accelerating time and starting torque shall be provided. The starter shall also contain auxiliary contacts and a thermal overload relay for motor protection.
6) Maintenance Receptacles: Electric power receptacles shall be furnished and installed in the upper and lower pits. Each receptacle shall be of the GFCI duplex type, waterproof, grounded, and rated for one hundred and twenty volts at twenty amperes. The receptacles in the pits shall be surface mounted on the walls, not less than thirty inches from the floor.
7) Relays shall be provided with visual indication that they are energized.
8) Adjustable settings for accelerating time and starting torque shall be provided. The starter shall also contain auxiliary contacts and a thermal overload relay for motor protection.

j. Monitoring System Interface: Provide controller with serial data link through RJ 45 Ethernet connection and install all devices necessary to monitor items outlined in Section 2.15. Moving Walk Contractor responsible to connect monitoring system interface to machine room monitoring compartment and LAN. Wiring from LAN to the machine room monitoring compartment by others.
k. Remote Monitoring and Diagnostics: Equip each controller with standard ports, interface boards, and drivers to accept maintenance, data logging, fault finding diagnostic, and monitoring system computers, keyboards, modems, and programming tools. The system shall be capable of driving remote color CRT monitors that continually scan and display the status of each moving walk. System shall be Lift-Net, or equal ready/compatible. System shall be compatible with other building management systems. Monitoring system shall not be proprietary to any individual control. Provide features described in Section 14 31 00, Escalators.

M. Control Station: Provide a control station at both the drive end and return end, located near the handrail inlet, include a key actuated direction starting switch at each station. Restarting shall require first positioning the key to "normal" (center position), and then selecting the appropriate direction. Restarting with the key in the “normal” position shall be prevented by the controller.

1. Per Reference Standard RS-18 the right side position for starting the moving walk in the upward direction shall be marked “start-up”, and the left side position for starting the moving walks in the downward direction shall be marked “start-down”. The starting devices shall be protected by a locked, transparent cover plate that can be opened by the starting key and clearly marked “For Start Only”. Starting devices shall be located at the top and bottom of the moving walk or ramp on the right side facing newel.

2. Provide a manual reset switch adjacent to each control station at top and bottom landings.

N. MOVING WALK POWER SAVING CONTROL

1. CERTIFICATIONS

   a. The motor controlling device shall be certified to meet US elevator / escalator / moving walk code (ASME-A A17.5 and CSA B44.1) standard for industrial control equipment as well as CE for the European Standard.

2. PERFORMANCE

   a. The supplier shall provide documented proof that the motor controlling device has been tested on a moving walk by at least one electric utility in the United States of America and shown positive energy savings test results. Furthermore, the supplier shall provide documented proof that the electric utility approved the motor controlling device for an energy efficiency rebate (if applicable).
   b. The motor controlling device shall continually monitor motor and be able correct energy requirement within 8ms and be able to respond to a 50% change in load within 1 second without changing the speed of the motor by over 0.5%. The motor controlling device shall be able to provide full power to a motor without using more than 0.5% more energy that an electrical mechanical motor starter.

3. EQUIPMENT MANUFACURER ACCEPTANCE

   a. The supplier shall show broad industry acceptance of the motor control device by documenting that all major moving walk service providers, including Otis Elevator, KONE Inc. Schindler, ThyssenKrupp, and Mitsubishi Electric, have experience installing such device on a moving walk.

4. FUNCTIONS

   a. The motor controlling device must include the following functions:
   b. Overload Current Protection
   c. Over Voltage Protection
   d. Under voltage Protection
   e. Over Current
   f. Under Current
   g. Phase Loss
   h. Reverse Direction
   i. S.C.R. Failure
   j. Fault logging capability

k. Remote monitoring capability

5. MOUNTING HARDWARE

a. The mounting hardware and enclosure shall be rated NEMA - 1 for indoor installations and NEMA 4 for exterior installations rated and specifically designed for ease of installation in moving walk applications.

6. CONTROL VOLATAGE CONNECTION

a. The motor controlling device shall not require an external dedicated power source to operate and shall operate based on existing line serving the moving walk.

7. DISCRETE INPUTS AND OUTPUTS

a. The motor controlling device shall have one input connection that controls the starting and stopping of the motor. The motor controlling device shall have two output contacts to provide the run and fault status of the motor controlling device.

8. MOTOR CONTROL FUNCTIONALITY

a. The motor controlling device shall provide a timed soft start with a start up time range of 0 to 10 seconds or more, to appropriately integrate with other motor starters and reduce the mechanical stress on the moving walk system during the starting of the motor.

9. HEAT SINK MATERIAL

a. The motor controlling device shall utilize a metal heat sink material to dissipate operating heat without requiring external cooling devices.

10. SUBMITTAL REQUIREMENTS

a. The supplier shall provide motor controlling device drawings including schematic wiring diagram and mounting dimensions.

11. DELIVERABLES

a. The supplier shall provide an installation and user's manual.

12. WARRANTY

a. The supplier shall warrant the motor controlling device for a period of two years from the date of sale.

O. Additional Safety Devices: Provide all safety devices required by Code including, but not limited to, the following. Design all safety devices to operate in accordance with the requirements of the Code.

1. Emergency Stop Buttons: Emergency stop buttons shall be provided, designed so that the momentary pressure of either button shall cut off the power supply to the motor and brake to bring the moving walk or ramp to rest.

    a. One emergency stop button shall be located at both the drive end and return end. Location shall be in the upper quadrant, 45 degrees above horizontal, in order to provide easy access. The stop button shall be red in color.
    b. The button shall be housed under a clear, high impact resistant plastic cover, which shall be self-closing. Instructions for operating the stop button shall be imprinted on the cover in half-inch high letters. When the cover is lifted, an audible alarm shall sound until the cover is returned to its closed position.

2. Broken Treadway, and Broken Drive Chain, Devices: Broken chain safety devices shall be provided with a safety switch for each chain designed to cut off the current and bring the moving walk to rest should either chain break.
3. Pit Stop Switch: Each moving walk shall be provided with an additional safety device, in the pit that shall interrupt power within the moving walk or ramp and automatically apply the brake to bring the moving walk or ramp to a smooth stop.
4. Reversal Stop Devices: The reversing device shall be designed to stop the moving walk automatically, should the direction of travel be accidentally reversed while the moving walk or ramp is operating in an ascending direction.
5. Pallet Level Devices: Moving walks or ramps equipped with pallets with trail wheels shall be provided with pallet level devices shall be located at the each end of the moving walk or ramp. These devices shall detect downward displacement of 1/8” or greater at the trailing edge of the pallet at either side of the pallet. When activated, the device shall cause the moving walk or ramp to stop prior to the pallet entering the combplate. The device shall cause power to be removed from the driving machine motor and brake.
6. Handrail Inlet Safety Devices: A handrail inlet safety device shall be provided at the handrail inlet in the newel. The electrical switch of this device shall be designed to cut off the current and bring the moving walk to rest should either an object become caught between the handrail and the handrail guard or an object approaches the area between the handrail and handrail guard.
7. Comb Pallet Impact Devices: Per Reference Standard RS-18 two independent safety devices, one at the side of the comb plate and the other at the center of the front edge of the comb plate shall be provided at the drive end and return end comb plate which will cause the opening of the power circuit to the moving walk or ramp drive machine motor and brake if either:

    a. a horizontal force in the direction of travel is applied exceeding 112 lbf at either side or exceeding 225 lbf at the center of the front edge of the comb plate; or,
    b. b. a resultant vertical force in upward direction is applied exceeding 150 lbf at the center of the front of the combplate.

8. Comb-Pallet Stop Device: Per Reference Standard RS-18 on every new moving walk a comb-pallet stop device shall be provided at the entrance to and the exit from a moving walk. Any obstruction exerting a pressure of 60 pounds for pallets over 32 inches in width between the moving treadway and the comb pallet shall activate the comb pallet stop device to cause the opening of the power circuit to the moving walk or ramp driving machine motor and brake.

9. Handrail Speed Monitoring Devices: A handrail speed monitoring device shall be provided which will cause the immediate activation of the audible alarm required for the emergency stop buttons whenever the speed of either handrail deviates from the pallet speed by 15% or more. The device shall cause electric power to be removed from the driving machine motor and brake if the speed deviation of 15% or more is continuous for more than 2 seconds.
10. Missing Pallet Switch: This safety feature shall be provided to prevent the unit from running if a pallet is missing.
11. Combplate Lights: Provide recessed light fixtures with flush lenses mounted in interior balustrade panels at each side of combplates designed to illuminate treadway at combplate.
12. Pallet Demarcation Lights: Pallet demarcation lights shall be furnished at the entrance to and the exit from a moving walk. They shall consist of a light fixture installed just below the track system where the pallet leaves or enters the comb plate. This fixture shall be furnished with two independently operating green fluorescent lamps and shall be capable of lighting the entire width of the pallet. The light shall be visible between the pallets. The lamps shall be activated whenever the moving walk or ramp is in operation.
13. Safety Signs: Worded and pictorial signage meeting the requirements of the ASME Code shall be provided at both the drive end and return end landings.

P. Remote Monitoring: Provide an interactive monitoring and diagnostic system tied to each individual elevator, escalator, and moving walk ready for connection to the new building management system (BMS). The BMS shall be centrally located in the BMS Control Room.

1. Lift-Net: Integrated Display Systems, Inc.

Q. Energy-Saving Feature: Provide moving walk motors and controls designed for motors to run on partial windings (at reduced power) when not under full load.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Refer to Section 14 20 00, VERTICAL TRANSPORTATION, GENERAL.

3.2 MOVING WALK SCHEDULE

A. Number Required:

B. Unit Numbers:

C. Location:

D. Vertical Rise/Slope:

E. Length:

F. Width: 56" (1420 m)

G. Speed: 100 feet/minute (.50 m/s).

H. Power Characteristics: 480 Volts, 3 Phase, 60 Hertz.

I. Maintenance Service: Provide 12-month maintenance for all moving walks with 24-hour callback service, as-built wiring diagrams, operating instructions, and parts ordering information, remote wiring to fire alarm panel.

J. Warranty: Provide 12 month warranty beginning at date of acceptance by LAWA.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train LAWA's maintenance personnel to operate, adjust, and maintain escalators.

B. Check operation of escalators with LAWA's personnel present and before date of Completion. Determine that operation systems and devices are functioning properly.

C. Check operation of escalators with LAWA personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 14 32 00

SECTION 21 05 00-COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

A. This section supplements all sections in this division, including pipe, fittings, valves, and connections for sprinkler standpipe and fire hose combination sprinkler and standpipe systems.

1.2 REFERENCES

A. General: Comply with appropriate standards.

1. American Society of Mechanical Engineers: ASME.
2. American Society for Testing and Materials: ASTM.
3. American Welding Society: AWS.
4. American Water Works Association: AWWA.
5. National Fire Protection Association: NFPA.
6. Underwriter Laboratories, Inc.: U.L.
7. Factory Mutual Standards: FM.
8. Los Angeles Department of Building and Safety: LADBS.
9. Los Angeles Fire Department: LAFD.

1.3 SUBMITTALS

A. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections. Submit data and shop drawings to indicate pipe materials, fittings, accessories, equipment and methods of installation.

B. Manufacturer’s Installation Instructions: Submit installation for all system components.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

D. Project Record Documents: Record actual locations of components and tag numbering.

E. Operation and Maintenance Data: Submit spare parts lists, exploded assembly views and recommended maintenance intervals.

1.4 WARRANTY

A. Furnish one-year minimum.

PART 2 – PRODUCTS

2.1 VALVES

A. Gate Valves:

1. Up to and including 2 inches: Bronze body and trim, rising stem, hand wheel, solid wedge or disc, threaded ends.
2. Over 2 inches: Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, hand wheel, OS&Y, solid bronze or cast iron wedge, flanged, grooved ends.
3. Over 4 inches: Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends.

B. Globe or Angle Valves:

1. Up to and including 2 inches: Bronze body, bronze trim, rising stem and hand wheel, inside screw, renewable rubber disc, threaded ends, with back seating capacity.
2. Over 2 inches: Iron body, bronze trim, rising stem, hand wheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

C. Ball Valves:

1. Up to and including 2 inches: Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle, threaded ends.
2. Over 2 inches: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle or gear drive hand wheel for sizes 10 inches and over, flanged.

D. Butterfly Valves:

1. Up to and Including 2 Inches Bronze Body: Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, hand wheel and gear drive and integral indicating device, and built-in tamper proof switch rated 10 amp at 115 volt AC.
2. Over 2 Inches Cast or Ductile Iron Body: Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends. With extended neck, hand wheel and gear drive and integral indicating device external tamper switch rated 10 amp at 115 volt AC.

E. Check Valves:

1. Up to and including 2 inches: Bronze body and swing disc, rubber seat, threaded ends.
2. Over 2 inches: Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends.
3. 4 inches and over: Iron body, bronze disc with stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

F. Drain Valves:

1. Compression Stop: Bronze with hose thread nipple and cap.
2. Ball Valve: Brass with cap and chain, ¾ inch hose thread.

2.2 MATERIALS

A. Electrical

1. All electrical components furnished or installed under Fire Suppression shall be in complete compliance with the Electrical Specifications.
2. Wiring Diagrams. A wiring diagram of work not in Fire Suppression but necessary to operate equipment shown in this section shall be submitted for review as a shop drawing.

B. Equipment Identification.

1. Provide as required under “Identification”.

C. Access to Equipment.

1. All valves, control devices, equipment, specialties, etc. shall be located for easy access for operation, repair and maintenance. If items are concealed, provide access doors of size required for easy access to the items. Provide access doors as required.

2.3 BURIED PIPING

A. Ductile Iron Pipe, Class 350, AWWA C151, grooved ends.

1. Steel Fittings: ASME B16.5, steel flanges and fittings.
2. Ductile Iron Joints: ANSI/AWWA C-606.
3. Ductile Iron Coupling Housings: ASTM A-536, Grade 65-45-12.
4. Install piping with double-layer half over-lap 10 mil polyethylene tape.

2.4 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A135/135M UL listed, threadable, light wall; or ASME B36.10; Schedule 10 or 40 black steel.

1. Steel Fittings: ASME B16.5, steel flanges and fittings; ASME B16.11, forged steel socket welded and threaded.
2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings; or ASME B16.4, threaded fittings.
3. Malleable Iron Fittings: ASME B16.3, threaded fittings ASTM B47. Mechanical Grooved Couplings: Ductile iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers per ANSI/AWWA C-606; ASTM A-536 Grade 65-45-12.

2.5 PIPE HANGERS AND SUPPORTS

A. Per specification requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

B. Verify adequacies of all site utilities and points-of-connection for existing buildings and/or structures.

3.2 PREPARATION

A. Remove scale and foreign material, from inside and outside, before assembly.

B. Prepare piping connections to sprinkler heads and as required.

3.3 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Group piping whenever practical at common elevations.

D. Install pipe sleeve at piping penetrations through footings partitions, walls, and floors. Seal pipe and sleeve penetrations to maintain fire resistance equivalent to fire separation.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Heads, piping, hangers and supports where exposed to corrosive ambient air conditions shall be prime coated.

G. Pipe Hangers and Supports:

1. Install in accordance with NFPA 13 and NFPA 14.
2. Install hangers to with minimum 1/2 inch space between finished covering and adjacent work.
3. Place hangers within 12 inches of each horizontal elbow.
4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
6. Where installing several pipes in parallel and at same elevation, provide multiple or trapeze hangers.
7. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

H. Slope piping and arrange systems to drain at low points. Install eccentric reducers to maintain top of pipe level.

I. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

J. Do not penetrate building structural members without approval of LAWA.

K. Where more than one piping system material is specified, install compatible system components and joints. Install flanges, union, and couplings at locations requiring servicing.

L. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

M. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.

N. Install gate or butterfly valves for shut-off or isolating service.

O. Install drain valves at main shut-off valves, low points of piping and apparatus.

P. Where inserts are omitted, drill through concrete slab from below and install through-bolt with recessed square steel plate and nut above or flush with top of recessed into and grouted flush with slab.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Inserts:

1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Install hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.5 CLEANING

A. Clean entire system after other construction is complete.

END OF SECTION 21 05 00

SECTION 21 05 16-EXPANSION FITTINGS AND LOOPS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flexible pipe connectors.
2. Expansion joints.
3. Expansion compensators.
4. Pipe alignment guides.
5. Swivel joints.
6. Pipe anchors.

1.2 REFERENCES

A. General: Comply with appropriate standards.

1. American Society of Mechanical Engineers: ASME.
2. American Welding Society: AWS.
3. National Fire Protection Association: NFPA.
4. Underwriters' Laboratories: U.L.
5. Los Angeles Department of Building and Safety: LADBS.

1.3 DESIGN REQUIREMENTS

A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.

B. Expansion Compensation Design Criteria:

1. Installation Temperature: 50 degrees F.
2. Fire Protection System Temperature: 75 degrees F.
3. Safety Factor: 20 percent.

1.4 SUBMITTALS

A. Submit data on all materials.

B. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets and swing joints. Drawings shall be sealed by a registered professional engineer. Include information for piping expansion compensation in shop drawings for all fire suppression piping system as needed.

C. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

D. Design Data: Indicate criteria and show calculations. Submit sizing methods calculations sealed by a registered professional engineer.

E. Manufacturer's Installation Instructions: Submit special procedures.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Welders' Certificate: Include welders' certification of compliance with AWS D1.1.

H. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

I. Operation and Maintenance Data: submit adjustment instructions.

1.5 WARRANTY

A. Furnish five year manufacturer warranty for leak free performance of packed expansion joints.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS

A. Manufacturers:

1. Mason Ind.
2. Vibrex-Sausse.
3. Metraflex.

B. Steel Piping:

1. Inner Hose: Carbon Steel, Stainless Steel or Bronze.
2. Exterior Sleeve: Double braided stainless steel or bronze.
3. Pressure Rating: 200 psig WOG and 250 degrees F.
4. Joint: As specified in piping section.
5. Size: Use pipe-sized units.
6. Maximum offset: 1 inch on each side of installed center line.

C. Copper Piping:

1. Inner Hose: Bronze
2. Exterior Sleeve: Braided bronze.
3. Pressure Rating: 200 psig WOG and 250 degrees F.

4. Joint: As specified in piping section.
5. Size: Use pipe sized units
6. Maximum offset: 1 inch on each side of installed center line

2.2 EXPANSION JOINTS

A. Manufacturers:

1. Mason Ind.
2. Vibrex-Sausse.
3. Metraflex.

B. Stainless Steel Bellows Type:

1. Pressure Rating: 200 psig WOG and 250 degrees F.
2. Maximum Compression: 1-3/4 inch.
3. Maximum Extension: 1/4 inch.
4. Joint: As specified in piping section.
5. Size: Use pipe sized units
6. Application: Steel piping 3 inch and smaller.

C. External Ring Controlled Stainless Steel Bellows Type:

1. Pressure Rating: 225 psig and 70 degrees F.
2. Maximum Compression: 1-1/4 inch.
3. Maximum Extension: 5/16 inch.
4. Maximum Offset: 5/16 inch.
5. Joint: As specified in piping system.
6. Size: Use pipe sized units
7. Accessories: Internal flow liner.
8. Application: Steel piping 3 inch and larger.

D. Double Sphere, Elbow or Flexible Compensators:

1. Body: Teflon or Neoprene and nylon.
2. Working Pressure: 225 psi.
3. Maximum Temperature: 80 degrees F.
4. Maximum Compression: 1-1/8 inch.
5. Maximum Elongation: 7/8 inch.
6. Maximum Offset: 7/8 inch.
7. Maximum Angular Movement: 30 degrees.
8. Joint: As specified in piping system.
9. Size: Use pipe sized units.
10. Accessories: Control rods or Control cables.
11. Application: Steel piping 2 inch and larger.

E. Two-ply Bronze Bellows Type:

1. Construction: Bronze with anti-torque device, limit stops, internal guides.

2. Pressure Rating: 200 psi WOG and 250 degrees F.
3. Maximum Compression: 1-3/4 inch.
4. Maximum Extension: 1/4 inch.
5. Joint: As specified in piping section.
6. Size: Use pipe sized units
7. Application: Copper piping.

F. Copper with Packed Sliding Sleeve:

1. Maximum Temperature: 250 degrees F.
2. Joint: As specified in piping section.
3. Size: Use pipe sized units
4. Copper or steel piping 2 inches and larger.
5. Application: Copper or steel piping 2 inch and larger.

G. Pipe Alignment Guides: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

H. Swivel Joints: Fabricated steel Bronze Ductile Iron Cast steel body, double ball bearing race, field lubricated, with rubber (Buna-N) O-ring seals.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.

B. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

C. Rigidly anchor pipe to building structure. Provide pipe guides to direct movement only along axis of pipe. Erect piping so strain and weight is not on cast connections or apparatus.

D. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints as required.

E. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.

3.2 MANUFACTURER'S FIELD SERVICES

A. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION 21 05 16

SECTION 21 12 00-FIRE-SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes entire standpipe system from fire department connection to fire hose connection.

1.2 REFERENCES

A. General: Comply with appropriate standards.

1. American Society of Mechanical Engineers: ASME.
2. American Society for Testing and Materials: ASTM.
3. American Welding Society: AWS.
4. American Water Works Association: AWWA.
5. National Fire Protection Association: NFPA.
6. Underwriter Laboratories, Inc.: U.L.
7. Factory Mutual Standards: FM.
8. Los Angeles Department of Building and Safety: LADBS.
9. Los Angeles Fire Department: LAFD.

1.3 SUBMITTALS

A. Submit data on all materials, including manufacturers' installation instructions.

B. Shop Drawings: Indicate supports, components, accessories, and sizes.

C. Product Data: Submit manufacturer's catalog sheet for equipment indicating rough-in size, finish, and accessories.

D. Field Test Reports: Indicate compliance with specified performance.

E. Manufacturer's Installation Instructions: Submit with product data.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Operation and Maintenance Data: Submit spare parts lists, exploded assembly views and recommended maintenance intervals.

1.4 WARRANTY

A. Provide one-year minimum.

PART 2 - PRODUCTS

2.1 FIRE HOSE CABINETS

A. Manufacturers:

1. **Potter-Roemer.**
2. **Larsen.**
3. **American Fire Hose & Cabinets.**

B. Hose Cabinets:

1. Style: Recessed, Semi-recessed, or Surface mounted. Fire rated when installed in fire rated assemblies.
2. Tub: 20 gauge thick steel with 18 gauge steel frame, prepared for pipe and accessory rough in.
3. Door: 20 gage thick steel, flush, or glazed, with 1/4 inch thick wired glass full panel, hinged, positive latch device.
4. Finish: Prime Coated or Enameled.

C. Hose Rack: Steel; with polished chrome finish; swivel or stationary type with pins and water stop.

D. Hose: 1 inch or 1-1/2 inch diameter; mildew and rot-resistant.

E. Nozzle: Chrome plated brass combination fog, straight stream, and adjustable shut-off.

2.2 VALVES

A. Manufacturers:

1. **Clow.**
2. **Nibco.**
3. **Viking.**

B. Hose Station Valve: Angle type, brass or chrome plated finish, 1-1/2 inch nominal size, with automatic ball drip.

C. Hose Connection Valve: Angle type; brass or chrome plated finish; 2-1/2 inch size, thread to match fire department hardware, 300 psi working pressure, with threaded cap and chain of chrome plated finish.

D. Pressure reducing Valve: Angle or Straight away type; brass finish with inner hydraulic controls. 1-1/2 inch size, fire department thread, 400 psi inlet pressure, with threaded cap and chain of chrome plated finish.

E. Hose Connection Valve Cabinets:

1. Style: Recessed, Semi-recessed, or Surface mounted. Fire rated when installed in fire rated assemblies.
2. Tub: 20 gauge thick steel with 18 gauge steel frame, prepared for pipe and accessory rough in.
3. Door: 20 gauge thick steel, flush, or glazed, with 1/4 inch thick wired glass full panel, hinged, positive latch device.
4. Finish: Prime Coated or Enameled.

2.3 FIRE DEPARTMENT CONNECTION

A. Type: Flush mounted wall type with brass or chrome plated finish. Free standing type shall be with ductile iron pedestal with red enamel finish.

B. Outlets: Two-way with fire department thread size. Threaded dust cap and chain of matching material and finish.

C. Drain: 3/4 inch automatic drip, outside connected to approved receptor.

D. Label: "Standpipe - Fire Department Connection".

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify blocking in place for cabinet installation.

3.2 INSTALLATION

A. Install cabinets plumb and level. Secure to adjacent surfaces.

B. Install hose station valve in cabinet at 60 inches above floor. Install hose-connection valve under hose station valve and not closer than 4 inches from side or bottom of cabinet.

C. Connect standpipe system to water source ahead of domestic water connection.

D. Where static pressure exceeds 100 psi but is less than 100 psi at any hose station, furnish pressure orifice disc in discharge of hose station valve to prevent pressure on hose exceeding 90 psi.

E. Install two way fire department outlet on roof.

3.3 CLEANING

A. Flush entire system of foreign matter.

END OF SECTION 21 12 00

SECTION 21 13 13-WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wet-pipe sprinkler system, system design, installation, and certification.

1.2 REFERENCES

A. General: Comply with appropriate standards.

1. American Society of Mechanical Engineers: ASME.
2. American Society for Testing and Materials: ASTM.
3. American Welding Society: AWS.
4. American Water Works Association: AWWA.
5. National Fire Protection Association: NFPA.
6. Underwriter Laboratories, Inc.: U.L.
7. Factory Mutual Standards: FM.
8. Los Angeles Department of Building and Safety: LADBS.
9. Los Angeles Fire Department: LAFD.

1.3 SCHEDULES

A. System Hazard Areas: Per NFPA 13.

1.4 SUBMITTALS

A. Submit data on all materials including manufacturers' installation instructions.

B. Shop Drawings: Indicate complete layout of all system components, including: coordinated sprinkler locations, detailed pipe layout, hangers and supports, components, accessories and system controls.

C. Samples: Submit two of each style of sprinkler specified.

D. Design Data: Submit signed and sealed design calculations.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Operation and Maintenance Data: Submit components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

1.5 WARRANTY

A. Provide one-year minimum.

1.6 EXTRA MATERIALS

A. Furnish extra sprinklers.

B. Furnish suitable wrenches for each sprinkler type.

C. Furnish metal storage cabinet in location designated by facility representative.

PART 2 - PRODUCTS

2.1 SPRINKLERS

A. Manufacturers:

1. Viking.
2. Reliable.
3. Grinnell.

B. Suspended Ceiling Type:

1. Type: Standard, Semi-recessed, Recessed, or Concealed pendant type with matching adjustable semi-recessed escutcheon plate.
2. Construction: All bass frame with metal Belleville spring seal, Teflon coated, brass or chrome finish.
3. Escutcheon Plate Finish: Chrome plated.
4. Fusible Link: Glass bulb type, temperature rated for specific area hazard.

C. Exposed Area Type:

1. Type: Standard upright type, with guard.
2. Factory applied corrosion-resistant coating.
3. Fusible Link: Glass bulb type, temperature rated for specific area hazard.

D. Side wall Type:

1. Type: Standard, Semi-recessed, or Recessed horizontal side wall type with matching adjustable escutcheon plate and guard.
2. Construction: All bass frame with metal Belleville spring seal, Teflon coated, brass or chrome finish.
3. Escutcheon Plate Finish: Brass. Chrome plated. Enamel, color as selected.
4. Fusible Link: Glass bulb type temperature rated for specific area hazard.

E. Guards: Finish to match sprinkler finish.

2.2 PIPING SPECIALTIES

A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm or electric alarm, with pressure retard chamber and variable pressure trim; test and drain valve; strainer and gages.

B. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy red enameled gong and motor housing, nylon bearings, and inlet strainer.

C. Electric Alarm: Electrically operated red enameled gong with pressure alarm switch.

D. Water Flow Switch: Vane or paddle type switch with u-bolt mounting, horizontal or vertical, with adjustable alarm delay-0-120 second range.

E. Fire Department Connections:

1. Type: Flush mounted wall type with chrome plated finish or free standing type with ductile iron pedestal with red enamel finish.
2. Outlets: Two-way with fire department thread size. Threaded dust-cap and chain of matching material and finish.
3. Drain: 3/4 inch min. automatic drip.
4. Label: "Sprinkler - Fire Department Connection"

2.3 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Controls: Supervisory switches, Water Level Supervisory Switches, Tank Temperature Supervisory Switches, Room Temperature Supervisory Switches.

B. Disconnect Switch: Factory mount in control panel and/or on equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install buried shut-off valves in valve box, furnish post indicator as required.

B. Install and/or indicate location of approved double check valve assembly at sprinkler system water source connection and fire department connection.

C. Install outside alarm-gong on building wall.

D. Place pipe runs to minimize obstruction to other work.

E. Install piping in concealed spaces above finished ceilings.

F. Locate sprinklers in coordination with architectural reflected ceiling plan.

G. Install and connect to existing fire pump system as required.

H. Install guards on sprinklers.

I. Hydrostatically test entire system.

J. Under the direction of L.A.F.D. Inspector of Record and LAWA.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Verify signal devices are installed and connected to fire alarm system.

3.3 CLEANING

A. Flush entire piping system of foreign matter.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

A. Apply masking tape or paper cover to protect concealed sprinklers, cover plates, and sprinkler escutcheons not receiving field paint finish. Remove after painting. Replace painted sprinklers with new.

END OF SECTION 21 13 13

SECTION 21 13 16-PRE-ACTION/DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes dry-pipe sprinkler system, system design, installation, and certification.

1.2 REFERENCES

A. General: Comply with appropriate standards.

1. American Society of Mechanical Engineers: ASME.
2. American Society for Testing and Materials: ASTM.
3. American Welding Society: AWS.
4. American Water Works Association: AWWA.
5. National Fire Protection Association: NFPA.
6. Underwriter Laboratories, Inc.: U.L.
7. Factory Mutual Standards: FM.
8. Los Angeles Department of Building and Safety: LADBS.
9. Los Angeles Fire Department: LAFD.

1.3 SUBMITTALS

A. Submit data on all materials, including manufacturers' installation instructions.

B. Shop Drawings: Indicate complete layout of all systems, including: coordinated sprinkler locations, detailed pipe layout, hangers and supports, components, accessories and system controls.

C. Product Data: Submit data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

D. Samples: Submit two of each style of sprinkler specified.

E. Design Data: Submit signed and sealed design calculations.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Operation and Maintenance Data: Submit components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

H. System Hazard Areas: Per NFPA 13.

1.4 WARRANTY

A. Provide one-year minimum.

1.5 EXTRA MATERIALS

A. Furnish extra sprinklers.

B. Furnish suitable wrenches for each sprinkler type.

C. Furnish metal storage cabinet in location designated by facility representative.

PART 2 - PRODUCTS

2.1 SPRINKLERS

A. Manufacturers:

1. Viking.
2. Reliable.
3. Grinnell.

B. Suspended Ceiling Type:

1. Type: Standard, Semi-recessed, Recessed, or Concealed pendant type with matching adjustable semi-recessed escutcheon plate.
2. Construction: All brass frame with metal Belleville spring seal, Teflon coated, brass or chrome finish.
3. Escutcheon Plate Finish: Chrome plated.
4. Fusible Link: Glass bulb type, temperature rated for specific area hazard.

C. Exposed Area Type:

1. Type: Standard upright type, with guard.
2. Factory applied corrosion-resistant coating.
3. Fusible Link: Glass bulb type, temperature rated for specific area hazard.

D. Side wall Type:

1. Type: Standard, Semi-recessed, or Recessed horizontal side wall type with matching adjustable escutcheon plate and guard.
2. Construction: All brass frame with metal Belleville spring seal, Teflon coated, brass or chrome finish.
3. Escutcheon Plate Finish: Brass. Chrome plated. Enamel, color as selected.
4. Fusible Link: Glass bulb type temperature rated for specific area hazard.

E. Dry Sprinklers:

1. Type: Standard, upright or side wall with matching plate.
2. Construction: All brass frame with metal Belleville spring seal, Teflon coated, brass or chrome plated.
3. Fusible solder link type, temperature rated for use.

F. Guards: Finish to match sprinkler finish.

2.2 PIPING SPECIALTIES

A. Dry Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and/or electric alarm, with accelerator, test and drain.

B. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy red enameled gong and motor housing, nylon bearings, and inlet strainer.

C. Electric Alarm: Electrically operated red enameled gong with pressure alarm switch.

D. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts.

E. Air Compressor: Shall be single unit type/electric motor driven with air maintenance device, 1/3 H.P. 120/1/60 minimum.

F. Fire Department Connections:

1. Type: Flush mounted wall type with chrome plated finish or free standing type with ductile iron pedestal red enamel finish.
2. Outlets: Two way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
3. Drain: 3/4 inch min. automatic drip.
4. Label: "Sprinkler - Fire Department Connection"

2.3 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Controls: Supervisory switches, Water Level Supervisory Switches, Tank Temperature Supervisory Switches, Room Temperature Supervisory Switches.

B. Disconnect Switch: Factory mount in control panel on equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install buried shut-off valves in valve box furnish post indicator as required.

B. Install and/or indicate location of approved double check valve assembly at sprinkler system water source connection and fire department connection.

C. Install outside alarm-gong on building wall.

D. Place pipe runs to minimize obstruction to other work.

E. Install piping in concealed spaces above finished ceilings.

F. Locate sprinklers in coordination with architectural reflected ceiling plan.

G. Install and connect to existing fire pump system as required.

H. Install guards on sprinklers.

I. Hydrostatically test entire system.

J. Under the direction of L.A.F.D. Inspector of Record and LAWA Facility Representative.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Verify signal devices are installed and connected to fire alarm system.

3.3 CLEANING

A. Flush entire piping system of foreign matter.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

A. Apply masking tape or paper cover to protect concealed sprinklers, cover plates, and sprinkler escutcheons not receiving field paint finish. Remove after painting. Replace painted sprinklers with new.

END OF SECTION 21 13 16

SECTION 21 22 00-CLEAN AGENT FIRE SUPPRESSION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes design, installation and certification of Clean Agent Fire Suppression Systems Addressable Detection.

1.2 REFERENCES

A. General: Comply with appropriate standards.

1. American Society of Mechanical Engineers: ASME.
2. American Society for Testing and Materials: ASTM.
3. American Welding Society: AWS.
4. American Water Works Association: AWWA.
5. National Fire Protection Association: NFPA.
6. Underwriter Laboratories, Inc.: U.L.
7. Factory Mutual Standards: FM.
8. City of Los Angeles Plumbing Code: LAPC.

1.3 SUBMITTALS

A. Submit data on all materials, including manufacturers' installation instructions.

B. Shop Drawings: Indicate complete layout of all system components, including: coordinated nozzle locations, detailed pipe layout, hangers and supports, required components, accessories and system controls.

C. Design Data: Submit signed and sealed design calculations for the complete system, including battery stand-by power calculations for the control panel and the battery stand-by power supply.

D. Provide Manufacturers Certificate.

1.4 WARRANTY

A. All System components furnished under this contract shall be guaranteed against defect in design, material and workmanship for the full warranty time which is standard with the manufacturer and/or supplier, but in no case less than one year.

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to LAWA.

1. Detection Devices: Not less than 10 percent of amount of each type installed.
2. Audible Devices: Not less than 10 percent of amount of each size and type installed.
3. Visual Devices: Not less than 10 percent of amount of each type installed.

PART 2 - PRODUCTS

2.1 INTEGRATED FIRE SUPPRESSION SYSTEMS

A. Manufacturers:

1. Fike Corp.
2. Ansul.
3. Viking.

2.2 PERFORMANCE REQUIREMENTS

A. Design clean-agent extinguishing system and obtain approval from authorities having jurisdiction. Design system for Class A, B, or C fires as appropriate for areas being protected and include safety factor. Use clean agent indicated and in concentration suitable for normally occupied areas.

B. The system shall be complete in all ways necessary for a functional, UL listed and/or FM approved, clean agent suppression system. It shall include: All mechanical and electrical installation, all detection and control equipment, agent storage containers, clean agent, nozzles, pipe and fittings, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, shutdowns, alarm interface, caution/advisory signs, functional checkout testing, and training.

C. Performance Requirements (Agent): Per manufacturer’s data.

D. Performance Requirements (Detection): Per manufacturer’s data.

E. System Operating Sequence: As described by manufacturer.

2.3 PIPING MATERALS

A. Steel Pipe: ASTM A 53, Type S, Grade B or ASTM A 106, Grade B; Schedule 40, or Schedule 80, seamless steel pipe.

1. Threaded Fittings:

a. Malleable-Iron Fittings: ASME B16.3, Class 300.
b. Flanges and Flanged Fittings: ASME B16.5, Class 300, unless Class 600 is indicated.

2. Grooved-End Fittings: FMG approved and NRTL listed, ASTM A47 malleable iron or ASTM A 536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

2.4 VALVES

A. General: Brass; suitable for intended operation.

B. Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.

2.5 EXTINGUISHING-AGENT CONTAINERS

A. Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.

1. Finish: Red and white enamel or epoxy paint.
2. Storage-Tank Brackets: Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.
3. Each cylinder shall have a low-pressure switch to provide visual and electrical supervision of the container pressure. The low-pressure switch shall be wired to the control panel to provide an audible and visual “Trouble” alarm in the even the container pressure drops below 272 psi.
4. Each cylinder shall be fitted with a liquid level device to determine the clean agent quantity without removing the cylinder from its mounting bracket, disconnecting the distribution piping, or removing the clean agent system from service. (35 lb. and 60 lb. cylinders are excluded).

2.6 FIRE-EXTINGUISHING CLEAN AGENT

A. Manufacturers:

1. Fike Corporation.
2. Ansul.
3. Viking.

B. Clean Agent: HFC-125, pentafluoroethane or HFC-227ea, heptafluoropropane.

2.7 DISCHARGE NOZZLES

A. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, discharge pattern, and capacity required for application.

1. Deflector plates shall be used with the nozzles when sensitive ceiling tiles must be protected.
2. A maximum nozzle flow rate of 17 lbs./sec shall be designed for all areas with false ceilings or delicate operations. Higher flow rates may dislodge objects, which could damage or affect equipment and/or process.

2.8 FIRE SUPPRESSION RELEASING CONTROL PANEL

A. Control panel and its components shall be listed and approved type.

B. The addressable control panel shall be UL listed and Factory Mutual Global (FMG) approved for use as a local fire alarm system, and/or releasing clean agent, deluge and pre-action sprinkler fire suppression systems.

C. Control panels shall be capable of networking with similar panels to allow for internal and external NOC communications.

D. Power Requirements: 120-Vac; with electrical contacts as described in manufacturers data.

E. The control-panel shall include the following features:

1. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.
2. Automatic switchover to standby power at loss of primary power.
3. Storage container, low-pressure indicator.
4. Service disconnect to interrupt system operation for maintenance with visual status indication on the control panel.

F. Standby Power: Lead-acid or nickel-cadmium batteries with capacity to operate system for 24 hours and alarm for minimum of 5 minutes. Include automatic battery charger, with varying charging rate between trickle and high depending on battery voltage that is capable of maintaining batteries fully charged.

2.9 DETECTION DEVICES

A. These shall include ionization detectors and remote air-sampling detector system. Including air-sampling pipe network, a laser-based photoelectric detector, a sample transport fan, and a control unit.

2.10 MANUAL STATIONS WITH DIGITAL COUNTDOWN TIMER

A. General Description: A manual release shall also consist of a digital countdown timer and abort switch combined as one unit.

B. Manual Release: "AGENT RELEASE" caption, and red finish. Unit shall have a metal housing with a dual action release configuration to prevent accidental system discharge.

C. Abort Switch: "ABORT" caption, momentary contact, with yellow button.

D. Countdown Timer: The countdown timer provides a digital readout, indicating the number of seconds remaining until the clean agent discharges. There shall be a label stating "Seconds Remaining to Discharge" at the digital readout.

E. Each manual release and abort station shall include a contact monitor module to provide for a custom message and device location at the control panel.

2.11 SWITCHES

A. Listed and approved type, 120-Vac or low voltage compatible with controls. Include contacts for connection to control panel.

1. Low-Agent Pressure Switches: Pneumatic operation.
2. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

2.12 ALARM DEVICES

A. Low voltage, and surface mounting, unless otherwise indicated.

B. Bell: Minimum 6-inch diameter.

C. Horns: 90 to 94 dBA.

D. Strobe Lights: Translucent lens, with "AGENT" or similar caption.

2.13 AUXILIARY PANELS

A. Maintenance By-Pass Switch/Panel: Shall be located adjacent to the clean agent releasing control panel. The maintenance by-pass switch/panel shall have a key-switch which, when operated, will place the clean agent control panel in a "TEST" mode without affecting the detection system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting work performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Verification of existing conditions before starting work.

3.2 PIPING APPLICATIONS

A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.

B. Fitting Working Pressure: 620 psig minimum.

C. Flanged Joints: Class 300 minimum.

D. NPS 2 and Smaller: ASTM B 88, Type L, ASTM B 88M, Type B, copper tube; copper, solder-joint fittings; and brazed joints.

E. NPS 2 and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.

F. NPS 2-1/2 and NPS 3: ASTM B 88, Type L, ASTM B 88M, Type B, copper tube; copper, solder-joint fittings; and brazed joints.

G. NPS 2-1/2 and NPS 3: Schedule 40, steel pipe; forged-steel welding fittings; and welded joints.

H. NPS 2-1/2 and NPS 3: Schedule 40, steel pipe; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.

I. Retain one of two paragraphs below.

J. NPS 4 and Larger: Schedule 40, steel pipe; steel, grooved-end fittings; keyed couplings; and grooved joints.

K. NPS 4 and Larger: Schedule 40, steel pipe; forged-steel welding fittings; and welded joints.

L. Piping between Storage Containers and Orifice Union:

1. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
2. Fittings Working Pressure: 2175 psig minimum.
3. Flanged Joints: Class 600 minimum.
4. All sizes: Schedule 80, steel pipe; forged-steel welding fittings; and welded joints.

M. Piping Downstream from Orifice Union:

1. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
2. Fittings Working Pressure: 1000 psig minimum.
3. Flanged Joints: Class 300 minimum.
4. All sizes: Schedule 40, steel pipe; forged-steel welding fittings; and welded joints.

3.3 CLEAN-AGENT EXTINGUISHING PIPING INSTALLATION

A. Install clean-agent extinguishing piping and other components level and plumb.

B. Install pipe and fittings, valves, and discharge nozzles as required.

C. Support piping shall include required seismic restraints.

3.4 CONNECTIONS

A. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 2001, Section “Detection, Actuation, and Control Systems”, as required for supervised system application.

B. Install piping adjacent to extinguishing-agent containers to allow service and maintenance.

C. Connect electrical devices to control panel and for interfacing to building’s fire alarm system.

3.5 LABELING AND SIGNS

A. Provide as required.

3.6 DEMONSTRATION

A. Train LAWA’s maintenance personnel to adjust, operate, and maintain clean-agent extinguishing systems.

END OF SECTION 21 22 00

SECTION 22 05 00-COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section supplements all Sections of this Division and shall apply to all phases of Work specified or required to provide for the complete installation of plumbing systems. The intent of this Specification is to provide a complete plumbing system.

> **NOTE:** Noise and vibration control measures shall be incorporated into the plumbing design, including resilient support for plumbing lines, flexible connections for pipe work, selection of moderate plumbing fluid velocities and vibration isolation for the pumps.

1.2 REFERENCES

A. General: Comply with Appropriate Standards

1. American National Standards Institute: ANSI
2. American Society of Mechanical Engineers: ASME
3. American Society of Sanitary Engineering: ASSE
4. ASTM International: American Society of Testing and Materials: ASTM
5. American Welding Society: AWS
6. American Water Works Association: AWWS
7. Manufacturers Standardization Society of the Valve and Fittings Industry: MSS
8. National Electrical Manufacturers Association: NEMA
9. Plumbing and Drainage Institute: PDI
10. Underwriters Laboratories Inc.: U.L.
11. American society of Mechanical Engineers: ASME
12. California Energy Commission: C.E.C.
13. National Fire Protection Association: NFPA
14. Canadian Standards Association: CSA
15. Factory Mutual Standards: FM
16. American gas Association: AGA
17. California State Fire Marshal Regulations: CSFM
18. National Sanitation Foundation: NSF
19. International Association of Plumbing & Mechanical Officials: IAPMO
20. Cast Iron Soil Pipe Institute: CISPI
21. Los Angeles City Disabled Access Division: LAC-DAV
22. Los Angeles Plumbing Code: LAPC
23. Los Angeles Department of Building and Safety: LADBS
24. Los Angeles Fire Department: LAFD.

1.3 SUBMITTALS

A. Submit data on pipe materials, fittings, accessories, and equipment.

B. Manufacturer's Installation Instructions: Submit installation instructions for pumps, valves and accessories.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 ENVIRONMENT REQUIREMENTS

A. Do not install underground piping when bedding is wet.

1.5 WARRANTY

A. Furnish one year minimum.

1.6 JOB CONDITIONS

A. Existing Conditions:

1. Existing Pipe Lines.

a. If any existing water, gas, or other pipes and appurtenances are encountered which interfere with the proper installation of new Work and which will not be used in connection with new Work, or existing systems, close such pipe in a proper manner, and if necessary, move or remove the pipes as directed by LAWA.
b. Where existing Work is to be modified, it shall be done in conformance with the Specifications. Materials used shall be same as existing unless otherwise specified.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Electrical.

1. All electrical components furnished or installed under the Plumbing Division shall be in complete compliance with the Electrical Specifications.
2. Wiring Diagrams. A wiring diagram of Work not in the Plumbing Division but necessary to put equipment shown in the Plumbing Division, and shall be submitted for review as a shop drawing.

B. Equipment Identification.

1. Provide as required.

C. Access to Equipment.

1. All valves, control devices, equipment, specialties, etc. shall be located for easy access for

operation, repair and maintenance. If items are concealed, provide access doors of size required for easy access to the items. Provide access doors per specification.

D. List of Materials and Equipment

1. All items of material and equipment required by this section shall bear the approval of the LAWA prior to the start of any work.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify excavations are to required grade, dry, and not over-excavated.

B. Verify adequacies of all site utilities and points-of-connection for existing buildings and/or structures prior to bid and start of work.

END OF SECTION 22 05 00

SECTION 22 05 16-EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flexible pipe connectors.
2. Expansion joints.
3. Expansion compensators.
4. Pipe alignment guides.
5. Swivel joints.
6. Pipe anchors.

1.2 REFERENCES

A. General: Comply with appropriate standards.

1. American Society of Mechanical Engineers: ASME.
2. American Welding Society: AWS D1.1.
3. Los Angeles Department of Building and Safety: LADBS.

1.3 DESIGN REQUIREMENTS

A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.

B. Expansion Compensation Design Criteria:

1. Installation Temperature: 50 degrees F.
2. Domestic Hot Water: 140 degrees F.

1.4 SUBMITTALS

A. Submit data on all materials.

B. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets and swing joints. Submit shop drawings sealed by a registered professional engineer.

C. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per

assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

D. Design Data: Indicate criteria and show calculations. Submit sizing methods calculations sealed by a registered professional engineer.

E. Manufacturer's Installation Instructions: Submit special procedures.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Welders' Certificate: Provide welders' certificate.

H. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

I. Operation and Maintenance Data: Submit adjustment instructions.

1.5 WARRANTY

A. Provide one-year minimum.

B. Furnish five year manufacturer warranty for leak free performance of packed expansion joints.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS

A. Manufacturers:

1. Mason Ind.
2. Vibrex-Sausse.
3. Metraflex.

B. Steel Piping:

1. Inner Hose: Carbon Steel Stainless Steel Bronze.
2. Exterior Sleeve: Double braided stainless steel bronze.
3. Pressure Rating: 200 psig WOG and 250 degrees F.
4. Joint: As specified for pipe joints.
5. Size: Use pipe-sized units.
6. Maximum offset: 3/4 inch on each side of installed center line.

C. Copper Piping:

1. Inner Hose: Bronze.
2. Exterior Sleeve: Braided bronze.
3. Pressure Rating: 125 psig and 250 degrees F.

4. Joint: As specified for pipe joints.
5. Size: Use pipe sized units.
6. Maximum offset: 3/4 inch on each side of installed center line.

2.2 EXPANSION JOINTS

A. Manufacturers:

1. Mason Ind.
2. Vibrex-Sausse.
3. Metraflex.

B. Stainless Steel Bellows Type:

1. Pressure Rating: 125 psig and 250 degrees F.
2. Maximum Compression: 1-3/4 inch.
3. Maximum Extension: 1/4 inch.
4. Joint: As specified in piping section.
5. Size: Use pipe sized units.
6. Application: Steel piping 3 inch and smaller.

C. External Ring Controlled Stainless Steel Bellows Type:

1. Pressure Rating: 125 psig and 250 degrees F.
2. Maximum Compression: 1-1/4 inch.
3. Maximum Extension: 5/16 inch.
4. Maximum Offset: 5/16 inch.
5. Joint: As specified in piping system.
6. Size: Use pipe sized units.
7. Accessories: Internal flow liner.
8. Application: Steel piping 3 inch and larger.

D. Single or Double Sphere, Elbow or Flexible Compensators:

1. Body: Teflon or Neoprene and nylon.
2. Working Pressure: 125 psi.
3. Maximum Temperature: 150 degrees F.
4. Maximum Compression: 1-1/8 inch.
5. Maximum Elongation: 7/8 inch.
6. Maximum Offset: 7/8 inch.
7. Maximum Angular Movement: 30 degrees.
8. Joint: As specified in piping system.
9. Size: Use pipe sized units.
10. Accessories: Control rods or Control cables.
11. Application: Steel piping 2 inch and larger.

E. Two-ply Bronze Bellows Type:

1. Construction: Bronze with anti-torque device, limit stops, internal guides.

2. Pressure Rating: 125 psig WOG and 250 degrees F.
3. Maximum Compression: 1-3/4 inch.
4. Maximum Extension: 1/4 inch.
5. Joint: Soldered as specified in piping system.
6. Size: Use pipe sized units.
7. Application: Copper piping.

F. Low Pressure Compensators with two-ply Bronze Bellows:

1. Working Pressure: 80 psig.
2. Maximum Temperatures: 250 degrees F.
3. Maximum Compression: 1/2 inch.
4. Maximum Extension: 5/32 inch.
5. Joint: As specified in piping system.
6. Size: Use pipe sized units.
7. Application: Copper or steel piping 2 inch and smaller.

G. Copper with Packed Sliding Sleeve:

1. Maximum Temperature: 250 degrees F.
2. Joint: As specified in piping section.
3. Size: Use pipe sized units.
4. Copper or steel piping 2 inches and larger.
5. Application: Copper or steel piping 2 inch and larger.

H. Rubber Expansion Joints: ASTM F 1123, fabric-reinforced rubber with external control rods and complying with FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

1. Manufacturers:

   a. Flex-Weld, Inc.
   b. Mason Industries.
   c. Metraflex, Inc.

2. Arch Type: Single or multiple arches.
3. Spherical Type: Single or multiple spheres.

   a. Minimum Pressure and Temperature Ratings for NPS 1-1/2 to NPS 4: 150 psig at 220 deg F.
   b. Minimum Pressure and Temperature Ratings for NPS 5 and NPS 6: 140 psig at 200 deg F.

4. Material: EPDM.
5. End Connections: Full-faced, integral, steel flanges with steel retaining rings.
6. Equal to Mason Industries Vibraflex.

2.3 ACCESSORIES

A. Pipe Alignment Guides and Anchors: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel with weld down or bolt down anchor base.

B. Swivel Joints: Fabricated steel, Bronze, Ductile Iron or Cast steel body, double ball bearing race, field lubricated, with rubber or (Buna-N) o-ring seals.

2.4 MATERIALS FOR ANCHORS

A. Steel Shapes and Plates: ASTM A 36/A 36M.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.

C. Washers: ASTM F 844, steel, plain, flat washers.

D. Expansion Anchors

1. Smooth wall, non-self-drilling internal plug expansion type anchors constructed of AISC 12L14 steel and zinc plated in accordance with Fed. Spec. QQ-A-325 type 1, Class 3.
2. Do not exceed 1/4 of average values for a specific anchor size using 2000 PSIG concrete only, for maximum working loads.
3. Locate spacing and install anchors in accordance with the manufacturer's recommendations.
4. Expansion anchors shall be U.L listed.

E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.

1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
3. Washer and Nut: Zinc-coated steel.

F. Concrete: Portland cement mix, 3000 psi minimum.

G. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

B. Install expansion joints of sizes matching size of piping in which they are installed.

C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

D. Provide cast iron test tee expansion joints every 150 feet on vertical drainage and vent lines and where noted or required.

3.2 PIPE BEND AND LOOP INSTALLATION

A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Attach pipe bends and loops to anchors.

1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.3 SWING CONNECTIONS

A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.4 ALIGNMENT-GUIDE INSTALLATION

A. Install guides on piping adjoining pipe expansion fittings and loops.

B. Attach guides to pipe and secure to building structure.

3.5 ANCHOR INSTALLATION

A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.

C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.

D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints are indicated.

E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

3.6 MANUFACTURER'S FIELD SERVICES

A. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION 22 05 16

SECTION 22 05 23-GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gate valves.
2. Globe valves.
3. Ball valves.
4. Plug valves.
5. Butterfly valves.
6. Check valves.
7. Chainwheels.

1.2 REFERENCES

A. General: Comply with Appropriate Standards

1. American National Standards Institute: ANSI
2. American Society of Mechanical Engineers: ASME
3. American Society of Sanitary Engineering: ASSE
4. ASTM International: American Society of Testing and Materials: ASTM
5. American Welding Society: AWS
6. American Water Works Association: AWWS
7. Manufacturers Standardization Society of the Valve and Fittings Industry: MSS
8. National Electrical Manufacturers Association: NEMA
9. Plumbing and Drainage Institute: PDI
10. Underwriters Laboratories Inc.: U.L.
11. American Society of Mechanical Engineers – ASME
12. California Energy Commission – C.E.C.
13. National Fire Protection Association – NFPA
14. Canadian Standards Association - CSA
15. Factory Mutual Standards – FM
16. American gas Association – AGA
17. California State Fire Marshal Regulations – CSFM
18. National Sanitation Foundation – NSF
19. International Association of Plumbing & Mechanical Officials – IAPMO
20. Cast Iron Soil Pipe Institute – CISPI
21. Los Angeles City Disabled Access Division – LAC-DAV
22. Los Angeles Plumbing Code - LAPC
23. Los Angeles Department of Building and Safety – LADBS

1.3 SUBMITTALS

A. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.

1.4 QUALITY ASSURANCE

A. For drinking water service, provide valves complying with NSF 61 State of California AB 1953 and C.P.C. latest approved edition.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not install valves underground when bedding is wet.

1.6 WARRANTY

A. Furnish five year manufacturer warranty for valves excluding packing.

1.7 EXTRA MATERIALS

A. Furnish two packing kits for each size valve.

PART 2 – PRODUCTS

NOTE: As much as possible, all valves should be from one manufacturer.

2.1 GATE VALVES

A. Manufacturers:

1. **Nibco.**
2. **Crane.**
3. **Milwaukee.**

B. 2 inches and Smaller: MSS-SP-80 Class 125, bronze body, bronze trim, union bonnet, non-rising stem, hand-wheel, inside screw, solid wedge disc, alloy seat rings, threaded, soldered or press-fit ends.

C. 2-1/2 inches and Larger: MSSP-SP-80 Class 125, cast iron body, bronze trim, bolted bonnet, non-rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

D. Class 150, NRS, Ductile-Iron Gate Valves:

1. Manufacturers:

a. Nibco.
b. Crane.
c. Powell.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 285 psig.
c. Body Material: ASTM A 395, ductile iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

E. Class 150, OS&Y, Ductile-Iron Gate Valves:

1. Manufacturers:

a. Nibco.
b. Crane.
c. Powell.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 285 psig.
c. Body Material: ASTM A 395, ductile iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

2.2 GLOBE VALVES

A. Manufacturers:

1. Crane.
2. Milwaukee.
3. **Nibco**.

B. 2 inches and Smaller: MSS SP 80, Class 125, bronze body, bronze trim, threaded bonnet, hand wheel, Buna-N composition disc, solder or threaded ends.

C. 2-1/2 inches and Larger: MSS SP 85, Class 125, cast iron body, bronze trim, hand wheel, outside screw and yoke, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

D. Class 125, Iron Globe Valves:

1. Manufacturers:

a. Nibco.
b. Crane.
c. Powell.

2. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

E. Class 150, Iron Globe Valves:

1. Manufacturers:

a. Nibco.
b. Crane.
c. Powell.

2. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 285 psig.
c. Body Material: ASTM A 395, ductile iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

2.3 BALL VALVES

A. Manufacturers:

1. Milwaukee.
2. Crane.
3. Nibco.

B. 2 inches and Smaller: 400 psi WOG two piece bronze body, chrome plated brass ball, full port, teflon seats, blow-out proof stem, threaded, soldered or press-fit ends with union, lever handle.

C. 2 inches and Smaller: Class 150, bronze, two piece body, type 316 stainless steel ball, full port, teflon seats, blow-out proof stem, threaded, soldered or press-fit ends with union, lever handle.

D. 2 inches and Smaller: Class 150, bronze, three piece body, type 316 stainless steel ball, full port, teflon seats, blow-out proof stem, threaded, soldered or press-fit ends, lever handle.

E. Class 150, Full-Port Stainless Steel Three-Piece Ball Valves:

1. Description:

a. Threaded or socket-weld up to 2-inches, with locking mechanism.
b. WOG Rating: 1000 psig.
c. Body Design: Split body.
d. Body Material: Stainless steel ASTM A-351, grade CF8M.
e. Seats: PTFE.
f. Stem: Stainless steel ASTM A-276, Type 316.
g. Ball: Stainless steel, ASTM A-351, GRADE CF8M.
h. Port: Full.

F. Flanged Class 150, split body, full bore, stainless steel ball valve.

1. Description:

a. Flanged 2-1/2-inch up to 6-inch, with locking mechanism.
b. Split body, full bore.
c. Body Material: Stainless steel A-351 grade CF8M.
d. Seats: Virgin Teflon.
e. Stem: A-276, 316SS.
f. Ball: Stainless steel A-351 grade CF8M.
g. Port: Full.

2.4 PLUG VALVES

A. Manufacturers:

1. Nordstrom.
2. Dezurik.
3. Crane.

B. 2 inches and Smaller: MSS SP 78, Class 300, cast iron construction, round port, full pipe area, pressure lubricated, teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.

C. 2-1/2 inches and Larger: MSS SP 78, Class 300, cast iron construction, round port, full pipe area, pressure lubricated, teflon packing, flanged ends. Furnish wrench-operated or worm gear-operated.

2.5 BUTTERFLY VALVES

A. Manufacturers:

1. Milwaukee.
2. Crane.
3. Nibco.

B. 2-1/2 inches and Larger: Class 150.

1. Body: Cast or ductile iron, wafer lug or grooved ends, stainless steel stem, extended neck.
2. Disc: Nickel-plated ductile iron or Elastomer coated ductile iron.
3. Seat: Resilient replaceable EPDM.
4. Handle and Operator: 10 position lever handle. Furnish gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.6 CHECK VALVES

A. Horizontal Swing Check Valves:

1. Manufacturers:

a. Milwaukee.
b. Crane.
c. Nibco.

2. 2 inches and Smaller: Class 150, bronze body and cap, bronze seat, Buna-N disc, solder or threaded ends.
3. 2-1/2 inches and Larger: Class 125, cast iron body, bolted cap, bronze or cast iron disc, renewable disc seal and seat, flanged ends.
4. 2-1/2 inches and Larger: Class 125, cast iron body, bronze swing disc, flanged ends, outside lever and weight.

B. Spring Loaded Check Valves:

1. Manufacturers:

a. Milwaukee.
b. Crane.
c. Nibco.

2. 2 inches and Smaller: Class 250, bronze body, in-line spring lift check, silent closing, Buna-N disc, integral seat, solder or threaded ends.
3. 2-1/2 inches and Larger: Class 250, wafer style, cast iron body, bronze seat, center guided bronze disc, stainless steel spring and screws, flanged ends.

2.7 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to ball valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install valves with clearance for installation of insulation and allowing access.

D. Provide access where valves and fittings are not accessible.

3.2 VALVE APPLICATIONS

A. Install shutoff and drain valves at required locations.

B. Install ball butterfly or gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install 3/4 inch gate ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

D. Install butterfly or globe valves for throttling, bypass, or manual flow control services.

E. Install spring loaded check valves on discharge side of all water pumps.

F. Install check valves on discharge of all pumps.

G. Install lug end butterfly valves adjacent to equipment when functioning to isolate equipment.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or gate valves.
2. Throttling Service: Globe or angle valves.
3. Pump-Discharge Check Valves:

    a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, resilient-seat check valves.
    c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 DOMESTIC, HOT AND COLD WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 150, nonmetallic disc.
3. Ball Valves: Three piece, full port, bronze with stainless-steel trim.
4. Bronze Lift Check Valves: Class 125, nonmetallic TFE disc.
5. Bronze Swing Check Valves: Class 150, nonmetallic TFE disc.
6. Bronze Gate Valves: Class 150, RS.
7. Bronze Globe Valves: Class 150, nonmetallic disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Angle Valves: Class 125.
3. Steel Ball Valves: Class 150, full-port.

4. Ductile-Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
5. Ductile-Iron, Grooved-End Butterfly Valves: 300 CWP.
6. High-Performance Butterfly Valves: Class 150, 285 CWP.
7. Iron Swing Check Valves: Class 125, metal seats.
8. Iron Swing Check Valves with Closure Control: Class 125, lever and weight.
9. Iron, Center-Guided Check Valves: Class 125, globe, resilient seat.
10. Iron Gate Valves: Class 125, OS&Y.
11. Iron Globe Valves: Class 125.

3.5 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Three piece, full port, bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 125, nonmetallic disc.
4. Bronze Gate Valves: Class 150, RS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Steel Ball Valves: Class 150, full port.
3. Iron Swing Check Valves: Class 125, metal seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and weight.
5. Iron Gate Valves: Class 125, OS&Y.
6. Lubricated Plug Valves: Class 125, regular gland, threaded or flanged.

END OF SECTION 22 05 23

SECTION 22 05 29-HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Sleeves.
6. Mechanical sleeve seals.
7. Formed steel channel.
8. Firestopping relating to plumbing work.
9. Firestopping accessories.
10. Equipment bases and supports.
11. Metal framing system.
12. Fastener systems.
13. Pipe stand fabrication.
14. Pipe positioning systems.

1.2 REFERENCES

A. General: Comply with Appropriate Standards.

1. American Society of Mechanical Engineers: ASME
2. American Society of Testing and Materials: ASTM
3. American Welding Society: AWS
4. Factory Mutual Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation: FM
5. Manufacturers Standardization Society of the Valve and Fittings Industry: MSS
6. Underwriters Laboratories Inc.: UL
7. Los Angeles Plumbing Code - LAPC
8. Los Angeles Department of Building and Safety - LADBS

1.3 SUBMITTALS

A. Submit Data on all materials.

B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and details of trapeze hangers.

C. Product Data:

1. Submit manufacturers catalog data including load capacities.
2. Submit Manufacturers preparation and installation instructions.
3. Submit Manufacturers Certificate to verify all products meet or exceed specified requirements.

D. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Review environmental conditions affecting products on site prior to installation.

B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

D. Provide ventilation in areas subject to corrosive ambient air conditions.

1.5 WARRANTY

A. Provide one-year minimum.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. B-Line.
2. Tolco.
3. PHD Manufacturing, Inc.

B. Plumbing Piping – Drainage, Waste, Vent and Storm:

1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
2. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
4. Wall Support: Welded steel bracket and wrought steel clamp.
5. Vertical Support: Steel riser clamp.
6. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
7. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.

C. Plumbing Piping - Water:

1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
2. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
3. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
7. Wall Support for Pipe Sizes 4 inches and Smaller: Welded steel bracket and wrought steel clamp.
8. Wall Support for Pipe Sizes 5 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
9. Vertical Support: Steel riser clamp.
10. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
11. Floor Support for Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
12. Floor Support for Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
13. Copper Pipe Support: Copper-plated, Carbon-steel ring.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

A. Manufacturers:

1. B-Line.
2. Tolco.
3. Hilti.

B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. Metal Flashing: 26 gage thick galvanized steel.

B. Metal Counterflashing: 22 gage thick galvanized steel.

C. Lead Flashing:

1. Waterproofing: 5 lb./sq. ft sheet lead.
2. Soundproofing: 1 lb./sq. ft sheet lead.

D. Flexible Flashing: 47 mil thick sheet; compatible with roofing.

E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.5 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sealant: Listed and approved type.

2.6 MECHANICAL SLEEVE SEALS

A. Manufacturers:

1. **Thunderline Link-Seal, Inc.**
2. **NMP Corporation Model.**

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.7 FORMED STEEL CHANNEL

A. Manufacturers:

1. **B-Line.**
2. **Tolco.**
3. **Unistrut.**

2.8 FIRESTOPPING

A. Manufacturers:

1. **Dow Corning.**
2. **Hilti.**
3. **3M.**

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

2.9 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Type as required.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL listed products or products tested by independent testing laboratory.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

2.10 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line.
2. Tolco.
3. Unistrut.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.11 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. B-Line.
b. Hilti.
c. Powers Fasteners.

2. Expansion Anchors:

    a. Smooth wall, non-self-drilling internal plug expansion type anchors constructed of AISC 12L14 steel and zinc plated in accordance with Fed. Spec. QQ-A-325 type 1, Class 3.
    b. Do not exceed 1/4 of average values for a specific anchor size using 2000 PSIG concrete only, for maximum working loads.
    c. Locate spacing and install anchors in accordance with the manufacturer's recommendations.
    d. Expansion anchors shall be U.L. listed.

2.12 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Manufacturers:

    a. ERICO/Michigan Hanger Co.
    b. MIRO Industries.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

1. Manufacturers:

    a. MIRO Industries.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:

    a. ERICO/Michigan Hanger Co.
    b. MIRO Industries.
    c. Portable Pipe Hangers.

2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.13 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

B. Manufacturers:

1. **C & S Mfg. Corp.**
2. **HOLDRITE Corp.; Hubbard Enterprises.**
3. **Samco Stamping, Inc.**

2.14 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing damming materials to arrest liquid material leakage.

D. Obtain permission from LAWA before drilling or cutting structural members.

3.3 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

    a. Inserts shall be steel, slotted type and factory-painted.

        1) Single rod shall be equal to Anvil International Fig. 281.
        2) Multi-rod shall be with end caps and closure strips.
        3) Clip form nails flush with inserts.
        4) Maximum loading including pipe, contents and covering shall not exceed 75% of rated insert capability.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
16. Supports from Steel Decks:

    a. Support piping from steel deck with metal deck ceiling bolt.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include

auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.
b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.4 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

F. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

N. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

O. Suspended Horizontal Piping:

1. Support piping independently from structure using heavy iron-hinged type hangers.
2. Provide electroplated solid-band hangers for 2-inch and smaller pipe.
3. Provide trapeze hangers of angles, angles bolted back-to-back, or channels to parallel lines of piping.
4. Provide wall brackets for wall-supported piping, and furnish pipe saddles for floor-mounted piping.
5. Provide supports with recommended lining for glass piping.
6. Provide supports with copper lining for uninsulated copper piping.
7. Suspend piping from inserts, using beam clamps with retaining clamp or locknut, steel fish plates, cantilever brackets or other accepted means.
8. Suspend piping by rods with double nuts.
9. Provide additional steel framing as required and accepted where overhead construction does not permit fastening hanger rods in required locations.
10. Support branch fixture water piping in chases with copper-plated metal brackets, secured to studs.

3.5 EQUIPMENT SUPPORTS

A. Mount on or support from accepted foundations and supports, all noted equipment and related piping.

B. Size, locate, and install noise and vibration isolation equipment in accordance with manufacturer's recommendations and after review.

C. Select noise and vibration isolation equipment for lowest operating speed of equipment to be isolated.

D. Ensure that lateral motion under equipment at start-up, shut-down or when unbalanced is no more than a maximum of 1/4 inch.

E. Provide corrosion resistant mounting systems when exposed to the elements and other corrosive environments. Provide hot dip galvanized metal parts of mountings (except springs and hardware). Provide cadmium-plated and neoprene-coated springs and cadmium-plated nuts and bolts.

F. Correct noise and vibration problems due to faulty equipment or poor workmanship, as directed, without additional charge to LAWA.

G. Steel Spring Type:

1. Utilize bare stable springs without restraints.
2. Provide spring with diameter not less than 80% of loaded operating height of spring.
3. Design ends of spring so that they remain parallel during and after springs are loaded to their minimum specified deflections.
4. Provide springs with 50% travel from operating deflection before reaching solid height.
5. Provide spring mounts with 1/4 inch thick waffled neoprene acoustical pad bonded to underside of base plate.

H. Provide resiliently mounted equipment bases raised to operating height with a minimum of 2 inch of clearance at bottom of base prior to installing equipment.

1. Temporarily support bases on 2-inch thick (minimum) spacer blocks.
2. Adjust mountings to transfer load from spacer blocks to mountings; remove spacer blocks after equipment installation, but immediately prior to operation.

I. Concrete inertia blocks with adequate reinforcing steel will be provided under General Construction Work.

J. Neoprene-In-Shear Isolation Rails: Furnish for horizontal pumps, air compressors, and vacuum pumps when supplied with fractional horsepower motors.

1. Provide top structural iron channel rails with tapped holes to accept machinery foundation bolts supported by properly loaded and located double deflection neoprene-in-shear mountings, equal to Type DNR - M.I.I.
2. Provide mountings with 3/8 inch minimum static deflection and bolt holes for anchoring onto foundation equal to Type DNR - M.I.I.

K. Neoprene-In-Shear Supported Concrete Inertia Bases: Provide for horizontal pumps, jockey pumps, air compressors, and vacuum pumps when supplied with one horsepower to three horsepower motors.

L. Provide a minimum 6-inch thick concrete inertia block supported by double deflection neoprene-in-shear mountings, equal to Type ND - M.I.I., with form as noted for foundations. Bolt and grout equipment to concrete base. Provide minimum static deflection of 1 inch.

M. Spring-Supported, Factory-Fabricated Inertia Bases: Provide for horizontal pumps (except fire pumps), bottom-supported vertical booster pumps, jockey pumps, rotary air compressors and vacuum pumps with five horsepower and larger motors.

1. Provide concrete inertia block with factory-fabricated steel structural perimeter frame, set on roofing paper, with equipment anchor bolt templates and mounting brackets supplied by vibration control manufacturer.
2. Provide and locate under brackets, spring supports with a minimum static deflection of 1 inch and with leveling device to raise entire isolation base 2 inch above foundation.
3. Provide minimum thickness required for concrete inertia bases as follows:

a. Motor Size 5 hp to 15 hp: 6 inch.
b. Motor Size 20 hp to 50 hp: 8 inch.
c. Motor Size 60 hp to 100 hp: 10 inch.
d. Motor Size Over 100 hp: 12 inch.

N. Spring supported factory fabricated structural steel bases: Provide for vertical booster pumps suspended from floor slab above and through penetration.

1. Provide equipment rigidly bolted to spring supported reinforced structural base and isolated from suitable framed structural supports erected from floor slab.
2. Provide reinforced structural steel base constructed with structural members having depth of section not less than 1/12 span between spring mountings and supplied by vibration control manufacturer.
3. Provide a framed base to permit removal of any pump mounted on structural base.
4. Provide structural supports erected from floor slab, sized and framed to accept spring mountings and supported loads.
5. Piping in projected area of isolated structural pump base may be rigidly supported from isolated pump base.
6. Provide spring mountings designed so that they are capable of supporting equipment at fixed elevation during installation, and adjusted to provide operating clearance in mountings of 1/4 inch.

O. Center of gravity (C.G.) mounted spring inertia blocks:

1. Equipment and its driving motor shall be integrally mounted on spring-supported concrete inertia blocks.
2. Provide inertia blocks sized to provide sufficient mass so that dynamic movement of equipment block assembly will be less than 1/16 inch peak-to-peak at any connection flange. Form shall be as noted for foundations.
3. Provide blocks and spring mountings arranged to accomplish dynamically symmetrical system with respect to total C.G. of spring assembly in all three major axes.
4. Provide steel spring mountings consisting of bare stable springs arranged in pendulum configuration with built-in adjustable side snubbers, leveling device and 1/4 inch thick neoprene acoustical base pad.
5. Provide mountings with a minimum static deflection corresponding to isolation efficiency of 90% at lowest equipment operating speed.

3.6 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.7 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.8 FIELD QUALITY CONTROL

A. All tests shall be in accordance with city of Los Angeles and Inspector of Record.

END OF SECTION 22 05 29

SECTION 22 05 48-VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Inertia bases.
2. Vibration isolators.
3. Flexible Connectors.
4. Seismic Restraint Devices.

1.2 REFERENCES

A. Comply with appropriate standards.

1. American National Standards Institute: ANSI
2. ANSI S1.4 - Sound Level Meters.
3. ANSI S1.8 - Reference Quantities for Acoustical Levels.
4. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.
5. Air-Conditioning and Refrigeration Institute: ARI
6. American Society of Heating, Refrigerating: ASHRAE
7. Los Angeles Building Code: LABC
8. ISAT
9. Los Angeles Department of Building and Safety: LADBS.

1.3 PERFORMANCE REQUIREMENTS

A. Provide vibration isolation on motor driven equipment over 0.5 hp, plus connected piping.

B. Provide minimum static deflection of isolators for equipment as recommended by manufacturer.

C. Consider upper floor locations critical unless otherwise indicated.

D. Use concrete inertia bases for motors in excess of 40 hp and on base mounted pumps over 10 hp.

E. Maintain sound level of spaces at levels not to exceed those listed below by utilizing acoustical devices.

F. Maintain room maximum sound levels, in Noise Criteria (NC) as defined by ANSI S1.8.

1.4 SUBMITTALS

A. Submit data on all materials.

B. Shop Drawings: Indicate equipment bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, material, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.

C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating, materials and dimensional data.

D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.

E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions.

F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.

G. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of hangers including attachment points.

1.6 WARRANTY

A. Provide one year minimum.

PART 2 - PRODUCTS

2.1 INERTIA BASES

A. Manufacturers:

1. **Mason Ind.**
2. **Amber/Booth Co.**
3. **Vibration Mountings & Control, Inc.**

B. Structural Bases:

1. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
2. Construction: Welded structural steel with gusset brackets, supporting equipment and motor with motor slide rails.

C. Concrete Inertia Bases:

1. Mass: Minimum of 1.5 times weight of isolated equipment.
2. Construction: Structured steel channel perimeter frame, with gusset brackets and anchor bolts, reinforced as required.
3. Connecting Point: Reinforced to connect isolators and snubbers to base.
4. Concrete: Reinforced 3,000 psi concrete minimum.
5. Minimum thickness shall be:

Motor Size		Minimum Thickness	
(hp)	(kW)	(in)	(mm)
5-15	(4-11)	6	(150)
20-50	(15-37)	8	(200)
60-75	(45-55)	10	(250)
100-250	(75-190)	12	(300)
300-500	(220-375)	18	(350)

2.2 VIBRATION ISOLATORS

A. Manufacturers:

1. Mason Industries.
2. Amber/Booth Company, Inc.
3. Vibration Mountings & Controls, Inc.

B. Vibration Isolator Types:

1. Type A: Spring isolators shall incorporate the following:

a. Minimum diameter of 0.8 of the loaded operating height.
b. Corrosion resistance where exposed to corrosive environment with:

1) Springs cadmium plated or electro-galvanized.
2) Hardware cadmium plated.
3) All other metal parts hot-dip galvanized.

c. Reserve deflection (from loaded to solid height) of 50 percent of rated deflection.

d. Minimum 1/4 inch thick neoprene acoustical base pad on underside, unless designated otherwise.
e. Designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.
f. Non-resonant with equipment forcing frequencies or support structure natural frequencies.
g. Spring isolators to be Mason Type SLF, or as approved.
h. This isolator must be accompanied by seismic isolator Type II.

2. Type B: Spring isolators shall be same as Type A, except:

a. Provide built-in vertical limit stops with minimum 1/4 inch clearance under normal operation.
b. Tapped holes in top plate for bolting to equipment when subject to wind load.
c. Capable of supporting equipment at a fixed elevation during equipment erection. Installed and operating heights shall be identical.
d. Adjustable and removable spring pack with separate neoprene pad isolation.
e. Housing shall be designed to accept 1 G of acceleration.
f. Mason Type SLR.

3. Type C: Spring hanger rod isolators shall incorporate the following:

a. Spring element seated on a steel washer within a neoprene cup incorporating a rod isolation bushing.
b. Steel retainer box encasing the spring and neoprene cup.
c. Requires seismic restraint Type III.
d. Mason Type HS.

4. Type E: Elastomer hanger rod isolators shall be incorporate the following:

a. Molded unit type neoprene element with projecting bushing lining rod clearance hole.
b. Neoprene element shall be minimum 1-3/4 inch thick.
c. Steel retainer box encasing neoprene mounting.
d. Clearance between mounting hanger rod and neoprene bushing shall be minimum of 1/8 inch.
e. Requires seismic restraint Type III.
f. Mason Type HD.

5. Type F: Combination spring/elastomer hanger rod isolators to incorporate the following:

a. Spring and neoprene isolator elements in a steel box retainer. Neoprene of double deflection type. Single deflection is unacceptable. Spring seated in a neoprene cup with extended rod bushing.
b. Characteristics of spring and neoprene as describe in Type A and Type E isolators.
c. Requires seismic restraint Type III.
d. Mason Type 30N.

6. Type G: Pad type elastomer mountings to incorporate the following:

a. 0.750 inch minimum thickness.
b. 50 psi maximum loading.
c. Ribbed or waffled design.
d. 0.10 inch deflection per pad thickness.
e. 1/16 inch galvanized steel plate between multiple layers or pad thickness.
f. Suitable bearing plate to distribute load.
g. Mason Type Super W.

7. Type H: Pad type elastomer mountings to incorporate the following:

a. Laminate canvas duck and neoprene.
b. Maximum loading 1000 psi.
c. Suitable bearing plate to distribute load.
d. Minimum thickness, 1/2 inch.
e. Mason Type HL.

8. Type J: Rail type spring isolators:

a. Rail type spring isolators shall provide steel members of sufficient strength to prevent flexure with equipment operation.
b. Springs shall be the same as Type A with seismic restraint Type II or seismic restraint Type I or IV isolation.
c. Mason Type ICS.

9. Type K: Pipe anchors:

a. Vibration isolator manufacturer shall provide an all directional acoustical pipe anchor, consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum half inch thickness of heavy duty neoprene and duck or neoprene isolation material.
b. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction.
c. Allowable loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction.
d. Mason Type ADA.

2.3 FLEXIBLE CONNECTORS

A. Elastomer Type FC-1:

1. Manufactured of nylon tire cord and EPDM both molded and cured with hydraulic presses.
2. Straight connectors shall have two spheres reinforced with a molded-in external ductile iron ring between spheres.
3. Elbow shall be long radius reducing type.
4. Rated 250 psi at 170 degrees F dropping in a straight line to 170 psi at 250 degrees F for sizes 1-1/2 inch to 12 inch elbows. Elbows shall be rated no less than 90 percent of straight connections.

5. Sizes 10 inches to 12 inches to employ control cables with neoprene end fittings isolated from anchor plates by means of 1/2 inch bridge bearing neoprene bushings.
6. Minimum safety factor, 4 to 1 at maximum pressure ratings.
7. Submittals shall include test reports.
8. Mason Type MFTNC Superflex.

B. Flexible Stainless Hose, Type FC-2:

1. Braided flexible metal hose.
2. 2 inch pipe size and smaller with male nipple fittings.
3. 2-1/2 inch and larger pipe size with fixed steel flanges.
4. Suitable for operating pressure with 4 to 1 minimum safety factor.
5. Length as required.
6. Mason Type BSS.

2.4 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers:

1. Mason Industries.
2. Amber/Booth Company, Inc.
3. Mason Industries.
4. Vibration Mountings & Controls, Inc.

B. Type B-1: Integral Structural Steel Base

1. Reinforced, as required, to prevent base flexure at start up and misalignment of drive and driven units. Centrifugal fan bases complete with motor slide rails. Drilled for drive and driven unit mounting template.
2. Mason Type M, WF.

C. Type B 2: Concrete Inertia Base

1. Concrete inertia bases shall be formed in a structural steel perimeter base, reinforced as required to prevent flexure, misalignment of drive and driven unit or stress transferal into equipment. The base shall be complete with motor slide rails, pump base elbow supports, and complete with height saving brackets, reinforcing, equipment bolting provisions and isolators.
2. Minimum thickness of the inertia base shall be according to the following tabulation:

Motor Size		Minimum Thickness	
(hp)	(kW)	(in)	(mm)
5-15	(4-11)	6	(150)
20-50	(15-37)	8	(200)
60-75	(45-55)	10	(250)
100-250	(75-190)	12	(300)
300-500	(220-375)	18	(350)

3. Mason Type K, BMK.

2.5 SEISMIC RESTRAINT DEVICES

A. Type I: Spring Incorporating Seismic Restraint

1. Shall comply with general characteristics of spring isolators.
2. Shall have vertical restraints and are capable of supporting equipment at fixed elevation during equipment erection. Vertical restraint shall be separate from equipment load support.
3. Shall incorporate seismic snubbing restraint in all directions at specified acceleration loadings.
4. System to be field bolted to structure with minimum capability to withstand external forces of 1.5.
5. Mason Type SSLR.

B. Type II: Stationary Seismic Restraint

1. Each corner or side seismic restraint shall incorporate minimum 5/8" thick pad limit stops. Restraints shall be made of plate, structural members or square metal tubing in a welded assembly, incorporating resilient pads. Angle bumpers are not acceptable. System to be field bolted to deck with 1.0 g acceleration capacity.
2. Seismic spring mountings as described above are an acceptable alternative providing all seismic loading requirements are met.
3. Mason Industries Type Z 1011, Type Z 1225.

C. Type III: Cable Seismic Restraint,

1. Metal cable type with approved end fastening devices to equipment and structure. System to be field bolted to deck or overhead structural members or deck with aircraft cable and clamps as per ISAT guidelines.

D. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

F. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

G. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

H. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

K. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

L. Adhesive Anchor Bolts: Adhesive anchor bolts are not permitted where seismic restraint is required. Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.6 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install isolation for motor driven equipment.

B. Bases:

1. Set steel bases for 1 inch clearance between housekeeping pad and base.
2. Set concrete inertia bases for 2 inch clearance between housekeeping pad and base.

C. Adjust equipment level.

D. Install spring hangers without binding.

E. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

F. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

G. Provide pairs of horizontal limit springs on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans.

H. Provide resiliently mounted equipment and piping with seismic snubbers. Provide each inertia base with minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.05 inch maximum clearance. Provide other snubbers with clearance between 0.15 inch and 0.25 inch.

I. Support piping connections to isolated equipment resiliently as follows:

1. Up to 4 inch Diameter: First three points of support.
2. 5 to 8 inch Diameter: First four points of support.
3. 10 inch Diameter and Over: First six points of support.
4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.

3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.
4. All equipment whether isolated or not, shall be bolted to structure to allow for minimum 1/2 G of acceleration. Bolt points and diameter of inserts shall be submitted and verified as part of the contractor's submission for each piece of equipment and certified by a licensed civil or structural engineer.
5. All structurally suspended overhead equipment isolated or non-isolated shall be four point independently braced within Type III seismic restraining system.
6. Where base anchoring is insufficient to resist seismic forces, supplementary restraining such as seismic restraint system Type III shall be used above systems center of gravity to suitably resist "G" force levels. Vertically mounted tanks may require this additional restraint.
7. All anchor bolts and tie-ins to structure shall be designed for a 1.5 importance factor to meet the California Building Code.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet at turns of more than 4 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.
4. Install Seismic Restraining System Type III: Taut for overhead suspended non-isolated equipment, piping and slack with 1/2 inch cable deflection for isolated systems.
5. Seismically restrain all piping with Type III restraining system in accordance with guideline as outlined below.
6. Seismic restraints are not required for the following (this does not apply to any life safety or high hazard equipment):

    a. Gas piping less than 1 inch I.D.
    b. Piping in Boiler and Mechanical Equipment rooms less than 1-1/4 inch I.D.
    c. All other piping less than 2-1/2 I.D.
    d. All piping suspended by individual hangers 12 inches in length or less from the top of the pipe to the bottom of the support for the hanger.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 SEISMIC RESTRAINTS FOR NON-ISOLATED EQUIPMENT

A. All ceiling suspended piping not excluded by diameter or distance required from support: Seismic Restraint type III.

B. All ceiling mounted equipment: Seismic Restraint Type III.

C. All floor mounted equipment, including but not limited to tanks, domestic water heaters, etc.: Seismic Restraint Type V.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements for piping flexible connections.

3.6 FIELD QUALITY CONTROL

A. Inspect isolated equipment after installation and submit report. Include static deflections.

B. After start-up, final corrections and balancing of systems take octave band sound measurements over full audio frequency range in areas adjacent to plumbing equipment rooms, duct and pipe shafts, and other critical locations. Provide one-third octave band measurements of artificial sound sources in areas indicated as having critical requirements. Submit complete report of test results including sound curves.

C. Furnish services of testing agency to take noise measurement. Use meters meeting requirements of ANSI S1.4.

3.7 PLUMBING VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Supported or Suspended Equipment:

1. Pads:

   a. Material: Neoprene.
   b. Thickness: ½".

2. Component Importance Factor: 1.5.
3. Component Response Modification Factor: 1.5.
4. Component Amplification Factor: 2.5.

Type of Equipment	**Below Grade**		**Above Grade**	
	Isolation Type	**Deflection**	**Isolation Type**	**Deflection**
Heat Exchangers	D	0.4 inch	B and Base Type B-1	1 inch
Pumps up to 15 HP	D-J	0.4 inch	B or SR Type I and Base Type J	1 inch
All Piping	Type I and SR Type III	1 inch	Type I and SR Type III	2 inches
Piping Flexible Connectors for Pumps	FC-1	--	FC-1	--

END OF SECTION 22 05 48

SECTION 22 05 53-IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.
8. Warning Signs and Labels.
9. Warning Tag.

1.2 REFERENCES

A. American Society of Mechanical Engineers: ASME

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Product Data: Submit manufacturers catalog literature for each product required.

B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.
4. Kolbi.

B. Product Description: Laminated three-layer plastic with engraved white letters on blue contrasting background color.

1. Plastic Labels for Equipment:

    a. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
    b. Letter Color: White.
    c. Background Color: Blue.
    d. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
    e. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
    f. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
    g. Fasteners: Stainless-steel rivets or self-tapping screws.
    h. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Metal Labels for Equipment:

1. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

    a. Seton.
    b. Brady.
    c. Kolbi.

2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 2 inches square.

B. Metal Tags:

1. Manufacturers:

    a. Seton.
    b. Brady.

c. **Kolbi.**

2. Stainless steel, 0.025” min. thickness and having predrilled holes or stamped roles for attachment hardware, with stamped or engraved letters; tag size minimum 2 inches square with finished edges.

2.3 STENCILS

A. Manufacturers:

1. Seton.
2. Brady.
3. Kolbi.

B. Stencils: With clean cut symbols and letters of following size:

1. Up to 2 inches Outside Diameter of Insulation or Pipe: 3/4 inch high letters.
2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1 ¼ inch high letters.
3. Over 6 inches Outside Diameter of Insulation or Pipe: 2 1/2 inches inches high letters.
4. 10 inch and above of insulation or pipe: 3 ½ inches high letters.
5. Equipment: 1-3/4 inches high letters.

C. Stencil Paint: Semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers:

1. Manufacturers:

a. Seton.
b. Brady.
c. Kolbi.

2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Pipe Markers:

1. Manufacturers:

a. Seton.
b. Brady.
c. Kolbi.

2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Plastic Underground Pipe Markers:

1. Manufacturers:

a. Seton.
b. Brady.
c. Kolbi.

2. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS

A. Manufacturers:

1. Seton.
2. Brady.
3. Kolbi.

B. Description: Steel with 3/4 inch diameter color-coded head.

C. Color code as follows:

1. Plumbing valves: Green.

2.6 LABELS

A. Manufacturers:

1. Seton.
2. Brady.
3. Kolbi.

B. Description: Stainless steel, size 2 ½ x 3/4 inches, adhesive backed with printed identification and bar code.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers:

a. Seton.
b. Brady.
c. Kolbi.

2. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

B. Valve Lockout Devices:

1. Manufacturers:

a. Seton.
b. Brady.
c. Kolbi.

2. Steel device preventing access to valve operator, accepting lock shackle.

2.8 WARNING SIGNS & LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.9 WARNING TAG

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Apply stencil painting.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain. Number tags consecutively by location.

F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

G. Identify water heaters, pumps, tanks, and water treatment devices with stencil painting. Identify in-line pumps and other small devices with tags.

H. Identify control panels and major control components outside panels with plastic nameplates.

I. Identify valves in main and branch piping with tags.

J. Identify piping, concealed or exposed, with plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

K. Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.2 PIPE LABEL INSTALLATION

A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 10 feet along each run.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
8. Where removable ceiling tiles are provided, install buttons, tabs, or markers to identify location of concealed work and/or valves.

C. Pipe Label Color Schedule:

1. Domestic Water Piping:

a. Background Color: Blue.
b. Letter Color: White.

2. Sanitary Waste and Storm Drainage Piping:

a. Background Color: Yellow.
b. Letter Color: Black.

3.3 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Cold Water: 2 inches, round.
b. Hot Water: 2 inches, round.

2. Valve-Tag Color:

a. Cold Water: Blue.
b. Hot Water: Red.

3. Letter Color:

a. Cold Water: White.
b. Hot Water: White.

3.4 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

SECTION 22 07 00-PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plumbing piping insulation, jackets and accessories.
2. Plumbing equipment insulation, jackets and accessories.

1.2 REFERENCES

A. Comply with appropriate standards

1. ASTM International: ASTM
2. California Plumbing Code: CPC
3. Los Angeles Plumbing Code: LAPC
4. Los Angeles Department of Building and Safety: LADBS
5. Americans with Disabilities Act: ADA
6. City of Los Angeles – Disabled Access: DA

a. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
b. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
c. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
d. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
e. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
f. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
g. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
h. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
i. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
j. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
k. ASTM C578 - Standard Specification, Cellular Polystyrene Thermal Insulation.
l. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
m. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

n. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
o. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
p. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
q. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
r. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
s. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
t. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
u. ASTM E84.
v. ASTM E223.

1.3 SUBMITTALS

A. Product Data: Submit product description, thermal characteristics and list of materials and thickness and jackets for each service, and location.

B. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

D. LEED Submittal:

1. Product data for cedit EQ4.1: For adhesives and sealants, including printed statement of VOC content.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by LAWA. Use materials indicated for the completed Work.

1. Piping Mockups:

   a. One 10-foot section of NPS 2 straight pipe.
   b. One each of a 90-degree threaded, welded, and flanged elbow.
   c. One each of a threaded, welded, and flanged tee fitting.
   d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
   e. Four support hangers including hanger shield and insert.
   f. One threaded strainer and one flanged strainer with removable portion of insulation.
   g. One threaded reducer and one welded reducer.
   h. One pressure temperature tap.
   i. One mechanical coupling.

2. Equipment Mockups: One tank or vessel.
3. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
4. Notify LAWA seven days in advance of dates and times when mockups will be constructed.
5. Obtain LAWA's approval of mockups before starting insulation application.
6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless LAWA specifically approves such deviations in writing.
7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
8. Demolish and remove mockups when directed.

1.5 WARRANTY

A. Furnish one-year minimum.

B. Furnish five year manufacturer warranty for man made fiber.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:

1. **CertainTeed.**
2. **Johns Manville.**
3. **Owens-Corning.**

2.2 PIPE INSULATION

A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 850 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

B. TYPE P-2: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 850 degrees F.

C. TYPE P-3: ASTM C612; semi-rigid, fibrous glass board noncombustible, end grain adhered to jacket. Conform to ASTM C795 for application on Austenitic stainless steel.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: 0 to 650 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

D. TYPE P-4: ASTM C612; semi-rigid, fibrous glass board noncombustible. Conform to ASTM C795 for application on Austenitic stainless steel.

1. Thermal Conductivity: 0.27 at 75 degrees F.

E. TYPE P-5: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: Range: Minus 70 to 180 degrees F.

F. TYPE P-6: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.30 at 75 degrees F.
2. Maximum Service Temperature: 300 degrees F.
3. Operating Temperature Range: Range: Minus 58 to 300 degrees F.

G. TYPE P-7: ASTM C534, Type I, flexible, nonhalogen, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Maximum Service Temperature: 250 degrees F.
3. Operating Temperature Range: Range: Minus 58 to 250 degrees F.

H. TYPE P-8: ASTM C547, Type I or II, mineral fiber preformed pipe insulation, noncombustible.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Maximum Service Temperature: 1200 degrees F.
3. Canvas Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric treated with fire retardant lagging adhesive.

I. TYPE P-9: ASTM C591, Type IV, polyisocyanurate foam insulation, formed into shapes for use as pipe insulation.

1. Density: 4.0 pounds per cubic foot.
2. Thermal Conductivity: 180 day aged value of 0.19 at 75 degrees F.
3. Operating Temperature Range: Range: Minus 297 to 300 degrees F.
4. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied film of 4 mils thickness and water vapor permeance of 0.02 perms.

J. TYPE P-10: ASTM C578, Type XIII, extruded polystyrene insulation, formed into shapes for use as pipe insulation.

1. Thermal Conductivity: 180 day aged value of 0.259 at 75 degrees F.
2. Operating Temperature Range: Range: Minus 297 to 165 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied film of 4 mils thickness and water vapor permeance of 0.02 perms.

K. TYPE P-11: ASTM C533; Type I, hydrous calcium silicate pipe insulation, rigid molded white; asbestos free.

1. Thermal Conductivity: 0.45 at 200 degrees F.
2. Operating Temperature Range: 140 to 1200 degrees F.

2.3 PIPE INSULATION JACKETS

A. Vapor Retarder Jacket:

1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.

B. PVC Plastic Pipe Jacket:

1. Product Description: ASTM D1785, one piece molded type fitting covers and sheet material, off-white color.
2. Thickness: 30 mil.
3. Connections: Brush on welding adhesive with VOC content of 50 g/l according to CFR 59, Subpart D (EPA Method 24).

C. ABS Plastic Pipe Jacket:

1. Jacket: One piece molded type fitting covers and sheet material, off-white color.

2. Minimum service temperature: -40 degrees F.
3. Maximum service temperature of 180 degrees F.
4. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
5. Thickness: 30 mil.
6. Connections: Brush on welding adhesive.
7. Connections: Brush on welding adhesive with VOC content of 50 g/l according to CFR 59, Subpart D (EPA Method 24).

D. Aluminum Pipe Jacket:

1. ASTM B209.
2. Thickness: 0.020 inch thick sheet.
3. Finish: Smooth Embossed.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.2 inch thick die shaped fitting covers with factory attached protective liner.
6. Metal Jacket Bands: 1/2 inch wide; 0.015 inch thick aluminum. 0.020 inch thick stainless steel.

E. Stainless Steel Pipe Jacket:

1. ASTM A240/A240M OR ASTM 666 Type 304 stainless steel.
2. Thickness: 0.016 inch thick.
3. Finish: Smooth.
4. Metal Jacket Bands: 1/2 inch wide; 0.020 inch thick stainless steel.

F. Field Applied Glass Fiber Fabric Jacket System:

1. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
2. Glass Fiber Fabric:

   a. Cloth: Untreated; 9 oz/sq yd weight.
   b. Blanket: 1.0 lb/cu ft density.

3. Indoor Vapor Retarder Finish:

   a. Cloth: Untreated; 9 oz/sq yd weight.
   b. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.4 PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.

D. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.

E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with aluminum single piece construction with self adhesive closure. Thickness to match pipe insulation.

F. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

G. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

H. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.

I. Adhesives: Compatible with insulation.

2.5 EQUIPMENT INSULATION

A. TYPE E-1: ASTM C553; glass fiber, flexible or semi-rigid, noncombustible.

1. Thermal Conductivity: 0.24 at 75 degrees F.
2. Operating Temperature Range: 0 to 450 degrees F.
3. Density: 1.65 pound per cubic foot.

B. TYPE E-2: ASTM C612; glass fiber, rigid board, noncombustible with factory applied kraft reinforced aluminum foil jacket.

1. Thermal Conductivity: 0.24 at 75 degrees F.
2. Operating Temperature Range: 0 to 450 degrees F.
3. Density: 3.0 pound per cubic foot.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

C. TYPE E-3: ASTM C612; semi-rigid, fibrous glass board noncombustible, end grain adhered to jacket.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: 0 to 650 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

D. TYPE E-4: ASTM C612; semi-rigid, fibrous glass board noncombustible.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: 0 to 650 degrees F.

E. TYPE E-5: ASTM C612, man made mineral fiber, noncombustible, Classes 1-4.

1. Thermal Conductivity: 0.25 at 100 degrees F.
2. Maximum Service Temperature: 1200 degrees F.
3. Density: 4 pound per cubic foot.

2.6 EQUIPMENT INSULATION JACKETS

A. PVC Plastic Equipment Jacket:

1. Product Description: ASTM D1785, sheet material, off-white color.
2. Minimum Service Temperature: -40 degrees F.
3. Maximum Service Temperature: 150 degrees F.
4. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
5. Thickness: 30 mil.
6. Connections: Brush on welding adhesive with VOC content of 50 g/l according to CFR 59, Subpart D (EPA Method 24).

B. Aluminum Equipment Jacket:

1. ASTM B209.
2. Thickness: 0.020 inch thick sheet.
3. Finish: Embossed.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.02 inch thick die shaped fitting covers with factory attached protective liner.
6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum. 0.020 inch thick stainless steel.

C. Canvas Equipment Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric with fire retardant lagging adhesive compatible with insulation.

D. Vapor Retarder Jacket:

1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.

E. Field Applied Glass Fiber Fabric Jacket System:

1. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
2. Glass Fiber Fabric:

    a. Cloth: Untreated; 9 oz/sq yd weight.
    b. Blanket: 1.0 lb/cu ft density.

3. Indoor Vapor Retarder Finish:

    a. Cloth: Untreated; 9 oz/sq yd weight.
    b. Vinyl emulsion type acrylic, compatible with insulation, black white color.

2.7 EQUIPMENT INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

E. Adhesives: Compatible with insulation.

2.8 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

1. Manufacturers:

a. Childers Products, Division of ITW; CP-97.
b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
c. Marathon Industries, Inc.; 290.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-96.
b. Foster Products Corporation, H. B. Fuller Company; 81-33.

2. calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers:

a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. Marathon Industries, Inc.; 225.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. Marathon Industries, Inc.; 225.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers:

a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. Speedline Corporation; Speedline Vinyl Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.9 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content that meets the requirement of the South Coast Air Quality Management District Rule #1168. VOC limits to be per amendment date 1/7/05.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Manufacturers:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. Marathon Industries, Inc.; 590.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Manufacturers:

a. Childers Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. Marathon Industries, Inc.; 501.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Manufacturers:

a. Childers Products, Division of ITW; Encacel.
b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
c. Marathon Industries, Inc.; 570.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.
6. For outdoor aluminum finish, use 60-39 mastic.

2.10 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products - Manufacturers:

a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Marathon Industries, Inc.; 405.

2. Joint Sealant for Polystyrene Products - Manufacturers:

a. Childers Products, Division of ITW; CP-70.
b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
c. Marathon Industries, Inc.; 405.

3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.

5. Service Temperature Range: Minus 100 to plus 300 deg F.
6. Color: White or gray.
7. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers:

a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Manufacturers:

a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.11 FIELD APPLIED FABRIC – REINFORCING MASH

A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.

1. Manufacturers:

a. Vimasco Corporation; Elastafab 894.

B. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.

1. Manufacturers:

a. Childers Products, Division of ITW; Chil-Glas No. 5.

C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.

1. Manufacturers:

a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

2.12 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

1. Manufacturers:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.13 SECUREMENTS

A. Bands:

1. Manufacturers:

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
5. Copper clad annealed steel wire having a minimum 16 gauge thickness.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.

a. Manufacturers:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

    a. Manufacturers:

        1) AGM Industries, Inc.; CWP-1.
        2) GEMCO; Cupped Head Weld Pin.
        3) Midwest Fasteners, Inc.; Cupped Head.

3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

    a. Manufacturers:

        1) AGM Industries, Inc.; RC-150.
        2) GEMCO; R-150.
        3) Midwest Fasteners, Inc.; WA-150.

    b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

4. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

    a. Manufacturers:

        1) GEMCO.
        2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.080-inch nickel-copper alloy.

1. Manufacturers:

    a. C & F Wire.
    b. Childers Products.
    c. PABCO Metals Corporation.

2.14 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 INSTALLATION - PIPING SYSTEMS

A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.

B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. For penetrations of assemblies with fire resistance rating greater than one hour. See all sections in Division.

C. Piping Systems Conveying Fluids Below Ambient Temperature:

1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.

D. Glass Fiber Board Insulation:

1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.

E. Polyisocyanurate Foam Insulation Extruded Polystyrene Insulation:

1. Wrap elbows and fitting with vapor retarder tape.
2. Seal butt joints with vapor retarder tape.

F. Hot Piping Systems 140 degrees F or less:

1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.

G. Inserts and Shields:

1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.

    a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
    b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.

3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.

H. Insulation Terminating Points:

1. Branch Piping 1 inch and Smaller: Terminate hot water piping at union upstream of the control valve.
2. Condensate Piping: Insulate entire piping system and components to prevent condensation.

I. Closed Cell Elastomeric Insulation:

1. Push insulation on to piping.
2. Miter joints at elbows.
3. Seal seams and butt joints with manufacturer's recommended adhesive.
4. When application requires multiple layers, apply with joints staggered.
5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.

J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

K. Piping Exterior to Building: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.

L. Buried Piping: Insulate only where insulation manufacturer recommends insulation product may be installed in trench, tunnel or direct buried. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.

M. Heat Traced Piping Interior to Building: As recommended by Heat Trace System Manufacturer.

N. Heat Traced Piping Exterior to Building: As recommended by Heat Trace System Manufacturer.

O. Prepare pipe insulation for finish painting.

3.2 INSTALLATION - EQUIPMENT

A. Factory Insulated Equipment: Do not insulate.

B. Exposed Equipment: Locate insulation and cover seams in least visible locations.

C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.

D. Equipment Containing Fluids Below Ambient Temperature:

1. Insulate entire equipment surfaces.
2. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
3. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
4. Finish insulation at supports, protrusions, and interruptions.

E. Equipment Containing Fluids 140 degrees F Or Less:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation.
2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
3. Finish insulation at supports, protrusions, and interruptions.

F. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.

G. Equipment Located Exterior to Building: Install vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.

H. Cover insulation with aluminum jacket.

I. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation.

J. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

K. Prepare equipment insulation for finish painting.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies.

3.4 SCHEDULES

A. Water Supply Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Domestic Hot Water Supply and Recirculation	P-1	1-1/4 inches and smaller 1-1/2 inches and larger	1.0 2.0
Domestic Hot Water Supply and Recirculation systems with domestic water temperature maintenance cable	P-1	1 inch and smaller 1-1/4 inches to 2 inches 2-1/2 inches and larger	1.0 1.5 2.0
Domestic Cold Water (Exposed)	P-1 or P-5	1-1/4 inches and smaller 1-1/2 inches and larger	0.75 1.0
Deionized Water	P-1 or P-5	All sizes	1.0

B. Drainage Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Storm Piping (horizontal above ground within building)	P-1 or P-5	All sizes	1.0
Sanitary Sewer Piping (Exposed)	P-1 or P-5	All sizes	1.0

C. Equipment Insulation Schedule:

EQUIPMENT	INSULATION TYPE	INSULATION THICKNESS inches
Roof Drain Bodies	E-2	1.0
Domestic Hot Water Storage Tanks	E-1 E-2	2.0
Domestic Water Storage Tanks	E-1, E-2,	2.0
Domestic Water Booster Pump Bodies	E-5	1.0
Water Softeners and Tanks	E-1, E-2,	2.0

3.5 DOMESTIC WATER HEAT EXCHANGER INSULATION SCHEDULE

A. Round, exposed breeching and connector insulation shall be the following:

1. Calcium Silicate: 4 inches thick.
2. High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
3. High-Temperature Mineral-Fiber Board: 3 inches thick and 6-lb/cu. ft. nominal density.

B. Round, concealed breeching and connector insulation shall be the following:

1. Calcium Silicate: 4 inches thick.
2. High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
3. High-Temperature Mineral-Fiber Board: 3 inches thick and 6-lb/cu. ft. nominal density.

C. Rectangular, exposed breeching and connector insulation shall be the following:

1. Calcium Silicate: 4 inches thick.
2. High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
3. High-Temperature Mineral-Fiber Board: 3 inches thick and 6-lb/cu. ft. nominal density.

D. Rectangular, concealed breeching and connector insulation shall be the following:

1. Calcium Silicate: 4 inches thick.
2. High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
3. High-Temperature Mineral-Fiber Board: 3 inches thick and 6-lb/cu. ft. nominal density.

3.6 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

A. Grease Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.

3.7 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 22 07 00

SECTION 22 11 00-FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section Includes:

1. Domestic water piping, within 5 feet of building.
2. Domestic water piping, above grade.
3. Pressure gages.
4. Pressure gage taps.
5. Thermometers.
6. Flow control valves.
7. Water pressure reducing valves.
8. Relief valves.
9. Strainers.
10. Hose bibs.
11. Hydrants.
12. Wall box outlet.
13. Backflow preventers.
14. Water hammer arrestors.
15. Thermostatic mixing valves.
16. Pressure balanced mixing valves.

1.2 REFERENCES

A. Comply with appropriate standards.

1. American National Standards Institute: ANSI
2. American Society of Mechanical Engineers: ASME
3. American Society of Sanitary Engineering: ASSE
4. ASTM International: American Society of Testing and Materials: ASTM
5. American Welding Society: AWS
6. American Water Works Association: AWWS
7. Manufacturers Standardization Society of the Valve and Fittings Industry: MSS
8. National Electrical Manufacturers Association: NEMA
9. Plumbing and Drainage Institute: PDI
10. Underwriters Laboratories Inc.: U.L.
11. Los Angeles Plumbing Code: LAPC
12. Los Angeles Department of Building and Safety: LADBS
13. National Sanitation Foundation: NSF

1.3 SUBMITTALS

A. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturer's catalog information.
2. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

B. Manufacturer's Installation Instructions: Submit installation instructions for pumps, valves and accessories.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves and equipment.

B. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.5 WARRANTY

A. Furnish one-year minimum warranty.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Tubing: ASTM B88, Type K, hard drawn.

1. Fittings: ASME B16.18, cast copper alloy ASME B16.22, wrought copper and bronze Annex G NSF/ANSI 61.
2. Joints:

a. Soldered – ASTM B32 E & HB lead-free allow, with water soluble flux per ASTM B-13.
b. Press-fit – ASTM B75; NSF 61, C.S.A., UPC listed and approved; 250 degree F – 200 PSI; compatible with ASTM B88 seamless copper; with elastomeric EPDM seals.

B. Copper Tubing: ASTM B88 Type L, annealed soft copper, to trap primers – fittings and joints not allowed.

C. Ductile-Iron Pipe And Fittings

1. Mechanical-Joint, Thickness Class 54, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

    a. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
    b. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.

        1) Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.2 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L hard drawn.

1. Fittings: ASME B16.18, cast copper alloy ASME B16.22, wrought copper and bronze Annex G NSF/ANSI 61.
2. Joints:

    a. Soldered – ASTM B32 E & HB lead-free allow, with water soluble flux per ASTM B-13.
    b. Press-fit – ASTM B75; NSF 61, C.S.A., UPC listed and approved; 250 degree F – 200 PSI; compatible with ASTM B88 seamless copper; with elastomeric EPDM seals.

B. Copper Tubing: ASTM B88, Type L, rolled grooved ends.

1. Fittings: ASME B16.18 cast copper alloy, or ASME B16.22 wrought copper and bronze, grooved ends.
2. Joints: Grooved mechanical couplings meeting ASTM F1476.

    a. Housing Clamps: ASTM A395/A395M and ASTM A536 ductile iron, enamel coated, compatible with copper tubing sizes, to engage and lock designed to permit some angular deflection, contraction, and expansion.
    b. Gasket: Elastomer composition for operating temperature range to 200 degrees F.
    c. Accessories: Stainless steel bolts, nuts, and washers.

2.3 PIPE JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 CORROSION PROTECTION PIPING ENCASEMENT

A. Encasement for Underground Metal Piping:

1. Standards: ASTM A 674 or AWWA C105.
2. Form: Sheet or tube.
3. Material: LLDPE film of 0.008-inch minimum thickness.
4. Material: LLDPE film of 0.008-inch minimum thickness, or high-density, crosslaminated PE film of 0.004-inch minimum thickness.
5. Material: High-density, crosslaminated PE film of 0.004-inch minimum thickness.
6. Color: Black.

2.5 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.6 WATER METERS

A. Displacement-Type Water Meters:

1. Manufacturers:

a. Badger Meter, Inc.
b. Neptune.
c. Sensus Metering Systems.

2. Description:

a. Standard: AWWA C700, and C710 Standards.
b. Pressure Rating: 150-psig working pressure.
c. Temperature Rating: -40° to + 150° F.
d. Registration: In gallons or cubic feet as required by LAWA.
e. Case: Bronze.
f. End Connections: Threaded.
g. Remote read per AWWA Standard C706.

3. Magnetic drive, type meter with 150 psig bronze body, lined cast iron frost proof body, threaded ends, internal strainer, wheel encoder register and receptacle.

B. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by LAWA.

C. Remote Registration System: Encoder type complying with AWWA C707; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by LAWA.

2.7 UNIONS AND FLANGES

A. Unions for Pipe 2-1/2 inches and Smaller:

1. Ferrous Piping: Class 150, malleable iron, threaded.
2. Copper Piping: Class 150, bronze unions with brazed joints.
3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
2. Copper Piping: Class 150, slip-on bronze flanges.
3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.8 PRESSURE GAGES

A. Manufacturers:

1. Ametek, Inc.
2. Trerice.
3. Weiss.

B. Gage: ASME B40.1, with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.

1. Case: Cast aluminum.
2. Bourdon Tube: Copper plated brass.
3. Dial Size: 6 inch diameter.

2.9 PRESSURE GAGE TAPS

A. Manufacturers:

1. Ametek, Inc.
2. Trerice.
3. Weiss.

2.10 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.

C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.

D. One Piece, Stamped Steel: Chrome-plated finish with setscrew.

E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.

F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge.

G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.11 WALL PENETRATION SYSTEMS

A. Manufacturer:

1. SIGMA.

B. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.

1. Carrier-Pipe Deflection: Up to 5 percent without leakage.
2. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
3. Housing-to-Sleeve Gasket: EPDM rubber.
4. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
5. Pipe Sleeve: AWWA C151, ductile-iron pipe or ASTM A 53/A 53M, Schedule 40, zinc-coated steel pipe.

2.12 STEM TYPE THERMOMETERS

A. Manufacturers:

1. Ashcroft.
2. Trerice.
3. Weiss.

B. Thermometer: ASTM E1, red appearing mercury, lens front tube, cast aluminum case with enamel finish.

1. Size: 6” scale.
2. Window: Clear glass.

3. Stem: Copper plated brass, 3/4 inch NPT, 3-1/2 inch long.
4. Accuracy: ASTM E77. Plus or minus 1 percent to 1.5 max of range.
5. Calibration: Degrees F.

2.13 FLOW CONTROL VALVES

A. Manufacturers:

1. Bell & Gossett.
2. Griswold.
3. Flocon.

B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, combination blow-down or back-flush drain.

C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 5 psi.

2.14 WATER PRESSURE REDUCING VALVES

A. Manufacturers:

1. Zurn-Wilkins.
2. Conbraco.
3. Watts.

B. 2 inches and Smaller: MSS SP 80, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded and single union double union ends.

C. 2 inches and Larger: MSS SP 85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.15 TEST PLUGS

A. Manufacturers:

1. Peterson.
2. Sisco.
3. Watts.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for water service at 20 to 200 deg F shall be CR.
2. Insert material for water service at minus 30 to plus 275 deg F shall be EPDM.

E. Test Kit: Furnish two test kit(s) containing one pressure gage and adaptor, two thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
2. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
3. Carrying case shall have formed instrument padding.

2.16 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers:

a. Watts.
b. Zurn.
c. Conbraco.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.
7. Equal to Watts No. 288A.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers:

a. Watts.
b. Zurn.
c. Conbraco.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.
6. Equal to Watts No. NF8 or No. 8A.

C. Pressure Vacuum Breakers:

1. Manufacturers:

a. Watts.
b. Zurn.
c. Conbraco.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Accessories: Ball type, on inlet and outlet.

D. Spill-Resistant Vacuum Breakers:

1. Manufacturers:

a. Watts.
b. Zurn.
c. Conbraco.

2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.17 RELIEF VALVES

A. Manufacturers:

1. Conbraco.
2. Watts.
3. Zurn-Wilkins.

B. Pressure Relief:

1. ANSI Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

C. Temperature and Pressure Relief:

1. ANSI Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME certified and labeled.

2.18 STRAINERS

A. Manufacturers:

1. Conbraco.
2. Watts.

3. **Zurn-Wilkins.**

B. 2 inch and Smaller: Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

C. 3 inch and Larger: Class 125, flanged iron body, basket pattern with type 304 1/8 inch stainless steel perforated screen.

2.19 HOSE BIBS

A. Manufacturers:

1. **Acorn Mfg.**
2. **MIFAB.**
3. **J.R. Smith.**

B. Rough-Bronze body with integral wall flange, threaded or soldered end, replaceable disc, hose thread spout, with lock shield and removable key integral and non-removable vacuum breaker in conformance with ASSE 1011.

C. Provide rough-chrome or polished chrome finish as required.

2.20 HYDRANTS

A. Manufacturers:

1. **Acorn Mfg.**
2. **MIFAB.**
3. **Zurn.**

B. Wall Hydrant: ASSE 1019; non-freeze, self-draining type with chrome plated, or polished bronze; wall plate lockable recessed box hose thread spout, hand wheel lock shield and removable key, and integral non-removable vacuum breaker.

C. Floor Hydrant: ASSE 1019; chrome plated polished bronze; lockable recessed box, hose thread spout, lock shield and removable key, or non-removable vacuum breaker.

2.21 RECESSED VALVE BOX

A. Manufacturers:

1. **I.P.S. Corp.**
2. **Sioux Chief Mfg.**

B. Washing Machine: Water tight recessed plastic, preformed rough-in box, ½" copper connections with chrome ¼ turn ball valves; integral water hammer arrestors; 2" center drain outlet.

C. Refrigerator: Plastic water-tight recessed plastic, preformed rough-in box, ½" copper connection with chrome ¼ turn ball valve preformed rough-in box with brass valves with wheel handle slip finishing cover.

2.22 BACKFLOW PREVENTERS

A. Manufacturers:

1. **Conbraco Ind.**
2. **Watts.**
3. **Zurn-Wilkins.**

B. Reduced Pressure Principle Backflow Preventers:

1. Comply with ASSE 1013 for continuous pressure operations.
2. Bronze body, with bronze internal parts and stainless steel springs.
3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; integral with two gate valves, strainer, and four test cocks.

C. Double Check Valve Assemblies: Comply with ASSE ASSE 1015 or AWWA C510; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.23 WATER HAMMER ARRESTORS

A. Manufacturers:

1. **MIFAB.**
2. **Watts.**
3. **Zurn-Wilkins**.

B. ASSE 1010; copper construction, bellows or piston type sized in accordance with PDI WH-201.

C. Pre-charged suitable for 35 to 100 degrees temperature range, working pressure.

D. Provide distribution box as required.

2.24 THERMOSTATIC MIXING VALVES

A. Manufacturers:

1. **Watts.**
2. **Zurn**
3. **Simmons Ind.**

B. Master Mixing Valves

1. Bronze body and cap with replaceable corrosion-resistant stainless steel piston and liner.
2. Factory assembly shall include: Check stops, thermometer removable strainers, inlet and outlet ball-type shut-off valves.
3. Provide recessed or surface mounted cabinet, stainless steel or white enamel.
4. Hi-low or standard type valve assembly shall comply with ASSE 1017, U.P.C. and C.S.A. for 125 PSI max. operating pressure, 200 degrees max. inlet temperature, for 5 G.P.M. min. flow.

C. Point-of-Use Mixing Valves

1. For lavatory or sink faucets – 0.5 G.P.M. min. flow capacity.
2. Integral adjustable set-point and in-line check stops.
3. 105 degree maximum outlet temperature.

2.25 PRESSURE BALANCED MIXING VALVES

A. Manufacturers:

1. Symmons Ind.
2. Watts.
3. Zurn.

B. Valve: Chrome plated cast brass body, stainless steel cylinder and integral temperature adjustment.

C. Accessories:

1. Volume control shut-off valve on outlet.
2. Stem thermometer on outlet.
3. Strainer stop checks on inlets.

D. Provide recessed or surface mounted cabinet, stainless steel or white enamel, as required.

2.26 WATER FILTERS

A. In-line cold water filter for up to 1.3 GPM capable of removing dirt/rust, odor and scale.

1. Manufacturer:

a. Everpure.

B. On cold water lines for the following:

1. Coffee makers.
2. Electric water coolers.

3. Refrigerators.
4. Ice makers.

2.27 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.28 TRAP SSEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Manufacturers:

a. PPP Inc. Solo Prime for single traps.
b. PPP Inc. Mini Prime for up to four traps.

2. Standard: ASSE 1044,
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Recessed-mounting steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
6. Vacuum Breaker: ASSE 1001.
7. Size Outlets: NPS 1/2.

PART 3 - EXECUTION

3.1 INSTALLATION - ABOVE GROUND PIPING

A. Install non-conducting dielectric connections wherever jointing dissimilar metals.

3.2 INSTALLATION - SERVICE CONNECTIONS

A. Provide new water service complete with approved reduced pressure double check back-flow preventer and water meter with by-pass valves pressure reducing valve, and strainer as required.

B. Provide sleeve in wall for service main and support at wall with reinforced-concrete bridge. Caulk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

C. Provide 18 gage galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

END OF SECTION 22 11 00

SECTION 22 13 00-FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sanitary sewer piping buried beyond 5 feet of building.
2. Sanitary sewer piping buried within 5 feet of building.
3. Sanitary sewer piping above grade.
4. Chemical resistant sewer piping.
5. Unions and flanges.
6. Floor drains.
7. Floor sinks.
8. Cleanouts.
9. Backwater valves.
10. Sumps.
11. Interceptors.
12. Manholes.
13. Sewage ejectors.
14. Bedding and cover materials.

1.2 REFERENCES

A. General: Comply with appropriate standards.

1. American Society of Mechanical Engineers: ASME.
2. American Society of Testing and Materials: ASTM.
3. Cast Iron Soil Pipe Institute: CISPI.
4. Manufacturers Standardization Society of the Valve and Fittings Industry: MSS.
5. Plumbing and Drainage Institute: PDI.
6. Los Angeles Plumbing Code: LAPC.
7. Los Angeles Department of Building and Safety: LADBS.
8. Los Angeles Public Works: LAPW.

1.3 SUBMITTALS

A. Submit data on all materials, fittings, accessories and equipment.

B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

D. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes for sewage-ejectors, and manholes.

E. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
2. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
3. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

F. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

H. Product Data: For grease interceptor indicated. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

I. Shop Drawings: For each type and size of pre-cast concrete interceptor indicated.

1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.
2. Include calculations for aircraft loading.

J. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Interceptors.
2. Piping connections. Include size, location, and elevation of each.
3. Interface with underground structures and utility services.
4. Coordinate installation with site utility and site paving contractor to prevent interceptor damage.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of equipment and clean-outs.

B. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include, spare parts lists, exploded assembly views for pumps and equipment.

1.5 WARRANTY

A. Furnish one-year minimum warranty.

PART 2 - PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Coordinate with Civil Engineer.

B. Cast Iron Soil Pipe: CISPI, ASTM A888 service weight, hubless.

1. Fittings: Cast iron, ASTM A888 and CISPI – with stainless steel clamp and shield assembly.
2. Joints: CISPI ASTM C564, rubber gasket joint devices.
3. Manufacturers – Heavy Duty Stainless Steel Couplings

    a. Husky SD 4000.
    b. Clamp-All Corp.
    c. Ideal Corp.

4. Manufacturers – Heavy Duty Cast Iron or Ductile Iron Couplings

    a. MG Piping Products.
    b. Victaulic.

C. Ductile-Iron Pipe and Fittings

1. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

    a. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    b. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
2. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

    1) Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    2) Gaskets: AWWA C111, rubber.

3. Flanges: ASME 16.1, Class 125, cast iron.

D. ABS Pipe: Pipe, fittings and joints shall comply with codes and standards in effect at time of installation.

E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.

F. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.

G. Pressure Fittings:

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
4. Cast-Iron Flanges: ASME B16.1, Class 125.
5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

2.2 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Soil Pipe: CISPI, ASTM A888 service weight, hubless.

1. Fittings: Cast iron, ASTM A888 and CISPI – with stainless steel clamp and shield assembly.
2. Joints: CISPI ASTM C564, rubber gasket joint devices.
3. Manufacturers – Heavy Duty Stainless Steel Couplings

   a. Husky SD 4000.
   b. Clamp-All Corp.
   c. Ideal Corp.

4. Manufacturers – Heavy Duty Cast or Ductile Iron Couplings

   a. MG Piping Products.
   b. Victaulic.

B. Ductile-Iron Pipe and Fittings

1. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

   a. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   b. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
2. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

   1) Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   2) Gaskets: AWWA C111, rubber.

3. Flanges: ASME 16.1, Class 125, cast iron.

C. ABS Pipe: Pipe, fittings and joints shall comply with codes and standards in effect at time of installation.

2.3 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI, ASTM A888, hub-less, service weight, hubless.

1. Fittings: Cast iron, CISPI, ASTM A888.
2. Joints: CISPI, ASTM C564, rubber gaskets and stainless steel clamp-and-shield assemblies.

B. Copper Tube: ASTM B306, DWV. Type L.

1. Fittings: ASME B16.23, cast bronze, or ASME B16.29, wrought copper.
2. Joints:

    a. Solder - ASTM B32, Alloy Grade Sb5 tin-antimony.
    b. Press-Fit-ASTM B75; NSF 61; C.S.A., UPC Listed and Approved; 250 Degree F, 200 PSI.

C. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized.

1. Fittings: Cast Iron, ASME B16.1, flanges and fittings or ASME B16.4, threaded fittings.
2. Fittings: Malleable Iron, ASME B16.3, threaded type ASTM A47/A47M.
3. Joints: Threaded for pipe 2 inch and smaller; flanged for pipe 2-1/2 inches and larger.

D. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized, grooved ends.

1. Fittings: ASTM A395/A395M and ASTM A536 ductile iron, or ASTM A234/A234M carbon steel, grooved ends.
2. Joints: Grooved mechanical couplings meeting ASTM F1476.

    a. Housing Clamps: ASTM A395/A395M and ASTM A536 ductile iron, enamel coated hot dipped galvanized, compatible with steel piping sizes, rigid or flexible type.
    b. Gasket: Elastomer composition for operating temperature range from -30 86 degrees F to 230 180 degrees F.
    c. Accessories: Steel Stainless steel bolts, nuts, and washers.

2.4 CHEMICAL RESISTANT SEWER PIPING

A. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron, CISPI 301.
2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

B. ABS Pipe: ASTM D2751 or ASTM F628, Acrylonitrile-Butadiene-Styrene (ABS) material.

1. Fittings: ABS, ASTM D2751.
2. Joints: ASTM D2235, solvent weld.

C. PVC Pipe: ASTM D2729 or ASTM D2665, polyvinyl chloride (PVC) material.

1. Fittings: PVC, ASTM D2729 or ASTM D2665.
2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

D. Glass Pipe: ASTM C1053, borosilicate glass material.

1. Fittings: ASTM C1053, borosilicate glass.
2. Joints: Stainless steel compression couplings with tetra-fluoroethylene seal ring.

E. PP PPFR Pipe: Polypropylene, flame retardant.

1. Fittings: Polypropylene.
2. Joints: Electrical resistance fusion.

2.5 SPECIAL PIPE FITTINGS

A. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

a. EBAA Iron Sales, Inc.
b. Romac Industries, Inc.
c. Star Pipe Products; Star Fittings Div.

B. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

a. SIGMA Corp.

2.6 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Description: ASTM A 674 or AWWA C105, LLDPE film of 0.008-inch minimum thickness.

B. Form: tube.

C. Color: Black.

2.7 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

1. Copper Piping: Class 150, bronze unions with soldered brazed joints.
2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Copper Piping: Class 150, slip-on bronze flanges.
2. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.8 FLOOR DRAINS

A. Manufacturers:

1. J.R. Smith.
2. Zurn.
3. MiFAB.

B. Floor Drain: Shall be ductile, cast or grey iron body with double drainage flange, weep holes, anchor flange, round or square, adjustable nickel-bronze strainer, trap primer inlet, white acid resistant interior-size as required.

C. Provide heavy-duty traffic weight grate, sediment bucket, or stainless steel type where required.

D. Furnish materials in accordance with Sate of California Codes and City of Los Angeles Department of Building and Safety Standards.

E. Cast-Iron Floor Drains:

1. Manufacturers:

a. J.R.Smith.
b. MIFAB, Inc.
c. Zurn.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Outlet: Bottom.
6. Backwater Valve: Integral, ASME A112.14.1, swing-check type.
7. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
8. Top or Strainer Material: Nickel bronze.
9. Top of Body and Strainer Finish: Nickel bronze.
10. Top Shape: Round.
11. Top Loading Classification: Heavy Duty.
12. Trap Material: Cast iron.
13. Trap Pattern: Deep-seal P-trap.
14. Trap Features: Trap-seal primer valve drain connection.

F. General:

1. In accordance with ANSI A112.21.1 and where required for the following construction types. For built up membrane, provide a flashing clamp. For liquid membrane, provide a four inch wide flange. For elastomeric type floor, provide a four inch wide top flange at required height. Provide strainers with a nickel bronze finish except as noted.
2. Provide a coated cast iron body, except as noted, with integral double drainage flange and weep holes, inside caulked outlet or hub outlet for compression gasket connection, or hubless outlet except as noted.
3. Type, General, Shown Round: An adjustable extension neck and 6-inch diameter cast strainer, flashing clamp for membrane, equal to MIFAB 1100C, Smith No. 2010-A or Zurn ZN-415-6B. Floor drains with back water valves, equal to MIFAB 1100C-B, Smith No. 2010-AV or Zurn ZN415-6B-V. 6-inch x 6-inch strainers in kitchens equal to Smith No. 2010-B or Zurn ZN-415-6S, MIFAB F1100C-X.
4. Type, Showers: 6-inch diameter strainers for 3-inch outlet size and five-inch diameter strainers for 2-inch outlet size.
5. Type, In machinery rooms and unfinished areas shown round, adjustable cast iron extension neck and tractor type top grate, equal to MIFAB F1320C, Smith No. 2320 or Zurn Z520.
6. Type, In machinery rooms and unfinished areas shown square, adjustable cast iron extension neck and maximum diameter bottom bar strainer on short legs, equal to MIFAB F1320C, Smith No. 2320 or Zurn Z520 for 3-inch outlet and MIFAB 1340, Smith 2340 for 4 inch and 6-inch outlet modified without top grate.
7. Type, Shown square in kitchens and where noted. As noted above for floor drains in kitchens shown round or square, plus funnel where required.

    a. For drains receiving single indirect waste, provide strainer with matching 4-inch diameter x 3-1/4 inch high secured funnel, equal to MIFAB F4, Smith No. 3580 or Zurn Z-328-4.
    b. For drains receiving multiple indirect wastes, provide with matching 83 inch x 33 inch x 3 inch high secured funnel, equal to MIFAB G, Smith No. 3591 or Zurn Z-329-9.
    c. Where indirect waste is too low for standard funnel, provide strainer with matching 6 inch x 2½ inch x 1 inch high secured funnel, equal to MIFAB-J, Smith No. 3590 or Zurn-Z329-7.

8. Type, Vegetable Peeler Drain: An adjustable cast iron extension neck and deep removable bucket, equal to MIFAB F1340-14-5, Smith No. 2360 or Zurn Z526-Y.
9. Type, Can Wash Area: An adjustable cast iron extension neck and deep removable bucket, equal to MIFAB F1480-5, Smith No. 2630 (less top grate) or Zurn Z566-6T-Y-L6.
10. Type, Pit Wall Drain: Side outlet body and brass flap type backwater valve and bronze wall grate, equal to MIFAB BV1210, Smith No. 7000 or Zurn Z-629.
11. Type, Walk in Areaway Drain: Bottom outlet and flat strainer, equal to MIFAB F1320-Y-14, Smith No. 2110 or Zurn Z550 and with side outlet and flat strainer, equal to MIFAB F-1320C-90-Y-14, Smith No. 2115 or Zurn Z550-90.
12. Type, For Other Areaways: Bottom outlet and dome strainer, equal to MIFAB F1320C-Y-14-18, Smith No. 2110 D or Zurn 2550-D and with side outlet and dome strainer, equal to MIFAB F1320C-Y-14-18, Smith No. 2115-D or Zurn Z550-D-90.

13. Type, for Elastomeric Type Floors: Four-inch wide top flange at required depth. Shown round provide drain equal to MIFAB F1320-Y-14-5-2, Smith No. DX 2565 or Zurn Z-531 less bucket. Shown square Type , provide with maximum diameter bottom bar strainer, MIFAB F1340-Y-2-5-14, equal to Smith No. DX-2566 or Zurn Z532-LG modified without top grate.
14. Type, Flushing Rim Floor Drain: Acid resistant porcelain enamel inside and flushing connection and brass flushing rim top with.

2.9 FLOOR SINKS

A. Manufacturers:

1. J.R. Smith.
2. Zurn.
3. MiFAB.

B. Floor Sink: Shall be ductile, cast or grey iron body with double drainage flange, weep holes, anchor flange, round or square, or ½ or ¾ nichel-bronze grate, trap primer inlet, white acid resistant enamel interior-size as required.

C. Provide heavy-duty traffic weight grate, sediment bucket, or stainless steel type where required.

D. Cast-Iron Floor Sinks Except as Noted:

1. Manufacturers:

a. J.R. Smith.
b. MIFAB, Inc.
c. Zurn

2. Standard: ASME A112.6.3.
3. Pattern: Indirect waste receptors.
4. Body Material: Gray iron.
5. Outlet: Bottom.
6. Backwater Valve: Integral, ASME A112.14.1, swing-check type.
7. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
8. Top or Strainer Material: Cast iron.
9. Top of Body and Strainer Finish: Cast iron.
10. Top Shape: Round, square.
11. Top Loading Classification: Heavy Duty.
12. Trap Material: Cast iron.
13. Trap Pattern: P-trap.
14. Trap Features: Trap-seal primer valve drain connection.

E. General:

1. In accordance with ANSI A112.21.1 and where required for the following construction types. For built up membrane, provide a flashing clamp. For liquid membrane, provide a

four inch wide flange. For elastomeric type floor, provide a four inch wide top flange at required height. Provide strainers with a nickel bronze finish except as noted.

2. Provide a coated cast iron body, except as noted, with integral double drainage flange and weep holes, inside caulked outlet or hub outlet for compression gasket connection, or hubless outlet except as noted.
3. Type FS-1, General, Shown Square: An adjustable extension neck and 6-inch diameter cast strainer, flashing clamp for membrane, adjustable cast iron extension neck and tractor type top grate, equal to MIFAB FS-1730-FL-150, Smith No. 3150-Y-C-12 or Zurn Z520,
4. Type FS-2, In plumbing chases shown round, adjustable cast iron extension neck, bottom dome strainer, equal to MIFAB FS-1750-FL or Smith No. 3040-Y.

    a. For floor sinks receiving indirect waste, provide ½ grate strainer and frame.
    b. For round floor sinks, provide full round strainer and grate.

2.10 CLEANOUTS

A. Manufacturers:

1. J.R. Smith.
2. Zurn.
3. MiFAB.

B. Exterior Surfaced Areas: Round or Square lacquered cast iron body with anchor flange, neoprene gasket, adjustable access cover and plug top assembly.

C. Exterior Unsurfaced Areas: Line type with lacquered cast iron body and round epoxy coated cover with gasket.

D. Interior Finished Floor Areas: Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round scored cover with gasket in service areas and round square depressed cover with gasket to accept floor finish in finished floor areas.

E. Interior Finished Wall Areas: Cast bronze or cast iron body raised head plug, gasket, round or square stainless steel access cover secured with machine screw.

F. Interior Unfinished Accessible Areas: Threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.11 BACK WATER VALVES

A. Manufacturers:

1. J.R. Smith.
2. Zurn.
3. MiFAB.

B. Cast Iron: ASME A112.14.1; cast iron body and cover, removable bronze swing valve, extension sleeve as required, Bolted access cover, horizontal or vertical type, threaded or hubless ends.

2.12 SUMPS

A. Manufacturers:

1. **Pro-Cast Inc.**
2. **Jensen.**
3. **Zoeller.**

B. Water-tight, factory fabricated; reinforced fiberglass or concrete; sleeved inlet, outlet and vent openings. Provide sidewall openings for pipe and vent connections.

C. Cover shall have integral seals, gaskets and bushings, sized for sump access.

D. Exterior locations shall have hinged and lockable traffic weight covers.

E. Furnish materials in accordance with Sate of California Codes and City of Los Angeles Department of Building and Safety Standards.

2.13 GREASE INTERCEPTORS

A. Manufacturers:

1. **Pro-Cast Inc.**
2. **Jensen Precast.**
3. **Pro-Ceptor.**

B. Furnish materials in accordance with Sate of California Codes and City of Los Angeles Department of Building and Safety Standards.

C. Comply with LAC – industrial waste division requirements.

D. Construction:

1. Material: Per equipment schedule and details.
2. Rough in: Below grade.

E. Accessories: Integral baffle, deep seal trap, sample box.

F. Cover: Heavy duty steel with gasket, liquid tight, bolt-down frame.

2.14 OIL INTERCEPTORS

A. Manufacturers:

1. **Zurn.**
2. **Pro-Cast Inc.**
3. **Jensen Precast.**

B. Construction:

1. Material: Epoxy coated fabricated steel, or pre-cast concrete.
2. Rough in: Flush with floor (suspended) installation with anchor flange.

C. Accessories: Integral deep seal trap, removable, adjustable draw-off assembly, sediment bucket.

D. Cover: Steel, epoxy coated, non-skid with gasket, securing handle.

E. Cover shall have integral seals, gaskets and bushings, sized for sump access.

F. Exterior locations shall have hinged and lockable traffic weight covers.

2.15 SEDIMENT INTERCEPTORS

A. Manufacturers:

1. **Zurn.**
2. **Pro-Cast Inc.**
3. **Jensen Precast.**

B. Construction:

1. Material: Epoxy coated fabricated steel, or pre-cast concrete.
2. Rough in: Flush with floor (suspended) installation with anchor flange.

C. Accessories: Integral deep seal trap, removable, adjustable draw-off assembly, sediment bucket.

D. Cover: Steel, epoxy coated, non-skid with gasket, securing handle.

E. Cover shall have integral seals, gaskets and bushings, sized for sump access.

F. Exterior locations shall have hinged and lockable traffic weight covers.

2.16 MANHOLES

A. Coordinate with Civil Engineer.

2.17 PRECAST CONCRETE MANHOLE RISERS

A. Extra-Heavy Duty Precast Concrete Manhole Risers: ASTM C 478, with rubber-gasket joints.

1. Structural Design Loads:

    a. Extra-Heavy Duty -Traffic Load.

2. Length: From top of underground concrete structure to grade.
3. Riser Sections: 3-inch minimum thickness and 36-inch diameter.
4. Top Section: Eccentric cone, unless otherwise indicated. Include top of cone to match grade ring size.
5. Gaskets: ASTM C 443, rubber.

B. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.

C. Extra-Heavy Duty Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange and 26-inch- diameter cover.

1. Ductile Iron: ASTM A 536-80, Grade 100-70-03, or stronger, rated at 100,000 pounds.
2. Include indented top design with lettering cast into cover, using wording equivalent to the following:

    a. Grease Interceptors in Sanitary Sewerage System: "GREASE INTERCEPTOR."

2.18 SEWAGE EJECTORS

A. Manufacturers:

1. Weil Aquatronics.
2. Paco.
3. Zoeller.

B. Type: Vertical centrifugal, direct connected, simplex duplex arrangement.

C. Casing: Cast iron volute with radial clearance around impeller, slide away couplings.

D. Impeller: Cast iron; open non-clog, keyed and secured to stainless steel shaft.

E. Support: Cast iron pedestal motor support on steel floor plate with gas tight gaskets.

F. Bearings: Oil lubricated bronze sleeve spaced maximum 48 inches and grease lubricated ball thrust at floor plate.

G. Drive: Flexible coupling to vertical, solid shaft ball bearing electric motor.

H. Sump: Steel cover plate with steel curb frame for grouting sump with inspection opening and cover, and alarm fittings.

I. Controls (Duplex): Float operated mechanical alternator with float rod, stops, and corrosion resistant float to alternate operation of pumps. Cut-in second pump on rising level or lead pump failure. Furnish separate pressure switch high level alarm with transformer, alarm bell, and standpipe, and extra set of wired terminals for remote alarm circuit and emergency float

switch with float rod, stops, and corrosion resistant float to operate both pumps on failure of alternator. Provide NEMA 250, Type 1 enclosure.

2.19 SUBMERSIBLE SEWAGE EJECTORS

A. Manufacturers:

1. **Weil Aquatronics.**
2. **Paco.**
3. **Zoeller.**

B. Type: Completely submersible, vertical, centrifugal.

C. Casing: Cast iron pump body and oil filled motor chamber.

D. Impeller: Cast iron; open non-clog, stainless steel shaft.

E. Bearings: Ball bearings.

F. Sump: Fiberglass, steel or concrete with steel cover plate.

G. Accessories: Oil resistant cord and plug, with three-prong connector, for connection to electric wiring system including grounding connector.

H. Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks.

I. Controls: Integral level controls, with separate high level alarm.

J. Controls: Motor control panel containing across-the-line electric motor starters with ambient compensated quick trip overloads in each phase with manual trip button and reset button, circuit breaker, control transformer, electro-mechanical alternator, hand-off-automatic selector switches, pilot lights, high water alarm pilot light, reset button and alarm horn. Furnish mercury switch liquid level controls, steel shell switch encased in polyurethane foam with cast iron weight for pump on (each pump), pump off (common), and alarm. Provide NEMA 250, Type 1 enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. Field verify that connection to existing piping systems sizes, locations, and invert are as required.

F. Establish elevations of buried piping with not less than allowed per code.

G. Establish minimum separation of from other piping services in accordance with code.

3.2 PIPING APPLICATION

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
2. Steel pipe, drainage fittings, and threaded joints.
3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
4. Copper DWV tube, copper drainage fittings, and soldered joints.
5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. Aboveground, soil and waste piping NPS 5 and larger shall be the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
2. Steel pipe, drainage fittings, and threaded joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

D. Aboveground, vent piping NPS 4 and smaller shall be the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
2. Steel pipe, drainage fittings, and threaded joints.
3. Stainless-steel pipe and fittings gaskets, and gasketed joints.
4. Copper DWV tube, copper drainage fittings, and soldered joints.

    a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.

5. Galvanized steel piping for horizontal offsets of vent headers.

E. Aboveground, vent piping NPS 5 and larger shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Steel pipe, drainage fittings, and threaded joints.
3. Galvanized steel piping for horizontal offsets of vent headers.

4. Stainless steel pipe and fittings gaskets, and gasketed joints

F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:

1. Extra-Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, cast-iron couplings; and hubless-coupling joints.
3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.

G. Underground, soil and waste piping NPS 5 and larger shall be the following:

1. Extra-Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, cast-iron couplings; and hubless-coupling joints.

H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be the following:

1. Galvanized schedule 40 Steel pipe, pressure fittings, and threaded joints.

I. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 shall be the following:

1. Galvanized schedule 40 Steel pipe, pressure fittings, and threaded joints.

J. Underground sanitary-sewage force mains NPS 4 and smaller shall be the following:

1. Galvanized schedule 40 Steel pipe, pressure fittings, and threaded joints.

K. Above ground condensate shall be the following:

1. Hard copper ASTM B 88 with pressure fittings or DWV copper ASTM B 306 with drainage fittings.

3.3 PIPING INSTALLATION

A. Sanitary sewer piping five feet outside the building is specified in Civil Engineers Section."

B. Provide basic piping installation as required.

C. Install seismic restraints on piping.

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

F. Install underground, steel, force-main piping. Install encasement on piping according to ASTM A 674 or AWWA C105.

G. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside the building between wall and floor penetrations and connection to

sanitary sewer piping outside the building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

H. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Provide sleeves and mechanical sleeve seals as required.

I. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

J. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 6 and smaller.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow NPS 2 (DN80) and smaller at 1/4 inch per foot minimum.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

O. Hubless piping shall be installed in a rigid, linear, and plumb system without any deflection at the joints either horizontally or vertically. The system shall be supported and secured to the building structure to prevent movement induced by a ten-foot head of water and its associated thrust forces.

1. When horizontal hubless CI piping is suspended in excess of 18 inch by means of non-rigid hangers, provide sway bracing to prevent horizontal movement.
2. For all horizontal hubless CI piping 5-inch and larger, provide sway bracing to prevent horizontal movement at every branch opening and change of direction by securing to building structure, or provide pipe clamps and rodding across coupling.

P. Exterior exposed vent terminations to be stainless steel at through exterior wall penetrations.

3.4 HANGER & SUPPORT INSTALLATION

A. Pipe hangers and supports - Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports as required.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 10 feet, 0 inches with 3/8-inch rod.
2. NPS 3: 10 feet, 0 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 10 feet, 0 inches with 5/8-inch rod.
4. NPS 6: 10 feet, 0 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 10 feet, 0 inches with 7/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2: 84 inches with 3/8-inch rod.
2. NPS 3: 96 inches with 1/2-inch rod.
3. NPS 4: 108 inches with 1/2-inch rod.
4. NPS 6: 10 feet with 5/8-inch rod.

J. Install supports for vertical stainless-steel piping every 10 feet.

K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

L. Install supports for vertical copper tubing every 10 feet.

M. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 SANITARY PIPING INSTALLATION

A. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

I. Install through-penetration firestop assemblies in plastic at floor penetrations.

J. Assemble open drain fittings and install with top of hub 2 inches above floor.

K. Install deep-seal traps on floor drains and other waste outlets, if indicated.

L. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

M. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

N. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

O. Install vent caps on each vent pipe passing through roof.

P. Do not install vent caps at wall penetrations.

Q. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

R. Install grease interceptors, including trapping, venting, and sampling box, according to authorities having jurisdiction and with clear space for servicing.

S. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

T. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

U. Install electric self regulating temperature maintenance cable on all grease waste piping as required.

3.6 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings as required.

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.7 SANITARY INTERCEPTORS INSTALLATION

A. Install interceptor inlets and outlets at elevations indicated.

B. Place concrete for cast-in-place interceptors according to ACI 318/318R and ACI 350R.

C. Install precast concrete interceptors according to ASTM C 891. Set level and plumb.

D. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.

E. Set tops of manhole frames and covers coordinated with site paving contractor and LAWA requirements.

F. Clean and prepare concrete surfaces to be field painted. Remove loose efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen surface as required to remove glaze. Paint the following concrete surfaces as recommended by paint manufacturer:

1. Precast Concrete Interceptors: All exterior and interior.

3.8 SEWERAGE PUMPS INSTALLATION

A. Provide excavating, trenching, and backfilling as required.

B. Install sewage pumps according to applicable requirements in HI 1.4.

C. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.

D. Set submersible sewage pumps on basin floors. Make direct connections to sanitary drainage piping.

1. Anchor guide-rail supports to basin bottoms and sidewalls or covers. Install pumps so pump and discharge pipe disconnecting flanges make positive seals when pumps are lowered into place.

E. Install sewage pump basins and connect to drainage and vent piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top flange. Install cover so top surface is flush with finished floor.

F. Construct sewage pump pits and connect to drainage and vent piping. Set pit curb frame recessed in and anchored to concrete. Fasten pit cover to pit curb flange. Install cover so top surface is flush with finished floor.

G. Install packaged, submersible sewage pump units and make direct connections to drainage and vent piping.

H. Install packaged, wastewater pump unit basins on floor or concrete base unless recessed installation is indicated. Make direct connections to drainage and vent piping.

I. Support piping so weight of piping is not supported by pumps.

END OF SECTION 22 13 00

SECTION 22 14 00-FACILITY STORM DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Storm water piping buried beyond 5 feet of building.
2. Storm water piping buried within 5 feet of building.
3. Storm water piping above grade.
4. Unions and flanges.
5. Roof drains.
6. Parapet drains.
7. Canopy and cornice drains.
8. Special purpose downspout covers.
9. Downspout nozzles.
10. Area drains.
11. Exterior planter drains.
12. Cleanouts.
13. Sumps.
14. Interceptors.
15. Catch basins.
16. Manholes.
17. Sump pumps.
18. Bedding and cover materials.

1.2 REFERENCES

A. General: Comply with Appropriate Standards.

1. American Society of Mechanical Engineers: ASME.
2. American Society or Testing and Materials: ASTM.
3. Cast Iron Soil Pipe Institute: CISPI.
4. Manufacturers Standardization Society of the Valve and Fittings Industry: MSS.
5. Plumbing and Drainage Institute: PDI.
6. Los Angeles Plumbing Code: LAPC.
7. Los Angeles Department of Building and Safety: LADBS.
8. Los Angeles Department of Public Works: LADPW.
9. Standard Urban Stormwater Mitigation Plan: SUSMP.

1.3 SUBMITTALS

A. Submit data on all materials, fittings, accessories and equipment.

B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

D. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes for sump pumps, and manholes.

E. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes for sump-pumps, catch basins and manholes.

F. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
2. Storm Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
3. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

G. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

H. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 WARRANTY

A. Furnish one-year minimum warranty.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of equipment and clean-outs.

B. Operation and Maintenance Data: Submit spare parts lists, exploded assembly views for pumps and equipment.

PART 2 - PRODUCTS

2.1 STORM WATER PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Coordinate with Civil Engineer.

B. Cast Iron Soil Pipe: CISPI, ASTM A888 service weight, hubless.

1. Fittings: Cast iron, ASTM A888 and CISPI – with stainless steel clamp and shield assembly.

2. Joints: CISPI ASTM C564, rubber gasket joint devices.
3. Manufacturers – Heavy Duty Stainless Steel Couplings

    a. Husky SD 4000.
    b. Clamp-All Corp.
    c. Ideal Corp.

4. Manufacturers – Heavy Duty Cast Iron or Ductile Iron Couplings

    a. MG Piping Products.
    b. Victaulic.

C. Ductile-Iron Pipe and Fittings

1. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

    a. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    b. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
2. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

    1) Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    2) Gaskets: AWWA C111, rubber.

3. Flanges: ASME 16.1, Class 125, cast iron.

D. ABS Pipe: Pipe, fittings and joints shall comply with codes and standards in effect at time of installation.

2.2 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Soil Pipe: CISPI, ASTM A888 service weight, hubless.

1. Fittings: Cast iron, ASTM A888 and CISPI – with stainless steel clamp and shield assembly.
2. Joints: CISPI ASTM C564, rubber gasket joint devices.
3. Manufacturers – Heavy Duty Stainless Steel Couplings

    a. Husky SD 4000.
    b. Clamp-All Corp.
    c. Ideal Corp.

4. Manufacturers – Heavy Duty Cast Iron or Ductile Iron Couplings

    a. MG Piping Products.
    b. Victaulic.

B. Ductile-Iron Pipe and Fittings

1. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

    a. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    b. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
2. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

    1) Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    2) Gaskets: AWWA C111, rubber.

3. Flanges: ASME 16.1, Class 125, cast iron.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.

B. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.

C. Pressure Fittings:

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
4. Cast-Iron Flanges: ASME B16.1, Class 125.
5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

D. Grooved-Joint Systems:

1. Manufacturers:

    a. Anvil International.
    b. Star Pipe Products; Star Fittings Div.
    c. Victaulic Co. of America.
    d. Ward Manufacturing, Inc.

2. Grooved-End, Steel-Piping Fittings: ASTM A 47/A 47M, galvanized, malleable-iron casting; ASTM A 106, galvanized-steel pipe; or ASTM A 536, galvanized, ductile-iron casting; with dimensions matching steel pipe.
3. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

2.4 SPECIAL PIPE FITTINGS

A. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. ANACO.

B. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser, Inc.; DMD Div.
c. EBAA Iron Sales, Inc.

2. Center-Sleeve Material: Ductile iron or malleable iron.
3. Gasket Material: Natural or synthetic rubber.
4. Metal Component Finish: Corrosion-resistant coating or material.

C. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.

1. Manufacturers:

a. EBAA Iron Sales, Inc.

D. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

a. SIGMA Corp.

2.5 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch or LLDPE film of 0.008-inch minimum thickness.

B. Form: Sheet or tube.

C. Color: Black.

2.6 STORM WATER PIPING, ABOVE GRADE

A. Cast Iron Pipe CISPI: ASTM A888, service weight, hubless.

1. Fittings: Cast iron, ASTM A888.
2. Joints: ASTM C564, rubber gasket and stainless steel clamp and shield assemblies.
3. Unions for Pipe 2 inches and Smaller:

    a. Copper Piping: Class 150, bronze unions with soldered brazed joints.
    b. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

4. Flanges for Pipe 2-1/2 inches and Larger:

    a. Copper Piping: Class 150, slip-on bronze flanges.
    b. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.7 ROOF DRAINS

A. Manufacturers:

1. J.R. Smith.
2. Zurn.
3. MiFAB.

B. Roof Drain (RD-1):

1. Assembly: ASME A112.21.2M.
2. Body: Lacquered stainless steel with sump.
3. Strainer: Removable cast iron dome with vandal proof screws.
4. Accessories: Coordinate with roofing type as required.

    a. Membrane flange and membrane clamp with integral gravel stop.
    b. Adjustable under deck clamp.
    c. Roof sump receiver.
    d. Waterproofing flange.
    e. Leveling frame.
    f. Adjustable extension sleeve for roof insulation.
    g. Perforated or slotted ballast guard extension for inverted roof.
    h. Perforated stainless steel ballast guard extension.

C. Roof Drain (RD-2): Overflow type.

1. Same as RD-1, with 2” min. height water dam.

2.8 PARAPET DRAINS

A. Manufacturers:

1. **J.R. Smith.**
2. **Zurn.**
3. **MiFAB.**

B. Lacquered cast iron body with flashing clamp collar and nickel bronze grate.

2.9 CANOPY AND CORNICE DRAINS

A. Manufacturers:

1. **J.R. Smith.**
2. **Zurn.**
3. **MiFAB.**

B. Lacquered cast iron body with flashing clamp collar and nickel bronze flat strainer.

2.10 SPECIAL PURPOSE DOWNSPOUT COVER

A. Manufacturers:

1. **J.R. Smith.**
2. **Zurn.**
3. **MiFAB.**

B. Product Description: Brass or Stainless steel with stainless steel mesh liner, vandal proof lock nut, and pipe clamp.

2.11 DOWNSPOUT NOZZLES

A. Manufacturers:
1. **J.R. Smith.**
2. **Zurn.**
3. **MiFAB.**

B. Product Description: Nickel or Polished bronze body and round wall flange with straight bottom section and screened outlet.

2.12 AREA DRAINS

A. Manufacturers:

1. **J.R. Smith.**
2. **Zurn.**
3. **MiFAB.**

B. Area Drain (AD-1): Lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

C. Area Drain (Trench Drain) (AD-2): Lacquered cast iron ductile iron or stainless steel; with drainage flange, heavy duty grate 6 inches 12 inches wide, 12 inches 24 inches long, dome strainer, end plates with gaskets; end, middle or bottom outlet.

2.13 EXTERIOR PLANTER DRAINS

A. Manufacturers:

1. **J.R. Smith.**
2. **Zurn.**
3. **MiFAB.**

B. Furnish materials in accordance with State of California Codes City of Los Angeles and City of Los Angeles Department of Building and Safety Standards.

C. Lacquered cast iron body with sump.

D. Strainer: Removable polyethylene dome with stainless steel screen.

E. Accessories: Membrane flange and membrane clamp with integral gravel stops.

2.14 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected piping.

B. Downspout Boots:

1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout.
3. Description: ASTM A 74, Service class, hub-and-spigot, cast-iron soil pipe.
4. Size: Same as or larger than connected downspout.

C. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

D. Overflow Outlet:

1. Stainless steel type 304 with hinged perforated cover similar to J.R. Smith 1775, vandal proof, same size as connected downspout.

2.15 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft. thickness.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.16 CLEANOUTS

A. Exterior Surfaced Areas (CO-1): Round or square cast nickel bronze access frame and non-skid cover.

B. Exterior Unsurfaced Areas (CO-2): Line type with lacquered cast iron body and round epoxy coated cover with gasket.

C. Interior Finished Floor Areas (CO-3): Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round scored cover with gasket in service areas and round square depressed cover with gasket to accept floor finish in finished floor areas.

D. Interior Finished Wall Areas (CO-4): Line type with lacquered cast iron body and round epoxy coated cover with gasket, and round stainless steel access cover secured with machine screw.

E. Interior Unfinished Accessible Areas (CO-5): Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.17 SUMPS

A. Manufacturers:

1. **Pro-Cast Inc.**
2. **Jensen.**
3. **Zoeller.**

B. Water-tight, factory fabricated; reinforced fiberglass or concrete; sleeved inlet, outlet and vent openings, and any other sidewall openings for pipe connections.

C. Cover shall be cast iron, airtight and have integral seals, gaskets and bushings, sized for sump access.

D. Exterior locations shall have hinged and lockable traffic weight covers.

2.18 SEDIMENT INTERCEPTORS

A. Manufacturers:

1. **J.R. Smith.**
2. **Zurn.**

B. Sediment Interceptor: Epoxy coated cast iron, Stainless steel or Precast concrete body and secured cover with removable stainless steel sediment bucket.

2.19 SUMP PUMPS

A. Manufacturers:

1. **Weil Aquatronics.**
2. **Paco.**
3. **Zoeller.**

B. Pump Type: Vertical centrifugal, direct connected, simplex duplex arrangement.

C. Casing: Cast iron volute with radial clearance around impeller, inlet strainer, slide away couplings.

D. Impeller: Cast iron; open non-clog, keyed to stainless steel shaft.

E. Support: Cast iron pedestal motor support on steel floor plate with gas tight gaskets.

F. Bearings: Oil lubricated bronze sleeve spaced maximum 48 inches and grease lubricated ball thrust at floor plate.

G. Drive: Flexible coupling to vertical, solid shaft ball bearing electric motor.

H. Sump: Steel cover plate with steel curb frame for grouting into sump with inspection opening and cover, and alarm fittings.

I. Controls (Duplex): Float operated mechanical alternator with float rod, stops, and corrosion resistant float to alternate operation of pumps. Cut-in second pump on rising level or lead pump failure. Furnish separate pressure switch high level alarm with transformer, alarm bell, and standpipe, and extra set of wired terminals for remote alarm circuit and emergency float switch with float rod, stops, and corrosion resistant float to operate both pumps on failure of alternator. Provide NEMA 250, Type 1 enclosure.

2.20 SUBMERSIBLE SUMP PUMPS

A. Manufacturers:

1. **Weil Aquatronics.**
2. **Paco.**
3. **Zoeller.**

B. Pump Type: Completely submersible, vertical, centrifugal.

C. Casing: Cast iron pump body and oil filled motor chamber.

D. Impeller: Cast iron; closed, stainless steel.

E. Bearings: Ball bearings.

F. Sump: Fiberglass steel or concrete, basin with steel cover plate.

G. Accessories: Oil resistant cord and plug with three-prong connector for connection to electric wiring system including grounding connector.

H. Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks.

I. Integral level controls with separate level alarm.

J. Controls: Motor control panel containing across-the-line electric motor starters with ambient compensated quick trip overloads in each phase with manual trip button and reset button, circuit breaker, control transformer, electro-mechanical alternator, hand-off-automatic selector switches, pilot lights, high water alarm pilot light, reset button and alarm horn. Furnish mercury switch liquid level controls, steel shell switch encased in polyurethane foam with cast iron weight for pump on (each pump), pump off (common), and alarm. Provide NEMA 250, Type 1 enclosure.

2.21 BUILDING AUTOMATION SYSTEM INTERFACE

A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:

1. On-off status of each pump.
2. Alarm status.
3. Pump failure.

2.22 ALARM PANEL

A. Remote-mounted alarm panel, shall consist of a single NEMA 1 enclosure complete with 3 indicating lights, reset buttons, alarm horn or bell and silencing switch. Lights shall be normally dim-glow and shall change to full-glow and sound the alarm under any of the following conditions:

1. Power failure to the pump control panel.
2. High water condition.
3. Simultaneous two pump operation.
4. Failure of either pump.

B. Coordinate location and wiring of alarm panel with electrical contractor

C. Wiring diagrams:

1. Furnish and turn over to LAWA, complete wiring diagrams showing full details of the factory wiring.

2.23 CONTROL PANEL

A. Combination unfused disconnect switch and across-the-line magnetic starter with overload protection for each phase leg, for each pump.

1. Undervoltage protection.
2. 120 volt control circuit transformer, fused on primary, and grounded on secondary, with automatic transfer between each pump's incoming supply in the event of failure or shutdown of power supply to any pump. Connections to pump incoming supplies shall be made downstream of controller disconnect devices.
3. Momentary contact push buttons marked MANUAL, for bypassing automatic control when held in (JOGGING).
4. Automatic electric alternator (four lead units).
5. Moisture sensing audible and visual alarm.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. Field verify that connection to existing piping systems sizes, locations, and invert are as required.

F. Establish elevations of buried piping with not less than allowed per code.

G. Establish minimum separation of from other piping services in accordance with code.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 and smaller shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.
3. Galvanized steel pipe, drainage fittings, and threaded joints.
4. Grooved end galvanized malleable iron fittings and bolted clamp type malleable iron couplings with rubber sealing gaskets for grooved end pipe equal to Victaulic Style 75 or 77.
5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. Aboveground, storm drainage piping NPS 8 and larger shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.
3. Steel pipe, drainage fittings, and threaded joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

D. Underground storm drainage piping NPS 6 and smaller shall be the following:

1. Extra-heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.
3. Galvanized steel pipe, drainage fittings, and threaded joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

E. Underground, storm drainage piping NPS 8 and larger shall be the following:

1. Extra-Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel and heavy-duty shielded, cast-iron couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

F. Aboveground storm drainage force mains NPS 2-1/2 to NPS 6 shall be the following:

1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
2. Galvanized steel pipe, pressure fittings, and threaded joints.
3. Grooved-end galvanized steel pipe, grooved-joint system fittings and couplings, and grooved joints.

G. Underground storm drainage force mains NPS 4 and smaller shall be the following:

1. Galvanized steel pipe, pressure fittings, and threaded joints.

    a. Include grooved-joint system fittings and couplings and grooved joints where indicated.

2. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile-iron fittings; glands, gaskets, and bolts; and mechanical joints.

    a. Include grooved-joint system fittings and couplings and grooved joints where indicated.

3. Pressure pipe couplings if dissimilar pipe materials or piping with small difference in OD must be joined.

3.3 PIPING INSTALLATION

A. Install seismic restraints on piping as required

B. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers as required.

C. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

D. Install underground, steel, force-main piping. Install encasement on piping according to ASTM A 674 or AWWA C105.

E. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

    1. Install encasement on piping according to ASTM A 674 or AWWA C105.

F. Install underground, ductile-iron, special pipe fittings according to AWWA C600.

    1. Install encasement on piping according to ASTM A 674 or AWWA C105.

G. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.

H. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.

I. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

    1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

J. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for all piping.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

M. Install force mains at elevations indicated.

N. Install engineered controlled-flow storm drainage piping in locations indicated.

O. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. Hubless piping shall be installed in a rigid, linear and plumb system without any deflection at the joints either horizontally or vertically. The system shall be supported and secured to the building structure to prevent movement induced by a ten-foot head of water and its associated thrust forces.

1. When horizontal hubless CI piping is suspended in excess of 18 inch by means of non-rigid hangers, provide sway bracing to prevent horizontal movement.
2. For all horizontal hubless CI piping 5-inch and larger, provide sway bracing to prevent horizontal movement at every branch opening and change of direction by securing to building structure, or provide pipe clamps and rodding across coupling.

3.4 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports - Install the following:

1. Vertical Piping: MSS Type 8 or Type 42 clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports as required.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

3.5 PIPING SPECIALTIES INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping.
4. Locate at base of each vertical storm drain riser.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

E. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

F. Install roof drains at low points of roof areas and where indicated according to roof membrane manufacturer's written installation instructions.

1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.
3. Coated cast iron body roof drains with an inside caulked bottom outlet, except as noted and in accordance with ANSI A112.21.2.
4. For liquid membrane roofs, use four inch wide flange, for built up membrane roofs, a combined flashing flange and gravel stop; and, for steel or precast decks, a deck clamp.
5. Where insulation is applied over a structural roof deck, provide an extension collar with weep holes.
6. For IRMA type roofs, 4 inch high, brass gravel guard, 16 inch diameter perforated with 1/4 inch holes.
7. Provide tops of drains for decks and canopies with a bronze, nickel bronze, statuary bronze finish.

G. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

H. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

I. Install manufactured, gray-iron downspout boots at grade with top 12 inches above grade. Secure to building wall.

J. Install cast-iron soil pipe downspout boots at grade with top of hub 12 inches above grade.

K. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

L. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.6 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.7 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.8 SUMP PUMP INSTALLATION

A. Provide excavating, trenching, and backfilling as required.

B. Install sump pumps according to applicable requirements in HI 1.4.

C. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.

D. Set submersible sump pumps on basin or pit floor. Make direct connections to storm drainage piping.

E. Install sump pump basins and connect to drainage piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top flange. Install cover so top surface is flush with finished floor.

F. Construct sump pump pits and connect to drainage piping. Set pit curb frame recessed in and anchored to concrete. Fasten pit cover to pit curb flange. Install cover so top surface is flush with finished floor.

G. Install packaged submersible, drainage pump unit basins on floor or concrete base unless recessed installation is indicated. Make direct connections to storm drainage piping.

H. Support piping so weight of piping is not supported by pumps.

3.9 START UP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify bearing lubrication.
3. Disconnect couplings and check motors for proper direction of rotation.
4. Verify that each pump is free to rotate by hand. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
5. Verify that pump controls are correct for required application.
6. Verify sump basin is clear and no large debris before pump start up.

B. Start pumps without exceeding safe motor power:

1. Start motors.
2. Open discharge valves slowly.
3. Check general mechanical operation of pumps and motors.

C. Test and adjust controls and safeties.

D. Remove and replace damaged and malfunctioning components.

1. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
2. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.

E. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

END OF SECTION 22 14 00

SECTION 22 31 00-DOMESTIC WATER FILTRATION EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of filtering equipment:

1. Centralized softener, reverse osmosis or carbon filtering.
2. Point of use filters.

1.2 REFERENCES

A. General: Comply with appropriate standards.

1. American National Standards Institute: ANSI.
2. American Society of Mechanical Engineers: ASME.
3. American Society of Sanitary Engineering: ASSE.
4. American Society of Testing and Materials: ASTM.
5. American Welding Society: AWS
6. American Water Works Association: AWWS.
7. Manufacturers Standardization Society: MSS.
8. National Electrical Manufacturers Association: NEMA.
9. Plumbing and Drainage Institute: PDI.
10. Underwriters Laboratories Inc.: UL.
11. Los Angeles Plumbing Code: LAPC.
12. Los Angeles Department of Building and Safety: LADBS.
13. National Sanitation Foundation: NSF.
14. California AB 1953 Lead Free.

1.3 SUBMITTALS

A. Submit data on all materials, fittings, accessories and equipment.

B. Shop Drawings: Indicate pipe materials used, joining methods, supports, floor and wall penetrations seals. Indicate installation, layout, weights, mounting and support details, and piping connections. Provide detail water filtration assemblies and indicate dimensions, weight loads, and required clearances.

C. Product Data: Submit capacity, electrical characteristics and connection requirements. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, taps, drains, controls, and operating sequence. Indentify center of gravity and locate and describe mounting and anchorage provisions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Welding certificate.

F. Source quality-control test reports.

G. Field quality-control test reports.

H. Startup service test reports.

I. Operation and Maintenance Data: For water filtration equipment to include in emergency, operation, and maintenance manuals.

1. Do not install water filtration media until final water piping systems have been flushed and cleaned.
2. Prepare filter media per manufacturer requirements.

1.4 WARRANTY

A. Furnish five year manufacturer warranty or as required by facility representative.

PART 2 - PRODUCTS

2.1 CENTRALIZED FILTERING EQUIPMENT

A. Manufacturers:

1. Bottle-Free Water Co.
2. Filtrene Mfg Co..
3. Watersoft.

B. Equipment capacities and related piping as required.

2.2 POINT OF USE FILTERS

A. Manufacturers:

1. Bottle-Free Water Co.
2. Everpure.
3. Filtrene.

B. Sizes, flow capacities, and type as required.

2.3 CATRIDGE FILTER

A. Off-Floor Cartridge Filters:

1. Manufacturers:

a. Bottle-Free Water Company.

b. Everpure, Inc.
c. Filtrine.
d. WaterSoft.

2. Description: Simplex, in-line wall-mounting housing with replaceable element for removing suspended particles from water (1/2 micron).

   a. Housing: Corrosion resistant; designed to separate feedwater from filtrate and to direct feedwater through water filter element; with element support.

      1) Pipe Connections: Threaded according to ASME B1.20.1.
      2) Support: Wall bracket.

   b. Element: Replaceable; of shape to fit housing.

2.4 CARBON FILTER

A. Description: Simplex carbon filter, with media tank, media, and automatic backwash for removing chlorine from and improving color, odor, and taste of water.

   1. Manufacturers:

      a. Everpure.
      b. Culligan International Company.
      c. CUNO Incorporated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the following piping accessories on water conditioning equipment domestic water piping connections.

   1. On inlet:

      a. Thermometer.
      b. Strainer.
      c. Pressure gage.
      d. Shut-off valve.

   2. On outlet:

      a. Shut-off valve.

B. Install drain piping from tanks to nearest approved receptor.

END OF SECTION 22 31 00

SECTION 22 33 00-ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial electric water heaters.

1.2 REFERENCES

A. Comply with appropriate standards.

1. American Society of Heating, Refrigerating and Air-Conditioning Engineers: ASHRAE.
2. American Society of Mechanical Engineers: ASME.
3. American Society for Testing and Materials: ASTM.
4. National Fire Protection Association: NFPA.
5. California Energy Commission: C.E.C.
6. Canadian Standards Authority: C.S.A.
7. Department of Energy Test Procedures: D.O.E.
8. National Electrical Manufacturers Association: NEMA.
9. Southern California air Quality Management District: SCAQMD.
10. Los Angeles Plumbing Code: LAPC.
11. Los Angeles Department of Building and Safety: LADBS.
12. Los Angeles Municipal Code: LAMC.

1.3 SUBMITTALS

A. Submit data on all materials.

B. Shop Drawings: Indicate heat exchanger dimensions, size of taps, and performance data. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, taps, and drains.

C. Product Data: Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Submit electrical characteristics and connection locations.

D. Manufacturer's Installation Instructions: Submit mounting and support requirements.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 WARRANTY

A. One year standard warranty.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER HEATERS – TANK TYPE

A. Manufacturers:
   1. **Lochinvar.**
   2. **Rheem.**
   3. **A.O. Smith.**

B. Type: Automatic, electric, vertical storage.

C. Tank: Glass lined welded steel, thermally insulated with one inch Non-CFC foam, encased in corrosion-resistant steel jacket with baked-on enamel finish, dielectric fittings, brass drain valve, T&P relief valve.

D. Controls: Automatic water thermostat with adjustable temperature range from 120 to 170 degrees F, flanged or screw-in nichrome elements, enclosed controls and electrical junction box and operating light. Wire double element units so elements do not operate simultaneously.

E. Accessories: Seismic anchoring straps, State of California listed and approved.

2.2 COMMERCIAL ELECTRIC WATER HEATERS – INSTANTANEOUS/POINT-OF-USE

A. Manufacturers:

   1. **Chromite.**
   2. **Eemax.**
   3. **Rinnau.**

B. Type: Factory-assembled and wired, electric, non-storage type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Maintain manufacturer's recommended clearances around and over water heaters.

B. Install tank type water heater on concrete housekeeping pad, minimum 3-1/2 inches high and 6 inches larger than water heater base on each side or on listed and approved shelf.

C. Connect domestic hot water and domestic cold water piping to supply and return water heater connections mixing valves and/or circulating pump as required.

D. Install point-of-use type below counter height, adjacent to fixture on tank type.

E. Install the following piping accessories.

1. On supply:

    a. Thermometer well and thermometer.
    b. Strainer.
    c. Pressure gage.
    d. Shutoff valve.

2. On return:

    a. Thermometer well and thermometer.
    b. Pressure gage.
    c. Shutoff valve.

F. Install discharge piping from relief valves and drain valves to nearest approved receptor.

G. Install water heater trim and accessories furnished loose for field mounting.

H. Install electrical devices furnished loose for field mounting.

I. Install control wiring between water heater control panel and field mounted control devices.

END OF SECTION 22 33 00

SECTION 22 34 00-FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial gas-fired water heaters.
2. Packaged water heating systems.
3. Domestic hot water storage tanks.

1.2 REFERENCES

A. Comply with appropriate standards.

1. American National Standards Institute: ANSI.
2. American Society of Heating, Refrigerating and Air-Conditioning Engineers: ASHRAE.
3. American Society of Mechanical Engineers: ASME.
4. National Fire Protection Association: NFPA.
5. United States Department of Energy: D.O.E.
6. Canadian Standards Authority: CSA.
7. California Energy Commission: C.E.C.
8. National Electrical Manufacturers Association: NEMA.
9. Southern California Air Quality Control Management District: SCQMD Rule 1121 Low Nox Emission Stds.
10. Los Angeles Plumbing Code: LAPC.
11. Los Angeles Department of Building and Safety: LADBS.
12. Los Angeles Municipal Code: LAMC.

1.3 SUBMITTALS

A. Submit data on all materials.

B. Shop Drawings: Indicate heat exchanger dimensions, size of taps, and performance data. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, taps, and drains.

C. Product Data:

1. Water Heaters: Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit electrical characteristics and connection locations.
2. Pumps: Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

D. Manufacturer's Installation Instructions: Submit mounting and support requirements.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Conform to ASME code.

B. Water Heater Performance Requirements: Equipment efficiency not less than prescribed by ASHRAE 90.1 when tested in accordance with all required standards.

1.5 WARRANTY

A. One year standard warranty.

PART 2 - PRODUCTS

2.1 COMMERCIAL GAS FIRED WATER HEATERS

A. Manufacturers:

1. **Lochinvar.**
2. **Rheem.**
3. **A.O. Smith.**

B. Type: Automatic, natural gas-fired, vertical storage.

C. Capacity:

1. Minimum recovery rate: As required.
2. Maximum working pressure: 150 psig.
3. Certification: ANSI Z21.10.1.

D. Tank: Glass lined welded steel with single flue passage, flue baffle and draft hood; thermally insulated with Non-CFC foam and encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs, dielectric fittings, brass drain valve, T&P relief valve.

E. Controls: Automatic water thermostat and built-in gas pressure regulator; temperature range adjustable from 120 to 170 degrees F, cast iron or stainless steel burner, safety pilot and thermocouple, electronic ignition and power vent if required.

F. Accessories: Brass dip tube, drain valve, magnesium anode, anchoring straps, State of California listed and approved.

2.2 PACKAGED WATER HEATING SYSTEMS

A. Manufacturers:

1. **Rheem.**
2. **A.O. Smith.**
3. **Lochinvar.**

B. System: Gas-fired circulating pump, factory controls, piping and valves, storage tank, all mounted on skid or equipment pad as required.

C. Boiler:

1. Type: natural gas-fired water tube boiler, with copper finned tube heat exchanger, one inch minimum diameter, 13 gage steel boiler tubes and copper tube heat exchanger with bronze heads, steel jacket with glass fiber insulation.
2. Boiler Trim: Gas burner, thermometer and pressure gauge. Immersion thermostats for operating and high limit protection, 100 percent safety shut-off. Electric gas valve with transformer, electronic safety pilot and pilot burner, gas pressure regulator. Manual gas shut-off, low water cut off, ASME rated temperature and pressure relief valve, coil relief valve, automatic boiler fill and expansion tank, draft inverter.

D. Vertical or Horizontal storage tank:

1. Working pressure: 150 psi ASME labeled.
2. Lining: 15 mils thick epoxy lining extended through flanges and couplings.
3. Support: Two factory welded tank saddles not less than 4 inches wide by 1/4 inch thick, mounted on 2 inch pipe stand with minimum four cross braced legs; sheet teflon isolation strip between tank and saddle; dielectric unions between tank and piping system.
4. Insulation: 3 inch glass fiber insulation with aluminum jacket.

E. Pump:

1. Type: All bronze, in-line circulation pump mounted on boiler, between heater and storage tank, controlled by tank mounted immersion thermostat set at max. outlet temperature as required.
2. Pump Capacity: As required.
3. Electrical Characteristics: As required.

F. Thermostatic Valve: Three-way, self-contained, full line size, bronze body 1/2 to 2 inches size, iron body 2-1/2 inches and over, set at 140 degrees F max. inlet temperature – outlet temperature as required.

2.3 DOMESTIC HOT WATER STORAGE TANKS

A. Manufacturers:

1. **Rheem.**
2. **A.O. Smith.**
3. **Lochinvar.**

B. Tank: Welded steel, ASME labeled for working pressure of 125 psig psig, steel support saddles, taps for accessories, threaded connections of stainless steel, access manhole.

C. Lining:

1. Corrosion-resistant concrete approximately 3/4 inch thick. Glass-lined or as provided as manufacturer.

D. Openings: Up to 3 inches, copper-silicone threaded; over 4 inches, flanged; flanged collar for heat exchanger; man-way fitting.

E. Accessories: Tank drain, water inlet and outlet, thermometer range of 40 to 200 degrees F, ASME pressure relief valve suitable for maximum working pressure.

F. Vertical or Horizontal storage tank:

1. Nominal capacity: Length and dimensions as required.
2. Support: Two welded tank saddles not less than 4 inches wide by 1/4 inch thick, mounted on 2 inch pipe stand with minimum four cross braced legs; sheet teflon isolation strip between tank and saddle; dielectric unions between tank and piping system.

G. Insulation: Factory furnished 2 inch minimum glass fiber insulation with steel aluminum jacket.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Maintain manufacturer's recommended clearances around and over water heaters.

B. Install water heater on concrete housekeeping pad, minimum 4 inches high and 6 inches larger than water heater base on each side.

C. Seismic Bracing: Provide approved anchoring straps – two (2) minimum.

D. Connect natural gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.

E. Connect domestic hot water and domestic cold water piping to supply and return water heater connections.

F. Install the following piping accessories.

1. On supply:

a. Thermometer well and thermometer.
b. Strainer.
c. Pressure gage.
d. Shutoff valve.

2. On return:

a. Thermometer well and thermometer.
b. Pressure gage.
c. Shutoff valve.

G. Install the following piping accessories on natural gas piping connections.

1. Strainer.
2. Pressure gage.
3. Shutoff valve.
4. Pressure reducing valve.

H. Install discharge piping from relief valves and drain valves to nearest approved receptor.

I. Install circulator and diaphragm expansion tank on water heater.

J. Install water heater trim and accessories furnished loose for field mounting.

K. Install electrical devices furnished loose for field mounting.

L. Install control wiring between water heater control panel and field mounted control devices.

M. Connect flue to water heater outlet, full size of outlet.

N. Domestic Hot Water Storage Tanks:

1. Provide piping support, independent of building structural framing members.
2. Clean and flush after installation. Seal until pipe connections are made.
3. Provide seismic bracing.

END OF SECTION 22 34 00

SECTION 22 40 00-PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water closets.
2. Urinals.
3. Lavatories.
4. Sinks.
5. Service sinks.
6. Electric water coolers.
7. Wash fountains.

1.2 REFERENCES

A. General: comply with appropriate standards.

1. American National Standards Institute: ANSI.
2. Air-Conditioning and Refrigeration Institute: ARI.
3. American Society of Mechanical Engineers: ASME.
4. American Society for Testing and Materials: ASTM.
5. California Energy Commission: CEC.
6. National Electrical Manufacturers Association: NEMA.
7. Americans with Disabilities Act: ADA.
8. Los Angeles Plumbing Code: LAPC.
9. Los Angeles Department of Building and Safety: LADBS
10. National Sanitation Foundation: NSF.
11. International Association of Plumbing and Mechanical Officials: IAPMO.
12. California State AB 1953.

1.3 SUBMITTALS

A. Submit data on all materials, fittings, accessories and equipment. Indicate materials, finishes, dimensions, construction details and flow control roles.

B. Manufacturer's Installation Instructions: Submit installation methods and procedures.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

D. LEED Submittal:

1. Product Data for Credit WE 3.1 and 3.2: Documentation indicating flow and water consumption requirements.
2. Extra credit point for 40% water use reduction.

E. Shop Drawings: Diagram power, signal, and control wiring.

F. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

H. Operation and Maintenance Data: Submit fixture, trim, exploded view and replacement parts lists.

1.4 WARRANTY

A. Furnish five year minimum warranty.

PART 2 - PRODUCTS

2.1 GENERAL

The following gallons per flush or flow in gallons per minute are required maximum flows for project:

Water Closets Flushometer	1.128 gallons per flush
Urinals Flushometer	0.125 gallons per flush
Lavatory Faucet	0.5 gallons per minute
Showers Heads	1.5 gallons per minute
Pantry Sinks	1.5 gallons per minute
Mop Sinks	Per ASME A112.18.1, 4.0 gallons per minute

2.2 FLUSH VALVE WATER CLOSETS

A. Manufacturers: Vitreous China.

1. **American Standard.**
2. **Kohler.**
3. **Toto USA, Inc..**

B. Manufacturers: Type 304 stainless steel

1. **Zurn.**
2. **Willoughby.**

C. Manufacturers: Flush Valves.

1. **Sloan.**
2. **Zurn.**
3. **American Standard.**

D. Bowl: ASME A112.19.2M; wall hung, siphon jet , with elongated rim, exposed top spud, or concealed back-size per flush valve requirements, bolt caps; floor anchored carrier.

E. Bowl: ASME A112.19.2M; floor mounted, siphon jet or blow out, with elongated rim, exposed top spud, or concealed back-size per flush valve requirements; bolt caps.

F. Disabled Access: Where required.

G. Exposed Flush Valve: ASME A112.18.1; exposed chrome plated, diaphragm type with oscillating handle, escutcheon, seat bumper, integral screwdriver stop and vacuum breaker 1.128 maximum gallon per flush.

H. Water Closet Flushometers:

1. Sensor Operated - Hard Wired:

a. Concealed diaphragm type, chrome plated, sensor operated flushometer valve. Low consumption valves shall have dual filtered type diaphragm kit for flush discharge accuracy. Valve shall be non-hold-open, solenoid operator, skirted high back pressure vacuum breaker with bottom hex coupling nut, back-check control stop will have free spinning vandal resistant stop cap and sweat solder adapter kit with cast set screw all flange. Valve shall include self-adaptive infrared sensor with indicator light, courtesy flush override button, (2) chrome plated wall cover plates (for 2-gag electrical box) with vandal resistant screws. Valve body, cover tailpiece and control stop will be in conformance with ASTM Alloy Classification for Semi-Red Brass. Valve shall be in compliance with the applicable sections of ASSE 1037, ANSI/ASME 112.19.6, and Military Specification V-29193 Standards. Sloan Optima 152-1.28 ES-S.

2. Sensor Operated - Battery:

I. Sensor Operated Flush Valve: ASME A112.18.1; concealed rough brass, diaphragm type with low voltage or battery operated solenoid operator, infrared sensor and over-ride button in chrome plated plate, wheel handle stop and vacuum breaker 1.28 maximum gallon per flush.

J. Seats.

1. Manufacturers:

a. American Standard.
b. Beneke.
c. Kohler.

2. Seat: Shall be white heavy-duty plastic, open front, extended back, self-sustaining hinge, brass bolts, without cover.

K. Carriers.

1. Manufacturers:

a. J.R. Smith.
b. Zurn.
c. MiFAB.

2. Carrier: ASME A112.6.1; adjustable or non-adjustable, cast iron or ductile iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers; single, double, vertical or horizontal type as required.

L. Water-Closet Supports:

1. Description: Combination carrier designed for accessible and standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
2. Concealed adjustable extra heavy cast iron combination drainage fitting and chair carriers with an adjustable base anchored to slab using all base support holes, rear anchor foot assembly for stud walls, adjustable cast iron outlet nipple and/or coupling, neoprene gasket and steel supporting bolts with chrome plated washers and cap nuts, equal to Smith Series No. 100, No. 200, No. 400, or No. 500 for siphon jet.

    a. For employee use bariatric supports for a 1000 pound load rating.

3. Set bowls for physically handicapped with top of seat 17 to 19 inches above floor and provide carrier, equal to Smith No. 600. For blowout, use Smith No. 620.

2.3 WALL HUNG URINALS

A. Manufacturers: Vitreous China

1. Sloan.
2. American Standard.
3. Kohler.

B. Manufacturers: Flush Valves.

1. Sloan.
2. American Standard.
3. Zurn.

C. Urinal: ASME A112.19.2M or ANSI Z124.9, wall hung washout or siphon jet, integral trap, exposed or concealed spud type, size per flush valve requirements, floor anchored carrier.

D. Exposed Flush Valve: ASME A112.18.1; exposed chrome plated, diaphragm type with oscillating handle, or push plate, escutcheon, integral screwdriver stop, vacuum breaker; 0.125 maximum gallon per flush.

E. Sensor Operated Flush Valve: ASME A112.18.1; concealed rough brass or exposed chrome plated, diaphragm type with low voltage or battery operated solenoid operator, infrared sensor and over-ride button in chrome plated plate, wheel handle stop and vacuum breaker; 0.125 maximum gallon per flush.

F. Urinal Flushometers:

1. Sensor-Operated Hard-Wired:

a. Concealed diaphragm type, chrome plated, sensor operated flushometer valve. Low consumption valves shall have dual filtered type diaphragm kit for flush discharge accuracy. Valve shall be non-hold-open, solenoid operator, skirted high back pressure vacuum breaker with bottom hex coupling nut, back-check control stop will have free spinning vandal resistant stop cap and sweat solder adapter kit with cast set screw wall flange. Valve shall include Optima EL-1500 self-adaptive infrared sensor with indicator light, (2) chrome plated wall cover plates (for 2-gang electrical box) with vandal resistant screws. Valve, body, cover, tailpiece and control stop shall be in conformance with ASTM Alloy Classification for Semi-Red Brass. Valve shall be Sloan WEUS-1010.1311-0.13 ES-S.

G. Flush (Metering) Valve: ASME A112.18.1; exposed chrome plated, porous felt type for 1/2 inch supply with oscillating handle, or push button, screwdriver stop and vacuum breaker.

H. Carriers:

1. Manufacturers:

a. J.R. Smith.
b. Zurn.
c. MiFAB.

2. Wall Mounted Carrier: ASME A112.6.1; cast iron or ductile iron frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs, elastometric gasket or approved setting compound, for fixture to flange connection.

I. Disabled Access: Approved type where required.

2.4 LAVATORIES

A. Manufacturers: Vitreous China/Porcelain Enameled Cast Iron.

1. American Standard.
2. Kohler.
3. Crane.

B. Manufacturers: Integral basin type.

1. Corian.

C. Manufacturers: Faucets.

1. **Sloan.**
2. **Chicago.**
3. **American Standard.**

D. Wall Hung Basins: size as required, with 4 inch high back; drillings on 4 inch or 8 inch centers or single hold punch, rectangular basin with splash lip, front overflow, and soap depression.

E. Counter Top Basins: self-rimming lavatory-size as required with drillings on 4 inch or 8 inch centers, front overflow, soap depression, seal of putty, caulking, or concealed vinyl gasket.

F. Undercounter Lavatory: unglazed rim for under counter mount with rear overflow, size as required with drillings on 4 inch or 8 inch centers or single hole.

G. Manufacturers:

1. **American Standard Companies, Inc.**
2. **Brasscraft.**
3. **Chicago Faucet Co.**

H. Metered Faucet: ASME A112.18.1; chrome plated metered manual mixing faucet low voltage or battery operated solenoid operator and infrared sensor, water economy aerator spray and cover plate.

I. Disabled Access: Approved type where required with insulated stops, supplies, trap and drain outlet, offset grid strainer

J. Carriers: where required.

1. Manufacturers:

a. J.R. Smith.
b. Zurn.
c. MiFAB.

K. Lavatory insulation kit where required: Tru-Bro, Plumerex.

L. Waste Outlets - Manufacturers:

1. **American Standard.**
2. **Brasscraft.**
3. **Chicago Faucet Co.**

a. All Lavatory Types Unless Otherwise Noted:

1) Description: Lavatory waste outlets with open strainer waste & trap shall have a cast brass waste connection with brass compression ring and brass slip unit connected to concealed piping in wall. Connect to concealed piping using cast brass waste connection with brass compression ring and brass slip unit.

2) C.P. brass open strainer waste outlet with 17-gauge 1-1/4 inch tail piece, unless otherwise noted.

3) 1-1/4 inch by 1-1/2 inch cast brass P-trap with brass cleanout.

4) 17 gauge copper tubing wall outlet with set-screw type cast brass escutcheon.

5) Waste Outlets for handicap lavatories: Open strainer waste outlet with offset waste.

M. Fixture Supports - Manufacturers:

1. J.R. Smith.
2. American Standard.
3. Chicago Faucet Co.

a. All Lavatory Types Unless Otherwise Noted:

1) Description: For lavatories, provide concealed adjustable iron uprights with concealed arm chair carriers.
2) Locations: All lavatories.
3) For stud walls, supports with 3-inch x 1-inch rectangular uprights welded to base.
4) For Handicap Accessible Lavatories: Provide concealed adjustable iron arm chair carriers.

2.5 SINKS

A. Manufacturers: Fixtures.

1. Stainless Steel:

a. Elkay.
b. Franke.
c. Just.

B. Manufacturers: Faucets.

1. Chicago.
2. Sloan.
3. **American Standard**.

C. Sink Description: Two compartment, self-rimming, counter-mounting, stainless-steel commercial sink in counter with five (5) holes, faucet openings eight 8) inches on centers. Sink shall be No. 18 USSG genuine 18-8 solid stainless steel and shall be bonded to and reinforced with heavy gauge formed metal. Underside shall be sound deadened. Provide one piece with bowls welded integrally to tops. Horizontal and vertical corners of bowls shall be rounded to 1-3/4 inch radius. Joints shall be welded and ground smooth. Bottom shall be

pitched to drain outlet and drilled for trim as required. Provide wood strips for fastening top to cabinets.

1. Type SK1:

    a. Size: 33 inch x 21 ¼ inch x 5 ½ inch deep with five (5) holes, four (4) faucet openings one (1) stainless steel air-gap fitting (8) inches on centers.

D. Supplies, Stops, Fittings:

1. Chrome plated combination rigid supply fitting with grid strainer or crumb strainer, loose key stops, chrome plated trap and drain outlet.
2. Manufacturers:

    a. Brasscraft.
    b. Chicago.
    c. Zurn.

E. Waste Outlets - Manufacturers:

1. American Standard Companies, Inc.
2. Brasscraft.
3. Chicago Faucet Co.

a. Type: All Sinks.

1) Description:
2) Provide 316 stainless steel open strainer waste with 1 ½ inch 17 gauge copper tubing tailpiece.
3) 1-1/2 in. x 2 in., cast brass P-trap with cleanout, with 17 gage copper tubing.
4) Connect to concealed waste piping using C.P. cast brass wall outlet nipple with C.P. brass set screw and escutcheon.
5) Waste outlets for handicap stainless steel sinks: Provide open strainer waste.

b. Traps for handicap accessible fixtures shall run close to backwall to clear knees (if more than six [6] inches off wall). Provide ½ inch insulation on exposed drainage piping.

2.6 ELECTRIC WATER COOLERS

A. Manufacturers:

1. Elkay.
2. Haws.
3. Halsey Taylor.

B. Furnish materials in accordance with LADBS.

C. Fountain:

1. ARI 1010; stainless steel, single or dual height, type as required; with stainless steel top, stainless steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket, or floor anchored carrier refrigerated with integral air cooled condenser and stainless steel grille.
2. Capacity: 8 gph of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F.
3. Electrical: 115/1/60 compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.

2.7 WALL MOUNTED OPERATIONS LEVEL DRINKING FOUNTAINS

A. Drinking Fountains:

1. Manufacturers:

   a. Elkay.
   b. Halsey Taylor.
   c. Haws.

2. Type wall mount.
3. Description: Accessible, ARI 1010, Type PB, pressure with bubbler, Style W, wall-mounting drinking fountain for adult, child and ADA-mounting height.

   a. Cabinet: Single, all stainless steel.
   b. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
   c. Control: Push button.
   d. Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve.
   e. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
   f. Drain(s): Grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME A112.18.1.
   g. Support: Type I, drinking fountain carrier.

2.8 FIXTURE SUPPORTS

A. Manufacturers:

1. J.R. Smith.
2. MIFAB.
3. Zurn.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

2.9 MOP SINKS

A. Enameled Cast Iron or Terrazzo

B. Manufacturers:

1. Commercial Enameling Co..
2. American Standard.
3. Kohler.

C. Floor Mounted Basin: 28”x28”x12” high minimum chrome plated strainer, rim guard, 3” cast iron P-trap with adjustable floor flange.

D. Faucet:

1. Exposed wall type supply with lever handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges.
2. Manufacturers:

a. Chicago.
b. Speakman.
c. T & S Brass.

E. Accessories:

1. 5 feet of 1/2 inch diameter plain end reinforced plastic rubber hose.
2. Hose clamp hanger.
3. Mop hanger.

2.10 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers:

a. Engineered Brass Co.
b. TRUEBRO, Inc.
c. Zurn.

2. Description: Manufactured insulating wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.11 GARBAGE DISPOSER

A. Garbage disposer to be stainless steel grinder, chamber and blades, fully sound insulated, 1-horsepower, 120-volt, 1 phase, In-Sink-erator, Evolution Series 3-stage grind, Jam-sensor circuit and sound baffle collar.

B. Provide stainless steel or chrome plated air gap fitting at dishwasher only.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid supplies to fixtures with loose key stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall supports, carriers and bolts.

E. Seal fixtures to wall and floor surfaces with sealant color to match fixture.

3.2 PLUMBING FIXTURE INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
4. Lag fixture carrier base plates or feet to slab with lead expansion shields and insert bolts in all bolt holes.
5. Where wall hung water closets are supported adjacent to stud walls, provide rear anchor foot assembly bolted to slab.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb as required.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves as required.

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

N. Install toilet seats on water closets.

O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

P. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

Q. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

R. Install shower flow-control fittings with specified maximum flow rates in shower arms.

S. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

T. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings.

U. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

3.3 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use mounting frames for recessed water coolers, unless otherwise indicated.

C. Set remote water coolers on floor, unless otherwise indicated.

D. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.4 DRINKING FOUNTAINS AND WATER COOLERS INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

1. On block walls, fasten wall hanger to 18 inch by 4 inch built-in iron backing plates,
2. Fasten wall hanger to concealed adjustable iron chair carrier. For block walls, use supports
3. For stud walls, use supports

C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation.

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings.

G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

H. Do not install filter until after domestic water piping system has been disinfected and flushed.

END OF SECTION 22 40 00

SECTION 22 70 00-FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Natural gas piping buried within 5 feet of building.
2. Natural gas piping above grade.
3. Unions and flanges.
4. Strainers.
5. Natural gas pressure regulators.
6. Natural gas pressure relief valves.
7. Underground pipe markers.
8. Bedding and cover materials.

1.2 REFERENCES

A. General: Comply with appropriate standards.

1. American National Standards Institute: ANSI.
2. American Society of Mechanical Engineers: ASME.
3. American Society for Testing and Materials: ASTM.
4. American Welding Society: AWS.
5. American Water Works Association: AWWA.
6. Manufacturers Standardization Society of the Valve and Fittings Industry: MSS.
7. National Fire Protection Association: NFPA.
8. Underwriters Laboratories Inc.: U.L.
9. Los Angeles Plumbing Code: LAPC.
10. Los Angeles Department of Building and Safety: LADBS.
11. American Gas Association: AGA.

1.3 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.

B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded connections to valves, equipment.

C. Provide pipe hangers and supports in accordance with other sections.

D. Use plug, ball, or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.4 SUBMITTALS

A. Product Data:

1. Submit data on all pipe materials, fittings specialties, and accessories.

B. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangersSubmit data on all materials, fittings, accessories and equipment.

C. Manufacturers Installation Instructions: Submit installation instructions for material and equipment.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

F. Shop Drawings Provide product data for each type of the following:

1. Piping
2. Fittings
3. Joints.
4. Piping specialties
5. Corrugated, stainless-steel tubing with associated components.
6. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
7. Pressure regulators. Indicate pressure ratings and capacities.
8. Service meters including supports
9. Dielectric fittings.
10. Mechanical sleeve seals.
11. Escutcheons.
12. Supports.
13. Remote meter reading accessories.
14. Seismic gas shut off valves.

G. Seismic-Design Submittal: Provide for natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

H. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.5 WARRANTY

A. Furnish one-year minimum warranty.

PART 2 - PRODUCTS

2.1 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASTM A234/A234M forged steel welding type.
2. Joints: ASME B31.9, welded. For 3" and larger; threader for 2" and smaller.
3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

B. Plastic Pipe: ASTM D-2513 Schedule 40 Polyethylene.

1. Fittings: PE 2406 butt-fused.
2. Joints: PE 2406 butt-fused.

2.2 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, 150 psig.
2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

2.3 PIPING

A. Inside steel piping:

1. For low pressure 0.5 PSIG or less use standard weight black steel pipe with 150 PSIG threaded malleable iron fittings for piping 4 in. and smaller.
2. For pressure above 5 PSIG, all piping shall be welded.

B. Underground piping:

1. Steel pipe with Dresser type and steel welding fittings. Pre-wrap with Mill-wrapped corrosion protection extruded polyolefin coating in accordance with Gas Company requirements, equal to Energy Coating Co. or PlexCo.
2. High density polyethylene pipe and fittings in accordance with ASTM D-2513, Grades 2306, 3306, and 3408 with fusion joints only, equal to Driscopipe 8100-DRII Series.

C. Underground drips shall be AGA and local gas company approved and shall be cast iron or tar coated welded steel pots with adjustable tar coated cast iron extension shaft and flush box with lock type extra heavy cast iron cover marked GAS DRIP.

D. In no case shall any gas pipe be less than ¾ inch.

2.4 REGULATOR VENT PIPING, ABOVE GRADE

A. Indoors: Same as natural gas piping, above grade.

B. Outdoors: PVC pipe, tubing, and fittings, UL 651.

2.5 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

1. Ferrous Piping: Class 150, malleable iron, threaded.
2. Copper Piping: Class 150, bronze unions with soldered brazed joints.
3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
2. Copper Piping: Class 150, slip-on bronze flanges.
3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.6 STRAINERS

A. Manufacturers:

1. Mueller Steam Specialty.
2. O.C. Keckley Company.
3. Spirax Sarco, Inc.

B. 2 inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. 2-1/2 inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

D. 5 inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.7 NATURAL GAS PRESSURE REGULATORS

A. Manufacturers:

1. Equimeter.
2. American.
3. Sensus.

B. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.

1. Comply with ANSI Z21.80.
2. Temperatures: minus 20 degrees F to 150 degrees F.
3. Body: Cast iron with neoprene gasket.
4. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.
5. Disk, diaphragm, and O-ring: Nitrile.
6. Minimum Inlet Pressure: 5 P.S.I.
7. Furnish sizes 2 inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.

C. Service Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers:

a. Equimeter.
b. American.
c. Sensus.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 60 psig.

2.8 NATURAL GAS PRESSURE RELIEF VALVES

A. Manufacturers:

1. Fisher.
2. American.

B. Product Description: Spring loaded type relief valve.

1. Body: Aluminum.
2. Diaphragm: Nitrile.
3. Orifice: Stainless steel.

4. Maximum operating temperature: 150 degrees F.
5. Inlet Connections: Threaded.
6. Outlet or Vent Connection: Same size as inlet connection.

2.9 UNDERGROUND LABELING & IDENTIFYING

A. Detectable Warning Tape: Acid and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

2.10 GAS VENT TERMINALS

A. ¾ in. and one (1) in. aluminum threaded vent terminal with 16 x 16 mesh 0.018 gauge stainless steel screen.

B. 1¼ in. to 4 in. standard pipe threaded elbow with 12 x 12 mesh stainless steel screen.
   1. Equal to Upsco Inc.

C. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

   1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
   2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
   3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
   4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

      a. Material Group: 1.1.
      b. End Connections: Threaded or butt welding to match pipe.
      c. Lapped Face: Not permitted underground.
      d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
      e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

   5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

      a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.11 VALVES

A. Manual Shut-off Valves Inside Building.

B. Manufacturer:

1. Nordstrom.

C. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves where required by Con. Ed.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
7. Threaded cast iron body, 125 PSIG wog

D. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves where required by Con. Ed.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
5. 2½ in. to 4-in.: Flanged cast iron body lubricated tapered plug type, 175 PSIG wog.
6. 6 in. and larger: Flanged cast iron body lubricated tapered plug type, 200 PSIG wog, worm gear operated.

E. Provide 2 wrenches for each size used.

1. Attach wrench to each valve.

F. Ball Valves

1. On local branches three inches and smaller, provide threaded three piece full port wafer-type ball valve with bronze body, ball stem, Teflon seats, and level handles, 300 PSIG wog.

2. Manufacturer:

a. Contromatics.

G. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. 2 inch and smaller: Threaded brass ball valves with full port TFE sears and blowout proof stem, 600 psig wog.

2. Manufacturers:

a. BrassCraft.
b. Conbraco.

c. **NIBCO.**

3. Body: Bronze, complying with ASTM B 584.
4. Ball: Chrome-plated bronze.
5. Stem: Bronze; blowout proof.
6. Seats: Reinforced TFE; blowout proof.
7. Packing: Threaded-body packnut design with adjustable-stem packing.
8. Ends: Threaded, flared, or socket.
9. CWP Rating: 600 psig.
10. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
11. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. Check Valves:

1. Provide bronze body swing disc check valve.

a. Manufacturer:

1) Eclipse Series 1000.

I. Bronze Plug Valves: MSS SP-78.

1. Manufacturers:

a. Hammond.
b. Lee Brass Company.
c. NIBCO.

2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

J. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers:

a. McDonald.
b. Mueller Co.
c. Xomox Corporation.

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.

6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

K. Cast Lubricated Plug Valves Inside Building:

1. 2-inch and smaller: Cast iron body, threaded, equal to Nordstrom Valves, Inc. Figure 114.
2. 2½ inch to 4-inch: Flanged cast iron body lubricated tapered plug type, 175 PSIG wog, equal to Nordstrom Valves, Inc. Figure 115.
3. 6 inch and larger: Flanged cast iron body lubricated tapered plug type, 200 PSIG wog, worm gear operated, equal to Nordstrom Valves, Inc. Figure 165.
4. Valves 2 ½ inch and larger shall be flanged.
5. Provide 2 wrenches for each size used.
6. Attach wrench to each valve.
7. Gas Cocks:

    a. Gas cocks shall be for use only as manual gas shut-off valves at each piece of gas burning equipment; shall be of the plug type, bronze construction with check, nut and washer bottom and tee handle.
    b. Gas cocks shall be Figure 10596 as manufactured by A.Y. McDonald Mfg. Co., or Series 52 as manufactured by Conbraco Industries, Inc.
    c. Gas cocks shall only be used on piping 1 inch and smaller.

L. Valves Underground (Curb Type)

1. Provide welding end steel body tapered lubricated plug type with iron plug high head extension.

    a. 2 inch to 4 inch: 200 PSIG wog, equal to Nordstrom No. 1943.
    b. 6 inch and larger: 275 PSIG wog, equal to Nordstrom No. 4185.

2. Provide with adjustable tar coated cast iron extension shaft and flush box with lock type extra heavy cast iron cover marked GAS. Provide two operating wrenches.

M. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.12 EARTHQUAKE VALVES

A. Earthquake Valves: Comply with ASCE 25.

1. Manufacturers:

a. Pacific Seismic Products, Inc.
b. Quake Defense, Inc.
c. Strand Earthquake.

2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
3. Maximum Operating Pressure:
4. Cast-aluminum body with stainless-steel internal parts.
5. Nitrile-rubber, reset-stem o-ring seal.
6. Valve position, open or closed, indicator.
7. Composition valve seat with clapper held by spring or magnet locking mechanism.
8. Level indicator.
9. End Connections: Threaded for valves NPS ¾ 2 and smaller; flanged for valves NPS 2-1/2 and larger.
10. City of Los Angeles approved.

2.13 GAS SAFETY SHUTOFF VALVES

A. Gas safety shut-off valves shall be FM & UL listed, electric motor operated, normally closed, manual reset type. Valves shall be rising stem design with a straight through flow path with metal-to-metal seat and disc arrangement. The valve seat shall be stainless steel and the disc ductile iron. Valves shall be provided with a NEMA 4 enclosure modified for Class I, Division II hazardous locations, be provided with an electrical terminal block and shall operate on 120 Volt, A.C., 60 Cycles, single phase. Valves shall meet ANSI Class VI leakage standard and shall be provided with a visual indicator to note the position of the valve whether "OPEN" or "SHUT"

B. Gas safety shut-off valves 2" and smaller shall be threaded, 2 1/2" and larger shall be flanged. Flanged valves shall be provided with companion flange set by valve manufacturer.

1. Gas safety shut-off valves 2" and smaller

a. Manufacturer:

1) Maxon Corporation Series 808.

2. 2 1/2" and larger. All valves shall be provided with trim package 1-1.

a. Manufacturer:

1) Series 808-CP.

C. Gas safety shut-off valves shall be installed in the following locations:

1. On the firm gas line downstream of its meter and before any branch take-offs.

D. Gas safety shut-off valves shall be wired to the gas leak detection system and shall function to shut off all gas supply to the building upon:

1. Action of the gas leak detection system (alarm condition), and,
2. Loss of normal electrical power.

2.14 GAS TENANT METERS

A. Body and cover:

1. Die cast aluminum alloy factory painted.

B. Temperature compensation

1. Bi-metallic element that automatically corrects changes in gas temperature.

C. Gas Meter Register

1. UV stabilized clear polycarbonate index box to measure in cubic feet.
2. Gas register transmitter for remote reading to the building automation system.

D. Manufacturers:

1. Equimeter.
2. Sensus.
3. American Meter.

2.15 DIELECTRIC FITTINGS

A. Dielectric Unions:

1. Manufacturers:

a. Hart Industries.
b. Watts.
c. Zurn - Wilkins.

2. Minimum Operating-Pressure Rating: 125 psig (862 kPa).
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.16 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.17 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico Inc.
c. Metraflex Company.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.18 MECHANICAL GAS SLEEVES

A. Carbon steel, zinc chromate bolts and nuts with corrosion inhibiting coating.

B. Seal material EPDM, black in color.

C. Pressure pates of reinforced nylon polymer.

D. Equal to Thunderline Link Seal Model ‘C’.

2.19 ESCUTCHEONS

A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.

B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Escutcheons: With set screw.

1. Finish: Polished chrome-plated or rough brass.

D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.

1. Finish: Polished chrome-plated or rough brass.

E. One-Piece, Stamped-Steel Escutcheons: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw, and chrome-plated finish.

G. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

2.20 PRESSURE GUAGES

A. 4½ in. diameter, black enamel coated steel case ring with shatterproof glass, ½ in. bronze bellows with brass socket, blow out on back of case, ¼ in. bottom outlet connection, similar to Trerice No. 860 or Weksler Instruments Corp. No. BL14-PWE4-LWXX with 0 to 27 in. of water column dial, brass pressure snubber and brass tee-handle cock.

B. Locate pressure gauges on inlet and outlet of gas booster pressure pump, at farthest point in system and as noted.

2.21 REMOTE METER READING EQUIPMENT

A. Electronic hard wire transmitter to provide gas consumption readings for every individual tenant and concession to the building management system.

2.22 CATHODIC PROTECTION

A. Provide a complete electrically isolated, cathodic protection system for entire length of underground gas line, including all components, suitable for temperatures and pressures involved.

B. Prior to installation, conduct a corrosion site survey using a qualified corrosion engineer to evaluate soil conditions and establish system requirements.

C. System shall be the sacrificial magnesium anode type with 17 lb anodes, spacing based upon soil resistivity readings, with a maximum spacing of 300 feet Pack anodes in permeable cloth bag in backfill: 75% ground hydrated gypsum, 20% powdered Wyoming bentonite, 5% anhydrous sodium sulfate.

D. Magnesium anodes shall be high current type with magnesium wall having the following composition:

1. Aluminum: 5.3 to 6.7%.
2. Manganese: 0.15% minimum.
3. Zinc: 2.5 to 3.5%.
4. Silicone: 0.3% maximum.
5. Copper: 0.02% maximum.
6. Nickel: 0.003% maximum.

7. Iron: 0.003% maximum.
8. Other impurities: 0.3% maximum.
9. Magnesium: Remaining.

E. Anodes shall be cast with perforated galvanized steel strap core. One end of anode shall be recessed so one end of strap is accessible for lead wire connection. Anode lead wires shall be 25 feet long, silver soldered to strap core and with a minimum 1 turns of wire at connection. Fill anode recess connection with electrical potting compound. Conductors shall be No. 12 AWG Type TW copper wire.

F. Connectors shall be Cadwel Thermite brazing type elements for mechanically bonding conductors to steel pipe. Moisture proof all connections to piping. Splices shall be made with split bolt compression connectors and suitable protection tape.

G. For pipe installed in sleeves, provide insulators, equal to Maloney Model 57, spaced 10-feet on centers, installed in accordance with manufacturer's recommendations. Provide insulating coupling for pipe penetrating building wall.

H. Provide test stations housed in electrical conduit terminated in cast iron, waterproof junction boxes at ground surface. Embed in 12-inches x 12-inches x 6-inches concrete marker.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. Field verify that connection to existing piping systems sizes, locations, and invert are as required.

F. Establish elevations of buried piping with not less than allowed per code.

G. Establish minimum separation of from other piping services in accordance with code.

3.2 NATURAL FUEL GAS SYSTEMS INSTALLATION

A. Install piping free from traps and with drain pocket consisting of nipple and cap at low points for inside building and drip pot for underground piping.

B. Install shut-off valves at connection to each piece of equipment. Provide union or right and left nipple and coupling at equipment side of individual shut-off valve.

C. Install gas meter in a well ventilated and accessible location. Gas meter room (3 hr. rated enclosure) with explosion-proof fixtures.

D. Threaded Joints:

1. Make-up joints with U.L. listed gas resistant Teflon tape or Teflon paste, suited for gas piping.

E. Provide a two elbow-swing on all branches taken from a riser.

F. Provide valve tags for piping systems indicating the operating system pressure.

G. Color code piping at different pressures within the gas meter room. Paint fifteen (15) to five (5) psi system brown and reduced pressure piping yellow.

H. Welders must be qualified in accordance with either API 1104 or A.S.M.E. IX Boiler and Pressure Vessel Code and as required by local code.

I. Provide sign on the exterior of the gas meter door shall be provided with bold lettering at least 1 in. high and properly spaced with lettering and background in contrasting colors reading "Gas Meter Room - No Storage Permitted."

J. Support horizontal gas piping as follows:

1. ½ in. - 6 ft. on center.
2. ¾ in. or 1 in. - 8 ft. on center.
3. 1¼ in. or larger - 10 ft. on center.
4. Vertical piping at every floor.

K. Provide remote meter reading communication wiring to connect to building automation system. Wire gauge per manufacturer recommendation for distance required.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 22 inches below finished grade as required.

1. If natural-gas piping is installed less than 72 inches below finished grade, install it in ductile iron pipe containment conduit.
2. Coordinate with site paving contractor for finished grade location.
3. Protect exterior underground pipe from damage due to heavy equipment traffic during construction.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.

2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Install fittings for changes in direction and branch connections.

F. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

G. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

H. Install pressure gauge upstream and downstream from each service regulator as required.

3.4 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

1. Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
c. Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
d. Piping in Unfinished Service Spaces: One-piece, stamped-steel type with set screw.

e. Piping in Equipment Rooms: One-piece, cast-brass type.
f. Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
g. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

H. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials as required.

I. Verify final equipment locations for roughing-in.

J. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

K. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

L. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

M. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

N. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

a. Exception: Tubing passing horizontally through partitions or walls does not require striker barriers.

3. Prohibited Locations:

a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or ventilating ducts, or dumbwaiter or elevator shafts.
b. Do not install natural-gas piping embedded in concrete walls or partitions.

O. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

P. Connect branch piping from top or side of horizontal piping.

Q. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

R. Do not use natural-gas piping as grounding electrode.

S. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

T. Install pressure gauge upstream and downstream from each line regulator as required.

3.5 SERVICE METER ASSEMBLY INSTALLATION

A. Install service-meter assemblies aboveground, on concrete bases.

B. Install metal shutoff valves upstream from service regulators.

C. Install strainer on inlet of service-pressure regulator and meter set.

D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

F. Install service meters downstream from pressure regulators.

G. Install metal bollards to protect meter assemblies as required.

H. Install meters on full size gas headers.

3.6 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.7 HANGER & SUPPORT INSTALLATION

A. Install seismic restraints on piping as required.

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

END OF SECTION 22 70 00

SECTION 23 05 00-COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section supplements all Sections of this Division and shall apply to all phases of Work required to provide for complete installation of mechanical system.

> **NOTE:** Duct velocities shall be limited to values that ensure that the regenerated noise due to air movement is not excessive and is compliant with applicable noise criteria. Vibration isolation is recommended for all HVAC equipment. All suspended piping related to the mechanical system shall be isolated from the building structure.

1.2 QUALITY REQUIREMENTS

A. General Requirements.

1. All electrical Work performed under this Division shall be installed by competent craftsmen, skilled in the trade involved, and shall be installed in conformance with all applicable local codes.
2. Installation of all items shall be performed in strict accordance with all codes and regulations set forth by State, Local, and Federal authorities.

B. Requirements of Regulatory Agencies:

1. Codes and Ordinances.

a. All Work shall meet the requirements of local codes, ordinances, and utility companies except adhere to the Contract Documents when more strict requirements are specified.
b. Codes which govern mechanical Work in this Project are as follows:

1) California Plumbing Code
2) California Electrical Code
3) ASME Boiler Code
4) NFPA Life Safety Code l0l
5) NFPA 90A
6) NFPA l3
7) Factory Mutual Standards
8) California Mechanical Code
9) American Gas Association
10) California State Fire Marshal Regulations.
11) City of Los Angeles Mechanical Code.
12) City of Los Angeles Plumbing Code.
13) City of Los Angeles Electrical Code.
14) City of Los Angeles Building Code.

15) City of Los Angeles Fire Code.

C. Source Quality Control:

1. Manufacturer's Tests. All materials shall, so far as possible, be subjected to standard tests by the manufacturer before shipment.

1.3 SUBMITTALS

A. Shop Drawings and Product Data:

1. General requirements for all shop drawings are specified elsewhere in these specifications. Check individual sections for any specific submittal requirements.

B. Operation and Maintenance Data:

1. Maintenance Manuals.

a. Furnish two sets of maintenance manuals, each containing items specified below. Furnish manuals to LAWA before final acceptance of the mechanical Work.
b. Definitions Applicable to the Maintenance Manuals.

1) Literature. Any page (either whole or in part), sheet, drawing, or booklet describing the maintenance, operation, and parts of mechanical equipment, which is furnished either in the shipping carton, attached to the equipment, or otherwise prepared and distributed by the manufacturer for the user, not limited to papers submitted as shop drawings.
2) Mechanical Equipment. All major items shown in the Mechanical Division Drawings and Work for which shop drawings are requested except the following: thermometers, expansion tanks, air separating tanks, insulation materials, vibration isolation equipment, plumbing drains and fixture carriers, and boiler stack.
3) Instructions. An outline written by the Contractor with information necessary to help LAWA apply the maintenance manual and simplify verbal instructions.

c. Collection of "Literature." Collect "literature" in like new condition, of all pieces of "mechanical equipment" until two copies of each are obtained. Copies soiled during construction will not be accepted.
d. Assembly of "Literature."

1) Assemble "literature" in separate, multiples of two, 3-ring loose leaf binders, 2 inches (50 mm) size, with chrome-plated piano hinges and black hard coated covers.
2) Small or large "literature" not easily inserted in binders shall each be put in heavy manila envelopes.
3) Furnish each binder with plastic enclosed tabs on reinforced paper neatly arranged. Type each of the following on a separate tab.

a) Instructions
b) Valve Charts
c) Accessories
d) Lubrication
e) Testing and Balancing Reports
f) Each Specification and Title in the Project Specification for which "Literature" has been collected.

4) File "instructions" envelopes and "literature" under correct tabs. Clearly identify each piece of "literature" and envelope with equipment name and numbers.

e. Valve Charts.

1) Format. Arrange format of valve charts by rooms and sequence all valve numbers starting with mechanical equipment rooms and finishing with "occupied spaces."
2) Information. Furnish the following information typed on valve charts for each valve furnished throughout the Project in the Mechanical Division, except check valves and automatic valves.

a) Room numbers and name where valve is located, i.e. "ZG boiler room."
b) Valve number assigned by Contractor and stamped on brass plate, i.e. "l47."
c) Service medium using designation assigned to Drawings on mechanical symbols, i.e. "heating hot water supply" or "plumbing cold water."
d) Valve types as specified herein.
e) Function valve serves, i.e. "strainer shut-off" or "balancing valve."
f) Zone identification, i.e. "AHU-2" or "auxiliary heating."

3) Insert Charts in Manuals.

f. Lubrication Charts. Furnish a chart listing each lubricated piece of equipment, the proper type of oil or grease required, and recommended frequency of lubrication. Insert charts in manuals.

g. Accessories.

1) Furnish LAWA with a complete equipment accessory schedule listing each piece of equipment and the related size, type, number required, and manufacturer of the following items.

a) Filters
b) Fan Belts
c) Refrigerant Dryers

2) Insert Schedules in Manuals.

h. Insert 2 copies each of correct testing and balancing reports in manuals.

2. Instructions in Operation.

a. After all tests and adjustments have been made and the maintenance manual has been completed and given to LAWA, furnish one or more full-time qualified personnel as necessary to put the mechanical Work in continuous operation for a period of not less than two days, during which time the designated personnel's only purpose shall be to give complete operating and maintenance instructions to LAWA.

1.4 JOB CONDITIONS

A. Existing Conditions:

1. Existing Pipe Lines.

a. If any existing water, gas, or other pipes and appurtenances are encountered which interfere with the proper installation of new Work and which will not be used in connection with new Work, or existing systems, close such pipe in a proper manner, and if necessary, move or remove the pipes as directed by LAWA

b. Where existing Work is to be modified, it shall be done in conformance with the Specifications. Materials used shall be same as existing unless otherwise specified.

B. Sequencing, Scheduling:

1. Coordination of Work.

a. Plan all Work so that it proceeds with a minimum of interference with other trades. Inform the general Contractor of all openings required in the building construction for the installation of mechanical Work. Provisions shall be made for all special frames, openings, and pipe sleeves as required. The mechanical Contractor shall pay for all extra cutting and patching made necessary by his failure to properly direct such Work at the correct time.

b. Verify local utility company's inspection requirements and abide by their rights of inspection before covering or otherwise concealing any piping, wiring, or equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Electrical.

1. All motors, starters, or any other electrical components furnished or installed under the mechanical Division shall be in complete compliance with Division 26, ELECTRICAL.

2. Unless otherwise specified, all electric motors, provided under this Division shall be 60 hertz. All motors shall be single phase or 3-phase as indicated on the Drawings. Motor starters shall be as scheduled on the Drawings or specified herein. If motors appliances or apparatus are furnished varying in horsepower and/or characteristics from those specified, accommodate the change at no additional cost to LAWA.

    a. All fan and pump motors shall be of the premium efficiency type, NEMA Design A or B, continuous rated:

GUARANTEED MINIMUM FULL LOAD EFFICIENCY		
Rated HP	Nominal 1200 RPM	Nominal 1800 RPM
1	82.5	85.5
1.5	86.5	86.5
2	87.5	86.5
3	89.5	89.5
5	89.5	89.5
7.5	91.7	91.0
10	91.7	91.7
15	92.4	93.0
20	92.4	93.0
25	93.0	93.6
30	93.6	94.1
40	94.1	94.1
50	94.1	94.5
60	95.0	95.0
75	95.0	95.0
100	95.0	95.4
125	95.4	95.4
150	95.8	95.8
200	95.4	95.8

B. Electrical.

1. Raceways. Furnish UL approved rigid conduit raceways, sized in accordance with the allowable fill permitted by the National Electric Code.
2. Junction Boxes. Provide Appleton Electric Company, No. 4S-3/4 for interior use and "FS" series with cast cover and neoprene gaskets for exterior use. Size junction boxes in accordance with the allowable fill permitted by the National Electric Code.
3. Conductors. Furnish conductors conforming to UL, Fed. Specification. J-C-30, or IPCEA as applicable. Provide recently manufactured cable with guarantees and warranties initiated during the Contract period.

C. Equipment Identification.

1. Provide for each motor driven piece of equipment a "Dymo tape" identification tag, or 3M Tape shall be l/2 inch (l3 mm) wide with color and location as directed.

D. Access to Equipment.

1. All motors, valves, control devices, equipment, specialties, etc. shall be located for easy access for operation, repair and maintenance. If items are concealed, provide access doors of size required for easy access to the items.

E. List of Materials and Equipment

1. All items of material and equipment required by this section shall bear the approval of the LAWA prior to the start of any work. The Contractor shall submit all items requiring such approval, allowing ample time for checking and processing, and shall assume all responsibility for delays incurred due to rejected items. Neatly bind together submittal information covering all items into one or several packages; separate submittal of individual items not allowed. The procedure for submitting material shall be as specified herein. Within thirty (30) days after award of Contract, submit for approval, product information with at least the following minimum data for all materials, appurtenances, and equipment required under this section, including where applicable:

    a. Job name.
    b. Job location.
    c. Governing specification paragraph or subparagraphs, and governing drawing number.
    d. Dimensional information.
    e. Performance ratings, including at least the following, where applicable:

        1) Capacity in Btu per Hour.
        2) Water quantity.
        3) Entering and leaving water temperatures.
        4) Water pressure drop.
        5) Fouling factor.

    f. Pump size, RPM.
    g. Design working pressures.
    h. Motor horsepower and/or current rating; equipment current rating; voltage characteristics.
    i. Wiring diagrams for all equipment and control systems under this section requiring electrical connections.
    j. Cuts of all equipment, controls, thermometers, gauges and temperature indicators.

F. Substitutions and equal products

1. Named Manufacturers

    a. All design has been done with the first named equipment in each specification section of this Division.
    b. The first named manufacturer is the standard of quality, performance, space requirements, and coordination with other Divisions on the project.
    c. Any names beyond the first named is an acceptable manufacturer. However, being listed as an acceptable manufacturer does not imply that the manufacturer has a

product that meets or exceeds the project requirements. Contractor shall verify if these manufacturers provide items that meet or exceed the specifications.

d. All submittals of any manufacturer beyond the first named manufacturer shall be considered substitutions, shall be made in the form of substitutions, and will be reviewed as substitutions.
e. If an item is provided from a manufacturer that is not the first named, or a model number that is different from the Contract Documents, it is the Contractor's responsibility to determine that the item can be installed in the available location.

    1) Any redesign and change in installation methodology, and connections involved shall be the Contractor's responsibility, including coordination with all other trades.
    2) All costs for the changes of all trades involved shall be borne by the Contractor.
    3) Contractor shall pay for any redesign required.
    4) Contractor shall pay for and obtain any additional plan checks as a result of the substitution.
    5) Contractor shall provide dimensioned drawings of the revised installation with the submittal of the item.

PART 3 - EXECUTION

3.1 INSTALLATION/APPLICATION/PERFORMANCE/ERECTION

A. Installation:

1. General.

    a. Cooperate with all other Contractors in furnishing material and information for correct location, in proper sequence, of all sleeves, bucks, inserts, foundations, wiring, etc.
    b. All piping connections to equipment shall be made with unions or flanges to permit dismantling. Flanges and unions shall also be installed in the piping systems to permit disassembly consistent with good installation practice and as required for removal of connected equipment from place of installation.

2. All belt drives, flexible couplings, and other exposed rotating or reciprocating parts shall be covered with OSHA approved safety covers. Covers shall be permanent type and easily removable.
3. All motors and bearings shall be covered with watertight and dust-proof covers during construction period.
4. Sleeves, frames, and wall pipes shall be furnished and installed for all pipes and ducts, passing through concrete floors and walls and shall be coordinated with other trades. Special sleeves through floors and walls shall be installed in accordance with manufacturers printed instructions and as detailed.

    a. All sleeves and frames through exterior floors and walls above ground and all interior floors and walls shall be black iron pipe unless otherwise noted. Sleeves

and frames shall be of a size to accommodate the pipe or duct and insulation. Sleeves and frames shall be grouted in place with installation left smooth and finished to match surrounding surfaces.

b. Pipes passing through exterior floors and walls below ground, 3 inch (75 mm) and larger, shall utilize cast iron wall pipes unless noted or detailed otherwise. The wall pipe shall be used to convey the liquid or gas through the floor or wall without the use of sleeves. Wall pipes shall be furnished complete with end connections and adapters required to connect to the piping material. Size of wall pipe shall equal or exceed the maximum pipe size connected thereto. Wall pipes shall be integrally cast into floor or wall construction and provide the best possible seal at the exterior exposure.

c. Pipes passing through exterior floors and walls below ground, 2-1/2 inch (63 mm) and smaller, shall utilize black iron pipe sleeves as specified for aboveground in conjunction with a modular mechanical type seal as hereinafter specified.

    1) The modular mechanical type seal shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall sleeve. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. Tightening of the bolts shall cause the rubber sealing elements to expand providing a watertight seal between the pipe and wall sleeve.
    2) The required inside diameter of the sleeve and the installation of the seal shall be coordinated with the seal manufacturer to provide a watertight joint. Seals shall be "Link Seal" manufactured by Thunderline Corporation. A seal consisting of a combination of a sleeve and a pressure clamping system manufactured by O. Z. Manufacturing is acceptable.

d. Cutting of openings and installation of sleeves and frames through exterior floors and walls above grade, and interior floors and walls shall be done in a neat, workmanlike manner. Openings shall be cut only as large as required for the installation.

    1) At fire-rated floor and wall penetrations, provide penetration sealant as specified in herein.

e. Sleeves and frames at floors and walls in concealed locations and in unfinished spaces such as mechanical rooms, etc. shall extend 1 inch (25 mm) from the finished surface. All other sleeves at floors shall extend 1/4 inch (6 mm) from finished floor surface, but shall allow placement of escutcheons. All other sleeves at walls shall be installed flush with finished surface.

f. Escutcheons for exposed pipe through floors and walls where exposed to view shall be provided and shall be chromium plated except where special escutcheons are required under plumbing fixtures. Escutcheons shall be sized sufficiently to conceal the floor or wall opening and sleeve.

5. Interference.

    a. Wherever piping runs on ceilings, arrange the run of the piping in such a manner that it does not interfere with grilles, light outlets or light fixtures.

6. Valves.

    a. Valves shall be provided on all piping wherever shown or specified using adapters where required. All removable or replaceable equipment shall be valved. All valves shall have a securely fastened stamped brass metal plate each bearing a different number identified in the maintenance manual.

7. Openings in Pipes.

    a. All openings in pipes shall be kept closed during the progress of the Work.

8. Lubrication.

    a. Provide all lubrication for the operation of all equipment until substantial completion of the Project. Run in all bearings, and after they are run in, drain and flush bearings and refill with a new oil change. Refer to maintenance manual specification for lubrication chart.

3.2 ADJUSTMENT AND CLEANING

A. Safety Devices. Thoroughly check all safety devices to assure proper operation and protection.

B. Service.

1. Perform service on all mechanical Work until the date of substantial completion including oiling and greasing, adjustments, cleaning, packing of seals, and other items as recommended by equipment manufacturer in the maintenance manual hereinbefore specified.
2. Air filters.

    a. Do not operate air moving equipment having air filters unless temporary filters are in place to protect the mechanical Work.
    b. Clean or replace these temporary filters before final test and balance Work is begun as necessary for accurate readings. After completing the testing and balancing Work, replace temporary filters with new filter media as specified.

3. Strainers.

    a. Remove, clean and reinstall each strainer screen as specified below after systems have been flushed as specified in other sections of Division 23.

        1) Clean each strainer after all adjustments have been made and system has operated a minimum of 24 hours, but before final test and balancing operation is started.
        2) Clean each strainer again, after final test and balancing operation and before substantial completion of the Project.

    b. Certain screens may remain out of the strainer body after removal during the final cleaning only as directed by the LAWA.

4. Purge all air from water systems after each servicing.

    a. Protect all furnishings and finishes during each servicing operation, and repair or replace to original condition, those damaged as a result of servicing.

5. Replace insulation removed or damaged after each operation. Leave insulation as specified herein.
6. Contractor may coordinate servicing operations with LAWA's operating personnel so as to coincide with time interval specified for instruction in operation.
7. Put system in full operating condition before substantial completion of the Project.

C. Alarms. Test and adjust alarms for satisfactory operation.

D. Tests and Adjustments. Upon completion of the installation and before substantial completion of the Project, the Contractor shall make all necessary tests and adjustments to place the system in a working condition. Systems shall be balanced as specified herein. The general operating tests shall cover a period of not less than 12 hours after completion of final testing and balancing, and shall demonstrate that the entire equipment is functioning in accordance with the Specifications. Furnish all instruments, test equipment, and competent personnel that are required for the tests.

END OF SECTION 23 05 00

SECTION 23 05 16-EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flexible pipe connectors.
2. Expansion joints.
3. Expansion compensators.
4. Pipe alignment guides.
5. Pipe anchors.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.5 - Refrigeration Piping.
3. ASME B31.9 - Building Services Piping.
4. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

C. City of Los Angeles Codes.

1.3 DESIGN REQUIREMENTS

A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.

B. Expansion Compensation Design Criteria:

1. Installation Temperature: 50 degrees F.
2. Hot Water Heating System Temperature: 210 degrees F.
3. Chilled Water: 42 degrees F.

1.4 SUBMITTALS

A. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets and swing joints. Submit shop drawings sealed by a registered California Structure professional engineer.

B. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Design Data: Indicate criteria and show calculations.

D. Manufacturer's Installation Instructions: Submit special procedures.

E. Provide Manufacturer's Certificate.

F. Manufacturer’s Field Reports: Indicate results of inspection by manufacturer’s representative.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

B. Operation and Maintenance Data: Submit adjustment instructions.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

B. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS

A. Manufacturers:

1. Flexicraft.
2. Flex Hose.
3. Metraflex.

B. Steel Piping:

1. Inner Hose: Stainless Steel.
2. Exterior Sleeve: Double braided stainless steel.
3. Pressure Rating: 200 psig WOG and 250 degrees F.
4. Joint: As specified for pipe joints.
5. Size: Use pipe-sized units.
6. Maximum offset: 3/4 inch to 1 inch on each side of installed center line.

C. Copper Piping:

1. Inner Hose: Bronze.
2. Exterior Sleeve: Braided bronze.
3. Pressure Rating: 200 psig WOG and 250 degrees F.
4. Joint: As specified for pipe joints.
5. Size: Use pipe sized units.
6. Maximum offset: 3/4 inch on each side of installed center line.

2.2 EXPANSION JOINTS

A. Manufacturers:

1. Flexicraft.
2. Flex Hose.
3. Metraflex.

B. Stainless Steel Bellows Type:

1. Pressure Rating: 200 psig WOG and 250 degrees F.
2. Maximum Compression: 1-3/4 inch.
3. Maximum Extension: 1/4 inch.
4. Joint: As specified in for piping system.
5. Size: Use pipe sized units.
6. Application: Steel piping 3 inch and smaller.

C. External Ring Controlled Stainless Steel Bellows Type:

1. Pressure Rating: 200 psig WOG and 250 degrees F.
2. Maximum Compression: 15/16 inch.
3. Maximum Extension: 5/16 inch 3/8 inch.
4. Maximum Offset: 1/8 inch.
5. Joint: Flanged.
6. Size: Use pipe sized units.
7. Accessories: Internal flow liner.
8. Application: Steel piping 3 inch and larger.

2.3 ACCESSORIES

A. Pipe Alignment Guides: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.

B. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

C. Rigidly anchor pipe to building structure. Provide pipe guides to direct movement only along axis of pipe. Erect piping so strain and weight is not on cast connections or apparatus.

D. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

E. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.

3.2 MANUFACTURER'S FIELD SERVICES

A. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION 23 05 16

SECTION 23 05 23-GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gate valves.
2. Globe valves.
3. Ball valves.
4. Plug valves.
5. Butterfly valves.
6. Check valves.

1.2 REFERENCES

A. ASTM International:

1. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
2. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
3. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.

B. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 67 - Butterfly Valves.
2. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
3. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
4. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
5. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
6. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
7. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

C. City of Los Angeles Codes.

1.3 SUBMITTALS

A. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.

PART 2 - PRODUCTS

2.1 GATE VALVES

A. Manufacturers:

1. Crane.
2. Milwaukee.
3. Nibco

B. 2 inches and Smaller: MSS SP 80, Class 125, bronze body, bronze trim, threaded bonnet, rising stem, inside screw solid wedge disc, solder or threaded ends.

C. 2-1/2 inches and Larger: MSS SP 70, Class 125, cast iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.2 GLOBE VALVES

A. Manufacturers:

1. Crane
2. Milwaukee
3. Nibco

B. 2 inches and Smaller: MSS SP 80, Class 125, bronze body, bronze trim, threaded bonnet, hand wheel, Buna-N composition disc, solder or threaded ends.

C. 2-1/2 inches and Larger: MSS SP 85, Class 125, cast iron body, bronze trim, hand wheel, outside screw and yoke, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.3 BALL VALVES

A. Manufacturers:

1. Crane
2. Milwaukee
3. Nibco

B. 2 inches and Smaller: MSS SP 110, Class 150, bronze, two piece body, type 316 stainless steel ball, full port, teflon seats, blow-out proof stem, solder or threaded end and handle with balancing stops.

2.4 PLUG VALVES

A. Manufacturers:

1. **Nordstrom**
2. **Dezurik**
3. **Crane**

B. 2 inches and Smaller: MSS SP 78, Class 300, cast iron construction, round port, full pipe area, pressure lubricated, teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.

C. 2-1/2 inches and Larger: MSS SP 78, Class 300, cast iron construction, round port, full pipe area, pressure lubricated, teflon packing, flanged ends. Furnish wrench-operated or worm gear-operated.

2.5 BUTTERFLY VALVES

A. Manufacturers:

1. **Crane**
2. **Milwaukee**
3. **Nibco**

B. 2-1/2 inches and Larger: MSS SP 67, Class 200.

1. Body: Cast or ductile iron, lug or grooved ends, stainless steel stem, extended neck.
2. Disc: Aluminum bronze.
3. Seat: Resilient replaceable EPDM.
4. Handle and Operator: Infinite position lever handle with memory stop. Furnish gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.6 CHECK VALVES

A. Horizontal Swing Check Valves:

1. Manufacturers:

   a. **Crane**
   b. **Milwaukee**
   c. **Nibco**

2. 2 inches and Smaller: MSS SP 80, Class 150, bronze body and cap, bronze seat, Buna-N, solder or threaded ends.
3. 2-1/2 inches and Larger: MSS SP 71, Class 125, cast iron body, bolted cap, bronze or cast iron disc, renewable disc seal and seat, flanged ends.

B. Spring Loaded Check Valves:

1. Manufacturers:

    a. Crane.
    b. Milwaukee
    c. Nibco

2. 2 inches and Smaller: MSS SP 80, Class 250, bronze body, in-line spring lift check, silent closing, Buna-N disc, integral seat, solder or threaded ends.
3. 2-1/2 inches and Larger: MSS SP 71, Class 125, wafer style, cast iron body, bronze seat, center guided bronze disc, stainless steel spring and screws, flanged ends.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted.

B. Install valves with clearance for installation of insulation and allowing access.

C. Provide access where valves and fittings are not accessible.

3.2 VALVE APPLICATIONS

A. Install shutoff and drain valves at locations in accordance with this Section.

B. Install butterfly or gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install ball butterfly or globe valves for throttling, bypass, or manual flow control services.

D. Install spring loaded check valves on discharge of water pumps.

E. Install lug end butterfly valves adjacent to equipment when functioning to isolate equipment.

F. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly gate, or plug valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling and By-Pass Service: Globe, ball, or butterfly valves.
4. Pump-Discharge Check Valves: Center-guided silent check valves.
5. Lubricated plug valves may be used for throttling service. Non-lubricated plug valves may be used only when shut-off or isolating valves are also provided.
6. Install drain valves, with cap and chain, as noted.

    a. All applications use 3/4 inch ball or globe valves.

7. Provide 1/4 inch ball valve as gauge cocks.

G. Safety and Relief Valves:

1. Constructed, rated and stamped in accordance with ASME
   a. Install relief valves for unheated liquids.
   b. Install safety relief valves for heated liquids.
   c. Install safety valves for steam.
2. Set Pressures and Ratings:

   a. Suitable and rated for system pressure and temperature.

      1) For Safety Relief Valves: Minimum temperature rating shall be equal to saturated steam temperature corresponding to pressure 10 percent higher than valve set pressure.

   b. Set pressure; not to exceed pressure rating of protected equipment.

3. Valves to open, under test, at set pressure with following tolerance:

   a. Set pressure up to 70 psi: Plus or minus 2 psi.
   b. Set pressure, above 70 psi: Plus or minus 3 percent.

4. Capacities: Selected and sized to:

   a. Relieve maximum possible generated energy.
   b. Maintain pressure in protected equipment at not more than following:

      1) Low Pressure Boilers: 5 psi above boiler working pressure.
      2) Unfired Pressure Vessels: 10 percent above vessel working pressure.

5. Provide multiple valves if required to meet capacity requirements.

H. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

I. Select valves, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.

3.3 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, brass with brass trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, RS, bronze.
5. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
3. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, aluminum-bronze disc.
4. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.
5. Iron Swing Check Valves: Class 125, metal seats.
6. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
7. Iron, Center-Guided Check Valves: Class 125, globe, metal seat.
8. Iron Gate Valves: Class 125, OS&Y.
9. Iron Globe Valves: Class 125.
10. Lubricated Plug Valves: Class 125, regular gland, flanged.

3.4 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, brass with brass trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, RS.
5. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
3. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, aluminum-bronze disc.
4. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 CWP.
5. Iron Swing Check Valves: Class 125, metal seats.
6. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.

7. Iron, Center-Guided Check Valves: Class 125, globe, metal seat.
8. Iron Gate Valves: Class 125, OS&Y.
9. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 125.

3.5 HIGH TEMPERATURE HOT WATER VALVE SCHEDULE

A. Lubricated plug valves.

END OF SECTION 23 05 23

SECTION 23 05 29-HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Equipment curbs.
6. Sleeves.
7. Mechanical sleeve seals.
8. Formed steel channel.
9. Firestopping relating to HVAC work.
10. Firestopping accessories.
11. Equipment bases and supports.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.5 - Refrigeration Piping.
3. ASME B31.9 - Building Services Piping.

B. ASTM International:

1. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
2. ASTM E814 - Standard Test Method for Fire Tests of Through Penetration Fire Stops.
3. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

F. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

A. Firestopping Materials: To achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.

B. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to City of Los Angeles Mechanical Code and FM or UL for fire resistance ratings and surface burning characteristics.

B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

A. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.

B. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

C. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers. Submit sizing methods calculations sealed by a registered professional engineer.

E. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. B-Line Systems.
2. PHD Manufacturing.
3. Tolco Inc.

B. Hydronic Piping:

1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
9. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 4 Inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

14. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Copper-plated, carbon steel ring.

C. Refrigerant Piping:

1. Conform to ASME B31.5.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated carbon-steel ring.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

A. Manufacturers:

1. B-Line.
2. Tolco.
3. Hilti.

B. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to supportexterior piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

1. Manufacturers:

a. MIRO Industries.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.
c. Portable Pipe Hangers.

2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Manufacturers:

a. Portable Pipe Hangers.

2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.5 FLASHING

A. Metal Flashing: 26 gage thick galvanized steel.

B. Metal Counterflashing: 22 gage thick galvanized steel.

C. Lead Flashing:

1. Waterproofing: 5 lb./sq. ft sheet lead.
2. Soundproofing: 1 lb./sq. ft sheet lead.

D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.6 EQUIPMENT CURBS

A. Manufacturers: To match equipment.

2.7 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

2.8 MECHANICAL SLEEVE SEALS

A. Manufacturers:

1. Thunderline Link-Seal, Inc.
2. NMP Corporation.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.9 FORMED STEEL CHANNEL

A. Manufacturers:

1. Tolco.
2. B-Line Systems.
3. Unistrut Corp.

B. Product Description: Galvanized 12 gage) thick steel. With holes 1-1/2 inches on center.

2.10 FIRESTOPPING

A. Manufacturers:

1. Dow Corning Corp.
2. Hilti Corp.
3. 3M fire Protection Products.

2.11 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:

1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.
4. Plywood or particle board.
5. Alumina silicate fire board.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install materials to arrest liquid material leakage.

D. Obtain permission from LAWA before using powder-actuated anchors.

E. Obtain permission from LAWA before drilling or cutting structural members.

3.3 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

B. Place hangers within 12 inches of each horizontal elbow.

C. Use hangers with 1-1/2 inch minimum vertical adjustment.

D. Support vertical piping at every other floor.

E. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

F. Support riser piping independently of connected horizontal piping.

G. Design hangers for pipe movement without disengagement of supported pipe.

H. Prime coat exposed steel hangers and supports.

I. Provide clearance in hangers and from structure and other equipment for installation of insulation.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members formed steel channel steel pipe and fittings. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.6 INSTALLATION - FLASHING

A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.

C. Provide curbs for roof installations 14 inches minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing to equipment and lap base flashing on roof curbs. Flatten and solder joints.

D. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.

E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install escutcheons at finished surfaces to match surface, or chrome.

3.8 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.

D. Fire Rated Surface:

1. Seal openings.
2. Install firestopping product in accordance with manufacturer's instructions.

END OF SECTION 23 05 29

SECTION 23 05 48-VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vibration isolators.
2. Duct silencers.
3. Ductwork lagging.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.: AMCA.

B. American National Standards Institute:

1. ANSI S1.4 - Sound Level Meters.
2. ANSI S1.8 - Reference Quantities for Acoustical Levels.
3. ANSI S1.13 - Methods for the Measurement of Sound Pressure Levels in Air.
4. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.

C. Air-Conditioning and Refrigeration Institute:

1. ARI 575 - Method of Measuring Machinery Sound within Equipment Space.

D. American Society of Heating, Refrigerating and:

1. ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
2. ASHRAE Handbook - HVAC Applications.

E. ASTM International:

1. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
2. ASTM E477 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
3. ASTM E596 - Standard Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures.

F. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

G. MSS SP-127.

1.3 SUBMITTALS

A. Shop Drawings: Indicate equipment bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, material, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.

B. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.

1.4 PERFORMANCE

A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHDP, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings.

B. All anchor bolts and tie-ins to structure shall be designed for a 1.5 importance factor.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers:

1. Amber/Booth Company, Inc.
2. Mason Industries.
3. M.W. Sausse & Company (Vibrex).

B. Open Spring Isolators:

1. Spring Isolators:

   a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Furnish with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.

C. Restrained Spring Isolators:

1. Spring Isolators:

   a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Furnish with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
5. Restraint: Furnish mounting frame and limit stops.

D. Closed Spring Isolators:

1. Spring Isolators:

   a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.

2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.

E. Restrained Closed Spring Isolators:

1. Spring Isolators:

   a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.

2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.

3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.

F. Spring Hanger:

1. Spring Isolators:

a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators rubber hanger with threaded insert.
4. Misalignment: Capable of 20 degree hanger rod misalignment.

G. Neoprene Pad Isolators:

1. Rubber or neoprene-waffle pads.

a. 30 durometer.
b. Minimum 1/2 inch thick.
c. Maximum loading 40 psi.
d. Height of ribs: not to exceed 0.7 times width.

2. Configuration: Single layer. 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate.

H. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.

I. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.

J. Seismic Snubbers:

1. Type: Non-directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
2. Neoprene Elements: Replaceable, minimum of 0.75 inch thick.
3. Capacity: 4 times load assigned to mount groupings at 0.4 inch deflection.
4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.

2.2 DUCT SILENCERS

A. Manufacturers:

1. Noise Control, Inc.
2. McGill Airflow LLC.
3. Semco.

B. Description: Duct section with sheet metal outer casing, sound absorbing fill material, and inner casing of perforated sheet metal; incorporating interior baffles of similar construction.

2.3 DUCTWORK LAGGING

A. Acoustic Insulation: 2 inch thick, 3 to 5 lb/cu ft density glass fiber or mineral wool insulation.

B. Covering: Sheet lead, vinyl, or gypsum board with surface weight minimum 4 lb/sq ft.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify equipment, ductwork and piping is installed before work in this section is started.

3.2 EXISTING WORK

A. Provide access to existing piping and ductwork and other installations remaining active and requiring access.

B. Extend existing piping and ductwork installations using materials and methods compatible with existing electrical installations.

3.3 INSTALLATION

A. Support duct silencers independent of ductwork.

B. Lag ductwork by wrapping with insulation and covering. Apply covering to be airtight. Do not attach covering rigidly to ductwork.

C. Install isolation for motor driven equipment.

D. Adjust equipment level.

E. Install spring hangers without binding.

F. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

3.4 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
4. All equipment whether isolated or not, shall be bolted to structure to allow for minimum 1/2 G of acceleration.
5. All structurally suspended overhead equipment isolated or non-isolated shall be four point independently braced within Type III seismic restraining system.
6. Where base anchoring is insufficient to resist seismic forces, supplementary restraining such as seismic restraint system Type III shall be used above systems center of gravity to suitably resist "G" force levels. Vertically mounted tanks may require this additional restraint.

B. Piping Restraints:

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
2. Brace a change of direction longer than 12 feet.
3. Install Seismic Restraining System Type III: Taut for overhead suspended non-isolated equipment, piping and slack with 1/2 inch cable deflection for isolated systems.
4. Seismically restrain all piping with Type III restraining system in accordance with guideline as outlined below.
5. Install vibration isolation at all piping connected to rotating equipment and within 50 feet of each piece of equipment such as air handling units, fan coil units and computer room AC units, condensing units, exhaust fans and make-up air units.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify LAWA if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.
8. Warning Signs & Labels.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Product Data: Submit manufacturers catalog literature for each product required.

B. Samples.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Craftmark.
2. Seton.
3. Kolbi.

B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

C. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

a. Seton.
b. Brady.
c. Kolbi.

2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter square.

B. Metal Tags:

1. Manufacturers:

a. Seton.
b. Brady.
c. Kolbi.

2. Aluminum with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.

C. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum frame plastic laminated.

2.3 STENCILS

A. Manufacturers:

a. Seton.
b. Brady.
c. Kolbi.

B. Stencils: With clean cut symbols and letters of following size:

1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
4. Ductwork and Equipment: 1-3/4 inches high letters.

C. Stencil Paint: Semi-gloss enamel.

2.4 PIPE MARKERS

A. Plastic Pipe Markers:

1. Manufacturers:

a. Seton.
b. Brady.
c. Kolbi.

2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

B. Plastic Tape Pipe Markers:

1. Manufacturers:

a. Seton.
b. Brady.
c. Kolbi.

2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.5 CEILING TACKS

A. Manufacturers:

1. Seton.

2. Brady.
3. **Kolbi.**

B. Description: Steel with 3/4 inch diameter color-coded head.

C. Color code as follows:

1. HVAC equipment: Yellow.
2. Fire dampers/smoke dampers: Red.
3. Plumbing valves: Green.
4. Heating/cooling valves: Blue.

2.6 LABELS

A. Manufacturers:

1. Seton.
2. Brady.
3. Kolbi.

B. Description: Aluminum, size 1.9 x 0.75 inches, adhesive backed with printed identification.

C. Pipe Labels:

1. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
2. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

    a. NPS 5 (DN 125) and smaller: Attach to pipe without fasteners or adhesive.
    b. NPS 6 (DN 150) and larger: Attach to pipe with stainless steel spring fasteners.

3. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

    a. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
    b. Lettering Size: At least 1-1/2 inches high.

4. Maximum Temperature: Able to withstand temperatures up to 180 deg F (83 deg C).

D. Duct Labels:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: Blue.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
9. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

    a. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
    b. Lettering Size: At least 1-1/2 inches high.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers:

    a. Seton.
    b. Brady.
    c. Kolbi.

2. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

B. Valve Lockout Devices:

1. Manufacturers:

    a. Seton.
    b. Brady.
    c. Kolbi.

2. Steel device preventing access to valve operator, accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces for stencil painting.

3.2 INSTALLATION

A. Apply stencil painting.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain. Number tags consecutively by location.

END OF SECTION 23 05 53

SECTION 23 05 93-TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, adjusting, and balancing of air systems.
2. Testing, adjusting, and balancing of hydronic systems.
3. Measurement of final operating condition of HVAC systems.
4. Sound measurement of equipment operating conditions.
5. Vibration measurement of equipment operating conditions.
6. Testing, adjusting and balancing of smoke control systems.

1.2 REFERENCES

A. Associated Air Balance Council:

1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
2. ASHRAE 62.1, Section 7.2.2.
3. ASHRAE 90.1, Section 6.2.3 System Balancing.

1.3 SUBMITTALS

A. Prior to commencing Work, submit proof of latest calibration date of each instrument.

B. Test Reports: Indicate data on AABC MN-1 National Standards for Total System Balance forms.

C. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment.

D. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty.

E. Submit draft copies of report for review prior to final acceptance of Project.

F. Furnish printed reports (not hand-written) in binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced

drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Prior to commencing Work, calibrate each instrument to be used. Upon completing Work, recalibrate each instrument to assure reliability.

1.6 QUALIFICATIONS

A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum five years documented experience certified by AABC.

B. Perform Work under supervision of AABC Certified Test and Balance Engineer.

1.7 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.
3. Warranty Period: Five (5) years.

B. Special Guarantee: Provide a guarantee on AABC forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.
3. Warranty Period: Five (5) years.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify systems are complete and operable before commencing work. Verify the following:

1. Systems are started and operating in safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place or in normal position.
15. Service and balancing valves are open.
16. Drains are flushed and clean.

3.2 PREPARATION

A. Furnish instruments required for testing, adjusting, and balancing operations.

B. Make instruments available to LAWA to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 10 percent of design.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

A. Verify recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

D. Report defects and deficiencies noted during performance of services, preventing system balance.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by LAWA.

G. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.

E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes if applicable to vary fan speed. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries.

M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

N. For variable air volume system powered units set volume controller to airflow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable-air-volume temperature control.

O. On fan powered VAV boxes, adjust airflow switches for proper operation.

3.6 WATER SYSTEM PROCEDURE

A. Adjust water systems, after air balancing, to obtain design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.

C. Adjust systems to obtain prescribed pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, simulate full flow in one part by temporary restriction of flow to other parts.

3.7 PROCEDURES FOR SMOKE-CONTROL SYSTEM TESTING

A. Before testing smoke-control systems, verify that construction is complete and verify the integrity of each smoke-control zone boundary. Verify that windows and doors are closed and that applicable safing, gasket, and sealants are installed.

B. Measure and record wind speed and direction, outside-air temperature, and relative humidity on each test day.

C. Measure, adjust, and record airflow of each smoke-control system with all fans that are a part of the system.

D. Measure, adjust, and record the airflow of each fan. For ducted systems, measure the fan airflow by duct Pitot-tube traverse.

E. After air balancing is complete, perform the pressurization testing for each smoke-control zone.

F. Operational Tests:

1. Check the proper activation of each zoned smoke-control system in response to all means of activation, both automatic and manual.
2. Check automatic activation in response to fire alarm signals received from the building's fire alarm and detection system. Initiate a separate alarm for each means of activation to ensure that the proper operation of the correct zoned smoke-control system occurs.
3. Check and record the proper operation of fans, dampers, and related equipment for each separate zone of the smoke-control system.

G. Conduct additional tests required by authorities having jurisdiction. Unless required by authorities having jurisdiction, perform testing without the use of smoke or products that simulate smoke.

H. Prepare a complete report of observations, measurements, and deficiencies.

3.8 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:

1. Pumps.
2. Air Cooled Refrigerant Condensers/Condensing Units.
3. Packaged Roof Top Heating/Cooling Units.
4. Packaged Terminal Air Conditioning Units.
5. Unit Air Conditioners.
6. Computer Room Air Conditioning Units.
7. Air Coils.
8. Evaporative Humidifier.
9. Fan Coil Units.
10. Air Handling Units.
11. Fans.
12. Air Filters.
13. Air Terminal Units.
14. Air Inlets and Outlets.
15. Heat Exchangers.

B. Report Forms

1. Title Page:

a. Name of Testing, Adjusting, and Balancing Agency
b. Address of Testing, Adjusting, and Balancing Agency
c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency

d. Project name
e. Project location
f. Project Architect
g. Project Engineer
h. Project Contractor
i. Project altitude
j. Report date

2. Summary Comments:

a. Design versus final performance
b. Notable characteristics of system
c. Description of systems operation sequence
d. Summary of outdoor and exhaust flows to indicate building pressurization
e. Nomenclature used throughout report
f. Test conditions

3. Instrument List:

a. Instrument
b. Manufacturer
c. Model number
d. Serial number
e. Range
f. Calibration date

4. Electric Motors:

a. Manufacturer
b. Model/Frame
c. HP/BHP and kW
d. Phase, voltage, amperage; nameplate, actual, no load
e. RPM
f. Service factor
g. Starter size, rating, heater elements
h. Sheave Make/Size/Bore

5. V-Belt Drive:

a. Identification/location
b. Required driven RPM
c. Driven sheave, diameter and RPM
d. Belt, size and quantity
e. Motor sheave diameter and RPM
f. Center to center distance, maximum, minimum, and actual

6. Pump Data:

a. Identification/number
b. Manufacturer

c. Size/model
d. Impeller
e. Service
f. Design flow rate, pressure drop, BHP and kW
g. Actual flow rate, pressure drop, BHP and kW
h. Discharge pressure
i. Suction pressure
j. Total operating head pressure
k. Shut off, discharge and suction pressures
l. Shut off, total head pressure

7. Air Cooled Condenser/Condensing Unit:

a. Identification/number
b. Location
c. Manufacturer
d. Model number
e. Serial number
f. Entering DB air temperature, design and actual
g. Leaving DB air temperature, design and actual
h. Number of compressors

8. Heat Exchanger:

a. Identification/number
b. Location
c. Service
d. Manufacturer
e. Model number
f. Serial number
g. Steam pressure, design and actual
h. Primary water entering temperature, design and actual
i. Primary water leaving temperature, design and actual
j. Primary water flow, design and actual
k. Primary water pressure drop, design and actual
l. Secondary water leaving temperature, design and actual
m. Secondary water leaving temperature, design and actual
n. Secondary water flow, design and actual
o. Secondary water pressure drop, design and actual

9. Cooling Coil Data:

a. Identification/number
b. Location
c. Service
d. Manufacturer
e. Air flow, design and actual
f. Entering air DB temperature, design and actual
g. Entering air WB temperature, design and actual
h. Leaving air DB temperature, design and actual

i. Leaving air WB temperature, design and actual
j. Water flow, design and actual
k. Water pressure drop, design and actual
l. Entering water temperature, design and actual
m. Leaving water temperature, design and actual
n. Saturated suction temperature, design and actual
o. Air pressure drop, design and actual

10. Heating Coil Data:

    a. Identification/number
    b. Location
    c. Service
    d. Manufacturer
    e. Air flow, design and actual
    f. Water flow, design and actual
    g. Water pressure drop, design and actual
    h. Entering water temperature, design and actual
    i. Leaving water temperature, design and actual
    j. Entering air temperature, design and actual
    k. Leaving air temperature, design and actual
    l. Air pressure drop, design and actual

11. Unit Ventilator and Fan Coil Data:

    a. Manufacturer
    b. Identification/number
    c. Location
    d. Model number
    e. Size
    f. Air flow, design and actual
    g. Water flow, design and actual
    h. Water pressure drop, design and actual
    i. Entering water temperature, design and actual
    j. Leaving water temperature, design and actual
    k. Entering air temperature, design and actual
    l. Leaving air temperature, design and actual

12. Air Moving Equipment:

    a. Location
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Arrangement/Class/Discharge
    f. Air flow, specified and actual
    g. Return air flow, specified and actual
    h. Outside air flow, specified and actual
    i. Total static pressure (total external), specified and actual
    j. Inlet pressure

k. Discharge pressure
l. Sheave Make/Size/Bore
m. Number of Belts/Make/Size
n. Fan RPM

13. Return Air/Outside Air Data:

a. Identification/location
b. Design air flow
c. Actual air flow
d. Design return air flow
e. Actual return air flow
f. Design outside air flow
g. Actual outside air flow
h. Return air temperature
i. Outside air temperature
j. Required mixed air temperature
k. Actual mixed air temperature
l. Design outside/return air ratio
m. Actual outside/return air ratio

14. Exhaust Fan Data:

a. Location
b. Manufacturer
c. Model number
d. Serial number
e. Air flow, specified and actual
f. Total static pressure (total external), specified and actual
g. Inlet pressure
h. Discharge pressure
i. Sheave Make/Size/Bore
j. Number of Belts/Make/Size
k. Fan RPM

15. Duct Traverse:

a. System zone/branch
b. Duct size
c. Area
d. Design velocity
e. Design air flow
f. Test velocity
g. Test air flow
h. Duct static pressure
i. Air temperature
j. Air correction factor

16. Duct Leak Test:

a. Description of ductwork under test
b. Duct design operating pressure
c. Duct design test static pressure
d. Duct capacity, air flow
e. Maximum allowable leakage duct capacity times leak factor
f. Test apparatus

    1) Blower
    2) Orifice, tube size
    3) Orifice size
    4) Calibrated

g. Test static pressure
h. Test orifice differential pressure
i. Leakage

17. Air Monitoring Station Data:

    a. Identification/location
    b. System
    c. Size
    d. Area
    e. Design velocity
    f. Design air flow
    g. Test velocity
    h. Test air flow

18. Flow Measuring Station:

    a. Identification/number
    b. Location
    c. Size
    d. Manufacturer
    e. Model number
    f. Serial number
    g. Design Flow rate
    h. Design pressure drop
    i. Actual/final pressure drop
    j. Actual/final flow rate
    k. Station calibrated setting

19. Terminal Unit Data:

    a. Manufacturer
    b. Type, constant, variable, single, dual duct
    c. Identification/number
    d. Location
    e. Model number
    f. Size
    g. Minimum static pressure

h. Minimum design air flow
i. Maximum design air flow
j. Maximum actual air flow
k. Inlet static pressure

20. Air Distribution Test Sheet:

    a. Air terminal number
    b. Room number/location
    c. Terminal type
    d. Terminal size
    e. Area factor
    f. Design velocity
    g. Design air flow
    h. Test (final) velocity
    i. Test (final) air flow
    j. Percent of design air flow

21. Sound Level Report:

    a. Location
    b. Octave bands - equipment off
    c. Octave bands - equipment on
    d. RC level - equipment on

22. Vibration Test:

    a. Location of points:

        1) Fan bearing, drive end
        2) Fan bearing, opposite end
        3) Motor bearing, center (when applicable)
        4) Motor bearing, drive end
        5) Motor bearing, opposite end
        6) Casing (bottom or top)
        7) Casing (side)
        8) Duct after flexible connection (discharge)
        9) Duct after flexible connection (suction)

    b. Test readings:

        1) Horizontal, velocity and displacement
        2) Vertical, velocity and displacement
        3) Axial, velocity and displacement

    c. Normally acceptable readings, velocity and acceleration
    d. Unusual conditions at time of test
    e. Vibration source (when non-complying)

END OF SECTION 23 05 93

SECTION 23 07 00-HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. HVAC piping insulation, jackets and accessories.
2. HVAC ductwork insulation, jackets, and accessories.
3. Equipment Insulation, jackets and accessories.

1.2 REFERENCES

A. ASTM International:

1. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
2. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
3. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
4. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
5. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
6. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
7. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
8. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
9. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
10. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
11. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
12. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
13. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
14. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
15. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
16. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
17. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).

18. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
19. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
20. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
21. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
22. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
23. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

B. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

C. California Title 24

1. Insulation shall meet requirements of CA Title 24.

1.3 SUBMITTALS

A. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

1.4 WARRANTY

A. Furnish five year manufacturer warranty for man made fiber.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:

1. CertainTeed.
2. Johns Manville.
3. Owens-Corning.

B. Manufacturers for Closed Cell Elastomeric Insulation Products:

1. Aeroflex. Aerocell.
2. Armacell, LLC. Armaflex.
3. Nomaco. K-flex.

2.2 PIPE INSULATION

A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 850 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

B. TYPE P-2: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 850 degrees F.

C. TYPE P-3: ASTM C612; semi-rigid, fibrous glass board noncombustible, end grain adhered to jacket. Conform to ASTM C795 for application on Austenitic stainless steel.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: 0 to 650 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

D. TYPE P-4: ASTM C612; semi-rigid, fibrous glass board noncombustible. Conform to ASTM C795 for application on Austenitic stainless steel.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: 0 to 650 degrees F.

E. TYPE P-5: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: Range: Minus 70 to 180 degrees F.

F. TYPE P-6: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.30 at 75 degrees F.
2. Maximum Service Temperature: 300 degrees F.
3. Operating Temperature Range: Range: Minus 58 to 300 degrees F.

G. TYPE P-7: ASTM C534, Type I, flexible, nonhalogen, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Maximum Service Temperature: 250 degrees F.
3. Operating Temperature Range: Range: Minus 58 to 250 degrees F.

H. TYPE P-8: ASTM C547, Type I or II, mineral fiber preformed pipe insulation, noncombustible.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Maximum Service Temperature: 1200 degrees F.
3. Canvas Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric treated with fire retardant lagging adhesive.

2.3 PIPE INSULATION JACKETS

A. Vapor Retarder Jacket:

1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.

B. PVC Plastic Pipe Jacket:

1. Product Description: ASTM D1785, One piece molded type fitting covers and sheet material, off-white color.
2. Thickness: 30 mil.
3. Connections: Brush on welding adhesive with VOC content of 50 g/l according to 40 CFR 59, subpart D (EPA Method 24).

C. ABS Plastic Pipe Jacket:

1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
3. Thickness: 30 mil.
4. Connections: Brush on welding adhesive.

D. Aluminum Pipe Jacket:

1. ASTM B209.
2. Thickness: 0.2 inch thick sheet.
3. Finish: Embossed.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.2 inch thick die shaped fitting covers with factory attached protective liner.

E. Stainless Steel Pipe Jacket:

1. ASTM ASTM A240/A240M OR ASTM 666 Type 304 stainless steel.
2. Thickness: 0.016 inch thick.
3. Finish: Smooth.

F. Field Applied Glass Fiber Fabric Jacket System:

1. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
2. Glass Fiber Fabric:

    a. Cloth: Untreated; 9 oz/sq yd weight.

b. Blanket: 1.0 lb/cu ft density.

2.4 PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.

D. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.

E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with aluminum single piece construction with self-adhesive closure. Thickness to match pipe insulation.

F. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

G. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

H. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.

I. Adhesives: Compatible with insulation.

2.5 DUCTWORK INSULATION

A. TYPE D-1: ASTM C1290, Type III, flexible glass fiber, commercial grade with factory applied reinforced aluminum foil jacket meeting ASTM C1136, Type II.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Maximum Operating Temperature: 250 degrees F.
3. Density: 0.75 pound per cubic foot.

B. TYPE D-2: ASTM C612, Type IA or IB, rigid glass fiber, with factory applied all service facing meeting ASTM C1136, Type II.

1. Thermal Conductivity: 0.22 at 75 degrees F.
2. Density: 2.25 pound per cubic foot.

C. TYPE D-3: ASTM C612, Type IA or IB, rigid glass fiber, no facing.

1. Thermal Conductivity: 0.24 at 75 degrees F.
2. Density: 2.25 pound per cubic foot.

D. TYPE D-4: ASTM C1071, Type I, flexible, glass fiber duct liner with coated air side.

1. Thermal Conductivity: 0.25 at 75 degrees F.

2. Density: 1.5 pound per cubic foot.
3. Maximum Operating Temperature: 250 degrees F.
4. Maximum Air Velocity: 6,000 feet per minute.

E. TYPE D-5: ASTM C1071, Type II, rigid, glass fiber duct liner with coated air side.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Density: 3.0 pound per cubic foot.
3. Maximum Operating Temperature: 250 degrees F.
4. Maximum Air Velocity: 4,000 feet per minute.

F. TYPE D-6: ASTM C534, Type II, flexible, closed cell elastomeric insulation, sheet.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Service Temperature Range: Range: Minus 58 to 180 degrees F.

2.6 DUCTWORK INSULATION JACKETS

A. Aluminum Duct Jacket:

1. ASTM B209.
2. Thickness: 0.016 inch thick sheet.
3. Finish: Embossed.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

B. Vapor Retarder Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film 0.0032 inch vinyl.
2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
3. Secure with pressure sensitive tape.

C. Canvas Duct Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric with fire retardant lagging adhesive compatible with insulation.

D. Outdoor Duct Jacket: Asphalt impregnated and coated sheet, 36 lb/square.

2.7 DUCTWORK INSULATION ACCESSORIES

A. Vapor Retarder Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

B. Vapor Retarder Lap Adhesive: Compatible with insulation.

C. Adhesive: Waterproof, ASTM E162 fire-retardant type.

D. Liner Fasteners: Galvanized steel, self-adhesive pad with integral press-on head.

E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

F. Lagging Adhesive: Fire retardant type with maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

G. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.

H. Adhesives: Compatible with insulation.

I. Membrane Adhesives: As recommended by membrane manufacturer.

2.8 EQUIPMENT INSULATION

A. TYPE E-1: ASTM C553; glass fiber, flexible or semi-rigid, noncombustible.

1. Thermal Conductivity: 0.24 at 75 degrees F .
2. Operating Temperature Range: 0 to 450 degrees F .
3. Density: 1.5 pound per cubic foot.

B. TYPE E-2: ASTM C612; glass fiber, rigid board, noncombustible with factory applied reinforced foil kraft jacket.

1. Thermal Conductivity: 0.24 at 75 degrees F .
2. Operating Temperature Range: 0 to 450 degrees F
3. Density: 3.0 pound per cubic foot.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

C. TYPE E-3: ASTM C612; semi-rigid, fibrous glass board noncombustible, end grain adhered to jacket.

1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: 0 to 650 degrees F .
3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F .

D. TYPE E-4: ASTM C612; semi-rigid, fibrous glass board noncombustible.

1. Thermal Conductivity: 0.27 at 75 degrees F
2. Operating Temperature Range: 0 to 650 degrees F.

E. TYPE E-5: ASTM C552 Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Provide the following:

a. Cell-U-Foam Corporation; Ultra-CUF.

b. Pittsburgh Corning Corporation; Foamglas Super K.

2. Thermal Conductivity (k-value) at 75°F mean temperature is 0.27 Btu x in./hr. x ft. x degree F. or less.
3. Block Insulation: ASTM C 552, Type I.
4. Special-Shaped Insulation: ASTM C 552, Type III.
5. Board Insulation: ASTM C 552, Type IV.
6. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
7. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
8. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

F. TYPE E-7: ASTM C533; Type II, hydrous calcium silicate block insulation, asbestos free.

1. Thermal Conductivity: 0.45 at 200 degrees F
2. Operating Temperature Range: 140 to 1200 degrees F

G. TYPE E-9: ASTM C612, man made mineral fiber, noncombustible, Classes 1-4.

1. Thermal Conductivity: 0.25 at 100 degrees F
2. Maximum Service Temperature: 1200 degrees F
3. Density: 4 pound per cubic foot .

2.9 EQUIPMENT INSULATION JACKETS

A. PVC Plastic Equipment Jacket:

1. Product Description: ASTM D1785, sheet material, off-white color.
2. Minimum Service Temperature: -40 degrees
3. Maximum Service Temperature: 150 degrees F
4. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms
5. Thickness: 10 mil.
6. Connections Pressure sensitive color matching vinyl tape.

B. Aluminum Equipment Jacket:

1. ASTM B209Thickness: 0.016 inch thick sheet.
2. Finish: Smooth
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

C. Canvas Equipment Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric with fire retardant lagging adhesive compatible with insulation.

D. Vapor Retarder Jacket:

1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.

E. Field Applied Glass Fiber Fabric Jacket System:

1. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
2. Glass Fiber Fabric:

   a. Cloth: Untreated; 9 oz/sq yd weight.
   b. Blanket: 1.0 lb/cu ft density.
   c. Weave: 5 x 5.

3. Indoor Vapor Retarder Finish:

   a. Cloth: Untreated; 9 oz/sq yd weight.
   b. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.10 EQUIPMENT INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

E. Adhesives: Compatible with insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify piping, and ductwork has been tested before applying insulation materials.

B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.

B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.

C. Piping Systems Conveying Fluids Below Ambient Temperature:

1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.

D. Glass Fiber Board Insulation:

1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.

E. Hot Piping Systems less than 140 degrees F:

1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.

F. Hot Piping Systems greater than 140 degrees F:

1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
3. Insulate flanges and unions at equipment.

G. Inserts and Shields:

1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.

    a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
    b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.

3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.

H. Insulation Terminating Points:

1. Coil Branch Piping 1 inch and Smaller: Terminate hot water piping at union upstream of the coil control valve.
2. Chilled Water Coil Branch Piping: Insulate chilled water piping and associated components up to coil connection.
3. Condensate Piping: Insulate entire piping system and components to prevent condensation.

I. Closed Cell Elastomeric Insulation:

1. Push insulation on to piping.
2. Miter joints at elbows.
3. Seal seams and butt joints with manufacturer's recommended adhesive.
4. When application requires multiple layers, apply with joints staggered.
5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.

J. High Temperature Pipe Insulation:

1. Install in multiple layers to meet thickness scheduled.
2. Attach each layer with bands. Secure first layer with bands before installing next layer.
3. Stagger joints between layers.
4. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

L. Piping Exterior to Building: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.

M. Buried Piping: Insulate only where insulation manufacturer recommends insulation product may be installed in trench, tunnel or direct buried. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.

N. Heat Traced Piping Interior to Building: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer.

O. Heat Traced Piping Exterior to Building: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer. Cover with aluminum stainless steel jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water.

P. Prepare pipe insulation for finish painting.

3.3 INSTALLATION - DUCTWORK SYSTEMS

A. Insulated ductwork conveying air below ambient temperature:

1. Provide insulation with vapor retarder jackets.
2. Finish with tape and vapor retarder jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

B. Insulated ductwork conveying air above ambient temperature:

1. Provide with or without standard vapor retarder jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

C. Ductwork Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

D. External Glass Fiber Duct Insulation:

1. Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.
2. Secure insulation without vapor retarder with staples, tape, or wires.
3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
4. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

E. External Elastomeric Duct Insulation:

1. Adhere to clean oil-free surfaces with full coverage of adhesive.
2. Seal seams and butt joints with manufacturer’s recommended adhesive.
3. When application requires multiple layers, apply with joints staggered.
4. Insulate standing metal duct seams with insulation of like material and thickness as adjacent duct surface. Apply adhesive at joints with flat duct surfaces.
5. Lift ductwork off trapeze hangers and insert spacers.

F. Duct and Plenum Liner:

1. Adhere insulation with adhesive for 90 100 percent coverage.
2. Secure insulation with mechanical liner fasteners. Comply with SMACNA Standards for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.

5. Cut insulation for tight overlapped corner joints. Support top pieces of liner at edges with side pieces.

G. Ducts Exterior to Building:

1. Install insulation according to duct liner paragraph above.
2. Provide external insulation with vapor retarder jacket. Cover with outdoor jacket finished with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
3. Finish with aluminum duct jacket.
4. Calk seams at flanges and joints. Located major longitudinal seams on bottom side of horizontal duct sections.

H. Prepare duct insulation for finish painting.

3.4 INSTALLATION - EQUIPMENT

A. Factory Insulated Equipment: Do not insulate.

B. Exposed Equipment: Locate insulation and cover seams in least visible locations.

C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.

D. Equipment Containing Fluids Below Ambient Temperature:

1. Insulate entire equipment surfaces.
2. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
3. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
4. Finish insulation at supports, protrusions, and interruptions.

E. Equipment Containing Fluids 140 degrees or Less:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation.
2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
3. Finish insulation at supports, protrusions, and interruptions.

F. Equipment Containing Fluids Over 140 degrees F :

1. Insulate flanges and unions with removable sections and jackets.
2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
3. Finish insulation at supports, protrusions, and interruptions.

G. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting or PVC jacket and fitting covers.

H. Equipment Located Exterior to Building: Install vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.

I. Cover insulation with aluminum jacket.

J. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation.

K. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

3.5 SCHEDULES

A. Cooling Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Chilled Water Supply and Return 40 to 60 degrees F	P-1	1 inch and smaller 1-1/2 inches to 4 inches 5 inches and larger	1.5 1.5 3
Chilled Water Supply and Return less than 40 degrees F	P-1	3/4 inch and smaller 1 inch to 6 inches 8 inches and larger	1.5 2 3
Condensate Piping from Cooling Coils	P-5	All sizes	0.5
Refrigerant Suction	P-5	All sizes	1
Refrigerant Hot Gas	P-5	All sizes	1

B. Heating Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches

Heating Water Supply and Return 105 to 140 degrees F	P-1	2 inches and smaller 2-1/2 inches and larger	1.0 1.5
Heating Water Supply and Return 141 to 200 degrees F	P-1	2 inches and smaller 2-1/2 inches and larger	1.0 1.5
Over 200 degrees F	P-1	2 inches and smaller 2-1/2 inches and larger	1.5 3
Humidifier Supply Piping	P-1	2 inches and smaller 2-1/2 inches and larger	1.5 2
Humidifier Drain Piping	P-1	All sizes	1

C. Ductwork Insulation Schedule:

DUCTWORK SYSTEM	INSULATION TYPE	INSULATION THICKNESS inches
Combustion Air	D-2	1.5
Outside Air Intake	D-2	1.5
Equipment Casings	D-2	1.0
Supply Ducts (internally insulated)	D-4 or D-5	1.0
Return Ducts (internally insulated)	D-4 or D-5	1.0
Supply Ducts (externally insulated) Thickness indicated is installed thickness.	D-1 or D-2	1.0
Return Ducts (externally insulated) Thickness indicated is installed thickness.	D-1 or D-2	1.0
Duct Coils	D-1	1.0
Supply Air, Return Air, (exterior to building on roof)	D-2	2.0
Rectangular Supply Ducts Downstream of Variable Air Volume Boxes (internally insulated)	D-4 or D-5	1.0
Rectangular Supply Ducts Downstream of Variable Air Volume Boxes (externally insulated)	D-1 or D-2	1.5
Round Supply Ducts Downstream of Variable Air Volume Boxes (externally insulated)	D-1 or D-2	1.5

Transfer Air Ducts (internally insulated)	D-4 or D-5	1.0

D. Equipment Insulation Schedule:

EQUIPMENT SYSTEM	INSULATION TYPE	INSULATION THICKNESS inches
Chillers: Insulate cold surfaces on chillers, including, but not limited to, evaporator bundles, condenser bundles, heat-recovery bundles, suction piping, compressor inlets, tube sheets, water boxes, nozzles and other areas recommended by manufacturers	Cellular Glass (E-5) Mineral-Fiber Board (E-2, 3 ,4) Mineral-Fiber Pipe and Tank (E-9)	2 1 1
Heat-exchanger (water-to-water for cooling service) insulation	Cellular Glass (E-5) Mineral-Fiber Board (E-2, 3) Mineral-Fiber Pipe and Tank (E-9)	2 1 1
Heat-exchanger (water-to-water for heating service) insulation	Calcium Silicate (E-7) Cellular Glass (E-5) Mineral-Fiber Board (E-2,3) Mineral-Fiber Pipe and Tank (E-9)	3 3 2 2
Chilled-water pump insulation	Cellular Glass (E-5) Mineral-Fiber Board (E-2, 3)	3 2
Condenser-water pump insulation	Cellular Glass (E-5) Mineral-Fiber Board (E-2, 3)	3 2
Heating-hot-water pump insulation	Calcium Silicate (E-7) Cellular Glass (E-5) Mineral-Fiber Board (E-2) Mineral-Fiber Pipe and Tank (E-9)	3 3 2 2

Chilled-water expansion/compression tank insulation	Cellular Glass (E-5) Mineral-Fiber Board (E-2) Mineral-Fiber Pipe and Tank (E-9)	2 1 1
Heating-hot-water expansion/compression tank insulation	Cellular Glass (E-5) Mineral-Fiber Board (E-2)	3 2
Chilled-water air-separator insulation	Cellular Glass (E-5) Mineral-Fiber Board (E-2) Mineral-Fiber Pipe and Tank (E-9)	2 1 1
Condenser-water air-separator insulation	Cellular Glass (E-5) Mineral-Fiber Board (E-2) Mineral-Fiber Pipe and Tank (E-9)	2 1 1
Heating-hot-water air-separator	Cellular Glass (E-5) Mineral-Fiber Board (E-2)	3 2
Thermal storage tank (ice insulation)	Calcium Silicate (E-7)	3

END OF SECTION 23 07 00

SECTION 23 08 00-COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. HVAC commissioning description.
2. HVAC commissioning responsibilities.

1.2 REFERENCES

A. Associated Air Balance Council:

1. AABC - AABC Commissioning Guideline.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE Guideline 1 - The HVAC Commissioning Process.

C. Cal Green Building Code.

1.3 COMMISSIONING DESCRIPTION

A. HVAC commissioning process includes the following tasks:

1. Testing and startup of HVAC equipment and systems.
2. Equipment and system verification checks.
3. Assistance in functional performance testing to verify testing and balancing, and equipment and system performance.
4. Provide qualified personnel to assist in commissioning tests, including seasonal testing.
5. Complete and endorse functional performance test checklists provided by Commissioning Authority to assure equipment and systems are fully operational and ready for functional performance testing.
6. Provide equipment, materials, and labor necessary to correct deficiencies found during commissioning process to fulfill contract and warranty requirements.
7. Provide operation and maintenance information and record drawings to Commissioning Authority for review verification and organization, prior to distribution.
8. Provide assistance to Commissioning Authority to develop, edit, and document system operation descriptions.
9. Provide training for systems specified in this Section with coordination by Commissioning Authority.

B. Equipment and Systems to Be Commissioned:

1. Pumps

2. Piping systems.
3. Ductwork.
4. Variable frequency drives.
5. Packaged roof top air conditioning units.
6. Split system air conditioning units.
7. Humidifiers.
8. Air handling units.
9. Packaged heat pump units.
10. Self-contained air conditioning units.
11. Fan Coil Units.
12. Heat exchangers.
13. Computer room units.
14. Constant volume terminal units.
15. Variable volume terminal units.
16. Fans.
17. Fire dampers.
18. Smoke dampers.
19. Indoor air quality.
20. Equipment sound control – if noted on drawings.
21. Equipment vibration control – if noted on drawings.
22. Automatic temperature control system.
23. Testing, Adjusting and Balancing work.

1.4 COMMISSIONING SUBMITTALS

A. Draft Forms: Submit draft of system verification form and functional performance test checklist.

B. Test Reports: Indicate data on system verification form for each piece of equipment and system as specified. Use AABC forms as guidelines.

C. Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks equipment or system to achieve specified performance.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.

B. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with AABC and ASHRAE Guideline 1.

1.7 COMMISSIONING RESPONSIBILITIES

A. Equipment or System Installer Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Ensure temperature controls installer performs assigned commissioning responsibilities as specified below.
3. Ensure testing, adjusting, and balancing agency performs assigned commissioning responsibilities as specified.
4. Provide instructions and demonstrations for LAWA's personnel.
5. Ensure subcontractors perform assigned commissioning responsibilities.
6. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
7. Develop startup and initial checkout plan using manufacturer’s startup procedures and functional performance checklists for equipment and systems to be commissioned.
8. During verification check and startup process, execute HVAC related portions of checklists for equipment and systems to be commissioned.
9. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Authority.
10. Provide manufacturer’s representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
11. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
12. Provide personnel to assist Commissioning Authority during equipment or system verification checks and functional performance tests.
13. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
14. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
15. Provide factory supervised startup services for equipment and systems where specified. Coordinate work with manufacturer and Commissioning Authority.
16. Perform verification checks and startup on equipment and systems as specified.
17. Assist Commissioning Authority in performing functional performance tests on equipment and systems as specified.
18. Perform operation and maintenance training sessions scheduled by Commissioning Authority.
19. Conduct HVAC system orientation and inspection.

B. Temperature Controls Installer Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Review design for ability of systems to be controlled including the following:

    a. Confirm proper hardware requirements exists to perform functional performance testing.
    b. Confirm proper safeties and interlocks are included in design.

c. Confirm proper sizing of system control valves and actuators and control valve operation will result capacity control identified in Contract Documents.
d. Confirm proper sizing of system control dampers and actuators and damper operation will result in proper damper positioning.
e. Confirm sensors selected are within device ranges.
f. Review sequences of operation and obtain clarification from Architect/Engineer.
g. Indicate delineation of control between packaged controls and building automation system, listing BAS monitor points and BAS adjustable control points.
h. Provide written sequences of operation for packaged controlled equipment. Equipment manufacturers' stock sequences may be included, when accompanied by additional narrative to reflect Project conditions.

3. Inspect, check, and confirm proper operation and performance of control hardware and software provided in other HVAC sections.
4. Submit proposed procedures for performing automatic temperature control system point-to-point checks to Commissioning Authority and Architect/Engineer.
5. Inspect check and confirm correct installation and operation of automatic temperature control system input and output device operation through point-to-point checks.
6. Perform training sessions to instruct LAWA's personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan.
7. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.
8. Provide control system technician to assist during Commissioning Authority verification check and functional performance testing.
9. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.
10. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

C. Testing, Adjusting, and Balancing Agency Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Participate in verification of testing, adjusting, and balancing report for verification or diagnostic purposes. Repeat sample of percent of measurements contained in testing, adjusting, and balancing report as indicated in commissioning plan.
3. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.8 COMMISSIONING MEETINGS

A. Attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.9 SCHEDULING

A. Prepare schedule indicating anticipated start dates for the following:

1. Piping system pressure testing.

2. Piping system flushing and cleaning.
3. Ductwork cleaning.
4. Ductwork pressure testing.
5. Equipment and system startups.
6. Automatic temperature control system checkout.
7. Testing, adjusting, and balancing.
8. HVAC system orientation and inspections.
9. Operation and maintenance manual submittals.
10. Training sessions.

B. Schedule seasonal tests of equipment and systems during peak weather conditions to observe full-load performance.

C. Schedule occupancy sensitive tests of equipment and systems during conditions of both minimum and maximum occupancy or use.

1.10 COORDINATION

A. Notify Commissioning Authority minimum of four weeks in advance of the following:

1. Scheduled equipment and system startups.
2. Scheduled automatic temperature control system checkout.
3. Scheduled start of testing, adjusting, and balancing work.

B. Coordinate programming of automatic temperature control system with construction and commissioning schedules.

PART 2 - PRODUCTS

2.1 DESIGN DOCUMENT AND SUBMITTAL REVIEWS

A. General:

1. Submit design documents.

2.2 SEQUENCE OF OPERATIONS OF HVAC SYSTEM

A. General:

1. Sequences of Operation submitted shall describe in detail operation of building control system and its components. The sequences provided in the contract drawings and specifications provide a good overview, but they shall be supplemented by finalized sequences used to program the system. Sequences of operation should address all critical system interactions in detail to enable their verification and troubleshooting.
2. Control system components and hardware.

2.3 START-UP AND TESTING, ADJUSTING AND BALANCING REPORTS

A. Startup and testing reports shall be generated by the installing contractor for all equipment/systems and submittted to Contractor who provides a copy to CxA.

B. TAB reports shall be created for designated systems by a certified TAB provider and submitted to Contractor who provides a copy to CxA.

2.4 FUNCTIONAL PERFORMANCE TESTS

A. General:

1. See attached FPT samples below.

2.5 OPERATION & MAINTENANCE MANUAL AND PERSONNEL TRAINING REVIEWS

A. Submit O&M Manuals and Personnel Training Reviews.

2.6 SYSTEMS MANUAL

A. Submit Systems Manual.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install additional balancing dampers, balancing valves, access doors, test ports, and pressure and temperature taps required by Commissioning Authority or commissioning plan.

B. Place HVAC systems and equipment into full operation and continue operation during each working day of commissioning.

C. Install replacement sheaves and belts to obtain system performance, as requested by Commissioning Authority.

D. Install test holes in ductwork and plenums as requested by Commissioning Authority for taking air measurements.

E. Prior to start of functional performance test, install replacement filters in equipment.

3.2 COMMISSIONING

A. Seasonal Sensitive Functional Performance Tests (as far as possible and in consultation with LAWA:

1. Test heating equipment at winter design temperatures.
2. Test cooling equipment at summer design temperatures.

B. Be responsible to participate in initial and alternate peak season test of systems required to demonstrate performance.

C. Occupancy Sensitive Functional Performance Tests:

1. Test equipment and systems affected by occupancy variations at minimum and peak loads to observe system performance.
2. Participate in testing delayed beyond Final Completion to test performance with actual occupancy conditions.

END OF SECTION 23 08 00

SECTION 23 09 23-DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes control equipment and software.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI MC85.1 - Terminology for Automatic Control.

1.3 SYSTEM DESCRIPTION

A. Automatic temperature controls field monitoring and control system using field programmable microprocessor based units with communications to Building Automation System (BAS).

B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.

C. Provide computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.

D. Provide controls for variable air volume terminals, reheat coils, fan coils, airhandling units, condensing units, fans, etc. when directly connected to control units.

E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories to operate mechanical systems, and to perform functions specified.

F. Provide installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

1.4 SUBMITTALS

A. Shop Drawings: Indicate the following:

1. Trunk cable schematic showing programmable control-unit locations and trunk data conductors.
2. Connected data points, including connected control unit and input device.
3. System graphics showing monitored systems, data (connected and calculated) point addresses, and operator notations.

4. System configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
5. Description and sequence of operation for operating, user, and application software.
6. Use terminology in submittals conforming to ASME MC85.1.

B. Product Data: Submit data for each system component and software module.

C. Manufacturer's Installation Instructions: Submit installation instruction for each control system component.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.

1. Revise shop drawings to reflect actual installation and operating sequences.
2. Submit data specified in "Submittals" in final "Record Documents" form.

B. Operation and Maintenance Data:

1. Submit interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices. Submit paper copies in 3-ring binder and electronic copy on CD or DVD.
2. Submit keyboard illustrations and step-by-step procedures indexed for each operator function.
3. Submit inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing work of this section or at the direction of LAWA or the General Contractor.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Furnish five year manufacturer warranty for direct digital controls.

1.10 MAINTENANCE SERVICE

A. Furnish service and maintenance of control systems for two years from Date of Substantial Completion.

B. Furnish complete service of controls systems, including callbacks. Submit written report after each inspection.

C. Furnish four complete inspections per year, to inspect, calibrate, and adjust controls. Submit written report after each inspection.

D. Examine unit components during inspections. Clean, adjust, and lubricate equipment.

E. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.

F. Perform work without removing units from service during building normal occupied hours.

G. Provide emergency call back service at all hours for this maintenance period.

H. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

I. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.

J. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of LAWA.

PART 2 - PRODUCTS

2.1 DIRECT DIGITAL CONTROLS

A. Manufacturers:

1. Automated Logic.
2. Siemens.
3. Johnson Controls.

2.2 OPERATOR WORKSTATION

A. Manufacturers:

1. Dell Corporation.
2. Hewlett Packard.
3. Toshiba.

B. Furnish each operator workstation consisting of the following:

C. Personal Computer: IBM PC compatible with sufficient memory and hard drive storage to support graphics, reports, and communication requirements. Furnish with the following minimum configuration requirements:

1. Processor: Dual Core, 2.1 GHZ minimum.
2. Hard Drive: 500 Gigabyte.
3. Memory: 4 Gigabyte DDR SDRAM.
4. Drive 1: 48x CD/DVD Burner.
5. Drive 2: 48x CD-ROM, DVD combination.
6. Modem: Auto-dial telephone, 56,000 baud.
7. Ports: Required serial, parallel, network communications, for USB ports, and cables for proper system operation.
8. Expansion Slots: 1 used for LAN card, 1 available.
9. LAN Card: 10/100/1000 Gigabyte with RJ-45 connection.
10. Built-in wireless 802.11 b/g/n LAN.
11. Mouse: two-button optical type wireless.
12. Keyboard: 104 key.

D. Monitor: Minimum of 17 inch color, flat panel display.

E. Operating System: Windows 7.

F. Printer: Furnish each operator workstation with laser printer and associated cables. Color and wireless capability.

G. System Support: Minimum ten (10) work stations connected to multi-user, multi-tasking environment with concurrent capability to:

1. Access DDC network via wire ethernet and wireless.
2. Access or control same control unit.
3. Access or modify same control unit database.
4. Archive data, alarms, and network actions to hard disk regardless of what application programs are being currently executed.
5. Develop and edit database.
6. Implement and tune DDC control.
7. Develop graphics.
8. Control facility.

2.3 PORTABLE OPERATOR'S TERMINAL

A. Manufacturers:

1. Dell Corporation.
2. HP.
3. Toshiba.

B. Furnish device capable of accessing system data and capable of being connected to any point on system network or connected directly to any controller for programming, set-up, and troubleshooting. Portable Operators Terminal uses Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.8, respectively, of ASHRAE Standard 135, to communicate with BACnet objects in internetwork. Objects supported include: Analog input, analog output, analog value, binary input, binary output, binary value, device.

C. Furnish IBM compatible lap-top style PC including software and hardware required with:

1. Processor: Dual Core 2.1 GHz.
2. Hard Drive: 500 Gigabyte (minimum).
3. Memory: 4 Gigabyte DDR SDRAM.
4. Drive 1: 24x CD/DVD Burner.
5. WIFI Capable, with wireless card (internal), 802.11 b/g capable.
6. Ports: Required serial, parallel, network communications, for USB ports, and cables for proper system operation.
7. LAN Card: EtherNet - RJ45 (100 base-T minimum).
8. Mouse: two-button optical type wireless.
9. Keyboard: integral to PC.
10. Screen: Minimum 15 inch display, color.
11. Operating System: Windows 7.
12. Battery: Minimum four hour service.

2.4 CONTROL UNITS

A. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment.

B. Battery Backup: For minimum of 100 hours for complete system including RAM without interruption, with automatic battery charger.

C. Control Units Functions:

1. Monitor or control each input/output point.
2. Completely independent with hardware clock/calendar and software to maintain control independently.
3. Acquire, process, and transfer information to operator station or other control units on network.
4. Accept, process, and execute commands from other control unit's or devices or operator stations.
5. Access both data base and control functions simultaneously.

6. Record, evaluate, and report changes of state or value occurring among associated points. Continue to perform associated control functions regardless of status of network.
7. Perform in stand-alone mode:

    a. Start/stop.
    b. Duty cycling.
    c. Automatic Temperature Control.
    d. Demand control via a sliding window, predictive algorithm.
    e. Event initiated control.
    f. Calculated point.
    g. Scanning and alarm processing.
    h. Full direct digital control.
    i. Trend logging.
    j. Global communications.
    k. Maintenance scheduling.

D. Global Communications:

1. Broadcast point data onto network, making information available to other system controls units.
2. Transmit input/output points onto network for use by other control units and use data from other control units.

E. Input/output Capability:

1. Discrete/digital input (contact status).
2. Discrete/digital output.
3. Analog input.
4. Analog output.
5. Pulse input (5 pulses/second).
6. Pulse output (0-655 seconds in duration with 0.01-second resolution).

F. Monitor, control, or address data points. Include analog inputs, analog outputs, pulse inputs, pulse outputs and discrete inputs/outputs. Furnish control units with minimum 30 percent spare capacity.

G. Point Scanning: Set scan or execution speed of each point to operator selected time from 1 to 250 seconds.

H. Upload/Download Capability: Download from or upload to operator station. Upload/Download time for entire control unit database maximum 10 seconds on hard-wired LAN or 60 seconds over voice grade phone lines.

I. Test Mode Operation: Place input/output points in test mode to allow testing and developing of control algorithms on line without disrupting field hardware and controlled environment. In test mode:

1. Inhibit scanning and calculation of input points. Issue manual control to input points (set analog or digital input point to operator determined test value) from workstation.

2. Control output points but change only database state or value; leave external field hardware unchanged.
3. Enable control-actions on output points but change only data base state or value.

J. Local display and adjustment panel: Portable or Integral to control-unit containing digital display, and numerical keyboard. Display and adjust:

1. Input/output point information and status.
2. Controller set points.
3. Controller tuning constants.
4. Program execution times.
5. High and low limit values.
6. Limit differential.
7. Set/display date and time.
8. Control outputs connected to the network.
9. Automatic control outputs.
10. Perform control unit diagnostic testing.

K. Points in "Test" mode.

2.5 LOCAL AREA NETWORKS (LAN):

A. Furnish communication between control units over local area network (LAN).

B. LAN Capacity: Not less than 248 stations or nodes.

C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.

D. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.

E. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.

F. Network Support: Time for global point to be received by any station, less than 3 seconds. Furnish automatic reconfiguration when station is added or lost. In event transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

2.6 OPERATING SYSTEM SOFTWARE

A. Input/output Capability From Operator Station:

1. Request display of current values or status in tabular or graphic format.
2. Command selected equipment to specified state.
3. Initiate logs and reports.
4. Change analog limits.

5. Add, delete, or change points within each control unit or application routine.
6. Change point input/output descriptors, status, alarm descriptors, and unit descriptors.
7. Add new control units to system.
8. Modify and set up maintenance scheduling parameters.
9. Develop, modify, delete or display full range of color graphic displays.
10. Automatically archive select data even when running third party software.
11. Capability to sort and extract data from archived files and to generate custom reports.
12. Support two printer operations.
13. Alarm printer: Print alarms, operator acknowledgments, action messages, system alarms, operator sign-on and sign-off.
14. Data printer: Print reports, page prints, and data base prints.
15. Select daily, weekly or monthly as scheduled frequency to synchronize time and date in digital control units. Accommodate daylight savings time adjustments.
16. Print selected control unit database.

B. Operator System Access: Via software password with minimum 30 access levels at work station and minimum four access levels at each control unit.

C. Data Base Creation and Support: Use standard procedures for changes. Control unit automatically checks workstation data base files upon connection and verify data base match. Include the following minimum capabilities:

1. Add and delete points.
2. Modify point parameters.
3. Change, add, or delete English language descriptors.
4. Add, modify, or delete alarm limits.
5. Add, modify, or delete points in start/stop programs, trend logs, and other items.
6. Create custom relationship between points.
7. Create or modify DDC loops and parameters.
8. Create or modify override parameters.
9. Add, modify, and delete applications programs.
10. Add, delete, develop, or modify dynamic color graphic displays.

D. Dynamic Color Graphic Displays:

1. Utilizes custom symbols or system supported library of symbols.
2. Sixteen (16) colors.
3. Sixty (60) outputs of real-time live dynamic data for each graphic.
4. Dynamic graphic data.
5. 1,000 separate graphic pages.
6. Modify graphic screen refresh rate between 1 and 60 seconds.

E. Operator Station:

1. Accept data from LAN as needed without scanning entire network for updated point data.
2. Interrogate LAN for updated point data when requested.
3. Allow operator command of devices.
4. Allow operator to place specific control units in or out of service.
5. Allow parameter editing of control units.

6. Store duplicate data base for every control unit and allow down loading while system is on line.
7. Control or modify specific programs.
8. Develop, store and modify dynamic color graphics.
9. Data archiving of assigned points and support overlay graphing of this data using up to four (4) variables.

F. Alarm Processing:

1. Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state or value and alarms causing automatic dial-out.
2. Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.
3. Print on line changeable message, up to 60 characters in length, for each alarm point specified.
4. Display alarm reports on video. Display multiple alarms in order of occurrence.
5. Define time delay for equipment start-up or shutdown.
6. Allow unique routing of specific alarms.
7. Operator specifies when alarm requires acknowledgment.
8. Continue to indicate unacknowledged alarms after return to normal.
9. Alarm notification:
10. Print automatically.
11. Display indicating alarm condition.
12. Selectable audible alarm indication.

G. Event Processing: Automatically initiate commands, user defined messages, take specific control actions or change control strategy and application programs resulting from event condition. Event condition may be value crossing operator defined limit, change of state, specified state, or alarm occurrence or return to normal.

H. Automatic Restart: Automatically start field equipment on restoration of power. Furnish time delay between individual equipment restart and time of day start/stop.

I. Messages:

1. Automatically display or print user-defined message subsequent to occurrence of selected events.
2. Compose, change, or delete message.
3. Display or log message at any time.
4. Assign any message to event.

J. Reports:

1. Manually requested with time and date.
2. Long term data archiving to hard disk.
3. Automatic directives to download to transportable media including floppy diskettes for storage.
4. Data selection methods to include data base search and manipulation.
5. Data extraction with mathematical manipulation.

6. Data reports to allow development of XY curve plotting, tabular reports (both statistical and summary), and multi-point timed based plots with not less than four (4) variables displayed.
7. Generating reports either normally at operator direction, or automatically under workstation direction.
8. Either manually display or print reports. Automatically print reports on daily, weekly, monthly, yearly or scheduled basis.
9. Include capability for statistical data manipulation and extraction.
10. Capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.

K. Parameter Save/Restore: Store most current operating system, parameter changes, and modifications on disk or diskette.

L. Data Collection:

1. Automatically collect and store in disk files.
2. Daily electrical energy consumption, peak demand, and time of peak demand for up to electrical meters over 2-year period.
3. Daily consumption for up to 30 meters over a 2 year period.
4. Daily billable electrical energy consumption and time for up to 1024 zones over a 10 year period.
5. Archiving of stored data for use with system supplied custom reports.

M. Graphic Display: Support graphic development on work station with software features:

1. Page linking.
2. Generate, store, and retrieve library symbols.
3. Single or double height characters.
4. Sixty (60) dynamic points of data for each graphic page.
5. Pixel level resolution.
6. Animated graphics for discrete points.
7. Analog bar graphs.
8. Display real time value of each input or output line diagram fashion.

N. Maintenance Management:

1. Run time monitoring, for each point.
2. Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
3. Equipment safety targets.
4. Display of maintenance material and estimated labor.
5. Target point reset, for each point.

O. Advisories:

1. Summary containing status of points in locked out condition.
2. Continuous operational or not operational report of interrogation of system hardware and programmable control units for failure.
3. Report of power failure detection, time and date.

4. Report of communication failure with operator device, field interface unit, point and programmable control unit.

2.7 LOAD CONTROL PROGRAMS

A. General: Support inch-pounds and S.I. metric units of measurement.

B. Demand Limiting:

1. Monitor total power consumption for each power meter and shed associated loads automatically to reduce power consumption to an operator set maximum demand level.
2. Input: Pulse count from incoming power meter connected to pulse accumulator in control unit.
3. Forecast demand (kW): Predicted by sliding window method.
4. Automatically shed loads throughout the demand interval selecting loads with independently adjustable on and off time of between one and 255 minutes.
5. Demand Target: Minimum of 3 for each demand meter; change targets based upon (1) time, (2) status of pre-selected points, or (3) temperature.
6. Load: Assign load shed priority, minimum "ON" time and maximum "OFF" time.
7. Limits: Include control band (upper and lower limits).
8. Output advisory when loads are not available to satisfy required shed quantity, advise shed requirements and requiring operator acknowledgment.

C. Duty Cycling:

1. Periodically stop and start loads, based on space temperature, and according to various On/Off patterns.
2. Modify off portion of cycle based on operator specified comfort parameters. Maintain total cycle time by increasing on portion of cycle by equal quantity off portion is reduced.
3. Set and modify following parameters for each individual load.

    a. Minimum and maximum off time.
    b. On/Off time in one-minute increments.
    c. Time period from beginning of interval until cycling of load.
    d. Manually override the DDC program and place a load in an On or Off state.
    e. Cooling Target Temperature and Differential.
    f. Heating Target Temperature and Differential.
    g. Cycle off adjustment.

D. Automatic Time Scheduling:

1. Self-contained programs for automatic start/stop/scheduling of building loads.
2. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary day schedules.
3. Special day’s schedule supporting up to 30 unique date/duration combinations.
4. Number of loads assigned to time program; with each load having individual time program.
5. Each load assigned at least 16 control actions for each day with 1 minute resolution.
6. Furnish the following time schedule operations:

a. Start.
b. Optimized Start.
c. Stop.
d. Optimized Stop.
e. Cycle.
f. Optimized Cycle.

7. Capable of specifying minimum of 30 holiday periods up to 100 days in length for the year.
8. Create temporary schedules.
9. Broadcast temporary "special day" date and duration.

E. Start/Stop Time Optimization:

1. Perform optimized start/stop as function of outside conditions, inside conditions, or both.
2. Adaptive and self-tuning, adjusting to changing conditions unattended.
3. For each point under control, establish and modify:

a. Occupancy period.
b. Desired temperature at beginning of occupancy period.
c. Desired temperature at end of occupancy period.

F. Night Setback/Setup Program: Reduce heating space temperature set point or raise cooling space temperature set-point during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.

G. Calculated Points: Define calculations and totals computed from monitored points (analog/digital points), constants, or other calculated points.

1. Employ arithmetic, algebraic, Boolean, and special function operations.
2. Treat calculated values like any other analog value; use for any function where a "hard wired point" might be used.

H. Event Initiated Programming: Any data point capable of initiating event, causing series of controls in a sequence.

1. Define time interval between each control action between 0 to 3600 seconds.
2. Output may be analog value.
3. Provide for "skip" logic.
4. Verify completion of one action before proceeding to next action. When not verified, program capable of skipping to next action.

I. Direct Digital Control: Furnish with each control unit Direct Digital Control software so operator is capable of customizing control strategies and sequences of operation by defining appropriate control loop algorithms and choosing optimum loop parameters.

1. Control loops: Defined using "modules" are analogous to standard control devices.
2. Output: Paired or individual digital outputs for pulse width modulation, and analog outputs.
3. Firmware:

a. PID with analog or pulse-width modulation output.
b. Floating control with pulse-width modulated outputs.
c. Two-position control.
d. Primary and secondary reset schedule selector.
e. Hi/Low signal selector.
f. Single pole double-throw relay.
g. Single pole double throw time delay relay with delay before break, delay before make and interval time capabilities.

4. Direct Digital Control loop: Downloaded upon creation or on operator request. On sensor failure, program executes user defined failsafe output.
5. Display: Value or state of each of lines interconnecting DDC modules.

J. Fine Tuning Direct Digital Control PID or floating loops:

1. Display information:

a. Control loop being tuned.
b. Input (process) variable.
c. Output (control) variable.
d. Set-point of loop.
e. Proportional band.
f. Integral (reset) Interval.
g. Derivative (rate) Interval.

2. Display format: Graphic, with automatic scaling; with input and output variable superimposed on graph of "time" versus "variable".

K. Trend logging:

1. Each control unit capable of storing samples of control unit's data points.
2. Update file continuously at operator assigned intervals.
3. Automatically initiate upload requests and then stores data on hard disk.
4. Time synchronize sampling at operator specified times and intervals with sample resolution of one minute.
5. Co-ordinate sampling with specified on/off point- state.
6. Display trend samples on workstation in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time versus data.

2.8 HVAC CONTROL PROGRAMS

A. General:

1. Support Inch-pounds and S.I. metric units of measurement.
2. Identify each HVAC Control system.

B. Optimal Run Time:

1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.

2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
4. Use outside air temperature to determine early shut down with ventilation override.
5. Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
6. Operator commands:

    a. Define term schedule.
    b. Add/delete fan status point.
    c. Add/delete outside air temperature point.
    d. Add/delete mass temperature point.
    e. Define heating/cooling parameters.
    f. Define mass sensor heating/cooling parameters.
    g. Lock/unlock program.
    h. Request optimal run-time control summary.
    i. Request optimal run-time mass temperature summary.
    j. Request HVAC point summary.
    k. Request HVAC saving profile summary.

7. Control Summary:

    a. HVAC Control system begin/end status.
    b. Optimal run time lock/unlock control status.
    c. Heating/cooling mode status.
    d. Optimal run time schedule.
    e. Start/Stop times.
    f. Selected mass temperature point ID.
    g. Optimal run-time system normal start-times.
    h. Occupancy and vacancy times.
    i. Optimal run time system heating/cooling mode parameters.

8. Mass temperature summary:

    a. Mass temperature point type and ID.
    b. Desired and current mass temperature values.
    c. Calculated warm-up/cool-down time for each mass temperature.
    d. Heating/cooling season limits.
    e. Break point temperature for cooling mode analysis.

9. HVAC point summary:

    a. Control system identifier and status.
    b. Point ID and status.
    c. Outside air temperature point ID and status.
    d. Mass temperature point ID and status.
    e. Calculated optimal start and stop times.
    f. Period start.

C. Supply Air Reset:

1. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.
2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:

    a. Raising cooling temperatures to highest possible value.
    b. Reducing heating temperatures to lowest possible level.

3. Operator commands:

    a. Add/delete fan status point.
    b. Lock/unlock program.
    c. Request HVAC point summary.
    d. Add/Delete discharge controller point.
    e. Define discharge controller parameters.
    f. Add/delete air flow rate.
    g. Define space load and load parameters.
    h. Request space load summary.

4. Control summary:

    a. HVAC control system status (begin/end).
    b. Supply air reset system status.
    c. Optimal run time system status.
    d. Heating and cooling loop.
    e. High/low limits.
    f. Deadband.
    g. Response timer.
    h. Reset times.

5. Space load summary:
    a. HVAC system status.
    b. Optimal run time status.
    c. Heating/cooling loop status.
    d. Space load point ID.
    e. Current space load point value.
    f. Control heat/cool limited.
    g. Gain factor.
    h. Calculated reset values.
    i. Fan status point ID and status.
    j. Control discharge temperature point ID and status.
    k. Space load point ID and status.
    l. Airflow rate point ID and status.

D. Enthalpy Switchover:

1. Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.
2. Operator commands:

    a. Add/delete fan status point.
    b. Add/delete outside air temperature point.
    c. Add/delete discharge controller point.
    d. Define discharge controller parameters.
    e. Add/delete return air temperature point.
    f. Add/delete outside air dewpoint/humidity point.
    g. Add/delete return air dewpoint/humidity point.
    h. Add/delete damper switch.
    i. Add/delete minimum outside air.
    j. Add/delete atmospheric pressure.
    k. Add/delete heating override switch.
    l. Add/delete evaporative cooling switch.
    m. Add/delete air flow rate.
    n. Define enthalpy deadband.
    o. Lock/unlock program.
    p. Request control summary.
    q. Request HVAC point summary.

3. Control summary:

    a. HVAC control system begin/end status.
    b. Enthalpy switchover optimal system status.
    c. Optimal return time system status.
    d. Current outside air enthalpy.
    e. Calculated mixed air enthalpy.
    f. Calculated cooling cool enthalpy using outside air.
    g. Calculated cooling cool enthalpy using mixed air.
    h. Calculated enthalpy difference.
    i. Enthalpy switchover deadband.
    j. Status of damper mode switch.

2.9 PROGRAMMING APPLICATION FEATURES

A. Trend Point:

1. Sample up to 248 points, real or computed, with each point capable of collecting 8 samples at intervals specified in minutes, hours, days, or month.
2. Output trend logs as line-graphs or bar graphs. Output graphic on terminal, with each point for line and bar graphs designated with a unique pattern or color, vertical scale either actual values or percent of range, and horizontal scale time base. Print trend logs up to 12 columns of one point/column.

B. Alarm Messages:

1. Allow definition of minimum of 120 messages, each having minimum length of 60 characters for each individual message.
2. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totaled point's warning limit, hardware elements advisories.
3. Output assigned alarm with "message requiring acknowledgment".
4. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.

C. Weekly Scheduling:

1. Automatically initiate equipment or system commands, based on selected time schedule for points specified.
2. Program times for each day of week, for each point, with one minute resolution.
3. Automatically generate alarm output for points not responding to command.
4. Allow for holidays, minimum of 366 consecutive holidays.
5. Operator commands:

    a. System logs and summaries.
    b. Start of stop point.
    c. Lock or unlock control or alarm input.
    d. Add, delete, or modify analog limits and differentials.
    e. Adjust point operation position.
    f. Change point operational mode.
    g. Open or close point.
    h. Enable/disable, lock/unlock, or execute interlock sequence or computation profile.
    i. Begin or end point totals.
    j. Modify total values and limits.
    k. Access or secure point.
    l. Begin or end HVAC or load control system.
    m. Modify load parameter.
    n. Modify demand limiting and duty cycle targets.

6. Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.

D. Interlocking:

1. Permit events to occur, based on changing condition of one or more associated master points.
2. Binary contact, high/low limit of analog point or computed point capable of being used as master. Master capable of monitoring or commanding multiple slaves.
3. Operator commands:

    a. Define single master/multiple master interlock process.
    b. Define logic interlock process.
    c. Lock/unlock program.
    d. Enable/disable interlock process.
    e. Execute terminate interlock process.
    f. Request interlock type summary.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify conditioned power supply is available to control units and to operator workstation.

B. Verify field end devices and wiring are installed prior to installation proceeding.

3.2 INSTALLATION

A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

B. Install software in control units and in operator workstation. Implement features of programs to specified requirements and appropriate to sequence of operation.

C. Install with 120 volts alternating current, 15 amp dedicated emergency power circuit to each programmable control unit.

3.3 MANUFACTURER'S FIELD SERVICES

A. Start and commission systems. Allow adequate time for start-up and commissioning prior to placing control systems in permanent operation.

B. Furnish service technician employed by system installer to instruct LAWA's representative in operation of systems plant and equipment for 3 day period.

3.4 DEMONSTRATION AND TRAINING

A. Furnish basic operator training for 15 persons on data display, alarm and status descriptors, requesting data, execution commands and log requests. Include a minimum of 40 hours instructor time. Furnish training on site.

B. Demonstrate complete and operating system to LAWA.

END OF SECTION 23 09 23

SECTION 23 21 13-HYDRONIC PIPING

PART 1 -GENERAL

1.1 SUMMARY

A. Section Includes:

1. Heating water piping, above ground.
2. Chilled water piping and condenser water piping, above grade.
3. Equipment drains and over flows.
4. Unions and flanges.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B16.3 - Malleable Iron Threaded Fittings.
2. ASME B16.4 - Gray Iron Threaded Fittings.
3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
5. ASME B31.1 - Power Piping.
6. ASME B31.9 - Building Services Piping.
7. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
4. ASTM A536 - Standard Specification for Ductile Iron Castings.
5. ASTM B32 - Standard Specification for Solder Metal.
6. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
7. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

C. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
2. AWS D1.1 - Structural Welding Code - Steel.

1.3 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

B. Provide flanges, union, and couplings at locations requiring servicing. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

C. Provide pipe hangers and supports in accordance with these specifications and drawings.

D. Flexible Connectors: Use at or near pumps and motor driven equipment where piping configuration does not absorb vibration.

1.4 SUBMITTALS

A. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.

B. Welding certificates.

C. Qualification Data: For installer.

1.5 QUALITY ASSURANCE

A. Qualification for Welders: Welders performing work under this Contract shall be certified and qualified in accordance with tests prescribed by the National Certified Welding Bureau (NCWB) or by other approved test procedures using methodology and procedures covered in the ASME Boiler and Pressure Vessel Code, Section IX, "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators."

1. Submit for approval the names, identification, and welder's assigned number, letter or symbol of welders assigned to this project.
2. The assigned identification symbol shall be used to identify the work of each welder and shall be indelibly stamped immediately upon completion of each weld.
3. Welders shall be tested and certified for all positions.
4. Submit identifying stenciled test coupons made by each operator.
5. Any or all welders may be required to retake welding certification tests without additional expense.
6. When so requested, a welder shall not be permitted to work as a welder on this project until he has been recertified in accordance with NCWB.
7. Recertification of the welder shall be made after the welder has taken and passed the required tests.
8. When piping 1-1/2 in. and smaller is butt or socket welded, submit three samples of test welds for approval.

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 HEATING WATER PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53/A53M, Schedule 40, 0.375 inch wall for sizes 12 inch and larger, black.

1. Fittings: ASME B16.3, malleable iron or ASTM A234/A234M, forged steel welding type.
2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

B. Steel Pipe: ASTM A53/A53M, Schedule 40, 0.375 inch wall for sizes 12 inch and larger, black, grooved ends.

1. Fittings: ASTM A234/A234M carbon steel, grooved ends.
2. Joints: Grooved mechanical couplings meeting ASTM F1476.

a. Housing Clamps: ASTM A395/A395M and ASTM A536 ductile iron, compatible with steel piping sizes.
b. Gasket: Elastomer composition for operating temperature range from -30 degrees F to 230 degrees F.
c. Accessories: Steel bolts, nuts, and washers.

C. Copper Tubing: ASTM B88, Type L drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
2. Joints: Solder, lead free, ASTM B32, Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.

2.2 CHILLED WATER PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53/A53M, Schedule 40, 0.375 inch wall for sizes 12 inch and larger, black.

1. Fittings: ASME B16.3, malleable iron or ASTM A234/A234M, forged steel welding type.
2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

B. Steel Pipe: ASTM A53/A53M Schedule 40, black, cut rolled grooved ends.

1. Fittings: ASTM A395/A395M and ASTM A536 ductile iron, or ASTM A234/A234M carbon steel, grooved ends.
2. Joints: Grooved mechanical couplings meeting ASTM F1476.

    a. Housing Clamps: ASTM A395/A395M and ASTM A536 ductile iron, compatible with steel piping sizes, rigid type.
    b. Gasket: Elastomer composition for operating temperature range from -30 degrees F to 230 degrees F.
    c. Accessories: Steel bolts, nuts, and washers.

C. Copper Tubing: ASTM B88, Type L drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
2. Joints: Solder, lead free, ASTM B32, Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized.

1. Fittings: ASME B16.3, malleable iron or ASME B16.4, cast iron.
2. Joints: Threaded for pipe 2 inch and smaller; flanged for pipe 2-1/2 inches and larger.

B. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized, grooved ends.

1. Fittings: ASTM A395/A395M and ASTM A536 ductile iron, grooved ends.
2. Joints: Grooved mechanical couplings meeting ASTM F1476.

    a. Housing Clamps: ASTM A395/A395M and ASTM A536 ductile iron, compatible with steel piping sizes, rigid type.
    b. Gasket: Elastomer composition for operating temperature range from -30 degrees F to 230 degrees F.
    c. Accessories: Steel bolts, nuts, and washers.

C. Copper Tubing: ASTM B88, Type DWV, drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
2. Joints: Solder, lead free, ASTM B32.

2.4 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

1. Ferrous Piping: Class 150, malleable iron, threaded.
2. Copper Piping: Class 150, bronze unions with soldered joints.
3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
2. Copper Piping: Class 150, slip-on bronze flanges.
3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

PART 3 - EXECUTION

3.1 INSTALLATION - INSERTS

A. Provide inserts for placement in concrete forms.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.2 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Support horizontal piping per table - Copper & Steel.

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place hangers within 12 inches of each horizontal elbow.

D. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

E. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

F. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

3.3 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Route piping parallel to building structure and maintain gradient.

B. Install piping to conserve building space, and not interfere with use of space.

C. Group piping whenever practical at common elevations.

D. Sleeve pipe passing through partitions, walls and floors.

E. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.

F. Install pipe identification.

G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

H. Provide access where valves and fittings are not exposed.

I. Slope hydronic piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe aligned.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

K. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.

L. Install valves with stems upright or horizontal, not inverted.

M. Insulate piping as required.

3.4 FIELD QUALITY CONTROL

A. Test all piping to at least 150% of working pressure for minimum of two hours.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests on hydronic piping:

1. Verify that pipe cleaning has been completed.
2. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
3. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
4. Isolate expansion tanks and determine that hydronic system is full of water.
5. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
6. After hydrostatic test pressure has been applied for at least 2 hours, with system valves capped and pressure apparatus disconnected, and no change in test pressure, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

7. Prepare written report of testing.

3.6 ADJUSTMENT AND CLEANING

A. Cleaning:

1. During construction, prevent entry of foreign matter, clean pipe, fittings, and valves internally and hammer welds to remove all loose dirt, mill scale, metal chips, weld beads rust and harmful substances. Flush piping system with clear water prior to connection to coils, control valves and equipment. Install temporary by-pass piping around factory cleaned components such as coils, control valves and equipment where piping system is hot flushed prior to connection.
2. After erection, flush with clear water and seal ends after cleaning.
3. Water Systems:

    a. Open all valves, drains, vents and strainers at all system levels.
    b. Remove plugs, caps, spool pieces and components to facilitate early debris discharge from system.
    c. Isolate or protect clean systems components including pumps and pressure vessels and remove any component that may be damaged. Install temporary strainer where necessary.
    d. Flush bottoms of risers.
    e. After start-up flushing, fill with clean water, add products recommended by water treatment supplier to remove adherent organic soil, hydrocarbon flux, pipe mill varnish, joint compounds, rust and harmful substances not removed by initial flushing.
    f. Circulate water of each system at respective design flow rates for at least 8 hours.
    g. At end of 8 hour period, remove and clean strainers and blow off low point, then completely drain out entire systems of cleaning solution and clean out cooling tower basins and hose down for final flushing.
    h. Refill systems with clean water and circulate for an additional 4 hour period and, at the end of that interval, completely drain systems, operate all valves to dislodge debris.
    i. Drain, refill with clear water and circulate, and provide water treatment as directed by water treatment company.

4. Do not circulate water to the CUP until the CUP water treatment contractor has certified the water quality on both sides.

Copper and Steel Pipe Hanger Spacing Table

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING HANGER ROD DIAMETER Inches	STEEL PIPE HANGER ROD DIAMETER Inches
1/2	5	7	3/8	3/8
3/4	5	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	7	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8
2-1/2	9	11	1/2	1/2
3	10	12	1/2	1/2
4	12	14	1/2	5/8
5	13	16	1/2	5/8
6	14	17	5/8	3/4
8	16	19	3/4	3/4
10	18	22	3/4	7/8
12	19	23	3/4	7/8
14	22	25	7/8	1
16	23	27	7/8	1
18	25	28	1	1
20	27	30	1	1-1/4
24	28	32	1-1/4	1-1/4

END OF SECTION 23 21 13

SECTION 23 21 16-HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pressure gages.
2. Pressure gage taps.
3. Thermometers.
4. Termometer supports.
5. Test plugs.
6. Air vents.
7. Strainers.
8. Flow controls.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

B. ASTM International:

1. ASTM E1 - Standard Specification for ASTM Thermometers.
2. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

1.3 SUBMITTALS

A. Product Data: Submit for manufactured products and assemblies used in this Project.

1. Manufacturer’s data and list indicating use, operating range, total range, accuracy, and location for manufactured components.
2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
4. Submit electrical characteristics and connection requirements where appriopriate.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary protective coating on cast iron and steel valves.

B. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

A. Manufacturers:

1. **Trerice.**
2. **Peterson Equipment.**
3. **Watts Industries.**

B. Gage: ASME B40.1, UL Listed with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.

1. Case: Steel.
2. Bourdon Tube: Brass.
3. Dial Size: 2 inch diameter minimum.
4. Mid-Scale Accuracy: One percent.
5. Scale: Psi.

2.2 PRESSURE GAGE TAPS

A. Manufacturers:

1. **Trerice.**
2. **Peterson Equipment.**
3. **Watts Industries.**

B. Needle Valve: Brass, 1/4 inch NPT for minimum 300 psi.

C. Ball Valve: Brass 1/4 inch NPT for 250 psi.

D. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.

2.3 STEM TYPE THERMOMETERS

A. Manufacturers:

1. **Trerice.**
2. **Peterson Equipment.**
3. **Watts Industries.**

B. Thermometer: ASTM E1, red appearing mercury, lens front tube, cast aluminum case with enamel finish.

1. Size: 9 inch scale.
2. Window: Clear glass or Lexan.
3. Stem: Brass, 3/4 inch NPT long.
4. Accuracy: ASTM E77 2 percent.
5. Calibration: Degrees F.

C. Thermometer: ASTM E1, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.

1. Size: 9 inch scale.
2. Window: Clear glass or Lexan.
3. Stem: Brass, 3/4 inch NPT long.
4. Accuracy: ASTM E77 2 percent.
5. Calibration: Degrees F.

2.4 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions, and with cap and chain.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.5 TEST PLUGS

A. Manufacturers:

1. Trerice.
2. Peterson Equipment.
3. Watts Industries.

B. 1/4 inch NPT or 1/2 inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:

1. Neoprene core for temperatures up to 200 degrees F.
2. Nordel core for temperatures up to 350 degrees F.
3. Viton core for temperatures up to 400 degrees F.

C. Test Kit:

1. Carrying case, internally padded and fitted containing:

a. Two 2-1/2 inch diameter pressure gages.

2.6 AIR VENTS

A. Manufacturers:

1. **Trerice.**
2. **Peterson Equipment.**
3. **Watts Industries.**

B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

C. Float Type:

1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

D. Washer Type:

1. Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.7 STRAINERS

A. Manufacturers:

1. **Nibco.**
2. **Milwaukee.**
3. **Zurn-Wilkins.**

B. Size 2 inch and Smaller:

1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch:

1. Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

D. Size 5 inch and Larger:

1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.8 FLOW CONTROLS

A. Manufacturers:

1. **Griswold.**
2. **Bell & Gossett.**
3. **Flowcon.**

B. Construction: Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet combination blow-down and back-flush drain.

C. Calibration: Control within 5 percent of design flow over entire operating pressure.

D. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

E. Accessories: In-line strainer on inlet and ball valve on outlet.

PART 3 - EXECUTION

3.1 INSTALLATION - THERMOMETERS AND GAGES

A. Install one pressure gage for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.

B. Install gage taps in piping

C. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.

E. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Where thermometers are provided on local panels, pipe mounted thermometers are not required.

F. Coil and conceal excess capillary on remote element instruments.

G. Provide instruments with scale ranges selected according to service with largest appropriate scale.

H. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

I. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.2 INSTALLATION - HYDRONIC PIPING SPECIALTIES

A. Where large air quantities accumulate, provide enlarged air collection standpipes.

B. Install manual air vents at system high points.

C. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.

D. Provide drain and hose connection with valve on strainer blow down connection.

3.3 PROTECTION OF INSTALLED CONSTRUCTION

A. Do not install hydronic pressure gauges until after systems are pressure tested.

END OF SECTION 23 21 16

SECTION 23 21 23-HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. In-line circulators.
2. Close coupled pumps.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. Underwriters Laboratories Inc.:

1. UL 778 - Motor Operated Water Pumps.

1.3 PERFORMANCE REQUIREMENTS

A. Provide pumps to operate at system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.4 SUBMITTALS

A. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.

PART 2 - PRODUCTS

2.1 IN-LINE CIRCULATORS

A. Manufacturers:

1. **Bell & Gossett.**
2. **Armstrong.**
3. **Taco.**

B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 125 psig maximum working pressure.

C. Casing: Cast iron, with flanged pump connections.

D. Impeller: Stamped brass or cast bronze, keyed to shaft.

E. Bearings: Two, oil lubricated bronze sleeves.

F. Shaft: Alloy or stainless steel with copper or bronze sleeve, integral thrust collar.

G. Seal: Carbon rotating against stationary ceramic seat.

H. Drive: Flexible coupling.

GUARANTEED MINIMUM FULL LOAD EFFICIENCY OF MOTORS		
Rated HP	Nominal 1200 RPM	Nominal 1800 RPM
1	82.5	85.5
1.5	86.5	86.5
2	87.5	86.5
3	89.5	89.5
5	89.5	89.5
7.5	91.7	91.0
10	91.7	91.7
15	92.4	93.0
20	92.4	93.0
25	93.0	93.6
30	93.6	94.1
40	94.1	94.1
50	94.1	94.5
60	95.0	95.0
75	95.0	95.0
100	95.0	95.4
125	95.4	95.4
150	95.8	95.8
200	95.4	95.8

2.2 CLOSE COUPLED PUMPS

A. Manufacturers:

1. Bell & Gossett.
2. Armstrong.
3. Taco.

B. Type: Horizontal shaft, single stage, close coupled, radial split casing, for 175 psig maximum working pressure.

C. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

D. Impeller: Bronze, fully enclosed, keyed to motor shaft extension.

E. Shaft: Stainless steel.

2.3 ELECTRICAL

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled or base mounted pumps, install supports under elbows on pump suction and discharge line sizes 4 inches and over.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and larger.

D. Provide air cock and drain connection on horizontal pump casings.

E. Provide drains for bases and seals.

F. Check, align, and certify alignment of base mounted pumps prior to start-up.

G. Provide 1 year warranty.

H. Provide O & M Manuals to LAWA.

END OF SECTION 23 21 23

SECTION 23 23 00-REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Refrigerant piping.
2. Unions, flanges, and couplings.
3. Pipe hangers and supports.
4. Refrigerant moisture and liquid indicators.
5. Valves.
6. Refrigerant strainers.
7. Refrigerant pressure regulators.
8. Refrigerant pressure relief valves.
9. Refrigerant filter-driers.
10. Refrigerant solenoid valves.
11. Refrigerant expansion valves.
12. Electronic expansion valves.
13. Refrigerant receivers.
14. Underground pipe markers.
15. Bedding and cover materials.

1.2 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. ARI 495 - Refrigerant Liquid Receivers.
2. ARI 710 - Liquid-Line Driers.
3. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter Dryers.
4. ARI 750 - Thermostatic Refrigerant Expansion Valves.
5. ARI 760 - Solenoid Valves for Use with Volatile Refrigerants.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

C. American Society of Mechanical Engineers:

1. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
3. ASME B31.5 - Refrigeration Piping.
4. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

D. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
4. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
5. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
6. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.

E. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
2. AWS D1.1 - Structural Welding Code - Steel.

F. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

G. Underwriters Laboratories Inc.:

1. UL 429 - Electrically Operated Valves.

1.3 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.

B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.

C. Provide receivers on systems if recommended by equipment supplier.

D. Flexible Connectors: Use at or near compressors where piping configuration does not absorb vibration.

1.4 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-407C:

1. Suction Lines for Air-Conditioning Applications: 230 psig.
2. Suction Lines for Heat-Pump Applications: 380 psig.
3. Hot-Gas and Liquid Lines: 380 psig.

B. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

1.5 SUBMITTALS

A. Shop Drawings: Indicate layout of refrigeration piping system, including equipment, critical dimensions, and sizes.

B. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories.
2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
4. Refrigerant Specialties: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes for the following:

a. Refrigerant. Type.
b. Refrigerant moisture and liquid indicators.
c. Refrigerant strainers.
d. Refrigerant pressure regulators.
e. Refrigerant pressure relief valves.
f. Refrigerant filter-driers.
g. Refrigerant solenoid valves.
h. Refrigerant expansion valves.
i. Electronic expansion valves.

C. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

D. Test Reports: Indicate results of refrigerant leak test.

E. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.

F. Welding Certificates.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPING

A. Copper Tubing: ASTM B280, drawn.

1. Fittings: ASME B16.22 wrought copper.

2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.

2.2 UNIONS, FLANGES, AND COUPLINGS

A. 2 inches and Smaller:

1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

2.3 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. B-Line.
2. Tolco.
3. PHD.

B. Conform to ASME B31.5.

C. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron Carbon steel, adjustable swivel, split ring.

D. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.

E. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.

F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

G. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.

H. Vertical Support: Steel riser clamp.

I. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

J. Floor Support for Hot Pipe 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

K. Copper Pipe Support: Carbon steel rings, adjustable, copper plated.

L. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

M. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

N. Sheet Lead: ASTM B749.

2.4 REFRIGERANT MOISTURE AND LIQUID INDICATORS

A. Manufacturers:

1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
3. Sporlan Valve Co.

B. Indicators:

1. Port: Single or Double, UL listed.
2. Body: Copper or brass, flared or solder ends.
3. Sight glass: Color-coded paper moisture indicator with removable element cartridge and plastic cap.
4. Maximum working pressure: 500 psig
5. Maximum working temperature: 200 degrees F.

2.5 VALVES

A. Manufacturers:

1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
3. Sporlan Valve Co.

B. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet solder or flared ends.
2. Phosphor bronze and stainless steel diaphragms, rising stem and hand wheel.
3. Stainless steel spring, nylon seats, disc with positive back seating.
4. Maximum working pressure: 500 psig.
5. Maximum working temperature: 275 degrees F.

C. Packed Angle Valves:

1. Forged brass or nickel-plated forged steel, solder or flared ends.
2. Forged brass seal caps with copper gasket, rising stem and seat, molded stem packing.
3. Maximum working pressure: 500 psig.
4. Maximum working temperature: 275 degrees F.

D. Ball Valves:

1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals, soldered or threaded ends.
2. Maximum working pressure: 500 psig.
3. Maximum working temperature: 325 degrees F.

E. Service Valves:

1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends.
2. Maximum working pressure: 500 psig.

F. Refrigerant Check Valves:

1. Manufacturers:

a. Alco Controls Div, Emerson Electric Co.
b. Parker Hannifin Corp., Refrig. & Air Cond. Div.
c. Sporlan Valve Co.

2. Globe Type:

a. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc.
b. Maximum working pressure: 500 psig.
c. Maximum working temperature: 300 degrees F.

3. Straight Through Type:

a. Spring, neoprene seat.
b. Maximum working pressure: 500 psig.
c. Maximum working temperature: 250 degrees F.

2.6 REFRIGERANT STRAINERS

A. Manufacturers:

1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
3. Sporlan Valve Co.

B. Straight Line or Angle Line Type:

1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass.
2. Maximum working pressure: 430 psig.

C. Straight Line, Non-Cleanable Type:

1. Steel shell, copper plated fittings, stainless steel wire screen.

2.7 REFRIGERANT PRESSURE REGULATORS

A. Manufacturers:

1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrig. & Air Cond. Div.

3. Sporlan Valve Co.

B. Brass body, stainless steel diaphragm, direct acting or pilot operated with remote pressure pilot, adjustable over 0 to 80 psig range, for maximum working pressure of 450 psig.

2.8 REFRIGERANT PRESSURE RELIEF VALVES

A. Manufacturers:

1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
3. Sporlan Valve Co.

B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; for standard 425 psig setting; selected to ASHRAE 15.

2.9 REFRIGERANT FILTER-DRIERS

A. Manufacturers:

1. Alco Controls Div, Emerson Electric Co. Mo
2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
3. Sporlan Valve Co.

B. Replaceable Cartridge Angle Type:

1. Shell: ARI 710, UL listed, brass, steel, removable cap, for maximum working pressure of 500 psig, inches outside diameter size connections.
2. Filter Cartridge: Pleated media with integral end rings, stainless steel support, ARI 730 rating.
3. Filter/Dryer Cartridge: Pleated media with solid core sieve with activated alumina, ARI 730 rating.
4. Wax Removal Cartridge: Molded bonded core of activated charcoal with integral gaskets, ARI 710 moisture rating.

2.10 REFRIGERANT SOLENOID VALVES

A. Manufacturers:

1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
3. Sporlan Valve Co.

B. Valve: ARI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly, integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psig. Stem designed to allow manual operation in case of coil failure.

C. Coil Assembly: UL 429 listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box.

2.11 REFRIGERANT EXPANSION VALVES

A. Manufacturers:

1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
3. Sporlan Valve Co.

B. Angle or Straight Through Type: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer.

C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and oversized at part load.

2.12 ELECTRONIC EXPANSION VALVES

A. Manufacturers:

1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrig. & Air Cond. Div.
3. Sporlan Valve Co.

B. Valve:

1. Brass bodies with flared or solder connection, needle valve with floating needle and machined seat, stepper motor drive.
2. Capacity: Nominal as shown on drawings.

C. Evaporation Control System:

1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, pre-selection allowance for electrical defrost and hot gas bypass.

D. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

2.13 REFRIGERANT RECEIVERS

A. Internal Diameter 6 inch and Smaller: ARI 495, UL listed, steel, brazed; 400 psig maximum pressure rating, with taps for inlet, outlet, and pressure relief valve.

B. Internal Diameter 6 inch and Larger: ARI 495, welded steel, tested and stamped in accordance with ASME Section VIII; 400 psig with taps for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.

PART 3 - EXECUTION

3.1 INSTALLATION - INSERTS

A. Provide inserts for placement in concrete forms.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.2 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

B. Place hangers within 12 inches of each horizontal elbow.

C. Install hangers to allow 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

D. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

E. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.

F. Prime coat exposed steel hangers and supports in accordance with specifications herein. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

3.3 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Route piping parallel to building structure and maintain gradient.

B. Install piping to conserve building space, and not interfere with use of space.

C. Group piping whenever practical at common elevations.

D. Provide sleeve for pipe passing through partitions, walls and floors.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Provide access where valves and fittings are not exposed.

G. Arrange refrigerant piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

H. Flood refrigerant piping system with nitrogen when brazing.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

J. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.

K. Install valves with stems upright or horizontal, not inverted.

L. Insulate piping and equipment per these specifications.

M. Provide replaceable cartridge filter-dryers, with isolation valves and bypass with valve.

N. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

O. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

P. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

Q. Provide electrical connection to solenoid valves.

R. Fully charge completed system with refrigerant after testing.

S. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

T. Install insulation as required.

3.4 INSTALLATION - REFRIGERANT SPECIALTIES

A. Refrigerant Liquid Indicators:

1. Install line size liquid indicators in main liquid line downstream of condenser.

2. When receiver is provided, install line size liquid indicators in liquid line downstream of receiver.
3. Install line size liquid indicators downstream of liquid solenoid valves.

B. Refrigerant Valves:

1. Install service valves on compressor suction and discharge.
2. Install gage taps at compressor inlet and outlet.
3. Install gage taps at hot gas bypass regulators, inlet and outlet.
4. Install check valves on compressor discharge.
5. Install check valves on condenser liquid lines on multiple condenser systems.
6. Install refrigerant charging valve in liquid line between receiver shut-off valve and expansion valve.

C. Strainers:

1. Install line size strainer upstream of each automatic valve.
2. Where multiple expansion valves with integral strainers are used, install single main liquid-line strainer.
3. On steel piping systems, install strainer in suction line.
4. Install shut-off valves on each side of strainer.

D. Install pressure relief valves on ASME receivers. Install relief valve discharge piping to terminate outdoors.

E. Filter-Dryers:

1. Install permanent filter-dryers in low temperature systems.
2. Install permanent filter-dryer in systems containing hermetic compressors.
3. Install replaceable cartridge filter-dryer vertically in liquid line adjacent to receivers.
4. Install replaceable cartridge filter-dryer upstream of each solenoid valve.

F. Solenoid Valves:

1. Install in liquid line of systems operating with single pump-out or pump-down compressor control.
2. Install in liquid line of single or multiple evaporator systems.
3. Install in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

3.5 FIELD QUALITY CONTROL

A. Test refrigeration system in accordance with ASME B31.5.

B. Pressure test refrigeration system with dry nitrogen to 200 psig.

C. Repair leaks.

D. Retest until no leaks are detected.

END OF SECTION 23 23 00

SECTION 23 25 00-HVAC WATER TREATMENT

PART 1 -GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. HVAC water-treatment systems.
2. Chemical treatment test equipment.
3. HVAC water-treatment chemicals.

1.2 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available, HVAC system equipment material characteristics and functional performance characteristics.

C. Provide temporary water treatment for chilled, hot and condenser water until facility has final connections.

D. After connection to the Central Utilities Plant direct connected systems (chilled water and high temperature hot water), those systems will be treated from the Central Plant. Provide ongoing annual water treatment for the hot water heating system. Treatment shall consist of monthly site visits with analysis of water conditions and adjustment of chemical treatment to maintain specified levels. In glycol systems, glycol concentration, inhibitors and reserve alkalinity, as recommended by the glycol manufacturer.

E. Closed hydronic systems, including low temperature, hot-water heating, chilled water and glycol cooling and/or heating, shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. Turbidity: Maintain a value less than 15 NTU.
3. Boron: Maintain a value within 100 to 200 ppm.
4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. TDS: Maintain a maximum value of 3000 ppm.
7. Ammonia: Maintain a maximum value of 5 ppm.
8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
9. Microbiological Limits:

    a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
    b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
    c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.

d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

10. Treatment:

a. Low temperature hot water, closed cooling and chilled water -Mixture of sodium nitrite, borax and molybdate with other copper alloy inhibitor; non-oxidizing, non cationic biocide.
b. Glycol low temperature – Ethylene glycol with buffered phosphate based corrosion inhibitor with copper alloy inhibitor in deionized water, if water chloride levels are 750 ppm and contains hard water ions.

F. Open hydronic systems, including condenser water, shall have the following water qualities:

1. pH: Maintain a value within 7.0 to 9.0.
2. Langelier Saturation Index: Maintain a maximum value of +2.5 ppm.
3. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
4. Soluble Copper: Maintain a maximum value of 0.20 ppm.
5. Conductivity: Maintain a maximum value of 1500 uS/cm.
6. Ammonia: Maintain a maximum value of 20 ppm.
7. Free "OH" Alkalinity: Maintain a maximum value of 0 ppm
8. Silica: Maintain a maximum value of 125 ppm
9. Microbiological Limits:

a. Total Aerobic Plate Count: Maintain a maximum value of 10,000 organisms/ml.
b. Total Anaerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

10. Polymer Testable: Maintain a minimum value within 10 to 40.
11. Treatment: organic phosphonate and polymeric dispersant with copper alloy inhibitor, or other chromate- free treatment in liquid form; suitable for pumping from containers directly to water system.

a. Alternate two biocides, one oxidizer and one non-oxidizer; increase dosage when significant amount of algae or slime are detected after system operations.
b. Compounds of mercury, copper or arsenic shall not be permitted.

12. Bleed off:

a. Automatic control by condenser water conductivity and water meter signals.
b. To maintain maximum chloride concentration to 7 times concentration of make-up water to minimize corrosion and scale formation.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:

1. Water meters.
2. Inhibitor injection timers.
3. pH controllers.
4. TDS controllers.
5. Chemical solution tanks.
6. Injection pumps.
7. Chemical test equipment.
8. Chemical material safety data sheets.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.

1. Record actual locations of equipment and piping, including sampling points and locations of chemical injectors.
2. Wiring Diagrams: Power and control wiring.

C. Field quality-control test reports to indicate inhibitor levels, pH, conductivity, equipment conditions, chemical inventory and water usage data.

D. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

E. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
2. Water Analysis: Illustrate water quality available at Project site.
3. Certification of compliance: Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposal disposal.

1.4 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider with certified water technologists, capable of analyzing water qualities, installing water-treatment equipment.

1.5 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, chilled-water piping, heating, hot-water piping, condenser-water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:

1. Initial makeup and system water analysis with HVAC water-treatment recommendations.

2. Startup assistance for Contractor to flush the systems, clean with disinfectant detergents, and initially fill systems with required chemical treatment prior to operation.
3. Minimum 4 hours of on-site training of plant engineers to use water treatment equipment, to handle and administer treatment chemicals.
4. Monthly field service and consultation.
5. Customer report charts and log sheets.
6. Laboratory technical analysis.
7. Analyses and reports of all chemical items concerning safety and compliance with government regulations.
8. Summary review reports with graphs every six months.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following airport wide water treatment vendor:

1. ONDEO Nalco Company.

2.2 AUTOMATIC CHEMICAL-FEED EQUIPMENT

A. Inhibitor Injection Timers:

1. Microprocessor-based controller with LCD display in NEMA 4X, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at BAS.
2. Programmable timers with infinite adjustment over full range, and mounted in cabinet with hand-off-auto switches and status lights.
3. Test switch.
4. Hand-off-auto switch for chemical pump.
5. Illuminated legend to indicate feed when pump is activated.
6. Programmable lockout timer with indicator light. Lockout timer to deactivate the pump and activate alarm circuits.
7. LCD makeup totalizer to measure amount of makeup and bleed-off water from two water meter inputs.
8. Timer mode includes: Choice of percent timer, water meter timer, limit timer and 28-day programmable timer.

B. pH Integral Controller:

1. Microprocessor-based controller, 1 percent accuracy in a range from zero to 14 units. Incorporate solid-state integrated circuits and digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at BAS.
2. Digital display and touch pad for input.
3. Sensor probe adaptable to sample stream manifold.
4. High, low, and normal pH indication.

5. High or low pH alarm light, trip points field adjustable; with silence switch.
6. Hand-off-auto switch for acid pump.
7. Internal adjustable hysteresis or deadband.

C. Chemical Solution Tanks:

1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
2. Molded cover with recess for mounting pump.
3. Capacity: 30 gal. (114 L).

D. Chemical Solution Injection Pumps:

1. Self-priming, positive-displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
2. Adjustable flow rate.
3. Metal and thermoplastic construction.
4. Built-in relief valve.
5. Fully enclosed, continuous-duty, single-phase motor.

E. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints except ASTM A 269, Type 304, stainless steel for steam boiler injection assemblies.

F. Injection Assembly:

1. Quill: Minimum NPS 1/2 (DN 15) with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
2. Ball Valve: Two-piece, stainless steel.
3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
4. Assembly Pressure/Temperature Rating: Minimum 600 psig (4137 kPa) at 200 deg F (93 deg C).
5. Materials of construction: Stainless steel 316, Nickel alloy, Carpenter 20, PVC.

G. Fail-Safes and Alarms

1. Corrosion safety interlock: Alarm indication, lock-out all chemical feed, open bleed-off valve to flush corrosive water from system.
2. PH interlock: Alarm indication, lock-out all chemical feed, open bleed-off valve to reduce total dissolved solids in cooling tower water.
3. Flow interlock (on loss of flow): Alarm indication, lock-out all control outputs and chemical feeds.

H. Low Level Alarms

1. Low level alarm system to monitor chemical solution level in inhibitor, ph modifier (acid or alkali), biocide, and dispersant drums.
2. Alarm probes, suitable for use in 55 gal (207 L) drum and connected with flexible cable.
3. Signal output suitable for remote alarm function in addition to local alarm.

2.3 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, phosphate, silica and hardness; sulfite, diethylhydorxylamine, hydroquinone, ketoximes and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.

B. Sample Cooler:
   1. Shell: Cooling water.

      a. Material: ASTM A 666, Type 304 stainless steel.
      b. Pressure Rating: Minimum 250 psig (1725 kPa).
      c. Temperature Rating: Minimum 450 deg F (232 deg C).

   2. Capacities and Characteristics:

      a. Tube: Sample.

         1) Flow Rate: 0.25 gpm (0.016 L/s).
         2) Entering Temperature: 400 deg F (204 deg C).
         3) Leaving Temperature: 88 deg F (31 deg C).
         4) Pressure Loss: 6.5 psig (44.8 kPa).

      b. Shell: Cooling water.

         1) Flow Rate: 3 gpm (0.19 L/s).
         2) Entering Temperature: 70 deg F (21 deg C).
         3) Pressure Loss: 1.0 psig (6.89 kPa).

C. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons in accordance with ASTM D2688. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.

   1. Two-station rack for closed-loop systems.
   2. Four-station rack for open systems.

2.4 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified herein.

2.5 GLYCOL SYSTEMS – HEATING AND COOLING

A. Use "Environmentally Friendly" glycol.

B. Coordinate compatibility of glycol with materials used in piping, valves, equipment and accessories.

C. Provide glycol feed system.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure.

C. Install water testing equipment on wall near water chemical application equipment.

D. Install interconnecting control wiring for chemical treatment controls and sensors.

E. Mount sensors and injectors in piping circuits.

F. Install automatic chemical-feed equipment for condenser water and include the following:

1. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.

    a. Pumps shall operate for timed interval on contact closure at water meter in makeup water supply connection. Injection pump shall discharge into condenser water piping.

2. Install test equipment and provide test-kit to LAWA. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
3. Install TDS controller with sensor and bleed valves.

    a. Bleed valves shall cycle to maintain maximum TDS concentration.

4. Install pH, conductivity and orp sensors with integral controller, injection pumps and solution tanks.

    a. Injector pumps shall operate to maintain required pH and orp.

5. Install biocide feeder alternating timer with two sets of injection pumps and solution tanks.

    a. Injection pumps shall operate to feed biocide on an alternating basis.

G. Install corrosion resistant drip pan, a minimum of 3 in (75 mm) high, under tanks and pumps. Intent is to contain minor leaks.

3.3 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.

B. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings.

C. Install unions, shutoff valves on HVAC water-treatment equipment inlet and outlet.

D. Provide backflow preventers.

E. Provide appropriate equipment grounding.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Install and retrieve corrosion coupons every 90 days to generate quarterly reports on corrosion rates of steel and copper with photographic images of the coupons.

C. Tests and Inspections:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
7. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test

source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.

8. Repair leaks and defects with new materials and retest piping until no leaks exist.

D. Remove and replace malfunctioning units and retest as specified above.

E. At four-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified herein. Submit written reports of water analysis advising LAWA of changes necessary.

F. Comply with ASTM D 3370 and with the following standards:

1. Silica: ASTM D 859.
2. Acidity and Alkalinity: ASTM D 1067.
3. Iron: ASTM D 1068.
4. Water Hardness: ASTM D 1126.
5. Chloride: ASTM D4458
6. Copper: ASTM D1688
7. pH: ASTM D5464

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

B. Training: Provide a minimum of 4 hours of training on handling and testing of treatment chemicals with "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

3.6 FINAL CONNECTION TO SITE UTILITIES

A. Do not circulate any water from the site chilled and high temperature hot water mains until the CUP water treatment contractor has certified the water quality of both sides of the site utility isolation valves.

B. After connection to plant utilities are achieved remove temporary bypass pipes and cap.

END OF SECTION 23 25 00

SECTION 23 31 00-HVAC DUCTS AND CASINGS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Flush flat seam rectangular ducts and fittings.
4. Sheet metal materials.
5. Flexible Ducts.
6. Insulated flexible ducts.
7. Casings.
8. Duct Sealants and Gaskets.
9. Hangers and Supports
10. Seismic Restraint Devices.

1.2 REFERENCES

A. ASTM International: Provide appropriate references.

B. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

C. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Air Duct Leakage Test Manual.
2. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

D. Underwriters Laboratories Inc.:

1. UL 181 - Factory-Made Air Ducts and Connectors.

E. City of Los Angeles codes.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with the latest edition of the City of Los Angeles Mechanical Code and SMACNA's "HVAC Duct Construction Standards -

Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" section of this specification.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in the California Building Code to meet a 1.5 importance factor. Subject to compliance, SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems" may be followed.

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48. Refer to structural specification for additional seismic forces and allowable movement.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Sealants and gaskets.
2. Other factory made items specified herein.

B. LEED Submittals:

1. Product Data for Prerequisite EQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."
3. Leakage Test Report for Prerequisite EA 2: Documentation of work performed for compliance with ASHRAE/IESNA 90.1-2004, Section 6.4.4.2.2 - "Duct Leakage Tests."
4. Duct-Cleaning Test Report for Prerequisite IEQ 1: Documentation of work performed for compliance with ASHRAE 62.1-2004, Section 7.2.4 - "Ventilation System Start-Up."
5. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
3. Elevation of top and bottom of ducts.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Penetrations through fire-rated and other partitions.
7. Equipment installation based on equipment being used on Project, including curbs and bases.
8. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

D. Delegated-Design Submittal:

1. Factory- and shop-fabricated ducts and fittings min. scale 1/4".
2. Reinforcement and spacing.
3. Seam and joint construction.
4. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
5. Sheet metal thicknesses.
6. Joint and seam construction and sealing.
7. Reinforcement details and spacing.
8. Materials, fabrication, assembly, and spacing of hangers and supports.
9. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

E. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

F. Welding certificates.

G. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.

3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Rectangular Duct Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. McGill AirFlow LLC.
b. SEMCO Incorporated.
c. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Seams - Round Duct and Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 FLUSH FLAT SEAM RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class, except use sheet metal 2 gauge numbers heavier than required for classification with normal standing seam construction.

B. Transverse Joints: Fabricate joints in accordance with transverse joint detail shown on drawings. Provide all joints and seams, smooth, and alighted with no projections. In other aspects conform to SMACNA’s “HVAC Duct Construction Standards” for applicable sealing requirements, duct-support intervals and other provisions.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Install ducts with longitudinal seams at lop of ducts.

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Rectangular Duct Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Reinforcing: Install vertical stays for interval reinforcement at transverse joints and at 2 foot intervals along run of duct, as follows:

1. Ducts up to 60 inches wide: Provide 1 vertical stay at mid-point of duct.
2. Ducts 61 inches to 90 inches wide: Provide 2 vertical stays at third points of duct.
3. Ducts over 90 inches wide: Provide 3 vertical stays at quarter points of duct.
4. Vertical Stays: 10 USSG galvanized steel, free of burrs and rough edges, with both ends bent and fastened to the top and bottom of ducts.

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with the City of Los Angeles Mechanical Code and SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.5 FLEXIBLE DUCTS

A. Manufacturers:

1. Flexmaster USA, Inc.
2. McGill AirFlow LLC.
3. Ward Industries; a division of Hart & Cooley Inc.

B. Product Description: Two ply vinyl film supported by helical wound spring steel wire.

1. Pressure Rating: 10 inches wg positive and 1.0 inches wg negative.
2. Maximum Velocity: 4000 fpm.

3. Temperature Range: -10 degrees F to 160 degrees F.

2.6 INSULATED FLEXIBLE DUCTS

A. Manufacturers:

1. Flexmaster USA, Inc.
2. McGill AirFlow LLC.
3. Ward Industries; a division of Hart & Cooley Inc.

B. Product Description: Two ply vinyl film supported by helical wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.

1. Pressure Rating: 10 inches wg positive and 1.0 inches wg negative.
2. Maximum Velocity: 4000 fpm.
3. Temperature Range: -10 degrees F to 160 degrees F.
4. Thermal Resistance: Comply with ASHRAE 90.1-2004 or most recent version.

2.7 CASINGS

A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and construct for required operating pressures.

B. Reinforce access door frames with steel angles tied to horizontal and vertical plenum supporting angles. Furnish hinged access doors where indicated or required for access to equipment for cleaning and inspection. Furnish clear wire glass observation ports, minimum 6 x 6 inch size.

C. Fabricate acoustic casings with reinforcing turned inward. Furnish 16 gage back facing and 22 gage perforated front facing with 3/32 inch diameter holes on 5/32 inch centers. Construct panels 3 inches thick packed with 4.5 lb./cu ft minimum glass fiber media, on inverted channels of 16 gage.

2.8 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).

7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer, 1/8 inch thick of width to match angle connection.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Duct Attachments: All duct attachments and anchors to structure shall be designed and selected to meet a 1.5 importance factor per the California Building Code.

E. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.10 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.
5. Loos & Co.; Cableware Division.
6. Mason Industries.
7. TOLCO; a brand of NIBCO INC.
8. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Install round ducts in maximum practical lengths.

B. Install ducts with fewest possible joints.

C. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

D. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

E. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

F. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

G. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

H. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

I. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

J. Ducts that traverse smoke zones shall be fabricated of sheet metal gauges conforming to NFPA 90A.

K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

L. Duct Openings:

1. Provide openings in ducts where required to accommodate thermometers, smoke detectors, control devices, sensors, and devices. Install same though airtight rubber grommets.
2. Provide pilot tube openings where required for testing of systems. Each opening shall be complete with a metal cap, with a spring device or screw to ensure against air leakage.
3. At openings in insulated ducts, install insulation material inside metal ring.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets. Use drive-slip joints, except in mechanical rooms.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction, at junctions and at maximum intervals of 12 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 INSTALLATION OF DUCTS OUTDOORS

A. Ducts shall be made completely watertight.

B. Construct ducts as follows to assure water run-off.

1. Arrange standing seams so as not to act as dams.
2. Erect ducts with longitudinal seams at bottom of duct.
3. Slope entire top of duct down towards side.
4. Provide vertical struts within duct to bow tap panels of duct into convex shape.
5. Erect ducts with mastic sealant within sheet metal joints.

3.5 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.

8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection. Extend strap supports down both sides of ducts and turn under bottom at least 1 inch. Secure hanger to sides and bottom of ducts with sheet metal screws.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

G. Avoid penetrations of ducts. Provide airtight rubber grommets at unavoidable penetrations of hanger rods.

3.7 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.8 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.9 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
    b. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
    c. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
    d. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
    e. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.11 DUCT CLEANING

A. Clean new ductwork that fails the cleanliness test before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
2. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
3. Coils and related components.
4. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
5. Supply-air ducts, dampers, actuators, and turning vanes.
6. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.12 START UP

A. Air Balance: Comply with requirements in Section "Testing, Adjusting, and Balancing for HVAC."

3.13 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Outdoor, Exposed to Weather Ducts: Type 304, stainless steel sheet, watertight.
2. Cooling Tower Discharge Ducts: Type 304 stainless steel sheet, watertight.
3. Ductwork at Humidifiers: Type 316 stainless steel sheet, watertight, for a minimum of 2 feet upstream and 10 feet downstream.
4. Shower Exhaust Ducts: Stainless steel sheet, watertight, for 15 feet from registers.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

    a. Pressure Class: Positive 1-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round: 12.

2. Ducts Connected to Constant-Volume Air-Handling Units:

    a. Pressure Class: Positive 2-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 6.
    d. SMACNA Leakage Class for Round: 6.

3. Ducts Connected to Variable-Air-Volume Air-Handling Units:

    a. Pressure Class: Positive 4-inch wg (sheet metal gages as per City of Los Angeles Mechanical Code.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 3.
    d. SMACNA Leakage Class for Round and Flat Oval: 3.

4. Ducts Connected to Equipment Not Listed Above:

    a. Pressure Class: Positive 2-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 3.
    d. SMACNA Leakage Class for Round and Flat Oval: 3.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

    a. Pressure Class: Positive or negative 1-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units:

    a. Pressure Class: Positive or negative 2-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 6.
    d. SMACNA Leakage Class for Round and Flat Oval: 6.

3. Ducts Connected to Equipment Not Listed Above:

    a. Pressure Class: Positive or negative 2-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 3.
    d. SMACNA Leakage Class for Round and Flat Oval: 3.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

    a. Pressure Class: Negative 1-inch wg.
    b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 1-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 3.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. PVC-Coated Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Galvanized.

G. Liner:

1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
3. Exhaust Air Ducts: Fibrous glass, Type I, 1 inch thick.
4. Supply Fan Plenums: Fibrous glass, Type II, 1 inch thick.
5. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II, 2 inches thick.
6. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

b. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 00

SECTION 23 33 00-AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Back-draft dampers.
2. Backdraft and pressure relief dampers.
3. Barometric relief dampers.
4. Combination fire/smoke dampers.
5. Duct access doors.
6. Static fire dampers.
7. Ceiling fire dampers.
8. Volume control dampers.
9. Flexible duct connections.
10. Dial thermometers.
11. Static pressure gages.
12. Motorized control dampers.
13. Louvers.
14. Air flow measuring stations.
15. Turning vanes.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. ASTM International:

1. ASTM E1 - Standard Specification for ASTM Thermometers.

C. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
3. NFPA 92A - Recommended Practice for Smoke-Control Systems.

D. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

E. Underwriters Laboratories Inc.:

1. UL 555 - Standard for Safety for Fire Dampers.

2. UL 555C - Standard for Safety for Ceiling Dampers.
3. UL 555S - Standard for Safety for Smoke Dampers.

F. City of Los Angeles Codes.

1.3 SUBMITTALS

A. Product Data: Submit data for shop fabricated assemblies and hardware used.

B. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.

1. Fire dampers including locations and ratings.
2. Comination Fire-Smoke dampers including locations and ratings.
3. Backdraft dampers.
4. Flexible duct connections.
5. Volume control dampers.
6. Duct access doors.
7. Duct test holes.

C. Product Data: For fire dampers and combination fire/smoke dampers submit the following:

1. Include UL ratings, dynamic ratings, leakage, pressure drop and maximum pressure data.
2. Indicate materials, construction, dimensions, and installation details.
3. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

D. Manufacturer's Installation Instructions: Submit for Fire and Combination Smoke/Fire Dampers.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

PART 2 - PRODUCTS

2.1 BACK-DRAFT DAMPERS

A. Manufacturers:

1. **Air Balance, Inc.**
2. **Ruskin.**
3. **Pottorf.**

B. Product Description: Multi-Blade, back-draft dampers: Parallel-action, gravity-balanced, Galvanized 16 gage thick steel, or extruded aluminum. Blades, maximum 6 inch width, with felt or flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin. Furnish dampers with adjustment device to permit setting for varying differential static pressure.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc
2. Ruskin
3. Pottorf.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm (10 m/s).

D. Maximum System Pressure: 2-inch wg (0.5 kPa).

E. Frame: 0.063-inch- (1.6-mm-) thick extruded aluminum, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch (150-mm) width, 0.050-inch- (1.2-mm-) thick aluminum sheet noncombustible, tear-resistant, neoprene-coated fiberglass with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene, mechanically locked.

I. Blade Axles:

1. Material: Stainless steel.
2. Diameter: 0.20 inch (5 mm).

J. Tie Bars and Brackets: Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.

    a. Sleeve Thickness: 20-gage (1.0-mm) minimum.
    b. Sleeve Length: 6 inches (152 mm) minimum.

6. Screen Mounting: Rear mounted.
7. Screen Material: Aluminum.
8. Screen Type: Insect.

9. 90-degree stops.

2.3 BAROMETRIC RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.
2. Ruskin.
3. Pottorf.

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 2000 fpm (10 m/s).

D. Maximum System Pressure: 2-inch wg (0.5 kPa).

E. Frame: 0.063-inch- (1.6-mm-) thick extruded aluminum, with welded corners and mounting flange.

F. Blades:

1. Multiple, 0.050-inch- (1.2-mm-) thick aluminum sheet.
2. Maximum Width: 6 inches (150 mm).
3. Action: Parallel.
4. Balance: Gravity.
5. Eccentrically pivoted.

G. Blade Seals: Neoprene.

H. Blade Axles: Galvanized steel.

I. Tie Bars and Brackets:

1. Material: Aluminum.
2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Stainless steel.

L. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.

2.4 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. Ruskin.
3. Pottorf.

B. Fire Resistance: 1-1/2 hours or 3 hours.

C. Leakage Rating: Class I, maximum of 8 cfm at 4 inches wg differential pressure.

D. Damper Temperature Rating: 250 degrees F.

E. Frame: 16 gage, galvanized steel.

F. Blades:

1. Style: Airfoil-shaped, single piece, double skin.
2. Action: Opposed.
3. Orientation: Horizontal.
4. Material: Minimum 14 gage equivalent thickness, galvanized steel.
5. Width: Maximum 6 inches.

G. Bearings: Stainless steel pressed into frame.

H. Seals: Silicone blade edge seals and flexible stainless steel jamb seals.

I. Linkage: Concealed in frame.

J. Release Device: Close in controlled manner and allow damper to be automatically reset.

K. Actuator:

1. Type: Electric 120 volt, 60 hertz, two-position, fail close or Electric 24 volt, 60 hertz, two-position, fail close as shown on drawings.
2. Mounting: External or Internal.

L. Fusible Link Release Temperature: 165 degrees F.

M. Finish: Mill galvanized.

N. Factory installed sleeve and mounting angles. Furnish silicone caulk factory applied to sleeve at damper frame to comply with leakage rating requirements.

2.5 DUCT ACCESS DOORS

A. Manufacturers:

1. American Warming and Ventilating.
2. Pottorf.
3. McGill.

B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1 inch thick insulation with sheet metal cover.

1. Less than 12 inches square, secure with sash locks.
2. Up to 18 inches Square: Furnish two hinges and two sash locks.
3. Up to 24 x 48 inches: Three hinges and two compression latches.
4. Larger Sizes: Furnish additional hinge.
5. Access panels with sheet metal screw fasteners are not acceptable.

2.6 FIRE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. Ruskin.
3. Pottorf.

B. Fire Rating: UL 555 classified and labeled as a 1-1/2 or 3 hour static fire damper.

C. Air Flow Rating: UL approved for dual directional air flow.

D. Integral Sleeve Frame: Minimum 20 gage by 12 inches roll formed, galvanized steel.

1. Factory Sealant: Apply to dampers in HVAC systems with pressures to maximum 4 inches wg.

E. Blades:

1. Style: Curtain type, in airstream.
2. Action: Spring or gravity closure upon fusible link release.
3. Orientation: Horizontal.
4. Material: Minimum 24 gage roll formed, galvanized steel.

F. Closure Springs: Type 301 stainless steel, constant force type, if required.

G. Temperature Release Device:

1. Fusible link, 165 degrees F.
2. Mounting: Vertical or Horizontal as shown on the drawings.

H. Finish: Mill galvanized.

I. Picture Frame Mounting Angles:

1. One-piece, roll formed retaining angles as detailed.
2. Factory matched and shipped attached to damper.

2.7 CEILING FIRE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. Ruskin.
3. Pottorf.

B. Fire Rating: UL 555C classified and labeled as a 1-1/2 hour ceiling damper.

C. Air Flow Rating: UL approved for dual directional air flow.

D. Frame: Galvanized steel with roll formed ridge for blade stop.

E. Blades:

1. Style: Two-piece, single-thickness with blade insulation, hinged in center, and held open with fusible link.
2. Action: Butterfly.
3. Orientation: Horizontal.
4. Material: Minimum 20 gage galvanized steel.

F. Hinge: Spring stainless steel, mechanically attached to blades.

G. Mounting: Horizontal.

H. Temperature Release Device: Fusible link, 165 degrees F.

I. Finish: Mill galvanized.

J. Performance Data:

1. Pressure Drop: Maximum 0.1 inches w.g. at 500 fpm across 18 x 18 inch damper.

K. Fusible Volume Adjust: UL classified.

2.8 VOLUME CONTROL DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. Ruskin.
3. Pottorf.

B. Splitter Dampers:

1. Material: Same gage as duct to 24 inches size in both dimensions, and two gages heavier for sizes over 24 inches.
2. Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous hinge or rod.

3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
4. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.

C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized frame channel with suitable hardware.

D. Quadrants:

1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers.
2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.
3. Where rod lengths exceed 30 inches furnish regulator at both ends.

2.9 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:

1. Duro Dyne Inc.
2. Ventfabrics.
3. Ward Industries

B. Connector: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
2. Net Fabric Width: Approximately 3 inches wide.
3. Metal: 3 inch wide, 24 gage galvanized steel.

C. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.87 lbs. per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.10 DIAL THERMOMETERS

A. Manufacturers:

1. Ashcroft.
2. Trerice.
3. Watts.

B. Thermometer: ASTM E1, stainless steel case, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.

1. Size: 3 inch diameter dial.
2. Lens: Clear Lexan.
3. Accuracy: 1 percent.
4. Calibration: Degrees F.

2.11 STATIC PRESSURE GAGES

A. Manufacturers:

1. Ashcroft.
2. Trerice.
3. Watts.

B. Dial Gages: 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front calibration adjustment, 2 percent of full scale accuracy.

C. Inclined Manometer: Plastic with red liquid on white background with black figures, front calibration adjustment, 3 percent of full scale accuracy.

D. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

2.12 MOTORIZED CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Ruskin Company.
3. Pottorf.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat shaped.
2. Stainless-steel channels, 0.064 inch (1.62 mm) thick.
3. Mitered and welded corners.

D. Blades:

1. Multiple blades with maximum blade width of 8 inches (200 mm).
2. Opposed-blade design.
3. Stainless steel.
4. 0.064 inch (1.62 mm) thick.
5. Blade Edging: Closed-cell neoprene edging.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch- (13-mm-) diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

F. Bearings:

1. Stainless-steel sleeve.
2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

G. Damper Motors: Modulating action.

2.13 LOUVERS

A. Connect to louvers furnished under General Construction work.

2.14 AIR FLOW MEASURING STATIONS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ruskin, IAQ Measuring Damper.
2. Air Monitor Corp.
3. Wetmaster Co.

B. Description: Factory fabricated unit with casing, velocity traverse section and sensors, companion volume meter, and interconnection to volume meter.

C. Casing: 0.064 inch (1.62 mm) thick welded galvanized sheet steel, with flanged ends to match connecting ductwork.

D. Velocity Traverse Section:

1. Copper static pressure sensors.
2. Copper total pressure sensing manifolds and control averaging manifold.
3. Operation: Equalizing and integrating all sensor measurements into one total pressure and one static pressure metering port.
4. Sensors positioned on equal-area traverse principle.
5. Aluminum honeycomb air straightener.

E. E. Volume Meter:

1. Dry dial and diaphragm-actuated type.
2. Calibrated in CFM (cu cm/sec) and FPM (m/s).
3. Provided with mounting bracket.

F. Install nameplate for each station to indicate:

1. Unit size and unit designation.
2. Design air quantity.
3. Design air flow.
4. Design air velocity.

2.15 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Metailaire.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized steel, aluminum or stainless steel sheet, to match duct material; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

E. Vane Construction: Double wall.

PART 3 - EXECUTION

3.1 INSTALLATION.

A. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside.

B. Access Doors:

1. Install access doors at the following locations:

a. On both sides of duct coils.
b. Upstream and downstream from duct filters.
c. At outdoor-air intakes and mixed-air plenums.
d. At drain pans and seals.
e. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
f. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
g. At each change in direction and at maximum 50-foot spacing.

h. Upstream and downstream from turning vanes.
i. Upstream or downstream from duct silencers.
j. Control devices requiring inspection, including smoke detection heads.
k. At fan bearings enclosed in ducts.
l. Inlet side of each single width centrifugal fan.
m. Install at locations for cleaning kitchen exhaust ductwork in accordance with NFPA 96.

2. Install access doors with swing against duct static pressure.
3. Access Door Sizes:

a. One-Hand or Inspection Access: 8 by 5 inches.
b. Two-Hand Access: 12 by 6 inches.
c. Head and Hand Access: 18 by 12 inches.
d. Head and Shoulders Access: 21 by 14.
e. Body Access: 25 by 14 inches.
f. Body plus Ladder Access: 25 by 17 inches.

4. Label access doors according to Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
5. Mark access doors for fire and smoke dampers on outside surface, with minimum 1/2 inch high letters reading: FIRE/SMOKE DAMPER, SMOKE DAMPER, OR FIRE DAMPER.

C. Flexible Connectors.

1. Install flexible connectors at duct connections to equipment, at building expansion joints, at connections between ducts of dissimilar metals and at penetrations of mechanical equipment room walls.
2. Install flexible connections with 2 inches slack in fabric and minimum movement of 1 inch.
3. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

D. Flexible Ducts

1. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
2. Connect diffusers or light troffer boots to ducts with maximum 18-inch lengths of flexible duct clamped or strapped in place.
3. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws. Attach to supply air duct with low entrance lass, bellmouth type connector at air inlet end.

E. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

F. Install wire mesh screen grilles at return air ducts in hung ceilings and in other places where indicated. Bolt grilles to flanged connections or ducts at terminations.

G. Install louvers in building construction at locations where indicated. Coordinate mounting details with particular building construction and/or window framing details. Install blank-off panels at unused portions of louvers; secured with bolts and/or screws.

H. Air Flow Measuring Stations

1. Install air flow measuring stations where indicated, or as directed by engineer.
2. Install all interconnecting tubing between measuring station, companion meter and control systems, in accordance with the manufacturer's printed instructions.

I. Install temporary duct test holes and required for testing and balancing purposes. Cut or drill in ducts. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

J. Install fire dampers and combination fire and smoke dampers at required locations. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

1. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92A.
2. Install dampers square and free from racking with blades running horizontally.
3. Do not compress or stretch damper frame into duct or opening.
4. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jack shaft.
5. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

K. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

L. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts and as indicated. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install volume dampers at the following locations:

    a. At all splits, except grease exhaust ducts.
    b. In ducts serving single supply, return and exhaust outlets.
    c. In open return ducts above ceiling.
    d. In ducts connecting to a common plenum.
    e. Where required for balancing.

2. Install remote damper operators for volume dampers above ceilings which are non-accessible or without access panels.
3. Install steel volume dampers in steel ducts.
4. Install aluminum volume dampers in aluminum ducts.
5. Do not install volume dampers in grease ducts.

3.2 NSTALLATION - THERMOMETERS

A. Install thermometers in air duct systems on flanges where possible.

B. Locate duct-mounted thermometers minimum 10 feet downstream of mixing-dampers, coils, or other devices causing air turbulence.

C. Install static pressure gages to measure across filters and filter banks, (inlet to outlet). On multiple banks, provide manifold and single gage.

D. Provide instruments with scale ranges selected according to service with largest appropriate scale.

E. Install thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

F. Adjust thermometers to final angle, clean windows and lenses, and calibrate to zero.

END OF SECTION 23 33 00

SECTION 23 34 00-HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Centrifugal fans.
2. Propeller fans.
3. Downblast centrifugal roof fans.
4. Upblast centrifugal roof fans.
5. Ceiling fans.
6. Inline ceiling fans.
7. Duct blowers or cabinet fans.
8. Centrifugal square inline fans.

1.2 REFERENCES

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Air Movement and Control Association International, Inc.:

1. AMCA 99 - Standards Handbook.
2. AMCA 204 - Balance Quality and Vibration Levels for Fans.
3. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
4. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
5. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

C. ASTM International:

1. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

D. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.
2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. Underwriters Laboratories Inc.:

1. UL 705 - Power Ventilators.

1.3 SUBMITTALS

A. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL FANS

A. Manufacturers:

1. **Penn-Barry.**
2. **Greenheck.**
3. **Cook.**

B. Wheel and Inlet:

1. Backward Inclined: Steel construction with smooth curved inlet flange, back plate, backward curved blades welded or riveted to flange and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.
2. Forward Curved: Galvanized steel construction with inlet flange, back plate, shallow blades with inlet and tip curved forward in direction of airflow, mechanically secured to flange and back plate; steel hub swaged to back plate and keyed to shaft with set screw.
3. Airfoil Wheel: Steel construction with smooth curved inlet flange, back plate die formed hollow airfoil shaped blades continuously welded at tip flange, and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.

C. Housing:

1. Steel, spot welded for AMCA 99 Class I and II fans, and continuously welded for Class III, braced, designed to minimize turbulence with spun inlet bell and shaped cut-off.
2. Factory finish before assembly to manufacturer's standard.
3. Fabricate plug fans without volute housing, in lined steel cabinet.

D. Bearings and Sleeves:

1. Bearings: Pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA 9 L-10 life at 50,000 hours roller bearings, ABMA 11, L-10 life at 120,000 hours.
2. Shafts: Hot rolled steel, ground and polished, with key way, protectively coated with lubricating oil, and shaft guard.
3. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp and under, selected so required rpm is obtained with sheaves set at mid-position. Fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor.
4. Belt Guard: Fabricate to SMACNA Standard; 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan

supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.2 PROPELLER FANS

A. Manufacturers:

1. Penn-Barry.
2. Greenheck.
3. Cook.

B. Construction:

1. Impeller: Shaped steel or steel reinforced aluminum blade with hubs, statically and dynamically balanced, locked to shaft, directly connected to motor or furnished with V-belt drive.
2. Frame: One piece, square steel with die formed venturi orifice, mounting flanges and supports, with baked enamel finish.

2.3 DOWNBLAST CENTRIFUGAL ROOF FANS

A. Manufacturers:

1. Penn-Barry.
2. Greenheck.
3. Cook.

B. Fan Unit: Downblast type. V-belt or direct drive.

C. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

D. Disconnect Switch: Factory wired, non-fusible, in fan housing for thermal overload protected motor.

2.4 UPBLAST CENTRIFUGAL ROOF FANS

A. Manufacturers:

1. Penn.
2. Barry.
3. Greenheck.
4. Cook.

B. Fan Unit: Upblast type. V-belt or direct drive, spun aluminum housing with grease tray; resilient mounted motor; aluminum wire bird screen; square base to suit roof curb with continuous curb gaskets.

C. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

D. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.

2.5 CEILING FANS AND INLINE CEILING FANS

A. Manufacturers:

1. Penn-Barry.
2. Greenheck.
3. Cook.

B. Centrifugal Fan Unit: Direct driven with galvanized steel housing lined with 1/2 inch acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge opening, integral outlet duct collar. Discharge position convertible by moving interchangeable panels.

C. Disconnect Switch: Fan mounted toggle switch for thermal overload protected motor.

D. Motor: Open drip proof type with permanently lubricated sealed bearings and thermal overload protection.

2.6 DUCT BLOWER OR CABINET FANS

A. Manufacturers:

1. Penn-Barry.
2. Greenheck.
3. Cook.

B. Product Description: V-belt drive with galvanized steel housing lined with 1/2 or 1 inch acoustic glass fiber insulation as scheduled, removable side panel for access, inlet and outlet duct collar, gravity backdraft damper in discharge, horizontal hanging brackets.

C. Fan Wheel: Double width-double inlet backward inclined forward curved centrifugal type.

D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.7 CENTRIFUGAL SQUARE INLINE FANS

A. Manufacturers:

1. Penn-Barry.
2. Greenheck.

3. Cook.

B. Product Description: V-belt or Direct drive with galvanized steel housing lined with 1/2 or 1 inch acoustic glass fiber insulation, integral inlet cone, removable access doors on 3 sides, inlet and outlet duct collar, gravity backdraft damper in discharge, horizontal hanging brackets.

C. Fan Wheel: Backward inclined centrifugal type, aluminum construction.

D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

E. Motor and Drive Mounting: Out of air stream.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install per manufacturer's instructions.

B. Install backdraft dampers where required by code.

C. Install safety screen where inlet or outlet is exposed.

3.2 TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 23 34 00

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Constant volume terminal units.
2. Variable volume terminal units.
3. Fan powered terminal units.

1.2 REFERENCES

A. American Refrigeration Institute:

1. ARI 880 - Air Terminals.
2. ARI 885 -Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

D. Underwriters Laboratories Inc.:

1. UL 181 - Factory-Made Air Ducts and Connectors.

E. ASHRAE Standard 62.1 – Ventilation for Acceptable Indoor Air Quality.

1.3 SUBMITTALS

A. Product Data: Submit data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings indicating airflow, static pressure, heating coil capacity and NC designation. Include electrical characteristics and connection requirements. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of 1 inch to 4 inches wg.

B. Manufacturer's Installation Instructions: Submit support and hanging details, and service clearances required.

1.4 CLOSEOUT SUBMITTALS

A. Execution and Closeout Requirements:

B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.

1.5 WARRANTY

A. Minimum one-year warranty.

PART 2 – PRODUCTS

2.1 SINGLE DUCT CONSTANT AND VARIABLE VOLUME AIR TERMINAL UNITS

A. Manufacturers:

1. Anemostat.
2. Price
3. Titus.

B. Product Description: Variable air volume terminal units for connection to central air systems, with electronic controls and hot water heating coils.

C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.

D. Basic Assembly:

1. Casings: Minimum 22 gage galvanized steel.
2. Lining: Minimum 3/4 inch thick neoprene or vinyl coated glass fiber insulation, 1.5 lb./cu ft density, meeting NFPA 90A requirements and UL 181 erosion requirements.
3. Plenum Air Outlets: S slip-and-drive connections.

E. Basic Unit:

1. Configuration: Air volume damper assembly inside unit casing. Locate control components inside protective metal shroud.
2. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating bearings; maximum damper leakage: 2 percent of design air flow at 3 inches inlet static pressure.

F. Attenuation Section: Line attenuation sections with 1 or 2 inches thick insulation.

G. Round Outlet: Discharge collar matching inlet size.

H. Hot Water Heating Coil:

1. Construction: 1/2 inch copper tube mechanically expanded into aluminum plate fins, leak tested under water to 200 psig pressure, factory installed.
2. All coils shall be minimum 2-pass.

2.2 FAN POWERED VARIABLE VOLUME UNITS

A. Manufacturers:

1. Anemostat.
2. Price.
3. Titus.

B. Product Description: Variable air volume terminals for connection to central air systems with electronic controls and hot water heating coils.

C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.

D. Basic Assembly:

1. Casings: Minimum 22 gage galvanized steel.
2. Lining: Minimum 3/4 inch thick neoprene or vinyl coated glass fiber insulation, 1.5 lb./cu ft density, meeting NFPA 90A requirements and UL 181 erosion requirements.
3. Plenum Air Outlets: S-slip and drive connections.

E. Basic Unit:

1. Configuration: Air volume damper assembly and fan in series or parallel arrangement inside unit casing. Locate control components inside protective metal shroud.
2. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating bearings; maximum damper leakage: 2 percent of design air flow at 3 inches inlet static pressure.

F. Fan Assembly:

1. Fan: Forward curved centrifugal type with direct drive permanent-split-capacitor type, thermally protected motor.
2. Speed Control: Infinitely adjustable with electric/pneumatic and electronic controls.
3. Isolation: Fan/motor assembly on rubber isolators.

G. Wiring:

1. Factory mount and wire controls. Mount electrical components in control box with removable cover. Incorporate single point electrical connection to power source.
2. Factory mount transformer for control voltage on electric and electronic control units. Furnish terminal strip in control box for field wiring of thermostat and power source.

3. Wiring Terminations: Wire fan and controls to terminal strip. Furnish terminal lugs to match branch-circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box.
4. Disconnect Switch: Factory mount disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install ceiling access doors or locate units above easily removable ceiling components.

B. Support units individually from structure. Do not support from adjacent ductwork.

END OF SECTION 23 36 00

SECTION 23 37 00-AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Diffusers.
2. Registers
3. Grilles.
4. Louvered penthouses.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.

C. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 SUBMITTALS

A. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, noise level, and performance data.

PART 2 - PRODUCTS

2.1 ROUND CEILING DIFFUSERS

A. Manufacturers:

1. Anemostat.
2. Price.
3. Titus.

B. Product Description: Type: Round, adjustable pattern, stamped or spun, multi-core diffuser to discharge air in 360 degree pattern, with sector baffles where indicated. Diffuser collar not more than 1 inch above ceiling. In plaster ceilings, furnish plaster ring and ceiling plaque.

C. Fabrication: Steel or aluminum with baked enamel off-white finish.

2.2 RECTANGULAR CEILING DIFFUSERS

A. Manufacturers:

1. Anemostat.
2. Price.
3. Titus.

B. Type: Square and rectangular, adjustable pattern, multi-louvered diffuser.

C. Frame: To match the architectural surface.

D. Fabrication: Steel or Aluminum with baked enamel off-white finish.

2.3 PERFORATED FACE CEILING DIFFUSERS

A. Manufacturers:

1. Anemostat.
2. Price.
3. **Titus**.

B. Type: Perforated face with fully adjustable pattern and removable face.

C. Frame: To match architectural surface.

D. Fabrication: Steel or aluminum with steel frame and baked enamel off-white finish.

2.4 CEILING SLOT DIFFUSERS (LINEAR)

A. Manufacturers:

1. Anemostat.
2. Price.
3. Titus.

B. Type: Continuous with size and number of slots and adjustable vanes for left, right or vertical discharge.

C. Fabrication: Aluminum extrusions or Steel with factory finish and color to be selected by architect.

D. Frame: To match architectural surface.

2.5 CEILING SUPPLY REGISTERS/GRILLES

A. Manufacturers:

1. Anemostat.
2. Price.
3. Titus.

B. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.

C. Frame: 1 inch margin with countersunk screw mounting and gasket.

D. Fabrication: Steel or aluminum extrusions with factory off-white enamel finish unless noted otherwise.

E. Damper: Integral, gang-operated, opposed-blade type with removable key operator, operable from face.

2.6 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

A. Manufacturers:

1. Anemostat.
2. Price.
3. Titus.

B. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees.

C. Frame: 1 inch margin with countersunk screw mounting.

D. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory off-white baked enamel finish.

E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.7 CEILING GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES

A. Manufacturers:

1. Anemostat.
2. Price.
3. Titus.

B. Type: Fixed grilles of 1/2 x 1/2 x 1 inch louvers.

C. Fabrication: Steel or aluminum with off-white finish.

D. Frame: 1 inch margin with countersunk screw mounting. Channel lay-in frame for suspended grid ceilings.

2.8 CEILING LINEAR EXHAUST AND RETURN GRILLES

A. Manufacturers:

1. Anemostat.
2. Price.
3. Titus.

B. Type and materials to match those provided for supply air.

2.9 WALL SUPPLY REGISTERS/GRILLES

A. Manufacturers:

1. Anemostat.
2. Price.
3. Titus.

B. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, double deflection.

C. Frame: 1 inch margin with countersunk screw mounting and gasket.

D. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory off-white baked enamel finish.

E. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

2.10 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Manufacturers:

1. Anemostat.
2. Price.
3. Titus.

B. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, horizontal face.

C. Frame: 1 inch margin with countersunk screw mounting.

D. Fabrication: Steel or aluminum with 20 gage minimum frames and 22 gage minimum blades, with factory off-white baked enamel finish.

E. Damper (only if specifically called for on drawings): Integral, gang-operated, opposed-blade type with removable key operator, operable from face.

2.11 LINEAR WALL REGISTERS/GRILLES

A. Manufacturers:

1. Anemostat.
2. Price.
3. Titus.

B. Type: Streamlined blades with 15 degree deflection, 1/8 x 3/4 inch on 1/4 inch centers.

C. Frame: 1 inch margin with countersunk screw mounting and gasket.

D. Fabrication: Steel or aluminum extrusions, with factory off-white enamel finish.

E. Damper: Integral gang-operated opposed blade hinged single blade damper with removable key operator, operable from face.

2.12 LOUVERED PENTHOUSE

A. Manufacturers:

1. Greenheck.
2. Industrial Louvers Inc.
3. Ruskin.

B. Fabrication: Completely welded assembly. Fabricate with mitered corners. Structural supports rated for 20 psf wind and snow loading. Furnish sill water catch with 2 inch high water stop and depth to enclose structural supports.

C. Roof: Aluminum construction, standing seam type with formed water baffle plates open at corners for drainage.

D. Bird Screen: Interwoven wire mesh of aluminum, 0.063 inch diameter wire, 1/2 inch open weave.

E. Roof Curb: 12 inch inch high self-flashing galvanized steel construction with continuously welded seams 1 inch insulation and curb bottom, hinged curb adapter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify LAWA for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

D. Carefully install all ceiling mounted air distribution devices back pan insulation and vapor barrier. Where pre-molded insulation and vapor barrier is not furnished as an accessory to the air distribution device by the manufacturer the Contractor is responsible for field installation of insulation and vapor barrier for ceiling air distribution device back pans.

E. All visible interior surfaces of all grilles and air device accessories and components visible through the face of the outlet shall be factory painted flat black.

F. Install a manual volume damper in the branch duct to the air distribution device or at the conical bell-mouth spin-in fitting for connection of round flexible duct to the rectangular duct for balancing purposes.

G. Provide all required blank off for directional pattern.

H. Diffusers Utilizing a Plenum Box: Provide plenum box fabricated of 24 USBG galvanized steel, with internal surfaces lined with minimum 1/2 inch thick duct liner.

I. Install return and exhaust registers with blades oriented to prevent sight though outlets.

J. Transfer Grilles: Provide 2 grilles, one on each side of wall with connecting sheet metal collar.

K. Transfer Ducts: Provide 2 grilles, one at each end of duct.

3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles before starting air balancing.

END OF SECTION 23 37 00

SECTION 23 40 00-HVAC AIR CLEANING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Activated carbon filters.
2. Disposable, extended area panel filters.
3. Disposable panel filters.
4. Filter gages.
5. Bipolar Ionization

1.2 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. ARI 850 - Commercial and Industrial Air Filter Equipment.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

C. Military Standardization Documents:

1. MIL MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components, and Related Products: Performance-Test Methods.

D. Underwriters Laboratories Inc.:

1. UL 586 - High-Efficiency. Particulate, Air Filter Units.
2. UL 867 - Electrostatic Air Cleaners.
3. UL 900 - Air Filter Units.

1.3 SUBMITTALS

A. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.

B. Product Data: Submit data on filter media, filter performance data, dimensions, and electrical characteristics.

C. Submit performance data for this application including initial pressure drop, recommended replacement pressure drop, and maximum pressure drop.

D. Manufacturer's Installation Instructions: Submit assembly and change-out procedures.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 ACTIVATED CARBON FILTERS

A. Manufacturers:

1. Flanders.
2. Camfil-Farr.
3. American Air Filter.

B. Assembly: Galvanized steel unit incorporating extruded aluminum tracks to accommodate filter servicing trays in deep V arrangement arranged for upstream downstream side servicing with disposable panel pre-filter.

1. Nominal Size: 12 x 24 x 29 inches 24 x 24 x 29 inches.

C. Media:

1. Activated Carbon Density: 34 lb./cu ft, pellets or granular to 6 x 10 Tyler mesh screen.
2. Carbon Tetrachloride Activity: Minimum 60 percent; in thin bed.
3. Trays: Nominal size 24 x 24 x 5/8 inches thick.
4. Carbon: 1.42 cu ft per 1000 cfm nominal airflow capacity.

D. Rating: 500 fpm face velocity, 0.45 inch wg resistance.

2.2 DISPOSABLE, EXTENDED AREA PANEL FILTERS

A. Description: Factory-fabricated, ASHRAE Standard 50-60 percent efficiency (MERV 13), dry, extended-surface, self-supporting filters with holding frames. Quality Assurance Test Report required.

B. Manufacturers:

1. Flanders.
2. Farr.
3. American Air Filter.

C. Media: UL 900 Class 2, pleated, lofted, non-woven, reinforced synthetic fabric or fine, glass fiber laminated to synthetic backing.

1. Frame: Galvanized steel.
2. Nominal size: 24 x 24 inches.
3. Nominal thickness: As required for scheduled efficiency rating.

D. Rating, ASHRAE 52.1:

1. Dust spot efficiency: See schedule on drawings.
2. Weight arrestance: See schedule on drawings.
3. Initial resistance at 500 fpm face velocity: See schedule on drawings.
4. Recommended final resistance: See schedule on drawings.

2.3 DISPOSABLE PANEL FILTERS

A. Description: Factory-fabricated, dry, extended-surface filters with stainless steel holding frames.

B. Manufacturers:

1. Tridem.
2. Camfil-Farr.
3. American Air Filter.

C. Media: Synthetic glass fibrous material and other media pleated, UL Class II, 25-30 percent efficiency (MERV 8) formed into deep-V-shaped pleats and held by self-supporting wire grid.

1. Nominal Size: 24 x 24 inches.
2. Thickness: 1 or 2 inch.

D. Media and Media-Grid Frame: Nonflammable glass fiber, synthetics and other media to ensure adequacy for jet fuel.

E. Performance Rating:

1. Face Velocity: 500 fpm
2. Initial Resistance: 0.15 inch wg
3. Recommended Final Resistance: 0.50 inches wg.

F. Duct-Mounting Frames: Stainless steel with gaskets and fasteners, and suitable for bolting together into built-up filter banks.

1. Manufacturer:
   a. Pyramid Filters,
   b. Perkins Thermal Systems.
   c. Guru Filtration System.

2.4 FILTER GAGES

A. Manufacturers:

1. **Dwyer.**
2. **Trerice.**
3. **Weiss.**

B. Direct Reading Dial: 3-1/2 inch diameter diaphragm actuated dial in metal case. Furnish vent valves, black figures on white background, front calibration adjustment, range 0-3.0 inch wg 2 percent of full scale accuracy.

C. Accessories: Static pressure tips with integral compression fittings, 1/4 inch plastic tubing, 2-way or 3-way vent valves.

2.5 BIPOLAR IONIZATION

A. Manufacturers

1. **Plasma Air International.**
2. **Aerisa.**

B. Performance Criteria

1. The bipolar ionization system shall be capable of controlling gas phase contaminants generated from human occupants as well as products of combustion of jet fuel.
2. Capable of reducing static space charges.
3. Capable of reducing common VOC's encountered in schools, office buildings and commercial facilties.
4. Equipment shall be capable of performing in non condensing atmospheres at temperatures up to 140 degrees F.
5. Provide 5 year warranty.

C. Equipment Requirements

1. The bipolar ionization units shall include all power supplies, ion generating tubes, gaskets, indicators, switches, fuses, and accessories necessary for safe an deficient operation.
2. All duct mounted applications shall include a mounting frame permanently attached to the duct. Ionization units shall be attached to the mounting frame.
3. Ionization Tubes shall be UL or ETL listed and bear the UL or ETL mark.
4. The manufacturer shall provide ionization tubes of appropriate size and quantity for each air handling system to meet the requirements for the system.
5. All exposed metallic parts of ionization tubes shall be stainless steel.
6. Ionization units shall be suitable for duct mounting or air handling unit plenum mounting.
7. Ionization units shall be plenum rated per UL 2043.
8. Ionization unit output shall be user adjustable from approximately 50-100%. There shall be a minimum of five levels of adjustment.

9. An integral differential pressure switch shall be provided on duct mounted one-and two-tube units. Additional controls such as field mounted pressure switches or control relays shall be included as part of the ionization equipment scope.

D. Installation Requirements

1. Ionization units shall be installed per manufacturer's installation instructions.

E. Electrical Requirements

1. The electrical power wiring to the ionization units shall be detached without the use of tools to facilitate servicing of the equipment.
2. Ionization units shall be available for 120 and 240 volt applications.
3. The maximum power required for multi tube ionization units shall be 50 watts.
4. The electrical contractor shall provide shall a junction box with single outlet within 4 feet of the ionization equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install filters with felt, rubber, or neoprene gaskets to prevent passage of unfiltered air around filters.

B. Install filter gage static pressure tips upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum, in accessible position. Adjust and level.

C. Do not operate fan system until temporary filters are in place. Replace temporary filters used during construction and testing, with clean set.

D. Install filter gages on filter banks with separate static pressure tips upstream and downstream of filters.

E. Install filters in accordance with manufacturer's recommendations.

F. Provide maintenance training to LAWA, as required.

END OF SECTION 23 40 00

SECTION 23 42 00 - ULTRA VIOLET GERMICIDAL IRRADIATION (UVGI) SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. UL listed indoor air quality system (UVGI) mounted inside air handling units and packaged units.

1.2 SUBMITTALS

A. Product Data: Manufacturer's literature for UVGI Systems indicated.

1. Dimensions, weights, capacities and ratings.
2. Wiring diagrams, fixtures and control panel.
3. UVGI system components and accessories.
4. Heat output of UVGI system into air handling unit or air stream for each size of air handling unit scheduled.

B. Catalog cuts, engineering data sheets, list of unit numbers, UVGI output and power consumption. The following shall also be included with submittals:

1. Indoor air quality systems: Calculated intensity profile of entire irradiated surface demonstrating minimum intensity (mW/cm^2).

C. Operation and Maintenance Data: For UVGI systems to include in emergency operation and maintenance manuals:

1. Provide catalog cuts of equipment and components.
2. Include instructions for emitter replacement and component replacement.
3. Provide spare parts list.
4. Provide wiring diagram.
5. Provide installation, operation and maintenance manuals.

1.3 QUALITY ASSURANCE

A. System to be factory tested and the design, construction and installation to be in accordance with all state, local, federal or other regulations having jurisdiction.

B. Competency of Supplier/Manufacturer/Installer

1. The supplier/manufacturer/installer of the UVGI system to have a qualified service organization in active operation for a minimum of five (5) years. The organization to have had a history of competent service experience in designing,

installing and maintaining the specific types of systems described in the specifications, and has on its payroll sufficient qualified experienced personnel to guarantee satisfactory performance of the installation. All maintenance personnel used in fulfilling the requirements of the installation shall be qualified to maintain this type of equipment.

1.4 WARRANTY

A. The UVGI system shall be warranted to be free from defects in material and workmanship for a period of five (5) years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, acceptable manufacturers are:

1. **Steril-Aire.**
2. **Vigilair**
3. **Strion Air.**

2.2 ULTRAVIOLET DISINFECTION

A. Provide ultraviolet disinfection for bacteria, mold and odor control inside each equipment it is installed in. The UV dosage shall be calculated for theoretical 99% air disinfection at air velocity and temperature and shall be adequate to deactivate microbial growth on all exposed surfaces.

B. Construction. The UV System shall be of Stainless Steel, Galvanized and Aluminum Construction. Any exposed screws or fasteners shall be Stainless Steel. Safety limit switches and Exterior SPST On/Off switches shall be pre-wired and factory installed in a weatherproof junction box. All exterior safety signage shall be permanently silk-screened with UL warning requirements. Lamp supports shall be Stainless Steel. The lamps shall easily be removed for service without the use of tools or the disconnection of any wiring connections. UV System shall be complete with all miscellaneous accessories required to form a complete unit.

C. Independent Testing. The device submitted shall be classified by UL (Underwriters Laboratories) as an Air Duct Mounted Accessory (ABQK). Also meets the UL Standards 1598, UL 153, UL 1995. Manufacturers UL file number shall be permanently marked on the exterior of the product.

D. Ultra Violet Lamps. The lamp shall be available on the open market and not be prioritized in relationship to the UV equipment. Lamps shall be 60 Nominal Watt, 18 UV Watt High Output, Wind-chill Corrected 253.7 nanometer. The lamp shall be single

ended bi-tube design so that no external wires are exposed in the air path to provide power to the opposing end of the lamp. The lamp shall withstand a 5 minute 10 lb. direct pull Stress Load Test and not become disengaged from the socket. Mercury content of the lamp shall be stated in submittal data and MSDS sheets stating lamp mercury content of less than 4.5 mg. mercury shall be an integral part of the submittal data. Current replacement lamp costs shall be an integral part of submittal data. The lamp shall provide 175 microwatts/cm squared at 400fpm/50 degrees F, measured at a 1-meter distance from the lamp. The lamp shall provide 12.5 microwatts/cm squared per inch of arc length. The Lamp Change shall be performed without UV fixture disassembly and without the use of tools. The product shall not require maintenance personal to enter the wiring compartment of in order to facilitate lamp change. Manufacturer shall provide gloves appropriate for proper handling of the UV lamp. The manufacturer shall rate lamp life at minimum life of 8000 hours based on 3-hour start/stop cycles with a lamp depreciation not to exceed 15% at rated life.

1. Manufacturer. **Philips, GE or Sylvania.**

E. Ballasts. The ballast shall be available on the open market and not be prioritized in relationship to the UV equipment. Ballasts shall be UL Listed for the lamp provided. Ballasts shall be high power factor, class P, Sound Rating A, Type 1 Outdoor, Electronic. Ballasts shall be suitable for air handling spaces and shall have harmonic distortion in accordance with ANSI standards and a minimum operating temperature of B20 degrees F. Ballasts shall be warranted for a period of 5 years.

1. Manufacturer. **Advance, Magnetek or Robertson.**

F. Safety. The assembly shall employ a safety interlock switches, which interrupts power when the Air Handler is opened for servicing. The product employs germicidal lamps, which emit UV-C radiation, thereby posing a potential risk of exposure to eyes and bare skin during maintenance. Access doors shall be have a glass visual examination port as provided by equipment manufacturer. Warning signage provided by UV equipment manufacturer shall be silk-screened on stainless steel with UL requirements as to safety aspects. Manufacturer shall provide safety glasses to protect installers' eyes in case of accidental startup of lamps during installation process.

G. Warranty. UV Air Disinfection System, less lamps, shall be warranted to be free of defects in workmanship and material for a period of Five Years from date of shipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install per manufacturer's recommendation.

END OF SECTION 23 42 00

SECTION 23 64 11- PACKAGED WATER CHILLERS - RECIPROCATING, SCROLL, AND SCREW

PART 1 – GENERAL

NOTE: This section is for temporary equipment only with a fixed date for removal.

1.1 SUMMARY

A. Section includes chiller package, charge of refrigerant and oil, controls and control connections, chilled water connections, condenser water connections, refrigerant connections, auxiliary water connections, starters.

B. This applies to chillers smaller than 100 tons.

1.2 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. ARI 550/590 - Water Chilling Packages Using the Vapor Compression Cycle.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. American Society of Mechanical Engineers:

1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

D. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

A. Shop Drawings: Indicate components, assembly, dimensions, weights and loads, required clearances, and location and size of field connections. Indicate valves, strainers, and thermostatic valves required for complete system.

B. Product Data: Submit rated capacities, weights, specialties and accessories, electrical requirements, wiring diagrams, and control diagrams.

C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include startup instructions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements including those furnished but not produced by manufacturer.

E. Manufacturer’s Field Reports: Submit start-up report. Indicate results of leak test and refrigerant pressure test.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

1.6 WARRANTY

A. Furnish five year manufacturer warranty to include coverage for complete assembly including materials and labor.

1.7 MAINTENANCE SERVICE

A. Furnish service and maintenance of chiller for five years from Date of Substantial Completion.

B. Examine unit components monthly. Clean, adjust, and lubricate equipment.

C. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.

D. Perform work without removing units from service during building normal occupied hours.

E. Provide emergency call back service at all hours for this maintenance period.

F. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

G. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.

1.8 MAINTENANCE MATERIALS

A. Furnish two containers of lubricating oil.

PART 2 - PRODUCTS

2.1 PACKAGED WATER CHILLERS

A. Manufacturers:

1. **York.**
2. **Carrier.**
3. **Trane.**

B. Product Description: Factory assembled and tested, packaged, water cooled, liquid chillers consisting of compressors, compressor motor, condenser, evaporator, refrigeration accessories, instrument and control panel including gages and indicating lights, auxiliary components and accessories, and motor starters.

C. Refrigerant shall be R-410A or R-407C.

2.2 HERMETIC COMPRESSORS

A. Reciprocating Compressors:

1. Unit: Hermetically sealed motor-compressor with crankcase heater, suction and discharge service valves, rubber-in-shear isolators, and control panel.
2. Motor: Constant speed 3600 rpm, suction gas cooled with overheating protection.
3. Crankcase Heater: Energize continuously.

B. Scroll Compressors:

1. Unit: Direct drive, hermetic, 3600 RPM, fixed compression, scroll motor-compressor with control panel.
2. Features: Centrifugal oil pump, sump oil heater, oil level sight glass, oil charging valve, two point lubrication for each motor bearing, flooded lubrication for journal and thrust bearings, check valve on scroll discharge port.
3. Motor: Suction-gas cooled, hermetically sealed, squirrel cage induction.
4. Automatic Capacity Reduction: Electronic logic controller and air temperature sensor controls unit and hot gas bypass regulator valve.

2.3 SEMI-HERMETIC COMPRESSORS

A. Reciprocating Compressors:

1. Unit: Serviceable hermetic reciprocating motor-compressor with positive displacement oil pump lubrication system, spring loaded heads and replaceable cylinder liners, crankcase heater, suction inlet screen, discharge service valves, and control panel.
2. Automatic Capacity Reduction Equipment solenoid gas pressure operated. Furnish capability for unloaded compressor start.
3. Motor: Constant speed 1800 rpm, suction gas cooled with electronic overheating protection in each phase, reduced voltage starting.

4. Crankcase Heater: Energize continuously.

B. Screw Compressors:

1. Unit: Direct drive, semi-hermetic 3600 RPM, fixed compression, rotary screw compressor with control panel.
2. Features: Differential refrigerant pressure oil pump, oil heater, oil separator and filter and oil charging valve.
3. Motor: Suction gas-cooled, hermetically sealed, squirrel cage induction.
4. Automatic Capacity Reduction: Continuously variable slide valve with infinitely variable control to 25 percent of full load.

2.4 EVAPORATOR

A. Shell and tube type, seamless steel construction with fabricated steel, heads, seamless copper tubes with integral fins, rolled into tube sheets. Furnish multiple refrigerant circuits on multiple compressor units.

B. Design, test, and stamp refrigerant side for 225 psig working pressure and water side for 150 psig working pressure, in accordance with ASME Section VIII.

C. Insulate with 0.75 inch minimum thick flexible expanded polyvinyl chloride insulation with maximum K factor of 0.26.

D. Furnish water drain connection and thermometer wells for temperature controller and low temperature cutout.

2.5 CONDENSERS

A. Shell and tube type, seamless steel construction with fabricated steel heads, seamless copper tubes with integral fins, rolled into tube sheets.

B. Design, test, and stamp refrigerant side for 450 psig working pressure in accordance with ASME Section VIII.

C. Furnish integral sub-cooling circuit.

D. Furnish 450 psig safety relief valve on condenser shell.

E. Design, test, and stamp water side for 150 psig working pressure in accordance with ASME Section VIII.

2.6 CONDENSER COILS, FANS AND MOTORS

A. Coils: Copper fins mechanically bonded to seamless copper tubing. Furnish sub-cooling circuits as applicable. Air test under water to 425 psig, and vacuum dehydrate. Seal with holding charge of nitrogen.

B. Coil Guard: Louvered with lint screens.

C. Vertical propeller type condenser fans with fan guard on discharge.

D. Weatherproof motors suitable for outdoor use, with permanent lubricated ball bearings and built-in current and thermal overload protection.

2.7 REFRIGERANT CIRCUIT

A. Factory furnished and piped.

B. Furnish for each refrigerant circuit:

1. Liquid line solenoid valve.
2. Filter dryer (replaceable core type).
3. Liquid line sight glass and moisture indicator.
4. Thermal expansion for maximum operating pressure.
5. Charging valve.
6. Insulated suction line.
7. Discharge line check valve.
8. Compressor discharge service valve.
9. Pressure relief device.

2.8 CONTROLS

A. On or near chiller, mount steel control panel with NEMA 3R (NEMA 4X for outdoors location) enclosure, containing starters, power and control wiring, molded case disconnect switch, factory wired with single point power connection.

B. For each compressor, furnish part winding starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for control power. Furnish manual reset, current overload protection.

C. Furnish devices on control panel face:

1. Compressor, run lights.
2. System start-stop switch.
3. Control power fuse of circuit breaker.
4. Compressor lead-lag switch.
5. Demand limit switch.

D. Furnish safety controls with indicating lights arranged so machine is shut down and requires manual reset:

1. Low chilled water temperature switch.
2. High discharge pressure switch for each compressor.
3. Low suction pressure switch for each compressor.
4. Oil pressure switch.

5. Flow switch in chilled water line.
6. Flow switch in condenser water line.
7. Relay for remote mounted emergency shutdown.

E. Furnish the following operating controls:

1. Multi-step chilled water temperature controller to cycle compressor and activate capacity controls, with remote thermostat.
2. Five minute off timer prevents compressor from short cycling.
3. Part winding start timer.
4. Periodic pump-out-timer to pump down on chilled water flow and high evaporator refrigerant pressure.
5. Load limit thermostat to limit compressor loading on high return water temperature.
6. Three phase monitor to protect unit by stopping compressor on phase loss, phase reversal, phase unbalance, or under voltage.
7. Hot gas bypass sized for minimum compressor loading, bypasses hot refrigerant gas to evaporator.
8. Cycle counter and operating hour meter.

F. Furnish pre-piped gage board with pressure gages for suction and discharge refrigerant pressures, and oil pressures.

G. Furnish alarm package with test button and lights indicating control circuit is energized, compressor is running, and sounds audible alarm and activates indicating light upon detection of compressor malfunction, low chilled water temperature, or evaporator water flow failure.

2.9 SOURCE QUALITY CONTROL (AND TESTS)

A. Furnish testing of package chillers.

B. Furnish shop inspection and testing for package chillers.

C. Make completed chillers available for inspection at manufacturer's factory prior to packaging for shipment. Furnish at least seven days notice before packaging is scheduled.

D. Allow witnessing of factory inspections and tests at manufacturers test facility with 2 LAWA personnel. Furnish at least seven days notice before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install indoor chiller on concrete housekeeping pad minimum 3-1/2 inches high and 6 inches wider than equipment base on each side. Install packaged outdoor chiller on concrete foundation minimum 6 inches thick and 6 inches wider than equipment base on each side.

B. Provide seismic restraints as required.

C. Install the following piping accessories on evaporator chilled water piping connections.

1. On inlet:

a. Thermometer well for temperature controller.
b. Thermometer.
c. Strainer.
d. Flow switch.
e. Flexible pipe connection.
f. Pressure gage.
g. Shut-off valve.

2. On outlet:

a. Thermometer.
b. Flexible pipe connection.
c. Pressure gage.
d. Balancing valve.

D. Install auxiliary water piping for oil cooling units and purge condensers.

E. Install the following piping accessories on condenser water piping connections.

1. On inlet:

a. Thermometer well for temperature limit controller.
b. Thermometer well and thermometer.
c. Strainer.
d. Flow switch.
e. Flexible pipe connection.
f. Pressure gage.
g. Shut-off valve.

2. On outlet:

a. Thermometer well and thermometer.
b. Flexible pipe connection.
c. Pressure gage.
d. Balancing valve.

F. Arrange piping for easy dismantling to permit tube cleaning.

G. Install refrigerant piping connections to air-cooled condensing units.

H. Install piping from chiller safety relief valve to outdoors. Size as recommended by manufacturer.

I. Install chiller accessories furnished loose for field mounting.

J. Install electrical devices furnished loose for field mounting.

K. Install control wiring between chiller control panel and field mounted control devices.

L. Provide connection to electrical service.

3.2 FIELD QUALITY CONTROL

A. Furnish cooling season start-up, winter season shutdown service, for first year of operation. When initial start-up and testing takes place in winter and machines are to remain inoperative, repeat start-up and testing operation at beginning of first cooling season.

3.3 MANUFACTURER'S FIELD SERVICES

A. Furnish services of factory trained representative for minimum of three days to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance.

B. Furnish initial charge of refrigerant and oil.

3.4 DEMONSTRATION AND TRAINING

A. Demonstrate system operations and verify specified performance. Demonstrate low ambient operation during winter testing for air-cooled condensers.

B. Training to include minimum of 15 personnel for 40 hours training, 16 hours shall be classroom training and 24 hours shall be hands-on training.

C. Training shall occur after the system is fully operational.

3.5 FACTORY PERFORMANCE TESTS

A. Manufacturer shall conduct factory performance test for each chiller in accordance with ARI 550/590 98, to verify design capacity and part load capacity points indicated on Bid form. LAWA and/or LAWA's representative (2 persons) may elect to witness tests. Notify LAWA and/or LAWAs representative of test date at least 2 weeks in advanced. There will be zero tolerance on capacity and NPLV, other parameters are per ARI 550/590 tolerance.

B. Before shipment of chillers, all records and certifications approving testing requirements shall be submitted to and approved by LAWA.

C. Defective work or material shall be replaced or repaired, as necessary, and inspection and test repeated. Repairs shall be made with new materials. Run new performance test in accordance with ARI standard.

D. If chiller assembly fails to meet design capacity and a minimum of 15% more capacity at lower condenser water temperature, LAWA may elect not to accept delivery until chiller is modified at manufacturer's expense to meet design capacity.

E. If chiller assembly fails to meet any of part load performance data supplied by manufacturer with his bid, LAWA may elect not to accept delivery until chiller is modified at manufacturer's expense to meet all of design and part load performance data or to assess penalty charge equal to 10 years operating cost differential. This differential is to be determined by using part load data included in bid form and data obtained from performance test, subtracting bid data annual operating cost from test data annual operating cost, and multiplying difference by ten. Penalty charge shall apply to all chillers.

F. All design conditions and part load performance data shall be evaluated with 480 volt, 3 phase, 60 hertz power supplied to chiller.

G. Conduct test at approved ARI certified test facility of the manufacturer.

H. Instrumentation used for testing must be calibrated within 6 months of test date and traceable to National Bureau of Standards. Documentation verifying NBS traceability shall be submitted to LAWA.

1. Performance test shall be two point test for one chiller. Points will be selected at time of test. Points will be selected from submitted performance from 25 to 100% of capacity.

3.6 COMMISSIONING

A. The manufacturer shall be present during all commissioning events. The anticipated schedule is for commissioning to occur during the least six to eight weeks of construction just prior to the anticipated end of construction date of. Include 40 hours of field time to perform the commissioning requirements.

B. A factory authorized representative shall perform the startup service.

1. Fill out startup checklists and attach copy with Contractor Startup Report.

C. Complete installation and startup checks according to manufacturer's written instructions and check for the following items:

1. No physical damage to unit.
2. Unit is level.
3. Chiller vibration isolation and flexible pipe connections are installed.
4. Clearances have been maintained and piping is installed for easy removal for service and tube cleaning.
5. Chilled and condenser water pipes have been connected to correct ports.
6. Labels and safety instructions are clearly visible.
7. Oil levels are as recommended by manufacturer.
8. Refrigerant charge is sufficient and chiller has been leak tested.
9. Shipping skids, blocks and straps are removed.
10. Refrigerant pressure relief is vented to outside.
11. Thermometers and pressure gauges are installed.
12. Controls and safety interlocks are installed and connected.
13. Pumps are installed, connected and operational.

D. Check and record performance of chiller protection devices.

E. Check and record performance of chilled and condenser water flow and low temperature interlocks.

F. Operate chiller for run in period as recommended by manufacturer.

G. Check static deflection of vibration isolators, including deflection during chiller startup and shutdown.

1. Check refrigerant charge. Check oil level.

3.7 CLEANING

A. After completion of system installation, start up, testing and prior to commissioning, completely and thoroughly clean up the chillers from any foreign material and construction dirt and dust.

END OF SECTION 23 64 11

SECTION 23 64 16 - CENTRIFUGAL WATER CHILLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Packaged, water-cooled, electric-motor-driven centrifugal chillers.
2. Packaged, portable refrigerant recovery units.
3. Heat-exchanger, brush-cleaning system.
4. Motor controllers.
5. Charge of refrigerant and oil.
6. Accessories.

B. This applies to chillers that are greater than or equal to 100 tons.

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME):

1. Boiler and Pressure Vessel Code, Section VIII, Division 1, “Rules for Construction of Pressure Vessels”.
2. Boiler and Pressure Vessel Code, Section IX, “Welding and Brazing Qualifications”.
3. B31.1, “Power Piping”.
4. B31.5, “Refrigeration Piping and Heat Transfer Components”.

B. Air-Conditioning and Refrigeration Institute (ARI):

1. Standard 550/590, “Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle”.
2. Standard 575, “Method of Measuring Machinery Sound Within an Equipment Space”.

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

1. Standard 15, “Safety Standard for Refrigeration Systems”.
2. Standard 147, “Reducing the Release of Halogenated Refrigerants from Refrigerating and Air Conditioning Equipment and Systems”.
3. Standard 90.1, “Energy Standard for Buildings Except Low-Rise Residential Buildings”.

D. National Fire Protection Association (NFPA)

1. Standard 70, National Electrical Code (NEC)

E. American Gear Manufacturers Association (AGMA)

F. American National Standards Institute (ANSI)

G. American Society for Testing and Materials (ASTM)

H. Institute of Electrical and Electronics Engineers (IEEE)

1. National Electrical Manufacturers Association (NEMA)

I. Underwriters Laboratories (UL)

J. Occupational Safety & Health Act (OSHA) I International Building Code (IBC) 2009

1.3 PERFORMANCE REQUIREMENTS

A. Each chiller shall produce a capacity as scheduled on plans when operating on a fluid mixture of 30% propylene glycol.

B. The coolers shall be selected for 0.00010 fouling factor. Water side shall be designed for 150 psig working pressure. The condenser shall be selected for 0.00025 fouling factor. Water side shall be designed for 150 psig working pressure.

C. Chillers shall give 15 to 25% more capacity with better efficiency when condenser water temperature is lowered.

D. Seismic Performance: Centrifugal chillers shall withstand the effects of earthquake motions determined according to California Building Code.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

E. Condenser-Fluid Temperature Performance:

1. Startup Condenser-Fluid Temperature: Chiller shall be capable of starting with an entering condenser-fluid temperature of 40 deg F and providing stable operation until the system temperature is elevated to the minimum operating entering condenser-fluid temperature.
2. Minimum Operating Condenser-Fluid Temperature: Chiller shall be capable of continuous operation over the entire capacity range indicated with an entering condenser-fluid temperature of 55 deg F.
3. Make factory modifications to standard chiller design if necessary to comply with performance indicated.
4. Site Altitude: Chiller shall be suitable for altitude at which installed without affecting performance indicated. Make adjustments to affected chiller components to account for site altitude.
5. Performance Tolerance: Comply with the following in lieu of ARI 550/590:

a. Allowable Capacity Tolerance: Zero percent.
b. Allowable IPLV/NPLV Performance Tolerance: Zero percent.

c. Flow and temperature to follow ARI 550/590 Standards

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of chillers that fail in materials or workmanship within specified warranty period.

1. Extended warranties include, but are not limited to, the following:

a. Complete chiller including refrigerant and oil charge.
b. Complete compressor and drive assembly including refrigerant and oil charge.
c. Refrigerant and oil charge.
d. Parts and labor including the refrigerant.
e. Loss of refrigerant charge for any reason.

2. Warranty Period: Five (5) years.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

1. Performance at ARI standard conditions and at conditions indicated.
2. Performance at ARI standard unloading conditions.
3. Minimum evaporator flow rate.
4. Refrigerant capacity of chiller.
5. Oil capacity of chiller.
6. Fluid capacity of evaporator, condenser, and heat-reclaim condenser.
7. Characteristics of safety relief valves.
8. Minimum entering condenser-fluid temperature.
9. Performance at varying capacities with constant design condenser-fluid temperature. Repeat performance at varying capacities for different condenser-fluid temperatures from design to minimum in 5 deg F increments.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, load distribution, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural supports.

2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

D. Certificates: Provide certificate from manufacturer.

E. Seismic Qualification Certificates: For chillers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Source quality-control reports.

G. Startup service reports.

H. Operation and Maintenance Data: For each chiller to include in emergency, operation, and maintenance manuals. Include start-up instructions, maintenance data, parts lists, controls, accessories, and troubleshooting guide.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Carrier.

B. Trane.

C. York.

2.2 MANUFACTURED UNIT

A. Description: Factory-assembled and -tested chiller complete with compressor, compressor motor, compressor motor controller, lubrication system evaporator, condenser, controls, interconnecting unit piping and wiring, and indicated accessories.

1. For chillers with dual compressors, provide each compressor with a dedicated

motor and motor controller, and provide for continued operation when either compressor-drive assembly fails or is being serviced.

B. Seismic Fabrication Requirements:

1. Fabricate chiller mounting base with reinforcement strong enough to resist chiller movement during a seismic event when chiller is anchored to field support structure.

2.3 COMPRESSOR-DRIVE ASSEMBLY

A. Description: Single-stage or multistage, variable-displacement, centrifugal-type compressor driven by an electric motor.

B. Compressor:

1. Casing: Cast iron, precision ground.
2. Impeller: High-strength cast aluminum or cast-aluminum alloy on carbon- or alloy-steel shaft.

C. Drive: Direct- or gear-drive, open or hermetic design using an electric motor as the driver.

1. Gear Drives: For chillers with gear drives, provide single- or double-helical gear design continuously coated with oil while chiller is operating. Gears shall comply with American Gear Manufacturer Association standards. Temperature rise of gears shall not exceed 70 deg F above ambient at full load.
2. Drive Coupling: For chillers with open drives, provide flexible disc with all-metal construction and no wearing parts to ensure long life without the need for lubrication.
3. Seals: Seal drive assembly to prevent refrigerant leakage.

D. Compressor Motor:

1. Continuous-duty, squirrel-cage, induction-type, two-pole motor with energy efficiency required to suit chiller energy efficiency indicated.
2. Factory mounted, aligned, and balanced as part of compressor assembly before shipping.
3. Motor shall be of sufficient capacity to drive compressor throughout entire operating range without overload and with sufficient capacity to start and accelerate compressor without damage.
4. For chillers with open drives, provide motor with open-dripproof enclosure.
5. Provide motor with thermistor or RTD in single motor winding to monitor temperature and report information to chiller control panel.
6. Provide motor with thermistor or RTD to monitor bearing temperature and report information to chiller control panel.
7. Provide lifting lugs or eyebolts attached to motor.

E. Vibration Balance: Balance chiller compressor and drive assembly to provide a precision balance that is free of noticeable vibration over the entire operating range. Operating

speed shall be below the first critical speed.

1. Overspeed Test: 25 percent above design operating speed.

F. Service: Easily accessible for inspection and service.

1. Compressor's internal components shall be accessible without having to remove compressor-drive assembly from chiller.
2. Provide lifting lugs or eyebolts attached to casing.

G. Economizers: For multistage chillers, provide interstage economizers.

H. Sound Attenuation: Compressors shall be provided with Sound Attenuation package to reduce the low frequency noise levels.

I. Capacity Control: Modulating, VFD and variable-inlet, guide-vane assembly combined with hot-gas bypass, if necessary, to achieve performance indicated.

1. Maintain stable operation that is free of surge, cavitation, and vibration throughout range of operation. Configure to achieve most energy-efficient operation possible.
2. Operating Range: From 100 to 15 percent of design capacity.
3. Condenser-Fluid Unloading Requirements over Operating Range: Constant-design entering condenser-fluid temperature.
4. Chillers with variable frequency controllers shall modulate compressor speed with variable-inlet, guide-vane control to achieve optimum energy efficiency.
5. Provide external electric guide-vane operator and linkage.
6. Seal points where guide-vane operating mechanism passes through the compressor casing to prevent refrigerant leakage.

J. Oil Lubrication System: Consisting of oil reservoir pump, filtration, cooler, factory-wired power connection, motor controllers and controls.

1. Provide lubrication to bearings, gears, and other rotating surfaces at all operating, startup, coastdown, and standby conditions including power failure.
2. Manufacturer's standard method to remove refrigerant from oil.
3. Oil filter shall be the easily replaceable cartridge type, minimum 0.5-micron efficiency, with means of positive isolation while servicing.
4. Refrigerant- or water-cooled oil cooler.
5. Factory-installed and pressure-tested piping with isolation valves and accessories.
6. Oil compatible with refrigerant and chiller components.
7. Positive visual indication of oil level.
8. Oil flow must be proven for compressor to run.
9. Oil pump shall be submerged in the oil reservoir to assure a positive oil supply.

2.4 REFRIGERATION

A. Refrigerant:

1. Type: R-134a; ASHRAE 34, Class A1.
2. Compatibility: Chiller parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.

B. Refrigerant Flow Control: Manufacturer's standard refrigerant flow-control device satisfying performance requirements indicated.

C. Pressure Relief Device:

1. For Chillers Using R-134a: ASME-rated, spring-loaded, pressure relief valve; single- or multiplereseating type. Pressure relief valve(s) shall be provided for each heat exchanger. Condenser shall have dual valves with one being redundant and configured to allow either valve to be replaced without loss of refrigerant.

D. Refrigerant Transfer: Provide service valves and other factory-installed accessories required to facilitate transfer of refrigerant from chiller to a remote refrigerant storage and recycling system.

E. Refrigerant Isolation for Chillers Using R-134a: Factory install positive shutoff, manual isolation valves in the compressor discharge line to the condenser and the refrigerant liquid line leaving the condenser to allow for isolation and storage of full refrigerant charge in the chiller condenser shell. In addition, provide isolation valve on suction side of compressor from evaporator to allow for isolation and storage of full refrigerant charge in the chiller evaporator shell. Purge System:

1. System shall be a thermal purge design, refrigerant or air cooled, equipped with a carbon filter that includes an automatic regeneration cycle.
2. Factory wire to chiller's main power supply and system complete with controls, piping, and refrigerant valves to isolate the purge system from the chiller.
3. Construct components of noncorrodible materials.
4. Controls shall interface with chiller control panel to indicate modes of operation, set points, data reports, diagnostics, and alarms.
5. Efficiency of not more than 0.02 lb of refrigerant per pound of air when rated according to ARI 580.
6. Operation independent of chiller.

F. Positive-Pressure System:

1. During nonoperational periods, positive-pressure system shall automatically maintain a positive pressure for atmosphere in the refrigerant pressure vessel of not less than 0.5 psig (adjustable) up to a pressure that remains within the vessel design pressure limits.
2. System shall be factory wired and include controller, electric heat, pressure transmitter, or switch.

2.5 EVAPORATOR

A. Description: Shell-and-tube design with water in tubes and refrigerant surrounding tubes

within shell. Shell is separate from condenser.

B. Shell Material: Carbon-steel rolled plates with seamless pipe.

C. Designed to prevent liquid refrigerant carryover from entering compressor.

D. Provide evaporator with sight glass or other form of positive visual verification of liquid-refrigerant level.

E. Tubes:

1. Individually replaceable from either end and without damage to tube sheets and other tubes.
2. Mechanically expanded into end sheets and physically attached to intermediate tube sheets.
3. Material: Copper.
4. Nominal OD: Per manufacturer.
5. Minimum Wall Thickness: Per manufacturer.
6. External Finish: Per manufacturer.
7. Internal Finish: Enhanced or smooth.

F. End Tube Sheets: Continuously welded to each end of shell; drilled and reamed to accommodate tubes with positive seal between fluid in tubes and refrigerant in shell.

G. Intermediate Tube Sheets: Installed in shell and spaced along length of tube at intervals required to eliminate vibration and to avoid contact of tubes resulting in abrasion and wear.

H. Water Box:

1. Carbon-steel construction; arranged to provide visual inspection and cleaning of tubes from either end without disturbing refrigerant in shell.
2. Standard type for water box with piping connections. Standard type for water box without piping connections.
3. Provide water boxes with lifting lugs or eyebolts.
4. Nozzle Pipe Connections: Grooved with mechanical-joint coupling and flange adapter.
5. Thermistor or RTD temperature sensor factory installed in each nozzle.
6. Fit each water box with 3/4-inch drain connection at low point and vent connection at high point, each with threaded plug.

I. Additional Corrosion Protection. See FINISH later.

2.1 CONDENSER

A. Description: Shell-and-tube design with water in tubes and refrigerant surrounding tubes within shell. Shell is separate from evaporator.

B. Shell Material: Carbon-steel rolled plates with seamless pipe.

C. Designed to prevent direct impingement of high-velocity hot gas from compressor discharge on tubes.

D. Provide condenser with sight glass or other form of positive visual verification of refrigerant charge and condition.

E. Tubes:

1. Individually replaceable from either end and without damage to tube sheets and other tubes.
2. Mechanically expanded into end sheets and physically attached to intermediate tube sheets.
3. Material: Copper.
4. Nominal OD: Per manufacturer.
5. Minimum Wall Thickness: Per manufacturer.
6. External Finish: Per manufacturer.
7. Internal Finish: Enhanced or smooth.

F. End Tube Sheets: Continuously welded to each end of shell; drilled and reamed to accommodate tubes with positive seal between fluid in tubes and refrigerant in shell.

G. Intermediate Tube Sheets: Installed in shell and spaced along length of tube at intervals required to eliminate vibration and to avoid contact of tubes resulting in abrasion and wear.

H. Water Box:

1. Carbon-steel construction; arranged to provide visual inspection and cleaning of tubes from either end without disturbing refrigerant in shell.
2. Standard type for water box with piping connections. Standard type for water box without piping connections.
3. Provide water boxes with lifting lugs or eyebolts.
4. Nozzle Pipe Connections: Grooved with mechanical-joint coupling and flange adapter.
5. Thermistor or RTD temperature sensor factory installed in each nozzle.
6. Fit each water box with 3/4-inch drain connection at low point and vent connection at high point, each with threaded plug.

I. Additional Corrosion Protection. See FINISH later.

2.1 INSULATION

A. Closed-cell, flexible elastomeric thermal insulation complying with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Thickness: 1-1/2 inches.

B. Adhesive: As recommended by insulation manufacturer.

C. Factory-applied insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator shell and end tube sheets, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.

1. Apply adhesive to 100 percent of insulation contact surface.
2. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
3. Seal seams and joints to provide a vapor barrier.
4. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.
5. Provide removable insulations covers for water boxes.

2.2 ELECTRICAL

A. Factory installed and wired, and functionally tested at factory before shipment.

B. Single-point, field-power connection to fused disconnect switch. Minimum withstand rating shall be as required by electrical power distribution system, but not less than 65,000 A.

1. Branch power circuit to each motor, electric heater, dedicated electrical load, and controls with disconnect switch or circuit breaker.

    a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.

2. NEMA ICS 2-rated motor controller for auxiliary motors, hand-off-auto switch, and overcurrent protection for each motor. Provide variable frequency controller for each variable-speed motor furnished.
3. Control-circuit transformer with primary and secondary side fuses.

C. Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.

D. Factory-installed wiring outside of enclosures shall be in metal raceway except make terminal connections with not more than a 24-inch length of liquid tight or flexible metallic conduit.

2.3 VARIABLE FREQUENCY CONTROLLER

A. Motor controller shall be factory mounted and wired on the chiller to provide a single-point, field-power termination to the chiller and its auxiliaries.

B. Description: NEMA ICS 2; listed and labeled as a complete unit and arranged to provide variable speed by adjusting output voltage and frequency.

C. Enclosure: Unit mounted, NEMA 250, Type 14X, with hinged full-front access door with lock and key.

D. General: Comply with the requirements of Division 26.

E. Integral Disconnecting Means: Door-interlocked, NEMA AB 1, instantaneous-trip circuit breaker with lockable handle. Minimum withstand rating shall be as required by electrical power distribution system, but not less than 65,000 A.

F. Technology: Pulse width modulated (PWM) output with insulated gate bipolar transistors (IGBT); suitable for variable torque loads.

G. Controller shall consist of a rectifier converter section, a digital/analog driver regulator section, and an inverter output section.

1. Rectifier section shall be a full-wave diode bridge that changes fixed-voltage, fixed-frequency, ac line power to a fixed dc voltage. Silicon controller rectifiers, current source inverters, and paralleling of devices are unacceptable. Rectifier shall be insensitive to phase rotation of the ac line.
2. Regulator shall provide full digital control of frequency and voltage.
3. Inverter section shall change fixed dc voltage to variable-frequency, variable ac voltage, for application to a squirrel-cage motor. Inverter shall produce a sine-coded, pulse width modulated (PWM) output wave form and shall conduct no radio-frequency interference back to the input power supply.

H. Output Rating: Three phase; with voltage proportional to frequency throughout voltage range.

I. Operating Requirements:

1. Input AC Voltage Tolerance: 460-V ac, plus 10 percent or 506 V maximum.
2. Input frequency tolerance of 60 Hz, plus or minus 2 Hz.
3. Capable of driving full load, without derating, under the following conditions:

    a. Ambient Temperature: 0 to 50 deg C.
    b. Relative Humidity: Up to 90 percent (noncondensing).
    c. Altitude: sea level.

4. Minimum Efficiency: 96 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 95 percent without harmonic filter, 98 percent with harmonic filter.
6. Overload Capability: 1.05 times the full-load current for 7 seconds.
7. Starting Torque: As required by compressor-drive assembly.
8. Speed Regulation: Plus or minus 1 percent.
9. Isolated control interface to allow controller to follow control signal over a 10:1 speed range.
10. To avoid equipment resonant vibrations, provide critical speed lockout circuitry to allow bands of operating frequency at which controller shall not operate continuously.

11. Capable of being restarted into a motor coasting in either the forward or reverse direction without tripping.

J. Internal Adjustability Capabilities:

1. Minimum Output Frequency: 6 Hz.
2. Maximum Output Frequency: 60 Hz.
3. Acceleration: 2 seconds to a minimum of 60 seconds.
4. Deceleration: 2 seconds to a minimum of 60 seconds.
5. Current Limit: 30 percent to a minimum of 100 percent of maximum rating.

K. Self-Protection and Reliability Features: Subjecting the controller to any of the following conditions shall not result in component failure or the need for replacement:

1. Overtemperature.
2. Short circuit at controller output.
3. Ground fault at controller output. Variable frequency controller shall be able to start a grounded motor.
4. Open circuit at controller output.
5. Input undervoltage.
6. Input overvoltage.
7. Loss of input phase.
8. Reverse phase.
9. AC line switching transients.
10. Instantaneous overload, line to line or line to ground.
11. Sustained overload exceeding 100 percent of controller rated current.
12. Starting a rotating motor.

L. Motor Protection: Controller shall protect motor against overvoltage and undervoltage, phase loss, reverse phase, overcurrent, overtemperature, and ground fault.

M. Automatic Reset and Restart: Capable of three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Controller shall be capable of automatic restart on phase-loss and overvoltage and undervoltage trips.

N. Visual Indication: On face of controller enclosure or chiller control enclosure; indicating the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.
7. Motor speed (percent).
8. Fault or alarm status (code).
9. DC-link voltage.
10. Motor output voltage.
11. Input kilovolt amperes.

12. Total power factor.
13. Input kilowatts.
14. Input kilowatt-hours.
15. Three-phase input voltage.
16. Three-phase output voltage.
17. Three-phase input current.
18. Three-phase output current.
19. Three-phase input voltage total harmonic distortion.
20. Three-phase input current total harmonic distortion.
21. Output frequency (Hertz).
22. Elapsed operating time (hours).
23. Diagnostic and service parameters.

O. Operator Interface: At controller or chiller control panel; with start-stop and auto-manual selector with manual-speed-control potentiometer.

P. Control Signal Interface:

1. Electric Input Signal Interface: A minimum of two analog inputs (0 to 10 V or 0/4-20 mA) and six programmable digital inputs.

Q. Active Harmonic Distortion Filter: Factory mounted and wired to limit total voltage and current distortion to 5 percent.

R. Cooling: Air, refrigerant, or water cooled.

S. Accessories: Devices shall be factory installed in controller enclosure unless otherwise indicated.

1. Control Relays: Auxiliary and adjustable time-delay relays.

T. Chiller Capacity Control Interface: Equip chiller with adaptive control logic to automatically adjust the compressor motor speed and the compressor pre-rotation inlet vane position independently to achieve maximum part-load efficiency in response to sensor inputs that are integral to the chiller controls.

2.4 CONTROLS

A. Control: Standalone and microprocessor based, with all memory stored in nonvolatile memory so that reprogramming is not required on loss of electrical power.

B. Enclosure: Unit mounted, NEMA 4X, hinged or lockable; factory wired with a single-point, field-power connection and a separate control circuit.

C. Operator Interface: Multiple-character digital or graphic display with dynamic update of information and with keypad or touch-sensitive display located on front of control enclosure. In either imperial or metric units selectable through the interface, display the following information:

1. Date and time.
2. Operating or alarm status.
3. Fault history with not less than last 10 faults displayed.
4. Set points of controllable parameters.
5. Trend data.
6. Operating hours.
7. Number of chiller starts.
8. Entering- and leaving-fluid temperatures of evaporator and condenser.
9. Difference in fluid temperatures of evaporator and condenser.
10. Fluid flow of evaporator and condenser.
11. Fluid pressure drop of evaporator and condenser.
12. Refrigerant pressures in evaporator and condenser.
13. Refrigerant saturation temperature in evaporator and condenser shell.
14. Compressor refrigerant suction and discharge temperature.
15. Compressor bearing temperature.
16. Motor bearing temperature.
17. Motor winding temperature.
18. Oil temperature.
19. Oil discharge pressure.
20. Phase current.
21. Percent of motor rated load amperage.
22. Phase voltage.
23. Demand power (kilowatts).
24. Energy use (kilowatt-hours).
25. Power factor.
26. For chillers equipped with variable frequency controllers and harmonic filters, include the following:

    a. Output voltage and frequency.
    b. Voltage total harmonic distortion for each phase.
    c. Supply current total demand distortion for each phase.
    d. Inlet vane position.
    e. Controller internal ambient temperature.
    f. Heatsink temperature.

27. Purge suction temperature if purge system is provided.
28. Purge elapsed time if purge system is provided.

D. Control Functions:

1. Manual or automatic startup and shutdown time schedule.
2. Entering and leaving chilled-water temperatures, control set points, and motor load limits.
3. Current limit and demand limit.
4. Condenser-fluid temperature.
5. External chiller emergency stop.
6. Variable evaporator flow.
7. Thermal storage.
8. Heat reclaim.

E. Manually Reset Safety Controls: The following conditions shall shut down chiller and require manual reset:

1. Low evaporator pressure or temperature; high condenser pressure.
2. Low evaporator fluid temperature.
3. Low oil differential pressure.
4. High or low oil pressure.
5. High oil temperature.
6. High compressor-discharge temperature.
7. Loss of condenser-fluid flow.
8. Loss of evaporator fluid flow.
9. Motor overcurrent.
10. Motor overvoltage.
11. Motor undervoltage.
12. Motor phase reversal.
13. Motor phase failure.
14. Sensor- or detection-circuit fault.
15. Processor communication loss.
16. Motor controller fault.
17. Extended compressor surge.
18. High motor temperature.

F. Trending: Capability to trend analog data of up to five parameters simultaneously over an adjustable period and frequency of polling.

G. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: view only; view and operate; and view, operate, and service.

H. Control Authority: At least four conditions: Off, local manual control at chiller, local automatic control at chiller, and automatic control through a remote source.

I. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

J. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display chiller status and alarms.

1. ASHRAE 135 (BACnet) communication interface with the BAS shall enable the BAS operator to remotely control and monitor the chiller from an operator workstation. Control features and monitoring points displayed locally at chiller control panel shall be available through the BAS.

2.5 FINISH

A. Paint chiller, using manufacturer's standard procedures, except comply with the following minimum requirements:

1. Provide at least one coat of primer with a total dry film thickness of at least 4 mils.

2. Provide baked phenolic coating finish with a total dry film thickness of at least 6 mils.
3. Paint surfaces that are to be insulated before applying the insulation.
4. Paint installed insulation to match adjacent uninsulated surfaces.
5. Color of finish coat to be manufacturer's standard.

2.6 ACCESSORIES

A. Flow Switches:

1. Chiller manufacturer shall furnish a switch for each evaporator and condenser and verify fieldmounting location before installation.
2. Pressure Differential Switches:

    a. Construction: Wetted parts of body and trim constructed of Type 316 stainless steel.
    b. Performance: Switch shall withstand, without damage, the full-pressure rating of the heat exchanger applied to either port and exhibit zero set-point shift due to variation in working pressure.
    c. Set Point: Screw type, field adjustable.
    d. Electrical Connections: Internally mounted screw-type terminal blocks.
    e. Switch Enclosure: NEMA 250, Type 4.
    f. Switch Action: Double-pole, double-throw switch with one pole field wired to the chiller control panel and the other pole field wired to the BAS.

B. Chillers shall be provided with BACNet Controls including BACNet interface communication card. The Control panel shall provide mapping out all points, and the Chiller manufacturer shall allow enough time to assist the Control Company to map all the chiller points.

C. Sound Barrier:

1. Furnish removable and reusable sound-barrier covers over the compressor housing, hermetic motor, compressor suction and discharge piping, and condenser shell.
2. Provide for repeated installation and removal without use of tape or calk.
3. Inner and outer cover shall consist of a PTFE-impregnated fiberglass cloth enclosing heavydensity, needled fiberglass insulation material with a mass-loaded vinyl acoustic barrier.
4. Covers shall be double sewn and lock stitched with edges folded and sewn so no raw cut edges are exposed.
5. Form covers around control devices, gages, conduit, piping, and supports without degrading sound-barrier performance.
6. Continuously lap all exposed seams at least 2 inches for better sound containment.
7. Permanently label each section of cover to indicate its location, description, size, and number sequence.
8. Randomly place stainless-steel quilting pins to prevent covers from shifting and

sagging.

D. Tool Kit: Chiller manufacturer shall assemble a tool kit specially designed for use in serving the chiller(s) furnished. Include special tools required to service chiller components not readily available to LAWA service personnel in performing routine maintenance. Place tools in a lockable case with hinged cover. Provide a list of each tool furnished and attach the list to underside of case cover.

E. Quick Start B with Uninterruptible Power Supply (UPS)

1. Quick Start shall enable the chiller to restart in 15 seconds the power is restored. Quick Start minimizes the time to restart and loads the chiller as quickly as possible, to rapidly achieve the leaving chiller water temperature setpoint. The main objective is to provide minimum down time and the fastest restart/loading as possible. Once the chiller is running and close to setpoint, it will return to standard chiller YK control

2.7 SOURCE QUALITY CONTROL

A. Perform functional tests of chillers before shipping.

B. Factory performance test chillers, before shipping, according to ARI 550/590.

1. Test the following conditions:

a. Design conditions indicated.
b. Reduction in capacity from design to minimum load in steps of 10 with condenser fluid at design conditions.

2. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.

C. For chillers using R-134a refrigerant, factory test and inspect evaporator and condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. For chillers located indoors, rate sound power level according to ARI 575.

PART 3 - EXECUTION

3.1 GENERAL

A. The chillers will be delivered to the designated rigger's yard. Contractor shall coordinate shipment, receive, inspect and accept responsibility for equipment. Any damage or deficiency shall be resolved by Contractor directly with manufacturer and/or hauler, with no recourse to the LAWA.

B. Delivery and rigging of chillers will be staged based on the construction schedule. Contractor shall protect equipment, transport to the site, rig into place, install, pipe, wire

and test equipment in accordance with drawings, specifications and manufacturer's recommendations. Contractor shall coordinate any requirements directly with the manufacturer.

C. Consult equipment supplier regarding rigging requirements. If disassembly is required, both disassembly and reassembly shall be done by the Contractor in strict compliance with the manufacturer's instructions, under supervision of chiller manufacturer's representative, and shall not void any warranties.

3.2 EXAMINATION

A. Examine chillers before installation. Reject chillers that are damaged.

B. Examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting chiller performance, maintenance, and operations before equipment installation.

1. Determine exact locations before roughing-in for piping and electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 CHILLER INSTALLATION

A. Equipment Mounting: Install chiller on concrete bases using restrained spring isolators if required.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Maintain manufacturer's recommended clearances for service and maintenance.

C. Charge chiller with refrigerant and fill with oil if not factory installed.

D. Install separate devices furnished by manufacturer and not factory installed.

E. Install piping adjacent to chiller to allow service and maintenance.

F. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flow switch, thermometer, plugged tee with shutoff valve

and pressure gage, and drain connection with valve. Make connections to chiller with a mechanical coupling.

G. Condenser-Fluid Connections: Connect to condenser inlet with shutoff valve, thermometer, and plugged tee with pressure gage. Connect to condenser outlet with shutoff valve, balancing valve, flow switch, thermometer, plugged tee with shutoff valve and pressure gage, and drain connection with valve. Make connections to chiller with a mechanical coupling.

H. Refrigerant Pressure Relief Device Connections: For chillers installed indoors, extend vent piping to the outdoors without valves or restrictions. Connect to chiller pressure relief device with flexible connector and dirt leg with drain valve.

I. For chillers equipped with a purge system, extend purge vent piping to the outdoors.

J. Miscellaneous Unit Water Piping: Provide a water supply manifold piped to the compressor oil cooler and the unit-mounted refrigerant recovery unit condenser. The supply manifold shall be complete and include valves, sight glasses, thermometers and other devices to verify sufficient water flow.

K. Miscellaneous Unit Refrigerant Piping: Provide all interconnecting refrigerant piping between the chiller, refrigerant recovery unit, compressor and condenser, and remote refrigerant storage vessel, if required.

L. Connect each chiller drain connection with a union and drain pipe, and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that refrigerant charge is sufficient and chiller has been leak tested.
3. Verify that pumps are installed and functional.
4. Verify that thermometers and gages are installed.
5. Operate chiller for run-in period.
6. Check bearing lubrication and oil levels.
7. Verify that refrigerant pressure relief device is vented outside.
8. Verify proper motor rotation.
9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.
10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator and condenser.
11. Verify and record performance of chiller protection devices.
12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

B. Inspect field-assembled components, equipment installation, and piping and electrical

connections for proper assembly, installation, and connection.

C. Prepare test and inspection startup reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train LAWA's maintenance personnel to adjust, operate, and maintain chillers. Video record the training sessions. Provide 40 hour training sessions on site with equipment fully operational, minimum 15 LAWA personnel, 16 hours shall be classroom training and 24 hours shall be hands-on training.

3.6 FACTORY PERFORMANCE TESTS

A. Manufacturer shall conduct factory performance test for each chiller in accordance with ARI 550/590-98, to verify design capacity and part load capacity points indicated on Bid form. LAWA and/or LAWA's representative (2 persons) may elect to witness tests. Notify LAWA and/or LAWAs representative of test date at least 2 weeks in advanced. There will be zero tolerance on capacity and NPLV, other parameters are per ARI 550/590 tolerance.

B. Before shipment of chillers, all records and certifications approving testing requirements shall be submitted to and approved by LAWA.

C. Defective work or material shall be replaced or repaired, as necessary, and inspection and test repeated. Repairs shall be made with new materials. Run new performance test in accordance with ARI standard.

D. If chiller assembly fails to meet design capacity and a minimum of 15% more capacity at lower condenser water temperature, LAWA may elect not to accept delivery until chiller is modified at manufacturer's expense to meet design capacity.

E. If chiller assembly fails to meet any of part load performance data supplied by manufacturer with his bid, LAWA may elect not to accept delivery until chiller is modified at manufacturer's expense to meet all of design and part load performance data or to assess penalty charge equal to 10 years operating cost differential. This differential is to be determined by using part load data included in bid form and data obtained from performance test, subtracting bid data annual operating cost from test data annual operating cost, and multiplying difference by ten. Penalty charge shall apply to all chillers.

F. All design conditions and part load performance data shall be evaluated with 480 volt, 3-phase, 60 hertz power supplied to chiller.

G. Conduct test at approved ARI certified test facility of the manufacturer.

H. Instrumentation used for testing must be calibrated within 6 months of test date and traceable to National Bureau of Standards. Documentation verifying NBS traceability

shall be submitted to LAWA.

1. Performance test shall be two-point test for one chiller. Points will be selected at time of test. Points will be selected from submitted performance from 25 to 100% of capacity.

3.7 COMMISSIONING

A. The manufacturer shall be present during all commissioning events. The anticipated schedule is for commissioning to occur during the least six to eight weeks of construction just prior to the anticipated end of construction date of. Include 40 hours of field time to perform the commissioning requirements.

B. A factory-authorized representative shall perform the startup service.

1. Fill out startup checklists and attach copy with Contractor Startup Report.

C. Complete installation and startup checks according to manufacturer's written instructions and check for the following items:

1. No physical damage to unit.
2. Unit is level.
3. Chiller vibration isolation and flexible pipe connections are installed.
4. Clearances have been maintained and piping is installed for easy removal for service and tube cleaning.
5. Chilled and condenser water pipes have been connected to correct ports.
6. Labels and safety instructions are clearly visible.
7. Oil levels are as recommended by manufacturer.
8. Refrigerant charge is sufficient and chiller has been leak tested.
9. Shipping skids, blocks and straps are removed.
10. Refrigerant pressure relief is vented to outside.
11. Thermometers and pressure gauges are installed.
12. Controls and safety interlocks are installed and connected.
13. Pumps are installed, connected and operational.

D. Check and record performance of chiller protection devices.

E. Check and record performance of chilled and condenser water flow and low temperature interlocks.

F. Operate chiller for run-in period as recommended by manufacturer.

G. Check static deflection of vibration isolators, including deflection during chiller startup and shutdown.

1. Check refrigerant charge. Check oil level.

3.8 CLEANING

A. After completion of system installation, start-up, testing and prior to commissioning, completely and thoroughly clean up the chillers from any foreign material and construction dirt and dust.

END OF SECTION 23 64 16

SECTION 23 65 00 - COOLING TOWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Open-circuit, induced-draft, counterflow cooling towers.
2. Basin water level controls.
3. Closed circuit fluid coolers and/or condensers are also acceptable, subject to meeting the capacity requirements.

B. Cooling towers are specified herein for reference only and will be for temporary use.

C. Cooling tower shall operate in a manner that no visible plume is produced. If necessary provide gas fired heaters or HW coils for cooling tower discharge for plume abatement.

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME).

1. Boiler and Pressure Vessel Code, Section VIII, Division 1, “Rules for Construction of Pressure Vessels”.
2. Performance Test Code PTC 23, “Atmospheric Water Cooling Equipment”.

B. Cooling Technology Institute (CTI).

C. Standard 201, “Standard for the Certification of Water-Cooling Tower Thermal Performance”.

D. Acceptance Test Code ATC 105, “Acceptance Test Code for Water Cooling Towers”.

1. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

E. Standard 90.1, “Energy Standard for Building Except Low-Rise Residential Buildings”.

1. National Fire Protection Association (NFPA).

F. Standard 70, “National Electrical Code”.

1. American National Standards Institute (ANSI).
2. American Society for Testing and Materials (ASTM).
3. Institute of Electrical and Electronics Engineers (IEEE).
4. National Electrical Manufacturers Association (NEMA).

G. Factory Mutual (FM).

H. Underwriters Laboratories (UL).

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design:Design cooling tower support structure and seismic restraints, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Cooling tower support structure shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.

1. Dead Loads: By Structural Engineer
2. Live Loads: By Structural Engineer
3. Roof Loads: By Structural Engineer
4. Snow Loads: By Structural Engineer
5. Seismic Loads: By Structural Engineer
6. Wind Loads: By Structural Engineer
7. Deflection Limits: By Structural Engineer

C. Seismic Performance: Cooling towers shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

D. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 SUBMITTALS

A. Product Data: Include rated capacities, pressure drop, fan performance data, rating curves with selected points indicated, materials of construction, furnished specialties, and accessories.

1. Maximum flow rate.
2. Minimum flow rate.
3. Drift loss as percent of design flow rate.
4. Volume of water in suspension for purposes of sizing a remote storage tank.
5. Sound power levels in eight octave bands for operation with fans off, fans at minimum, and design speed.
6. Performance curves for the following:

    a. Varying entering-water temperatures from design to minimum.
    b. Varying ambient wet-bulb temperatures from design to minimum.
    c. Varying water flow rates from design to minimum.
    d. Varying fan operation (off, minimum, and design speed).

7. Fan airflow, brake horsepower, and drive losses.
8. Pump flow rate, head, brake horsepower, and efficiency.
9. Motor amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
10. Electrical power requirements for each cooling tower component requiring power.

B. Shop Drawings: Complete set of manufacturer's prints of cooling tower assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Sizes and locations of piping and wiring connections.
5. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For cooling tower support structure indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of support structure.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
3. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

D. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

E. Certificates: Provide certificate from manufacturer.

F. Seismic Qualification Certificates: For cooling towers, accessories, and components, from manufacturers.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

G. Source quality-control reports.

H. Field quality-control reports.

I. Startup service reports.

J. Operation and Maintenance Data: For each cooling tower to include in emergency, operation, and maintenance manuals. Include start-up instructions, maintenance data, parts lists, controls, accessories, and trouble-shooting guide.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of cooling towers that fail in materials or workmanship within specified warranty period:

1. Fan assembly including fan, drive, and motor.
2. All components of cooling tower.
3. Warranty Period: Five (5) years.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories.

PART 2 - PRODUCTS

2.1 OPEN-CIRCUIT, INDUCED-DRAFT, COUNTERFLOW COOLING TOWERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Baltimore Aircoil Company.
2. Delta Cooling Towers.
3. Evapco.

B. Fabricate cooling tower mounting base with reinforcement strong enough to resist cooling tower movement during a seismic event when cooling tower is anchored to field support structure.

C. Cooling tower designed to resist wind load of 30 lbf/sq. ft.

D. Casing and Frame:

1. Casing and Frame Material: Stainless steel, Type 304.

E. Collection Basin:

1. Material: Stainless steel, Type 304.
2. Strainer: Removable stainless-steel strainer with openings smaller than nozzle orifices.
3. Overflow and drain connections.
4. Makeup water connection.
5. Outlet Connection: ASME B16.5, Class 150 flange.
6. Removable equalization flume plate between adjacent cells of multiple-cell towers.
7. Equalizer connection for field-installed equalizer piping.
8. Basin Sweeper Distribution Piping and Nozzles:

    a. Pipe Material: PVC.
    b. Nozzle Material: Plastic.
    c. Configure piping and nozzles to minimize sediment from collecting in the collection basin.

F. Electric/Electronic, Collection Basin Water-Level Controller with Solenoid Valve:

1. Enclosure: NEMA 250, Type 4.
2. Sensor: Solid-state controls with multiple electrode probes and relays factory wired to a terminal strip to provide control of water makeup valve, low- and high-level alarms, and output for shutoff of pump on low level.
3. Electrode Probes: Stainless steel.
4. Water Stilling Chamber: Corrosion-resistant material.
5. Solenoid Valve: Slow closing with stainless-steel body; controlled and powered through level controller in response to water-level set point.
6. Electrical Connection Requirements: 120 V, single phase, 60 Hz.

G. Pressurized Water Distribution Piping: Main header and lateral branch piping designed for even distribution over heat-exchanger coil or fill throughout the flow range without the need for balancing valves and for connecting individual, removable, nonclogging spray nozzles.

1. Pipe Material: PVC.
2. Spray Nozzle Material: PVC.
3. Piping Supports: Corrosion-resistant hangers and supports to resist movement during operation and shipment.

H. Fill:

1. Materials: PVC, resistant to rot, decay, and biological attack; with maximum flame-spread index of 5 according to ASTM E 84.
2. Minimum Thickness: 15 mils before forming.
3. Fabrication: Fill-type sheets, fabricated, formed, and bonded together after forming into removable assemblies that are factory installed by manufacturer.
4. Fill Material Operating Temperature: Suitable for entering-water temperatures up through 120 deg F.

I. Removable Drift Eliminator:

1. Material: Fiberglass reinforced plastic; resistant to rot, decay, and biological

attack; with maximum flame-spread index of 5 according to ASTM E 84.
2. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
3. Configuration: Multipass, designed and tested to reduce water carryover to achieve performance indicated.

J. Air-Intake Louvers:

1. Material: Matching casing.
2. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
3. Louver Blades: Arranged to uniformly direct air into cooling tower, to minimize air resistance, and to prevent water from splashing out of tower during all modes of operation including operation with fans off.

K. Removable Air-Intake Screens: Stainless-steel wire mesh.

L. Axial Fan: Balanced at the factory after assembly.

1. Blade Material: Aluminum.
2. Hub Material: Aluminum.
3. Blade Pitch: Field adjustable.
4. Protective Enclosure: Removable, galvanized-steel, wire-mesh screens, complying with OSHA regulations.
5. Fan Shaft Bearings: Self-aligning ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F. Bearings designed for an L-10 life of 50,000 hours.
6. Bearings Grease Fittings: Extended lubrication lines to an easily accessible location.

M. Belt Drive:

1. Service Factor: 1.5 based on motor nameplate horsepower.
2. Sheaves: Fan and motor shafts shall have taper-lock sheaves fabricated from corrosion-resistant materials.

    a. Belt: Multiple V-belt design with a matched set of cogged belts.
    b. Belt: One-piece, multigrooved, solid-back belt.
    c. Belt Material: Oil resistant, nonstatic conducting, and constructed of neoprene polyester cord.
    d. Belt-Drive Guard: Comply with OSHA regulations.

N. Direct Drive: Fan hub directly connected, and properly secured, to motor shaft.

O. Fan Motor:

1. Motor Enclosure: Totally enclosed fan cooled (TEFC).
2. Service Factor: 1.15.
3. Insulation: Class F.
4. Variable-Speed Motors:

GUARANTEED MINIMUM FULL LOAD EFFICIENCY OF MOTORS		
Rated HP	Nominal 1200 RPM	Nominal 1800 RPM
1	82.5	85.5
1.5	86.5	86.5
2	87.5	86.5
3	89.5	89.5
5	89.5	89.5
7.5	91.7	91.0
10	91.7	91.7
15	92.4	93.0
20	92.4	93.0
25	93.0	93.6
30	93.6	94.1
40	94.1	94.1
50	94.1	94.5
60	95.0	95.0
75	95.0	95.0
100	95.0	95.4
125	95.4	95.4
150	95.8	95.8
200	95.4	95.8

5. Motor Location: Mounted outside of cooling tower casing and cooling tower discharge airstream.
6. Severe-duty rating with the following features:

    a. Rotor and stator protected with corrosion-inhibiting epoxy resin.
    b. Double-shielded, vacuum-degassed bearings lubricated with premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F.
    c. Internal heater automatically energized when motor is de-energized.

7. Motor Base: Adjustable, or other suitable provision for adjusting belt tension.

P. Fan Discharge Stack: Material shall match casing, manufacturer's standard design.

1. Stack Extension: Fabricated to extend above fan deck.
2. Stack Termination: Wire-mesh, stainless-steel screens.

Q. Gear-Drive, Oil-Level Switch: Low-oil-level warning switch for connection to a BMS.

1. Switch shall, on reaching a low-oil-level set point recommended by cooling tower manufacturer, signal an alarm through the BMS.

R. Controls: See Section "Building Automation System."

S. Control Package: Factory installed and wired, and functionally tested at factory before shipment.

1. NEMA 250, Type 4X enclosure with removable internally mount backplate.
2. Control-circuit transformer with primary and secondary side fuses.
3. Terminal blocks with numbered and color-coded wiring to match wiring

diagram. Spare wiring terminal block for connection to external controls or equipment.

4. Microprocessor-based controller for automatic control of fan based on cooling tower leaving water temperature with control features to improve operating efficiency based on outdoor ambient wet-bulb temperature by using adaptive logic.
5. Fan motor sequencer for multiple-cell and two-speed applications with automatic lead stage rotation.
6. Collection basin level controller complying with requirements in "Electric/Electronic, Collection Basin Water-Level Controller with Solenoid Valve" Paragraph.
7. Vibration switch for each fan, complying with requirements in "Vibration Switch" Paragraph.
8. Oil-level switch for each fan with a gear drive, complying with requirement in "Gear-Drive, Oil Level Switch" Paragraph.
9. Single-point, field-power connection to a circuit breaker.

    a. Branch power circuit to each motor and electric basin heater and to controls with a disconnect switch or circuit breaker.
    b. NEMA-rated motor controller, hand-off-auto switch, and overcurrent protection for each motor. Provide variable frequency controller with manual bypass and line reactors for each variable-speed motor indicated.

10. Factory-installed wiring outside of enclosures shall be in metal raceway, except make connections to each motor with liquidtight conduit.
11. Visual indication of status and alarm with momentary test push button for each motor.
12. Audible alarm and silence switch.
13. Visual indication of elapsed run time, graduated in hours for each motor.
14. Cooling tower shall have hardware to enable BMS to remotely monitor and display the following:

    a. Operational status of each motor.
    b. Position of dampers.
    c. Cooling tower leaving-fluid temperature.
    d. Fan vibration alarm.
    e. Oil-level alarm.
    f. Collection basin high- and low-water-level alarms.

T. Personnel Access Components:

1. Doors: Large enough for personnel to access cooling tower internal components from both cooling tower end walls. Doors shall be operable from both sides of the door.
2. External Ladders with Safety Cages: Aluminum, galvanized- or stainless-steel, fixed ladders with ladder extensions to access external platforms and top of cooling tower from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.
3. External Platforms with Handrails: Stainless-steel bar grating at cooling tower access doors when cooling towers are elevated and not accessible from grade.

4. Handrail: Stainless steel complete with kneerail and toeboard, around top of cooling tower. Comply with 29 CFR 1910.23.
5. Internal Platforms: Stainless-steel bar grating.

    a. Spanning the collection basin from one end of cooling tower to the other and positioned to form a path between the access doors. Platform shall be elevated so that all parts are above the high water level of the collection basin.
    b. Elevated internal platforms with handrails accessible from fixed vertical ladders to access the fan drive assembly when out of reach from collection basin platform.

2.1 SOURCE QUALITY CONTROL

A. Verification of Performance: Test and certify cooling tower performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

B. Factory pressure test heat exchangers after fabrication and prove to be free of leaks.

C. Shop Inspection – 2 LAWA personnel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Maintain manufacturer's recommended clearances for service and maintenance.

B. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.2 CONNECTIONS

A. Install piping adjacent to cooling towers to allow service and maintenance.

B. Install flexible pipe connectors at pipe connections of cooling towers mounted on vibration isolators.

C. Provide drain piping with valve at cooling tower drain connections and at low points in piping.

D. Connect cooling tower overflows and drains, and piping drains to sanitary sewage system.

E. Domestic Water Piping: Connect to water-level control with shutoff valve and union, flange, or mechanical coupling at each connection.

F. Supply and Return Piping: Connect to entering cooling tower connections with shutoff valve, balancing valve, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve. Connect to leaving cooling tower connection with shutoff valve. Make connections to cooling tower with a union, flange, or mechanical coupling.

G. Equalizer Piping: Piping requirements to match supply and return piping. Connect an equalizer pipe, full size of cooling tower connection, between tower cells. Connect to cooling tower with shutoff valve.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform field tests and inspections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections: Comply with ASME PTC 23, "ASME Performance Test Codes - Code on Atmospheric Water Cooling Equipment."

E. Cooling towers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Obtain performance data from manufacturer.

1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

a. Clean entire unit including basins.
b. Verify that accessories are properly installed.
c. Verify clearances for airflow and for cooling tower servicing.
d. Check for vibration isolation and structural support.
e. Lubricate bearings.
f. Verify fan rotation for correct direction and for vibration or binding and correct problems.
g. Adjust belts to proper alignment and tension.

h. Verify proper oil level in gear-drive housing. Fill with oil to proper level.
i. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
j. Check vibration switch setting. Verify operation.
k. Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.
l. Verify operation of basin heater and control.
m. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
n. Replace defective and malfunctioning units.

D. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.

E. Prepare a written startup report that records the results of tests and inspections.

3.5 ADJUSTING

A. Set and balance water flow to each tower inlet.

B. Adjust water-level control for proper operating level.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train LAWA's maintenance personnel to adjust, operate, and maintain cooling towers. Training to include minimum of 15 personnel for 40 hours training, 16 hours shall be classroom training and 24 hours shall be hands-on training.

END OF SECTION 23 65 00

SECTION 23 74 13 - CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes modular factory fabricated air-handling units and accessories for indoor and outdoor installation.

NOTE: Provide structural calculations and supporting analysis that the additional roof /floor load does not increase the force in any adjacent structural element by more than 5%. If the increase is greater than 5% demonstrate that the structural elements and their lateral resistance are in compliance with the Los Angeles Building Code.

Provide the following details to LAWA:

- The operational weight of the new equipement.
- The location of the center of gravity.
- Points of anchorage to the existing structure.

In addition, provide details and calculations pertaining to any new roof openings such as access hatches or any other new openings that relate to the installation of the new air handling units.

1.2 REFERENCES

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Air Movement and Control Association International, Inc.:

1. AMCA 99 - Standards Handbook.
2. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
3. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
4. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
5. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

C. Air-Conditioning and Refrigeration Institute:

1. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
2. ARI 430 - Central-Station Air-Handling Units.
3. ARI Guideline D - Application and Installation of Central Station Air-Handling Units.

D. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.

E. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

F. Underwriters Laboratories Inc.:

1. UL 900 - Air Filter Units.
2. UL - Fire Resistance Directory.

G. NRCA standards.

1.3 SUBMITTALS

A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

B. Product Data, Submit the following:

1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.
4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
5. Dampers: Include leakage, pressure drop, and sample calibration curves. Indicate materials, construction, dimensions, and installation details.
6. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
7. Clearly identify the type of Coating(s) being proposed for use.

C. Manufacturer's Installation Instructions

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.5 QUALITY ASSURANCE

A. All items shall be in accordance with the requirements dictated by the City of Los Angeles Department of Building and Safety, and LAWA standards.

1.6 WARRANTY

A. Furnish five year manufacturer warranty for air handling units and drives.

PART 2 - PRODUCTS

2.1 AIR HANDLING UNITS

A. Manufacturers:

1. **Temtrol.**
2. **Energy Labs.**
3. **Pace.**

B. Performance Base: Sea level.

C. Roof Curb: Required.

> **NOTE:** All roof top equipment shall be curb mounted. A 6 inch high concrete curb is also required for interior installations.

1. Factory assembled galvanized steel mounting curb designed and manufactured by unit manufacturer.
2. Perimeter type with support of air handling sections.
3. Furnish supply and return opening duct frames as part of curb structure allowing duct connections to be made directly to curb.
4. Minimum of 12 inches high.
5. Furnish gaskets for field mounting.

2.2 CASING

A. Channel base of welded steel. Assemble sections with gaskets and bolts.

B. Outside Casing:

1. Galvanized Steel: 0.0635 inch (16 gage).
2. Seal fixed joints with flexible weather tight sealer. Seal removable joints with closed-cell foam gasket.
3. Furnish cap strips over roof flanges. Furnish rain caps and gaskets on access doors.

C. Outside Casing Finish:

> **NOTE:** Coating is required due to LAX marine environment and the nearby Hyperion plant.

1. Zinc chromate, iron oxide, shop coated with 4.0 mils epoxy primer and 6.0 mils topcoat phenolic baked coating for a total of 10.0 mils. Coating shall withstand 5,000 hour of salt spray test in accordance with ASTM B117.
2. Finish exceeds 5000 hour salt spray test in accordance with ASTM B117.
3. Color: As selected by LAWA.

D. Inside Casing:

1. Galvanized Steel: Perforated 0.336 inch thick (22 gage) at fan section.
2. Galvanized Steel: Solid, 0.032 inch thick (20 gage).
3. Stainless Steel: Solid, 0.0375 inch thick (20 gage) at CHW coil section.
4. Shop coated with 4.0 mils epoxy primer and 6.0 mils topcoat phenolic baked coating for a total of 10.0 mils. Coating shall withstand 5,000 hour of salt spray test in accordance with ASTM B117.

E. Floor Plate:

1. Galvanized Steel: 0.0635 inch thick (16 gage) at inner floor with phenolic coating.
2. Galvanized Steel: 0.0396 inch thick (20 gage) at bottom floor.
3. Shop coated with 4.0 mils epoxy primer and 6.0 mils topcoat phenolic baked coating for a total of 10.0 mils. Coating shall withstand 5,000 hour of salt spray test in accordance with ASTM B117.

F. Insulation: Neoprene coated, glass fiber, applied to internal surfaces with adhesive and weld pins with exposed edges of insulation coated with adhesive.

1. 'K' factor at 75 degrees F: Maximum 0.26 Btuh inch/ sq ft/ degrees F.
2. Density: 4 inch thick, 3lbs/cu ft.

G. Inspection Doors: 10 x 10 inch of galvanized steel for flush mounting, with gasket, latch, and handle assembly and 1/4 inch thick Plexiglas inspection window. Furnish welded channel frame to set door out from casing to permit external insulation.

H. Walk-in Access Doors: 24 x 60 inch Galvanized steel insulated sandwich construction, for flush mounting, with hinges, gasket, latch, and handle assemblies, and 12 x 12 inch inspection window of 1/4 inch thick Plexiglas. Furnish welded channel frame to set door out from casing to permit external insulation.

I. Lights: Located in accessible sections suitable for damp locations with wire guards, factory wired to weatherproof switch and pilot light and duplex outlet mounted on casing exterior.

J. Drain Pans: Double thickness stainless steel with insulation between layers with welded corners. Cross break and pitch to drain connection. Furnish drain pans under mixing section cooling coil section. For units with multiple coils, provide drain pans for each coil section.

K. Bottom Inlet Units: Furnish steel or aluminum walking grate on structural supports.

L. Strength: Furnish structure to brace casings for suction pressure of 5 inch wg, with maximum deflection of 1 in 200.

M. Louvers: Stationary, of galvanized steel, 4 inch deep with plenum, nylon bearings, 1/2 inch mesh, 0.04 inch galvanized wire bird screen in aluminum frame, and bearing AMCA Certified Ratings Seal in accordance with AMCA 500.

2.3 FANS

A. Type: Double inlet, centrifugal type fan.

B. Performance Ratings: Conform to AMCA 210 and label with AMCA Certified Rating Seal.

C. Sound Ratings: AMCA 301, tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.

D. Bearings: Self-aligning, grease lubricated, ball or roller bearings with lubrication fittings extended to exterior of casing with copper tube and grease fitting rigidly attached to casing.

E. Mounting: Locate fan and motor internally on welded steel base coated with corrosion resistant paint. Factory mount motor on slide rails. Furnish access to motor, drive, and bearings through removable casing panels or hinged access doors. Mount base on spring vibration isolators.

F. Fan Modulation: Variable Frequency Drive. See Section on VARIABLE FREQUENCY DRIVES.

G. Flexible Connection: Separate unit from connecting ductwork.

NOTE: Fan-Wall systems may be considered in lieu of centrifugal plug fans.

2.4 BEARINGS AND DRIVES

A. Bearings: Pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA 9 L-50 life at 100,000 hours or roller bearings, or ABMA 11, L-50 life at 400,000 hours.

B. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

C. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor.

D. Belt Guard: Fabricate to SMACNA Standard; 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.5 COILS

A. Casing with access to both sides of coils. Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.

B. Drain Pans: 24 inch downstream of coil and down spouts for cooling coil banks more than one coil high. All drain pans shall be stainless steel.

C. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.

D. Fabrication:

1. Tubes: 5/8 inch OD seamless copper expanded into fins, brazed joints.
2. Fins: Copper.
3. Casing: Die formed channel frame of stainless steel.
4. All coils shall be coated with minimum 1.0 mil. aluminum impregnated polyurethane coating by Blygold PoluAl XT or approved equal. Coating shall withstand 4,000 hours in both salt spray test per ASTM B117 and acid salt spray test per ASTM D5339. Finned-tube coils applied coating shall have 5 year warranty.
5. Provide five (5) year warranty for all coils.

E. Water Heating Coils:

1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

F. Water Cooling Coils:

1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.

G. Refrigerant Coils:

1. Headers: Seamless copper tubes with silver brazed joints.
2. Liquid Distributors: Brass or copper venturi distributor with seamless copper distributor tubes.
3. Configuration: Down feed with bottom suction.

2.6 FILTERS

A. Various filter types are specified in HVAC AIR CLEANING DEVICES.

NOTE: Provide MERV 8 pre-filter, MERV 13 final filter, carbon filter and bipolar ionization unit.

2.7 DAMPERS

A. Mixing Boxes: Section with factory mounted outside and return air dampers of galvanized steel with vinyl bulb edging and edge seals in galvanized frame, with galvanized steel axles in self-lubricating nylon bearings, in opposed blade arrangement

B. Outside Air Damper Leakage: Maximum 3.0 cfm per square foot at 1.0 inches wg pressure differential.

C. Damper Leakage: Maximum 2 percent at 4 inch wg differential pressure when sized for 2000 fpm face velocity.

D. Damper Actuators: Furnish factory installed electric damper actuators for outside air, return air, and exhaust air dampers.

2.8 OUTSIDE AIR MEASURING AND MODULATION DEVICE

A. Factory mounted in outside air and return air openings.

B. Damper and airflow measurement assembly sized to accommodate economizer outside airflow.

C. Construction:

1. Frame: Extruded aluminum.
2. Blades:

    a. Modulating Air Control:

        1) Style: Airfoil-shaped, single-piece.
        2) Action: Parallel.
        3) Orientation: Horizontal.
        4) Material: Heavy gage 6063-T5 extruded aluminum.
        5) Width: Maximum 5 inches.

    b. Stationary Sensing:

        1) Style: Airfoil-shaped, single-piece.
        2) Orientation: Horizontal.
        3) Material: Heavy gage 6063-T5 extruded aluminum.
        4) Width: Maximum 5-1/4 inches.
        5) Finish: Anodized.

3. Bearings: Self-lubricating molded synthetic sleeve, turning in extruded hole in frame.
4. Seals:

    a. Blade: Extruded rubber. Mechanically attached to blade edge.
    b. Jamb: Stainless steel, flexible metal compression type.
    c. Linkage: Concealed in frame.

d. Axles: Minimum 1/2 inch diameter plated steel, hex-shaped, mechanically attached to blade.
e. Mounting: Vertical.
f. Electric Actuator: 24 V, 60 Hz, modulating, with position feedback.

5. Digital Controller: Application specific controller. Programming logic and calibration in nonvolatile EPROM. Controller uses generic 0 - 10 vdc inputs and outputs for interface to building automation system.
6. Air Straightener Section: 3 inches deep section contained in 5 inch long sleeve attached to damper-airflow monitor frame.
7. Finish: Mill aluminum.

D. Performance Data:

1. Temperature Rating: Withstand -40 to 140 degrees F.
2. Accuracy: Plus or minus 5 percent.
3. Leakage: Maximum of 2.0 cfm per square foot at 1.0 inches wg pressure differential.
4. Measures from 15 percent to 100 percent of unit nominal air flow.
5. Adjusts air flow for temperature variations.
6. Provides 2 to 10 volt DC signal corresponding to actual air flow.

GUARANTEED MINIMUM FULL LOAD EFFICIENCY OF MOTORS

Rated HP	Nominal 1200 RPM	Nominal 1800 RPM
1	82.5	85.5
1.5	86.5	86.5
2	87.5	86.5
3	89.5	89.5
5	89.5	89.5
7.5	91.7	91.0
10	91.7	91.7
15	92.4	93.0
20	92.4	93.0
25	93.0	93.6
30	93.6	94.1
40	94.1	94.1
50	94.1	94.5
60	95.0	95.0
75	95.0	95.0
100	95.0	95.4
125	95.4	95.4
150	95.8	95.8
200	95.4	95.8

2.9 CONTROLS

A. Coordinate with the Building Automation System for the Terminal.

2.10 ELECTRICAL

A. Motor:

1. Enclosure Type: Totally enclosed, fan cooled.
2. Inverter duty, NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
3. Motors must be “matched” with variable frequency drives.

B. Electrical Requirements

1. Where unit-mounted disconnects are provided, mount unit-mounted disconnect switches on exterior of unit.
2. Variable Frequency Controllers shall be factory mounted in a ventilated compartment which is part of the air handling unit and factory wired to motors and controls. Access shall be through a louvered access door. The access door shall be flush with the outside of unit.

2.11 FACTORY TESTING

A. The following testing shall be provided on a minimum of three units. LAWA shall select the three units to be tested. **Manufacturer shall include cost of travel to allow two LAWA's representatives to witness all factory tests.** Manufacturer shall provide a written report of all test results to the Contractor and LAWA as part of the shop drawing process. In the event that tested units do not meet performance requirements (Including but limited to leak, deflections, air volume, Sound), manufacturer shall provide enhancements, within the requirements of this specification, until unit meets testing requirements. In the event that two or more units do not meet performance requirements, LAWA shall select an additional three units for testing – and the above requirements shall be applicable to newly tested units.

B. Factory Leak Test

1. Factory test shall verify that unit casing leakage is less than 0.5% of design airflow at 1 ½ times design static pressure or a maximum of 10 in. w.g. Unit openings shall be sealed. A pressure blower shall be connected to the air-handling unit and adjusted to provide the test pressure. At the manufacturer's option, the unit shall be either positively or negatively pressurized. CFM shall be measured using a calibrated orifice. The measured CFM shall be considered casing leakage. Casing leakage must not exceed 0.5% of design CFM

C. Factory Cabinet Deflection Test:

1. Air handling unit manufacturer shall provide Panel Deflection Test on units in conjunction with the Casing Leakage Test. Panel deflection test shall verify casing deflection is less than 1/240 of longest plane being measured at design static pressure or a maximum of 10 in. w.g. The casing deflection shall be measured at mid point of panel and at panel seam.

D. Factory Air Performance Test:

1. Air handling unit manufacturer shall test at an AMCA Accredited Laboratory for air performance per AMCA Standard 210-99. For air handlers with air volumes below 65000 CFM, air volume shall be determined using a multiple nozzle chamber that meets the requirements of AMCA 210-99 (Laboratory Methods for Performance Testing) figure 12 or 15. Measured air volume, static pressure, and RPM shall be shall be within the tolerance limits of AMCA Standard 211 (Certified Ratings Program Air Performance).

E. Factory Sound & Air Performance Test:

1. Air handling unit manufacturer shall test a minimum of three units at an AMCA Accredited Laboratory for airflow testing in accordance with AMCA Standard 210-99 and sound testing in accordance with AMCA Standard 300-96. Specified air volume shall first be confirmed in accordance with AMCA standard 210-99 (Laboratory Methods of Testing Fans for Performance Rating). Air Volume, static pressure, and RPM shall be within the tolerance limits of AMCA Standard 211 (Certified Ratings Program Air Performance).
2. Once design operating point has been confirmed, the submitted sound power levels for both inlet and outlet shall be measured per AMCA Standard 300-96 (Reverberant Room

Method for Testing of Fans) and the relevant parts of ARI Standard 260-01 (Sound Rating of Ducted Air Moving and Conditioning Equipment). The total air handling unit volume shall not exceed 5% of the volume of the reverberant room. The reverberant room used for testing shall be qualified to perform narrow band measurements in accordance with AMCA Standard 300-96 Appendix B. All measurements shall be taken in 1/3 octave bands. If applicable, duct end correction and elbow corrections shall be calculated per ARI Standard 260-01. The test results will verify that inlet and outlet sound power levels are within the tolerance limits of AMCA-311 (Certified Sound Ratings Program) of the specified levels.

3. Sound power data shall be given at the supply connection(s) and return connection(s) in addition to radiated sound power from the cabinet. Raw fan sound power data shall be derived from tests done on the same sizes and types of fans scheduled. Data extrapolated from non-like fan sizes and types scheduled, is not acceptable. Attenuation assumed for cabinet configuration, type of insulation, opening locations, and sizes, etc., shall be verified through actual test measurements.
4. Alternate equivalent method of testing may be acceptable, subject to meeting the requirements and intent stated above.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install flexible connections between unit and inlet and discharge ductwork. Install metal bands of connectors parallel with minimum 1 inch flex between ductwork and fan while running.

B. Install assembled units with minimum 2” vibration isolators on minimum 4” high level platform. Install isolated fans with resilient mountings and flexible electrical leads. Install restraining seismic snubbers as indicated. Adjust snubbers to prevent tension in flexible connectors when fan is operating.

C. Install condensate piping with trap and route from drain pan to nearest approved roof receptacle, direct connection to lavatory waste, or air gap to janitor sink.

D. Provide sheaves required for final air balance if required.

E. Insulate coil headers located outside airflow as specified for piping.

3.2 INSTALLATION CHILLED WATER COOLING COIL

A. Make connections to coils with unions or flanges.

B. Connect water supply to leaving airside of coil (counter flow arrangement).

C. Locate water supply at bottom of supply header and return water connection at top.

D. Install water coils to allow draining and install drain connection at low points.

E. Install the following piping accessories on chilled water piping connections.

1. On supply:

    a. Thermometer well and thermometer.
    b. Well for control system temperature sensor.
    c. Shutoff valve.
    d. Strainer.
    e. Control valve.
    f. Pressure gage.

2. On return:

    a. Thermometer well and thermometer.
    b. Well for control system temperature sensor.
    c. Pressure gage.
    d. Shutoff valve.
    e. Balancing valve or Flow control valve.

3.3 INSTALLATION HOT WATER HEATING COIL

A. Same as for chilled water coil.

3.4 MANUFACTURER'S FIELD SERVICES

A. Furnish services of factory trained representative for minimum of one day to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct LAWA on operation and maintenance. Training to include minimum of 8 LAWA personnel for 40 hours training, 16 hours shall be classroom training per person and 24 hours shall be hands-on training per person.

3.5 CLEANING

A. Vacuum clean coils and inside of unit cabinet.

B. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.6 PROTECTION OF FINISHED WORK

A. Do not operate units until units and ductwork are clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION 23 74 13

SECTION 23 81 03-PACKAGED ROOFTOP AIR CONDITIONING UNITS – NON-CUSTOM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Packaged rooftop air conditioning unit (5 tons and smaller).
2. Roof curb.

1.2 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
2. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
3. ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.

B. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
2. ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality.
3. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ASTM International:

1. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

E. National Fire Protection Association:

1. NFPA 54 - National Fuel Gas Code.
2. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

A. Product Data: Submit data indicating:

1. Cooling and heating capacities.
2. Dimensions.
3. Weights.

4. Rough-in connections and connection requirements.
5. Duct connections.
6. Electrical requirements with electrical characteristics and connection requirements.
7. Controls.
8. Accessories.

B. Test Reports: Submit results of factory test at time of unit shipment.

C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Manufacturer’s Field Reports: Submit start-up report for each unit.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of controls installed remotely from units.

B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.5 WARRANTY

A. Furnish five year manufacturer’s warranty for compressors.

B. Furnish five year manufacturer’s warranty for heat exchangers.

C. Furnish five year manufacturer’s warranty for condenser coils.

1.6 MAINTENANCE SERVICE

A. Furnish service and maintenance of equipment for one year from Date of Substantial Completion. Include maintenance items as shown in manufacturer's operating and maintenance data, including filter replacements, fan belt replacement, and controls checkout and adjustments.

B. Furnish 24-hour emergency service on breakdowns and malfunctions for this maintenance period.

PART 2 - PRODUCTS

2.1 ROOFTOP AIR CONDITIONING UNITS

A. Manufacturers:

1. **Carrier**
2. **Trane**
3. **York**

B. Product Description: Self-contained, packaged, factory assembled and wired, consisting of roof curb, cabinet, supply fan, refrigerant cooling coil, compressor, refrigeration circuit, condenser, gas-fired heating section, air filters, mixed air casing, controls, and accessories.

C. Roof Mounting Curb: 14 inch high, galvanized steel, channel frame with gaskets, nailer strips. Full perimeter type for mounting under entire unit.

D. Cabinet:

1. Designed for outdoor installation with weatherproof construction.
2. Panels: Constructed of galvanized steel with baked enamel finish meeting salt spray test in accordance with ASTM B117. Furnish access doors or removable access panels.
3. Insulation: Factory applied to exposed vertical and horizontal panels. Minimum one inch thick neoprene coated glass fiber with edges protected from erosion.

E. Supply Fan: Forward curved centrifugal type, resiliently mounted with direct drive or V-belt drive, adjustable variable pitch motor pulley high efficiency motor. Motor permanently lubricated with built-in thermal overload protection.

F. Evaporator Coil: Constructed of copper tubes expanded onto copper fins. Stainless steel drain pan with piping connection. Factory leak tested under water.

G. Compressor: Hermetically sealed, resiliently mounted with positive lubrication, and internal motor overload protection. Furnish internal vibration isolators, short cycle protection.

H. Refrigeration circuit: Furnish the following for each circuit thermal expansion valve, filter-drier, suction, discharge, and liquid line service valves with gauge ports, high and low pressure safety controls. Dehydrate and factory charge each circuit with oil and refrigerant.

I. Condenser:

1. Coil: Copper tube copper fin coil assembly and coil guard. Factory leak tested under water.
2. Condenser Fan: Direct drive propeller fans statically and dynamically balanced. Wired to operate with compressor. Motor permanently lubricated with built-in thermal overload protection. Furnish high efficiency fan motors.

J. Gas-Fired Heating Section:

1. Fuel: Natural gas if so scheduled.
2. Heat Exchangers: Stainless steel, welded construction.
3. Gas Burner: Induced draft type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shut-off pilot. Require unit fan operation before allowing gas valve to open.

K. Air Filters: 2 inch thick glass fiber disposable media in metal frames. 25 to 30 percent efficiency based on ASHRAE 52.1.

L. Mixed Air Casing:

NOTE: Include additional filtration similar to custom package units.

1. Economizer: Factory installed fully modulating motorized outside air and return air dampers controlled by dry bulb controller with minimum position setting. Outside air damper normally closed and return air damper normally open. Furnish barometric relief damper capable of closing by gravity. Furnish rain hood with screen. Provide economizer components and controls.

M. Controls:

1. Furnish control to provide low ambient cooling to 0 degrees F.
2. Furnish low limit thermostat in supply air to close outside air damper and stop supply fan.
3. Furnish terminal strip on unit for connection of operating controls to remote panel.
4. Thermostat: 365 days programmable electronic space thermostat with 1 stage heating and 2 stage cooling with manual changeover and heating setback and cooling setup capability.
5. Furnish interface to Building Automation System.
6. Microprocessor Based Controls:

    a. Factory mounted with the following features:

        1) Monitor each mode of operation.
        2) Evaporator fan status.
        3) Filter status.
        4) Indoor air quality.
        5) Supply air temperature.
        6) Outdoor air temperature.

    b. Diagnostics for thermostat or temperature sensor commands for staged heating, staged cooling, fan operation, and economizer operation.
    c. Zone space temperature sensor to interface with microprocessor controls with Automatic programmable with night setback.

N. Accessories:

1. Convenience Outlet: Factory installed, 115 volt, 15 amp, GFCI type, internally mounted.
2. Roof Curb Adaptor Package: Furnish duct support hardware to adapt unit to existing roof curb.
3. Factory installed ultraviolet C light located downstream of cooling coil.

2.2 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Disconnect Switch: Factory mounted, non-fused type, interlocked with access door, accessible from outside unit, with power lockout capability.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Roof Curb:

1. Assemble roof curb.
2. Install roof curb level.
3. Coordinate curb installation and flashing with other trades.
4. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
5. Install gasket material between unit base and roof curb.

B. Connect units to supply and return ductwork with flexible connections.

C. Install condensate piping with trap and route from drain pan to condensate drainage system as shown on the drawings.

D. Install components furnished loose for field mounting.

E. Install electrical devices furnished loose for field mounting.

F. Install control wiring between unit and field installed accessories.

G. Install Work in accordance with City of Los Angeles codes and standards.

3.2 INSTALLATION - NATURAL GAS HEATING SECTION

A. Connect natural gas piping to unit, full size of unit gas train inlet. Arrange piping with clearances for burner service.

B. Install the following piping accessories on natural gas piping connections.

1. Strainer.
2. Pressure gage.
3. Shutoff valve.
4. Pressure reducing valve.

C. Install natural gas piping accessories above roof and readily accessible.

3.3 MANUFACTURER'S FIELD SERVICES

A. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

3.4 CLEANING

A. Vacuum clean coils and inside of unit cabinet.

B. Install new throwaway filters in units at Substantial Completion.

C. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.5 DEMONSTRATION

A. Demonstrate unit operation and maintenance.

END OF SECTION 23 81 03

SECTION 23 81 06 - PACKAGED ROOFTOP AIR CONDITIONING UNITS - CUSTOM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes equipment types that contain all the components of the refrigeration process within a single package.

1. Packaged rooftop air conditioning unit (larger than 5 tons).
2. Roof curb.

1.2 REFERENCES

A. AMCA Standard 99: Standards Handbook

B. AMCA /ANSI Standard 204: Balance Quality and Vibration Levels for Fans

C. AMCA Standard 210: Laboratory Methods of Testing Fans for Ratings

D. AMCA Standard 300: Reverberant Room Method for Sound Testing of Fans

E. AMCA Standard 500:Test Methods for Louvers, Dampers and Shutters

F. ARI Standards: 210/240, 270, 410, and 435

G. ASHRAE Standard 52: Gravimetric and Dust Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter

H. Unit shall be designed to conform to ANSI/ASHRAE 15, latest revision.

I. Unit shall be certified in accordance with ANSI Z21.47 Standards.

J. ASHRAE/ANSI Standard 111: Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems

K. UL Standard 1995: Heating and Cooling Equipment

L. ASTM A-525: Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

M. Equipment shall be UL or ETL listed.

N. Roof curb shall be designed to conform to NRCA Standards.

1.3 SUBMITTALS

A. Product Data: Submit data indicating:

1. Cooling and heating capacities.
2. Dimensions.
3. Weights.
4. Rough-in connections and connection requirements.
5. Duct connections.
6. Electrical requirements with electrical characteristics and connection requirements.
7. Controls.
8. Accessories.

B. Test Reports: Submit results of factory test at time of unit shipment.

C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

D. Manufacturer’s Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.5 TESTING

A. Equipment shall be factory run tested for a minimum of eight hours to ensure proper operation.

B. Factory test shall be witnessed by the Owner’s representative (2 people) prior to shipping to the project site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Packaged Rooftop Cooling Unit. Provide outdoor rooftop mounted electrically controlled cooling unit utilizing multiple compressors as specified herein for cooling.

B. Manufacturers

1. Mammoth
2. Energy Labs
3. Pace

2.2 EQUIPMENT

A. Cabinet and Frame

NOTE: Due to the corosive marine environment at the airport, a rust inhibiting high performance coating is mandatory for all exterior mechanical equipment including cabinets and frames. Most standard coatings will quickly deteriorate in this environment thereby exposing the underlying metal and accelerating the corrosion process.

1. The unit base frame shall be fabricated with 6-inch, 10.2 lb. per foot, structural steel C-channel. Structural cross members shall be placed at critical locations to support internal components. Vertical frame members shall be fabricated from formed 11-gauge channels. The unit base frame shall be furnished with lifting lugs capable of accepting cable or chain hooks for rigging. Prior to unit assembly, the entire frame shall be covered with a minimum one-mil coat of air-dried sandstone rust inhibiting coating for maximum corrosion protection.
2. Internal floor liners shall be fabricated from 14-gauge galvanized steel welded to the base frame and sealed to prevent air leakage. The entire unit length shall include an underliner constructed of 20-gauge galvanized steel to contain insulation and provide additional structural support. The air handler cabinet casing shall utilize double wall sandwich construction. The exterior surfaces of the wall shall form the air seal and shall be fabricated from 20-gauge galvanized steel. The interior shall be lined with 20-gauge galvanized steel. The exterior panels shall be galvanized steel, pre-coated with 6.0 mils of phenolic baked coating which will withstand 5,000 hours of salt spray per ASTM B-117 over 4.0 mils epoxy primer for a total of 10.0 mils for marine environments.
3. The unit base shall be insulated with 4-inch, 1-pound density of fiberglass insulation with a minimum R-value of 13. Wall and roof panels shall be insulated with 2-inch, 1-pound density fiberglass with a minimum R-value of 6.9. Compressing 2” insulation between 1” panels is not acceptable. A 4-inch space shall be provided between the air handler top liner and the roof panels to accommodate refrigerant piping and electrical runs. Electrical wiring shall be run in a full-length electrical raceway above the air handler top liner. Exterior roof panels shall be crowned for drainage and easily removable for service access.

B. Access Doors

1. A full-size hinged access door shall be provided for any section requiring service access. Removable casing panels shall not be allowed. Door frame shall be of rigid extruded aluminum. Adhesive-backed gasket applied to the frame shall not be allowed. Access doors shall be thermally broken and provided to the following components at a minimum: supply and return fan motors, supply and return fan inlets, filters, dampers, cooling/heating coils and any other serviceable component. Hinged access doors shall be complete with stainless steel hinges and multiple-point, single-handle compression-type latches to provide quick access and a positive air seal. Latch shall include integral keyed lock. Interior latch allows door closure during inclement weather. Doors shall include locking type

door retainers to protect doors against wind damage when open. Doors shall be nominal 18- or 24-inch or 36-inch width. Actual opening widths shall be 17.25 inches and 29.25 inches respectively.

2. Door safety restraints provide a 2-turn secondary latch which shall prevent unwanted rapid door opening against high interior pressures.
3. Each fan section access door shall include a secondary door. This door shall be constructed of expanded metal in a rigid frame which shall allow visual inspection of the fan, motor, and drive components. To gain access to the fan through this door requires the use of a tool.
4. Each door shall include a view port to allow visual inspection of interior components.

2.3 FANS

NOTE: Fan-Wall systems may be used in lieu of centrifugal plug fans.

A. Type: Double inlet, centrifugal type fan.

B. Performance Ratings: Conform to AMCA 210 and label with AMCA Certified Rating Seal.

C. Sound Ratings: AMCA 301, tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.

D. Bearings: Self-aligning, grease lubricated, ball or roller bearings with lubrication fittings extended to exterior of casing with copper tube and grease fitting rigidly attached to casing.

E. Mounting: Locate fan and motor internally on welded steel base coated with corrosion resistant paint. Factory mount motor on slide rails. Furnish access to motor, drive, and bearings through removable casing panels or hinged access doors. Mount base on spring vibration isolators.

F. Fan Modulation: Variable Frequency Drive. See Section on VARIBALE FREQUENCY DRIVES.

G. Flexible Connection: Separate unit from connecting ductwork.

2.4 VARIABLE FREQUENCY DRIVES

A. VFDs for supply fans and return fans and condenser fans shall be mounted and wired by the unit manufacturer inside of ventilated NEMA 3R enclosures. See Section on VARIABLE FREQUENCY DRIVES.

2.5 REFRIGERANT COILS

A. Air-Cooled Condensing Section: Condenser coils shall be constructed of seamless copper tubes, mechanically expanded into copper fins. Each coil shall include an integral 10 degree F sub-cooling circuit. The mechanical refrigerant system shall be capable of operating at ambient conditions down to 0 degree F and shall include ASME receivers on all circuits and ASME relief valve on all circuits. Condenser fans shall be direct drive, propeller type. Fans shall be VFD controlled to vary the speed to maintain a minimum head pressure. Condenser deck shall be insulated.

B. Compressors: The compressor shall be scroll or screw type. Compressors shall be high efficiency, suction-gas cooled, single speed, hermetic type, with three Teflon bearings and a cast iron motor frame. Compressors shall be mounted on rubber-in-shear isolators. The compressor circuit shall include high and low pressure taps, a discharge service valve, and a check valve at the discharge outlet to prevent reverse rotation. Compressors shall have internal motor protection for over-temperature and over-current conditions. Other safety devices include a crankcase heater, high-pressure cutout, and low pressure freeze protection. Capacity reduction shall be performed with compressor staging and hot gas bypass on tandem compressor models. Capacity reduction shall be performed with hot gas bypass on non-tandem compressor models.

C. Mechanical Pressure-Controlled Hot Gas Bypass: A pressure-controlled modulating hot gas bypass valve will trim the #1 compressor's effective capacity. The valve shall be controlled between each and every compressor control stage. The valve follows the cooling demand and must be commanded fully closed before a compressor stage is enabled and commanded to its maximum open position (adjustable) before a stage is disabled.

D. Refrigeration Circuit Specialties: Each independent refrigerant circuit shall be completely piped, tested, dehydrated, and fully charged with oil and refrigerant R410A or R407C. Each refrigerant circuit includes compressor, condenser with integral liquid sub-cooler, liquid line service and charging valve, filter drier, sight glass, fusible plug, and thermostatic expansion valve.

E. Evaporator Coil: Direct expansion coil shall be constructed of 2-inch seamless coated copper tubes expanded into copper fins and shall not be less than three rows in depth, nor have more than 12 fins per inch. Coil casing shall be constructed of type 201 stainless steel. Headers shall be copper. Evaporator coil shall be provided with adjustable superheat controls and external equalizers. Coils shall be tested to be leak-free with nitrogen at 500 PSIG under water. The entire refrigerant piping circuit shall be leak tested at 150 PSIG air pressure.

F. The evaporator coil shall be provided with a drain pan which shall be fabricated of 14-gauge 201 stainless steel and sloped for positive drainage of condensate. A 1-1/4-inch diameter condensate drain connection shall be provided on one side of the unit for slab coils and on both sides of the unit for V-bank coils and shall be field trapped by others.

G. All coils (evaporator and condenser) shall be coated with minimum 1.0 mil. aluminum impregnated polyurethane coating by Blygold PoluAl XT or approved equal. Coating shall withstand 4,000 hours in both salt spray test per ASTM B117 and acid salt spray test per ASTM D5339. Finned-tube coils applied coating shall have 5 year warranty.

2.6 DAMPERS, HOODS, AND LOUVERS

A. Low Leak Outside Air/Return Air (OA/RA) Dampers: Outside air and return air (economizer) dampers shall be constructed of heavy gauge, aluminum airfoil-shaped blades and 14-gauge galvanized steel frames. The damper blades shall be mounted to plated square shafts which rotate in permanently-lubricated nylon bearings to insure smooth operation. Vinyl blade seals shall be locked into extruded aluminum blade slots. Side seals shall be constructed of flexible metal compression-type stainless steel. Damper blades operate without clatter or binding and damper linkage will be located out of the air stream. Actuator shall be direct-mounting type.

B. Outside Air Louvers - Economizer: Outside air louvers shall be of a storm-proof design and provided with a 2-inch by 2-inch galvanized bird screen. A fully-insulated divider deck shall be provided to separate outside air from return air.

2.7 FILTERS

Provide MERV 8 pre-filter, carbon filter, bipolar ionization unit and MERV 13 final filter.

A. See Section on HVAC AIR CLEANING DEVICES.

2.8 ELECTRICAL

A. General: All electrical wiring conforms to UL 1995. Where required, wiring will be run in EMT. The unit shall be equipped for single source power connection.

B. Main Control Panel - Exterior: The main control panel will have access door(s) for direct access to the controls. The panel shall be equivalent to NEMA type 3R (rainproof) and contain a single externally-operated, molded case switch (non-automatic circuit breaker) suitable for copper wire up to and including 3-inch conduit. Low-voltage control panel wiring shall be enclosed in a wiring duct.

C. Service Outlet and Lights: GFI-type service outlet(s) shall be provided. Power is provided from the main unit. Circuit shall remain energized regardless of main unit disconnect position.

D. Lights not in the air stream shall be fluorescent with a wire guard. Lights in the air stream shall be vapor-proof screw-in type fluorescent with a cast alloy base with threaded hubs, gasketed glass cover, and wire guard. Lights are wired to a single switch. Power shall be on the same circuit as the Service Outlet. Light circuit shall

GUARANTEED MINIMUM FULL LOAD EFFICIENCY OF MOTORS		
Rated HP	Nominal 1200 RPM	Nominal 1800 RPM
1	82.5	85.5
1.5	86.5	86.5
2	87.5	86.5
3	89.5	89.5
5	89.5	89.5
7.5	91.7	91.0
10	91.7	91.7
15	92.4	93.0
20	92.4	93.0
25	93.0	93.6
30	93.6	94.1
40	94.1	94.1
50	94.1	94.5
60	95.0	95.0
75	95.0	95.0
100	95.0	95.4
125	95.4	95.4
150	95.8	95.8
200	95.4	95.8

remain energized regardless of main unit disconnect position.

2.9 CONTROLS

A. A microprocessor controller shall be mounted in the electrical panel. The unit will be provided with all necessary temperature, pressure sensors, filter switches and wiring for complete temperature controls and economizer operation as indicated on the control drawings.

B. Unit controller shall have capability as standard for remote access and monitoring over the internet.

C. Building BAS Interface. Provide an interface between the unit controls and the building automation system.

D. Connect unit to the Central Utility Plant via the LAWA intranet.

2.10 ROOF CURB

A. Factory assembled galvanized steel mounting curb designed and manufactured by unit manufacturer.

1. Perimeter type with support of air handling sections.
2. Furnish supply and return opening duct frames as part of curb structure allowing duct connections to be made directly to curb.
3. Minimum of 12 inches high.
4. Furnish gaskets for field mounting.

NOTE: All roof top equipment including packaged rooftop air conditioning units are to be curb mounted.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

3.2 TRAINING

A. Furnish services of factory trained representative for minimum of one day to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct LAWA on operation and maintenance. Training to include minimum of 8 LAWA personnel (minimum) for 40 hours training, 16 hours shall be classroom training per person and 24 hours shall be hands-on training per person.

B. Training shall occur after the system is fully operational.

3.3 WARRANTY

A. Provide 5 years parts and labor warranty for compressors, VFD, motors and Ultraviolet Disinfection System.

END OF SECTION 23 81 06

SECTION 23 81 07 - VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes all variable frequency drives. All standard and optional features shall be included within the VFD panel

1.2 QUALITY REQUIREMENTS

A. Requirements of Regulatory Agencies:

1. All variable frequency drives shall be tested and rated in conformity with applicable codes and authorities having jurisdiction, for variable frequency drives (VFD's).
2. VFDs and options shall be UL listed as a complete assembly. VFDs that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.

B. Manufacturer testing

1. To ensure quality, the complete VFD shall be tested by the manufacturer. The VFD shall drive a motor connected to a dynamometer at full load and speed and shall be cycled during the automated test procedure.
2. All optional features shall be functionally tested at the factory for proper operation.

1.3 SUBMITTALS

A. Shop Drawings and Product Data.

B. Variable Frequency Drives

1. Submit complete wiring diagrams, dimensional drawings, transformer data and connection diagrams.
2. Outline dimensions, conduit entry locations and weight.
3. Complete technical product description include a complete list of options provided
4. Customer connection and power wiring diagrams.
5. Compliance to IEEE 519 B harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).

    a. The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFDs shall include a minimum of 5% impedance reactors, no exceptions.

1.4 WARRANTY

A. Warranty shall be 5 years from the date of certified start-up. The warranty shall include all parts, labor, travel time and expenses. There shall be support available via a toll free phone number.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Variable Frequency Drives:

1. Description:

   a. Motors shall be provided with UL Listed variable frequency drive (VFD) control systems.
   b. The VFD shall be UL Type 1 or UL Type 12 for indoor applications or UL NEMA-3R for outdoor applications as required on the schedule. The VFD shall have been evaluated by UL and found acceptable for mounting in a plenum or other air handling compartment. Manufacturer shall supply a copy of the UL plenum evaluation upon request.
   c. The VFD shall be tested to UL 508C. The appropriate UL label shall be applied. When the VFDs are to be located in Canada, C-UL certifications shall apply. VFD shall be manufactured in ISO 9001, 2000 certified facilities.
   d. The VFD and any optional panels, of any type (bypass, etc.) shall be UL listed for a short circuit current rating of 100,000 amps and labeled with this rating.
   e. The VFD and any optional panels of any type (bypass, etc.), shall be shown to be in compliance with the seismic requirements of Section 1613 of the California Building Code (CBC) 2007 and ASCS 7-05. Compliance documentation shall be included as part of the equipment submittal.

2. Manufacturers.

   a. Danfoss.
   b. GE.
   c. ABB

3. General

   a. The VFD shall convert incoming fixed frequency three-phase AC power into an adjustable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for the driven load and to eliminate the need for motor derating. When properly sized, the VFD shall allow the motor to produce full rated power at rated motor voltage,

current, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.

b. The VFD shall include an input full-wave bridge rectifier and maintain a fundamental (displacement) power factor near unity regardless of speed or load.

c. The VFD shall have a dual 5% impedance DC link reactor on the positive and negative rails of the DC bus to minimize power line harmonics and protect the VFD from power line transients. The chokes shall be non-saturating. Swinging chokes that do not provide full harmonic filtering throughout the entire load range are not acceptable. VFDs with saturating (non-linear) DC link reactors shall require an additional 3% AC line reactor to provide acceptable harmonic performance at full load, where harmonic performance is most critical.

d. The VFD=s full load output current rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 120% of rated torque for up to 0.5 second while starting.

e. The VFD shall provide full motor torque at any selected frequency from 20 Hz to base speed while providing a variable torque V/Hz output at reduced speed. This is to allow driving direct drive fans without high speed derating or low speed excessive magnetization, as would occur if a constant torque V/Hz curve was used at reduced speeds. Breakaway torque of 160% shall be available.

f. A programmable automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continuously monitor the motor=s speed and load to adjust the applied voltage to maximize energy savings.

g. The VFD must be able to produce full torque at low speed to operate direct drive fans.

h. Output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD.

i. An automatic motor adaptation algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to perform the test.

j. Galvanic isolation shall be provided between the VFD=s power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs not including either galvanic or optical isolation on both analog I/O and discrete digital I/O shall include additional isolation modules.

k. VFD shall minimize the audible motor noise through the used of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD operation while reducing motor noise. VFDs with fixed carrier frequency are not acceptable.

l. All VFDs shall contain integral EMI filters to attenuate radio frequency interference conducted to the AC power line.

4. Protective Features

a. A minimum of Class 20 I^2t electronic motor overload protection for single motor applications shall be provided. Overload protection shall automatically compensate

for changes in motor speed.

b. Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature. The VFD shall display all faults in plain language. Codes are not acceptable.
c. Protect VFD from input phase loss. The VFD should be able to protect itself from damage and indicate the phase loss condition. During an input phase loss condition, the VFD shall be able to be programmed to either trip off while displaying an alarm, issue a warning while running at reduced output capacity, or issue a warning while running at full commanded speed. This function is independent of which input power phase is lost.
d. Protect from under voltage. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. The VFD will continue to operate with reduced output, without faulting, with an input voltage as low as 70% of the nominal voltage.
e. Protect from over voltage. The VFD shall continue to operate without faulting with an input voltage as high as 130% of the nominal voltage.
f. The VFD shall incorporate a programmable motor preheat feature to keep the motor warm and prevent condensation build up in the motor when it is stopped in a damp environment by providing the motor stator with a controlled level of current.
g. VFD shall include a “signal loss detection” algorithm with adjustable time delay to sense the loss of an analog input signal. It shall also include a programmable time delay to eliminate nuisance signal loss indications. The functions after detection shall be programmable.
h. VFD shall function normally when the keypad is removed while the VFD is running. No warnings or alarms shall be issued as a result of removing the keypad.
i. VFD shall catch a rotating motor operating forward or reverse up to full speed without VFD fault or component damage.
j. Selectable over-voltage control shall be provided to protect the drive from power regenerated by the motor while maintaining control of the driven load.
k. VFD shall include current sensors on all three output phases to accurately measure motor current, protect the VFD from output short circuits, output ground faults, and act as a motor overload. If an output phase loss is detected, the VFD will trip off and identify which of the output phases is low or lost.
l. If the temperature of the VFD’s heat sink rises to 80 degree C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. It shall also be possible to program the VFD so that it reduces its output current limit value if the VFD’s temperature becomes too high.
m. In order to ensure operation during periods of overload, it must be possible to program the VFD to periodically reduce its output current to a programmed value during periods of excessive load. This allows the VFD to continue to run the load without tripping.
n. The VFD shall have temperature controlled cooling fan(s) for quiet operation, minimized losses, and increased fan life. At low loads or low ambient temperatures, the fan(s) may be off even when the VFD is running.
o. The VFD shall store in memory the last 10 alarms. A description of the alarm, and the date and time of the alarm shall be recorded.
p. When used with a pumping system, the VFD shall be able to detect no-flow situations, dry pump conditions, and operation off the end of the pump curve. It shall

be programmable to take appropriate protective action when one of the above situations is detected.

5. Interface Features

   a. Hand, Off and Auto keys shall be provided to start and stop the VFD and determine the source of the speed reference. It shall be possible to either disable these keys or password protect them from undesired operation.
   b. There shall be an “Info” key on the keypad. The Info key shall include “on-line” context sensitive assistance for programming and troubleshooting.
   c. The VFD shall be programmable to provide a digital output signal to indicate whether the VFD is in Hand or Auto mode. This is to alert the Building Automation System whether the VFD is being controlled locally or by the Building Automation System.
   d. Password protected keypad with alphanumeric, graphical, backlit display can be remotely mounted. Two levels of password protection shall be provided to guard against unauthorized parameter changes.
   e. All VFDs shall have the same customer interface. The keypad and display shall be identical and interchangeable for all sizes of VFDs.
   f. To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFD’s keypad, place that keypad on all other VFDs in turn and download the setup parameters to each VFD. To facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters. Keypad shall provide visual indication of copy status.
   g. Display shall be programmable to communicate in multiple languages including English, Spanish and French.
   h. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
   i. A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD. The VFD shall also have individual Fan, Pump, and Compressor menus specifically designed to facilitate start-up of these applications.
   j. A three-feedback PID controller to control the speed of the VFD shall be standard.

      1) This controller shall accept up to three feedback signals. It shall be programmable to compare the feedback signals to a common setpoint or to individual setpoints and to automatically select either the maximum or the feedback signal as the controlling signal. It shall also be possible to calculate the controlling feedback signal as the average of all feedback signals or the difference between a pair of feedback signals.
      2) The VFD shall be able to apply individual scaling to each feedback signal.
      3) For fan flow tracking applications, the VFD shall be able to calculate the square root of any or all individual feedback signals so that a pressure sensor can be used to measure air flow.
      4) The VFD’s PID controller shall be able to actively adjust its setpoint based on flow. This allows the VFD to compensate for a pressure feedback sensor which is located near the output of the pump rather than out in the controlled system.

   k. The VFD shall have three additional PID controllers which can be used to control

damper and valve positioners in the system and to provide setpoint reset.

l. Floating point control interface shall be provided to increase/decrease speed in response to contact closures.

m. Five simultaneous meter displays shall be available. They shall include at a minimum, frequency, motor current, motor voltage, VFD output power, VFD output energy, VFD temperature in degrees, among others.

n. Programmable Sleep Mode shall be able to stop the VFD. When its output frequency drops below set "sleep" level for a specified time, when an external contact commands that the VFD go into Sleep Mode, or when the VFD detects a no-flow situation, the VFD may be programmed to stop. When the VFD's speed is being controlled by its PID controller, it shall be possible to program a "wake-up" feedback value that will cause the VFD to start. To avoid excessive starting and stopping of the driven equipment, it shall be possible to program a minimum run time before sleep mode can be initiated and a minimum sleep time for the VFD.

o. A run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of initiating an output "run request" signal to indicate to the external equipment that the VFD has received a request to run.

p. VFD shall be programmable to display feedback signals in appropriate units, such as inches of water column (in-wg), pressure per square inch (psi) or temperature (°F).

q. VFD shall be programmable to sense the loss of load. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. To ensure against nuisance indications, this feature must be based on motor torque, not current, and must include a proof timer to keep brief periods of no load from falsely triggering this indication.

r. Standard Control and Monitoring Inputs and Outputs

    1) Four dedicated, programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
    2) Two terminals shall be programmable to act as either as digital outputs or additional digital inputs.
    3) Two programmable relay outputs, Form C 240 V AC, 2 A, shall be provided for remote indication of VFD status.

        a) Each relay shall have an adjustable on delay / off delay time.

    4) Two programmable analog inputs shall be provided that can be either direct-or-reverse acting.

        a) Each shall be independently selectable to be used with either an analog voltage or current signal.
        b) The maximum and minimum range of each shall be able to be independently scalable from 0 to 10 V dc and 0 to 20 mA.
        c) A programmable low-pass filter for either or both of the analog inputs must be included to compensate for noise.
        d) The VFD shall provide front panel meter displays programmable to show the value of each analog input signal for system set-up and troubleshooting,

5) One programmable analog current output (0/4 to 20 mA) shall be provided for indication of VFD status. This output shall be programmable to show the reference or feedback signal supplied to the VFD and for VFD output frequency, current and power. It shall be possible to scale the minimum and maximum values of this output.
6) It shall be possible through serial bus communications to read the status of all analog and digital inputs of the VFD.
7) It shall be possible to command all digital and analog output through the serial communication bus.

s. Optional Control and Monitoring Inputs and Outputs

1) It shall be possible to add optional modules to the VFD in the field to expand its analog and digital inputs and outputs.
2) These modules shall use rigid connectors to plug into the VFD's control card.
3) The VFD shall automatically recognize the option module after it is powered up. There shall be no need to manually configure the module.
4) Modules may include such items as:

a) Additional digital outputs, including relay outputs
b) Additional digital inputs
c) Additional analog outputs
d) Additional analog inputs, including Ni or Pt temperature sensor inputs

5) It shall be possible through serial bus communications to control the status of all optional analog and digital outputs of the VFD.

t. Standard programmable firefighter's override mode allows a digital input to control the VFD and override all other local or remote commands. It shall be possible to program the VFD so that it will ignore most normal VFD safety circuits including motor overload. The VFD shall display FIREMODE whenever in firefighter's override mode. Firemode shall allow selection of forward or reverse operation and the selection of a speed source or preset speed, as required to accommodate local fire codes, standards and conditions.

u. A real-time clock shall be an integral part of the VFD.

1) It shall be possible to use this to display the current date and time on the VFD's display.
2) Ten programmable time periods, with individually selectable ON and OFF functions shall be available. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter setpoints and output relays. Is shall be possible to program unique events that occur only during normal work days, others that occur only on non-work days, and others that occur on specific days or dates. The manufacturer shall provide free PC-based software to set up the calendar for this schedule.
3) All VFD faults shall be time stamped to aid troubleshooting.
4) It shall be possible to program maintenance reminders based on date and time, VFD running hours, or VFD operating hours.
5) The real-time clock shall be able to time and date stamp all faults recorded in

the VFD fault log.

v. The VFD shall be able to store load profile data to assist in analyzing the system demand and energy consumption over time.
w. The VFD shall include a smart logic controller to provide advanced control interface capabilities. This shall include:

1) Comparators for comparing VFD analog values to programmed trigger values
2) Logic operators to combine up to three logic expressions using Boolean algebra
3) Delay timers
4) A 20-step programmable structure
5) The Smart Logic controller will allow the VFD to operate in closed loop set point (PID) control mode one motor at a controlled speed and control the operation of 2 additional constant speed motor starters. (Cascade Control).

6. Serial Communications

a. The VFD shall include a standard EIA-485 communications port and capabilities to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD:

1) Johnson Controls Metasys N2
2) Siemens Apogee FLN (P1)
3) Modbus RTU
4) LonWorks Free Topology (FTP) certified to LonMark standard 3.3
5) BACnet MS/TP

b. VFD shall have standard USB port for direct connection of Personal Computer (PC) to the VFD. The manufacturer shall provide no-charge PC software to allow complete setup and access of the VFD and logs of VFD operation through the USB port. It shall be possible to communicate to the VFD through this USB port without interrupting VFD communications to the building management system.
c. The VFD shall have provisions for an optional 24 V DC back-up power interface to power the VFD's control card. This is to allow the VFD to continue to communicate to the building automation system even if power to the VFD is lost.

7. Adjustments

a. The VFD shall have a manually adjustable carrier frequency that can be adjusted in 0.5 kHz increments to allow the user to select the desired operating characteristics. The VFD shall also be programmable to automatically reduce its carrier frequency to avoid tripping due to thermal loading.
b. Four independent setups shall be provided.
c. Four preset speeds per setup shall be provided for a total of 16.
d. Each setup shall have two programmable ramp up and ramp down times. Acceleration and deceleration ramp times shall be adjustable over the range from 1 to 3,600 seconds.
e. Each setup shall be programmable for a unique current limit value. If the output current from the VFD reaches this value, any further attempt to increase the current

produced by the VFD will cause the VFD to reduce its output frequency to reduce the load on the VFD. If desired, it shall be possible to program a timer which will cause the VFD to trip off after a programmed time period.

f. If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: external interlock, under-voltage, over-voltage, current limit, over temperature, and VFD overload.
g. The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.
h. An automatic "start delay" may be selected from 0 to 120 seconds. During this delay time, the VFD shall be programmable to either apply no voltage to the motor or apply a DC braking current if desired.
i. Four programmable critical frequency lockout ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment shall be provided. Automated setting of lockout ranges shall simplify the set-up.

8. Optional Features

a. All optional features shall be built and mounted by VFD manufacturer. All optional features shall be UL listed by the VFD manufacturer as a complete assembly and carry a UL label.
b. All panels shall be marked for 100,000 AMP short circuit current rating in compliance with UL.
c. The enclosure rating of the VFD w/options shall be consistent with the VFD rating of either NEMA/UL type 1 or NEMA/UL type 12, as required for the installation location and/or as called for on the schedule. The package shall include ALL optional devices and shipped as a complete factory tested assembly.
d. Three-Contactor bypass shall be provided that allows operation of the motor via line power in the event of a failure of the VFD. Motor control selection shall be through either a VFD output contactor or a bypass contactor that are electrically interlocked to ensure that both contactors are not energized simultaneously. A third contactor, the drive input contactor, shall be supplied as standard. This allows the powering of the VFD with the motor off or operating in bypass mode for testing, programming and troubleshooting purposes.

e. The three-contactor bypass shall include the following interface and control features:

1) Mode selection via a four position DRIVE/OFF/BYPASS/TEST switch.

a) DRIVE Mode: Both the drive input and output contactors are closed and the motor is operated via VFD power
b) OFF Mode: DRIVE input, drive output and bypass contactors are all open.
c) BYPASS Mode: Bypass contactor is closed and motor is operating from line power. Both the drive input and drive output contactors are open for servicing of the VFD without power.
d) TEST Mode: Bypass contactor is closed and the motor is operated from line power. The drive input contactor is closed but the drive output contactor is open. This allows for the testing and programming of the

VFD while the motor is operated via line power.

2) Contactors shall operate from a 24vdc power supply that shall function off of any two legs of the AC line and shall maintain power on the loss of any one of the AC lines.
3) A bypass pilot light is supplied to indicate that the motor is operating from line power.
4) Common start/stop command when operating in either bypass or VFD mode.
5) Selectable Run Permissive logic shall operate in either VFD or bypass operation. When activated, any command to start the motor, in either hand bypass, remote bypass, hand VFD or remote VFD shall not start the motor, but instead close a relay contact that is used to initiate operation of another device, such as an outside air damper. A contact closure from this device shall confirm that it is appropriately actuated and the motor shall then start.
6) Bypass package shall include an external safety interlock that will disable motor operation in either bypass or VFD when open.
7) Firemode bypass operation shall be standard. When activated via a contact closure, the motor shall transfer to bypass (line power) regardless of the mode selected. All calls to stop the motor shall be ignored. These include the opening of the start command, an external safety trip or the tripping of the motor overload. Firemode operation will take precedence over all other commands.
8) The bypass must include a selectable time delay of 0 to 60 seconds before the initiation of bypass operation. When transferring from VFD to bypass modes, the time delay starts after the motor has decelerated to zero speed. This delay allows the BAS to prepare for bypass operation. Bypass packages that do not include a time delay, or do not include a selectable delay period, will not be acceptable.
9) Automatic bypass shall be selectable. When active, the motor shall be transferred to line power on a VFD fault condition. The bypass time delay shall be activated prior to this transfer to line power to allow the VFD time to attempt to recover from the fault condition prior to running in bypass.

f. Protective Features

1) Main input disconnect shall be provided that removes power from both the bypass and VFD.
2) Main input motor rated fuses that protect the entire package.
3) VFD only fast acting input fuses shall be provided. Packages that include only main input motor rated fusing or circuit breaker are not acceptable.
4) Overload protection shall be supplied in bypass mode.

   a) This overload shall supply minimum class 20 protection as well as wide adjustable current setting for complete motor protection when operating on line power. Those overloads that are not class 20 or current selectable will not be acceptable.
   b) Overload protection shall include phase loss and phase imbalance protection.

5) Low voltage contactor operation shall be maintained to 70% of the packages nominally rated voltage. This will ensure VFD operation on low voltage conditions that would otherwise be interrupted due to contactor dropout.
6) The VFD shall be able to operate the motor at a reduced load with the loss of any one of the three phases of power. Contactors shall remain closed regardless of which phase is lost. This will ensure VFD operation on single phase conditions that would otherwise be interrupted due to contactor dropout.

g. Line/Load Conditioners

1) VFDs that do not include 5% DC link impedance shall include 5% AC line reactors in the operations enclosure. Lower levels of impedance will not be acceptable.
2) When the installation requires additional motor dV/dT protection, it shall be via a dV/dT filter mounted in the options enclosure. Packages that include only load reactors or filters supplied separately will not be accepted.

9. Service Conditions

a. Ambient temperature, continuous, full speed, full load operation:

1) -10 to 45°C (14 to 113°F) through 125 HP @ 460 and 600 volt, through 60 HP @ 208 volt

b. 0 to 95% relative humidity, non-condensing.
c. Elevation to 3,300 feet without derating.
d. AC line voltage variation, -10 to +10% of nominal with full output.
e. No side clearance shall be required for cooling.
f. All power and control wiring shall be done from the bottom.
g. All VFDs shall be plenum rated.

10. Quality Assurance

a. To ensure quality, the complete VFD shall be tested by the manufacturer. The VFD shall drive a motor connected to a dynamometer at full load and speed and shall be cycled during the automated test procedure.
b. All optional features shall be functionally tested at the factory for proper operation.

PART 3 - EXECUTION

3.1 START-UP SERVICE

A. The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.

B. armonic filtering. The VFD supplier shall, with the aid of the buyer's detailed electrical power single line diagram showing all impedances in the power path to the VFDs, perform an analysis to initially demonstrate the supplied equipment will met the IEEE recommendations after installation. If, as a result of the analysis, it is determined that additional filter equipment is required to meet the IEEE recommendations, then the cost of such equipment shall be included in the drive supplier quotation.

3.1 TRAINING

A. Factory representative shall provide on-site training (minimum of 24 hours) for LAWA operating personnel after the system is fully operational.

END OF SECTION 23 81 07

SECTION 23 81 23-COMPUTER-ROOM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes air conditioning units, controls and control panels.

1.2 REFERENCES

A. Air-Conditioning, Heating, and Refrigeration Institute

1. ARI 210/240 - Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment.
2. ARI 340/360 - Performance Rating of Commercial and Industrial Unitary Air-Conditioning & Air-Source Heat Pump Equipment.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

C. American Society of Mechanical Engineers:

1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

D. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s literature and data indicating water, drain, refrigeration, and electrical characteristics and connection requirements.

B. Manufacturer's Installation Instructions: Submit procedures for rigging and making service connections.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

D. Manufacturer's Field Reports: Indicate conditions at initial start-up including date, and initial set points.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

1.5 WARRANTY

A. Furnish five year manufacturer’s warranty.

1.6 MAINTENANCE SERVICE

A. Furnish service and maintenance of units for one year from Date of Substantial Completion.

B. Examine unit components monthly. Clean, adjust, and lubricate equipment.

C. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.

D. Perform work without removing units from service during building normal occupied hours.

E. Provide emergency call back service at all hours for this maintenance period.

F. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

G. Perform maintenance work using competent and qualified personnel under supervision of manufacturer or original installer.

H. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of LAWA.

1.7 EXTRA MATERIALS

A. Furnish one set of filters for each unit.

PART 2 - PRODUCTS

2.1 FLOOR MOUNTED AIR CONDITIONING UNITS

A. Manufacturers:

1. **Liebert.**
2. **APC.**

3. Stulz.

B. Product Description: Packaged, water or air cooled, factory assembled, pre-wired and pre-piped unit, consisting of cabinet, fans filters, humidifier and controls, reheat and heating coils. Refrigerant shall be R407C or R410A.

C. Cabinet and Frame:

1. Structural Frame: 14 gage welded steel suitably braced for rigidity, capable of supporting compressors and other mechanical equipment and fittings with welded tubular steel floor stand with adjustable legs and vibration isolation pads.
2. Doors and Access Panels: 20 gage galvanized steel with polyurethane gaskets, hinges to allow removal of panels, and concealed fastening devices.
3. Insulation: Thermally and acoustically line cabinet interior with 1 inch thick acoustic duct liner.
4. Finish of Exterior Surfaces: Shop coated with 4.0 mils epoxy primer and 6.0 mils topcoat phenolic baked coating for a total of 10.0 mils. Coating shall withstand 5,000 hour of salt spray test in accordance with ASTM B117.

D. Evaporator Fans and Motors:

1. Fans: Double inlet, forward curved centrifugal fans, statically and dynamically balanced.
2. Motor: Drip proof, permanently lubricated ball bearing motor with built-in current and overload protection.
3. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed, variable and adjustable pitch motor sheave, minimum of two matched belts, drive rated minimum 2.0 times nameplate rating of motor.

E. Compressors:

1. Type: Hermetic with resilient suspension system, oil strainer, crankcase sight glass, internal motor protection, low pressure switch, manual reset high pressure switch.
2. Compressors: Individually serviceable without dismantling other components or removing unit from service.
3. Refrigeration Circuits: Two, each with hot gas mufflers, thermal expansion valve with external equalizer, liquid line solenoid valve, liquid line filter-drier, refrigerant sight glass with moisture indicator, service shut-off valves and charging valves and accumulator sized for liquid seal under light load.

F. Evaporator Coils:

1. Direct expansion cooling coils of seamless copper tubes expanded into copper fins.
2. Mount coil assembly in stainless steel drain pan.

G. Condensers:

1. Water Cooled: Shell and tube type ASME Section VIII or Coaxial tube in tube type with liquid line stop valve and head pressure actuated water regulating valve. Terminate outside cabinet for easy external connections.

2. Air Cooled: Corrosion resistant cabinet, copper tube copper fin coils arranged for two circuits, multiple direct drive propeller fans with permanently lubricated ball bearing single phase motors with internal overload protection. Furnish capacity control by cycling fans.

H. Water Coil:

1. Seamless copper tubes expanded into copper fins with control valve and strainer.

I. Filters:

1. Media: Pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to welded wire grid; enclosed in cardboard frame; 2 inch nominal thickness.
2. Rating, ASHRAE 52.1:

a. Dust spot efficiency: 25-30 percent.
b. Weight arrestance: 90-92 percent.
c. Initial resistance at 500 fpm face velocity: 0.30 inch wg inch wg.
d. Recommended final resistance: 1.0 inch wg inch wg.

J. Refrigerant Reheat Coil:

1. Hot gas refrigerant coil of seamless copper tubes expanded into copper fins with three-way solenoid valve on first stage refrigerant circuit.

K. Reheat/heating Coils:

1. Heating Coils: Enclosed fin electrical elements arranged for minimum of two stages.
2. Circuit Protection: Primary and secondary thermal cutouts, differential air pressure switch, and manual reset overload protection and branch circuit overcurrent protection.
3. Hot water heating coil of seamless copper tubes expanded into copper fins.

L. Humidifier:

1. Infrared Type: High intensity quartz lamps mounted above stainless steel evaporator pan, serviceable without disconnecting water, drain, or electrical connections; pre-piped and utilizing condensate water from cooling coils with stainless steel or brass float valve mechanism; located in bypass air stream.

M. Control Cabinet: NEMA 250; Type 2 enclosure, UL listed, with piano hinged door, grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control circuit transformer.

N. Disconnect Switch: Non-automatic molded case circuit breaker with handle accessible with panel closed and capable of preventing access until switched to "off" position.

O. Electronic Control System:

1. Solid state with start button, stop button, temporary loss of power indicator, manual reset circuit breakers, temperature control humidity control, and monitor panel.

2. Monitor Panel: Back lighted with no visible indicator lights until operating function is activated; indicators include cooling, humidification, loss of air flow, change filters, high temperature, low temperature, high humidity, low humidity, high head pressure (each compressor), and low suction pressure (each compressor).
3. Temperature and Humidity Control Modules: Solid state plug-in with adjustable set point, "push-to-test" calibration check button, and built-in visual indicators to indicate mode of operation.
4. Location: Through hinged door in front of unit; isolated from conditioned air stream to allow service while system is operating.

P. Outside Casing Coating

> **NOTE:** A rust inhibiting coating is required due to the marine environment at LAX along with the corrosive atmosphere from the neighboring Hyperion plant .

1. Zinc chromate, iron oxide, shop coated with 4.0 mils epoxy primer and 6.0 mils topcoat phenolic baked coating for a total of 10.0 mils. Coating shall withstand 5,000 hour of salt spray test in accordance with ASTM B117.
2. Finish exceeds 5000 hour salt spray test in accordance with ASTM B117.

Q. Outside Coil Coating

1. All coils shall be coated with minimum 1.0 mil. aluminum impregnated polyurethane coating by Blygold PoluAl XT or approved equal. Coating shall withstand 4,000 hours in both salt spray test per ASTM B117 and acid salt spray test per ASTM D5339. Finned-tube coils applied coating shall have 5 year warranty.

2.2 CEILING MOUNTED AIR CONDITIONING UNITS

A. Manufacturers:

1. Liebert.
2. APC.
3. Stulz.

B. Product Description: Self-contained air cooled, factory assembled, pre-wired and pre-piped unit, consisting of cabinet, fan, filters, humidifier, controls.

C. Assembly: For horizontal ceiling mounting to fit 24 x 48 inches T-bar ceiling opening.

D. Cabinet: 14 gage welded steel with baked enamel finish, and lined with 1/2 inch thick acoustic duct liner.

E. Provide condensate pump integrated with unit.

F. Evaporator Fan: Forward curved centrifugal, directly driven by two-speed motor.

G. Compressor: Hermetic with resilient suspension system, oil strainer, internal motor overload protection, low pressure switch, manual reset high-pressure switch.

H. Evaporator Coil: Direct expansion cooling coil of seamless copper tubes expanded into aluminum fins, with thermal expansion valve with external equalizer, liquid line filter-drier, service shut-off valves and charging valves. Mount coil assembly in stainless steel drain pan.

I. Air Cooled Condenser: Integral copper tube aluminum fin coil sized for scheduled capacity.

J. Filter: 1 inch thick disposable glass fiber media.

K. Heating Coils: Nichrome wire electric elements with contactor, dehumidification relay, and high temperature limit switch.

L. Evaporative Pan Type: Stainless steel pan and cover, with stainless steel or brass float valve mechanism, electric heating coil with low water cut-off switch, flush cycle timer and solenoid drain valve.

M. Control System:

1. Unit Mounted: Main fan contactor, compressor and condenser fan contactor, compressor start capacitor, controls transformer with circuit breaker, solid state temperature and humidity control modules.
2. Solid state wall mounted with start/stop switch, adjustable humidity setpoint, adjustable temperature setpoint to interface with unit mounted controls.

NOTE: Provide leak detector kit for raised floor installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate installation of computer room air conditioning units with computer room raised floor. Floor mounted units shall be on level stand with 2” deflection spring isolators and seismic restraints. Units hung from above shall have 2” spring isolation hangers and seismic restraints.

B. Coordinate installation of air conditioning unit with computer room ceiling.

C. Install drainage piping connections for humidifier flushing system.

D. Install hot water heating piping connections to reheat coils. Install shut-off valves in hot water heating inlet and outlet piping.

E. Install refrigerant piping connections to air-cooled condensing units.

F. Install accessories furnished loose for field mounting.

G. Install electrical devices furnished loose for field mounting.

H. Install control wiring between control panel and field mounted control devices.

I. Provide connection to electrical service.

3.2 MANUFACTURER'S FIELD SERVICES

A. Furnish services of factory trained representative for minimum of one days to start-up, calibrate controls, and instruct a minimum of 8 LAWA personnel for 40 hours, 16 hours shall be classroom training and 24 hours shall be hands on training on operation and maintenance.

B. Set initial temperature and humidity set points.

3.3 DEMONSTRATION

A. Demonstrate system operations and verify specified performance.

B. Demonstrate alarm conditions.

END OF SECTION 23 81 23

SECTION 23 81 26-SPLIT-SYSTEM AIR-CONDITIONERS (DUCTED)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Air handling unit.
2. Condensing unit.

B. This applies to units less than 5 tons.

1.2 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
2. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
3. ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
4. ARI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
2. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ASTM International:

1. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

D. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.

E. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

A. Product Data: Submit data indicating:

1. Cooling and heating capacities.
2. Dimensions.

3. Weights.
4. Rough-in connections and connection requirements.
5. Duct connections.
6. Electrical requirements with electrical characteristics and connection requirements.
7. Controls.
8. Accessories.

B. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

1.4 QUALITY ASSURANCE

A. Performance Requirements: Energy Efficiency Rating (EER) and Coefficient of Performance (COP) not less than prescribed by ASHRAE 90.1 when used in combination with compressors and evaporator coils when tested in accordance with ARI Standards.

1.5 WARRANTY

A. Minimum one-year warranty.

PART 2 - PRODUCTS

2.1 SPLIT SYSTEM AIR CONDITIONING UNITS

A. Manufacturers:

1. Carrier.
2. Trane.
3. York.

B. Product Description: Split system consisting of air handling unit and condensing unit including cabinet, evaporator fan, refrigerant cooling coil, compressor, refrigeration circuit, condenser, air filters, controls, air handling unit accessories, condensing unit accessories, and refrigeration specialties.

C. Refrigerants R-410A and R-407C.

2.2 AIR HANDLING UNIT

A. Cabinet:

1. Panels: Constructed of galvanized steel with baked enamel finish. Access Panels: Located on both sides of unit. Furnish with duct collars on inlets and outlets.
2. Insulation: Factory applied to each surface to insulate entire cabinet. One inch thick neoprene coated aluminum foil faced glass fiber with edges protected from erosion.

B. Evaporator Fan: Forward curved centrifugal type, resiliently mounted with adjustable belt drive and high efficiency motor. Motor permanently lubricated with built-in thermal overload protection.

C. Evaporator Coil: Constructed of copper tubes expanded onto aluminum fins. Factory leak tested under water. Removable, PVC construction, double-sloped drain pan with piping connections on both sides.

D. Refrigeration System: Single or Dual refrigeration circuits controlled by factory installed thermal expansion valve.

E. Hot Water Heating Coil: Factory mounted Field installed with casing to match unit construction. Coil: Constructed of copper tubes expanded into aluminum fins. Factory leak tested under water.

F. Air Filters: 1 inch thick glass fiber disposable media in metal frames. 25 to 30 percent efficiency based on ASHRAE 52.1.

2.3 CONDENSING UNIT

A. General: Factory assembled and tested air cooled condensing units, consisting of casing, compressors, condensers, coils, condenser fans and motors, and unit controls.

B. Unit Casings: Exposed casing surfaces constructed of galvanized steel with manufacturer's standard baked enamel finish. Designed for outdoor installation and complete with weather protection for components and controls, and complete with removable panels for required access to compressors, controls, condenser fans, motors, and drives.

C. Compressor: Single refrigeration circuit or Two independent refrigeration circuits with rotary or hermetic semi-hermetic reciprocating type compressors, resiliently mounted, with positive lubrication, and internal motor overload protection.

D. Condenser Coil: Constructed of copper tubing mechanically bonded to copper fins, factory leak and pressure tested. Coil shall be coated with minimum 1.0 mil. aluminum impregnated polyurethane coating by Blygold PoluAl XT or approved equal. Coating shall withstand 4,000 hours in both salt spray test per ASTM B117 and acid salt spray test per ASTM D5339.

E. Controls: Furnish operating and safety controls including high and low pressure cutouts. Control transformer. Furnish magnetic contactors for compressor and condenser fan motors.

F. Condenser Fans and Drives: Direct drive propeller fans statically and dynamically balanced. Wired to operate with compressor. Permanently lubricated ball bearing type motors with built-in thermal overload protection. Furnish high efficiency fan motors.

G. Condensing Unit Accessories: Furnish the following accessories:

1. Controls to provide low ambient cooling to 0 degrees F.
2. Time delay relay.
3. Anti-short cycle timer.

4. Disconnect switch.
5. Vibration isolators.
6. Hot gas bypass kit.
7. Coil with corrosion resistant coating capable of withstanding salt spray test of 1000 hours in accordance with ASTM B117.
8. Condenser Coil Guard: Condenser fan openings furnished with PVC coated steel wire safety guards.
9. Suction and discharge pressure gauges.

H. Refrigeration specialties: Furnish the following for each circuit:

1. Charge of compressor oil.
2. Holding charge of refrigerant.
3. Replaceable core type filter drier.
4. Liquid line sight glass and moisture indicator.
5. Shut-off valves on suction and liquid piping.
6. Liquid line solenoid valve.
7. Charging valve.
8. Oil level sight glass.
9. Crankcase heater.
10. Hot gas muffler.
11. Pressure relief device.

2.4 CONTROLS

A. Capability to interface with BAS (Building Automation System).

PART 3 - EXECUTION

3.1 INSTALLATION - AIR HANDLING UNIT

A. Install per manufacturer’s recommendations.

B. Install condensate piping with trap and route from drain pan to approved receptor.

3.2 TRAINING

A. Training to include maximum of 15 LAWA personnel for 40 hour training, 16 hours shall be classroom training and 24 hours shall be hands-on training.

END OF SECTION 23 81 26

SECTION 23 81 27-DUCTLESS SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fan Coil Unit.
2. Condensing unit.
3. For units/systems up to three tons maximum.

B. This applies to units less than 5 tons.

1.2 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
2. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
3. ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
4. ARI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
2. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ASTM International:

1. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

D. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.

E. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

A. Product Data: Submit data indicating:

1. Cooling and heating capacities.

2. Dimensions.
3. Weights.
4. Rough-in connections and connection requirements.
5. Electrical requirements with electrical characteristics and connection requirements.
6. Controls.
7. Accessories.

B. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

1.4 QUALITY ASSURANCE

A. Performance Requirements: Energy Efficiency Rating (EER) and Coefficient of Performance (COP) not less than prescribed by ASHRAE 90.1 when used in combination with compressors and evaporator coils when tested in accordance with ARI Standards.

PART 2 - PRODUCTS

2.1 SPLIT SYSTEM AIR CONDITIONING UNITS

A. Product Description: Split system consisting of fan coil unit and condensing unit including cabinet, evaporator fan, refrigerant cooling coil, compressor, refrigeration circuit, condenser, air filters, controls, air handling unit accessories, condensing unit accessories, and refrigeration specialties.

B. Manufacturers:

1. Mitsubishi.
2. Daikin.
3. Sanyo.

C. Refrigerants R-410A and R-407C.

2.2 FAN COIL UNIT

A. Cabinet:

1. Panels: Constructed of galvanized steel with baked enamel finish. Access Panels: Located on both sides of unit. Furnish with duct collars on inlets and outlets.
2. Insulation: Factory applied to each surface to insulate entire cabinet. One inch thick neoprene coated aluminum foil faced glass fiber with edges protected from erosion.

B. Evaporator Fan: Forward curved centrifugal type, resiliently mounted with adjustable belt drive and high efficiency motor. Motor permanently lubricated with built-in thermal overload protection.

C. Evaporator Coil: Constructed of copper tubes expanded onto copper fins. Factory leak tested under water. Removable, PVC construction, double-sloped stainless steel drain pan with piping connections on both sides. Coil shall be coated with minimum 1.0 mil. aluminum impregnated polyurethane coating by Blygold PoluAl XT or approved equal. Coating shall withstand 4,000 hours in both salt spray test per ASTM B117 and acid salt spray test per ASTM D5339.

D. Refrigeration System: Single or Dual refrigeration circuits controlled by factory installed thermal expansion valve. Refrigerant shall be R407C or R410A.

E. Air Filters: 1 inch thick glass fiber disposable media in metal frames. 25 to 30 percent efficiency based on ASHRAE 52.1.

F. Unit shall be wall mounted, ceiling mounted, or ceiling cassette type (integral with grid).

2.3 CONDENSING UNIT

A. General: Factory assembled and tested air cooled condensing units, consisting of casing, compressors, condensers, coils, condenser fans and motors, and unit controls.

B. Unit Casings: Exposed casing surfaces constructed of galvanized steel with manufacturer's standard baked enamel finish. Designed for outdoor installation and complete with weather protection for components and controls, and complete with removable panels for required access to compressors, controls, condenser fans, motors, and drives.

C. Compressor: Single refrigeration circuit or two independent refrigeration circuits with rotary or hermetic semi-hermetic reciprocating type compressors, resiliently mounted, with positive lubrication, and internal motor overload protection. Compressor shall five (5) year warranty.

D. Condenser Coil: Constructed of copper tubing mechanically bonded to copper fins, factory leak and pressure tested. Coil shall be coated with minimum 1.0 mil. aluminum impregnated polyurethane coating by Blygold PoluAl XT or approved equal. Coating shall withstand 4,000 hours in both salt spray test per ASTM B117 and acid salt spray test per ASTM D5339.

E. Controls: Furnish operating and safety controls including high and low pressure cutouts. Control transformer. Furnish magnetic contactors for compressor and condenser fan motors.

F. Condenser Fans and Drives: Direct drive propeller fans statically and dynamically balanced. Wired to operate with compressor. Permanently lubricated ball bearing type motors with built-in thermal overload protection. Furnish high efficiency fan motors.

G. Condensing Unit Accessories: Furnish the following accessories:

1. Controls to provide low ambient cooling to 0 degrees F.
2. Time delay relay.
3. Anti-short cycle timer.
4. Disconnect switch.
5. Vibration isolators.
6. Hot gas bypass kit.

7. Coil with corrosion resistant coating capable of withstanding salt spray test of 1000 hours in accordance with ASTM B117.
8. Condenser Coil Guard: Condenser fan openings furnished with PVC coated steel wire safety guards.
9. Suction and discharge pressure gauges.

H. Refrigeration specialties: Furnish the following for each circuit:

1. Charge of compressor oil.
2. Holding charge of refrigerant.
3. Replaceable core type filter drier.
4. Liquid line sight glass and moisture indicator.
5. Shut-off valves on suction and liquid piping.
6. Liquid line solenoid valve.
7. Charging valve.
8. Oil level sight glass.
9. Crankcase heater.
10. Hot gas muffler.
11. Pressure relief device.

2.4 CONTROLS

A. Capability to interface with BAS (Building Automation System).

PART 3 - EXECUTION

3.1 INSTALLATION – FAN COIL UNIT

A. Install per manufacturer's recommendations. Where appropriate, provide 2" deflection spring vibration isolators and seismic restraints.

B. Install condensate piping with trap and route from drain pan to approved receptor.

C. Training include minimum of 15 LAWA personnel for 40 hours training, 16 hours shall be classroom training and 24 hours shall be hands on training.

END OF SECTION 23 81 27

SECTION 26 05 02 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This section supplements all sections of this Division and shall apply to all phases of work hereinafter specified, or required to provide a complete installation of electrical systems for the Project. The intent of the Specifications is to provide a complete electrical system that includes all documents that are a part of the Contract.

1. Work Included: Furnish all labor, material, services and skilled supervision necessary for the construction, erection, installation, connections, testing, and adjustment of all circuits and electrical equipment specified herein.

B. Equipment or Fixtures: Equipment and fixtures shall be connected to provide circuit continuity in accordance with the Specifications, whether or not each piece of conductor, conduit, or protective device is shown between such items of equipment or fixtures, and the point of circuit origin.

C. Work Installed but Furnished under Other Sections: The Electrical Work includes the installation or connection of certain materials and equipment furnished under other sections. Verify installation details. Foundations for apparatus and equipment will be furnished under other sections unless otherwise noted or detailed.

NOTE: Provide conduit for all controls and other devices both line and low voltage. Install all control housings and back bone boxes required for installing conduit and wire to the controls.

1.2 GENERAL REQUIREMENTS

A. Equipment Safety: All electrical materials and equipment shall be new and shall be listed by Underwriter's Laboratories and bear their label, or listed. Custom made equipment must have complete test data submitted by the manufacturer attesting to its safety.

B. Codes and Regulations:

1. Design, manufacture, testing and method of installation of all apparatus and materials furnished under the requirements of these specifications shall conform to the latest publications or standard rules of the following:
   a. Institute of Electrical and Electronic Designers - IEEE
   b. National Electrical Manufacturers' Association - NEMA
   c. California Fire Code - CFC
   d. California Building Code - CBC
   e. Underwriters' Laboratories, Inc. - UL

f. National Fire Protection Association - NFPA
g. American Society for Testing and Materials - ASTM
h. American National Standards Institute - ANSI
i. American Standard Association - ASA
j. National Electrical Code - NEC, as modified by the city of Los Angeles
k. Insulated Power Cable Designers Association - IPCEA
l. California Code of Regulations, Title 24
m. International Electrical Testing Association - NETA

C. The term "Code", when used within the specifications.

D. Seismic Design of Electrical Equipment:

1. All electrical prefabricated equipment is to be designed and constructed in such a manner that all portions, elements, sub assemblies and/or parts of said equipment and the equipment as a whole, including their attachments, will resist a horizontal load equal to the operating weights of those parts multiplied times the following factors:

Type of equipment	Horizontal cp	Vertical cp
Rigid and rigidly supported piping or equipment such as boilers, chillers, pumps, motors, transformers, unit substations and control panels.	0.50	0.33
Flexible and flexibly supported equipment such as air-handling units, piping and other equipment so supported that the fundamental period of vibration of the equipment and its supporting system is greater than 0.05 seconds. Communication equipment and emergency stand-by equipment	1.00	0.6

2. Load is to be applied at the center of gravity of the part and to be in any direction horizontally.
3. Design stresses shall be in accordance with the specifications for design of the American Institute of Steel Construction. Anchorage, support and/or attachment of said prefabricated equipment to the structure should be in accordance with the details found in the plans and specifications.
4. Seismic restraints shall be designed for a 1.5 importance factor, and stamped structural calculations, signed by a California Registered Structural Engineer, will be provided as support.
5. It is the entire responsibility of the Contractor to verify the design of equipment so that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
6. If the state of California requires that certain electrical equipment and components have a special seismic certification, the contractor and vendor shall provide such certification.

E. Requirements of Regulatory Agencies:

1. Codes, Permits and Fees: Where the Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where provisions differ in regard to code application, size, quality, quantity or type of equipment, Contractor shall include in the bid, costs for the most costly provision either denoted in the specifications or on the drawings. This provision shall apply as an amendment to the California Public Contracts Code.

    a. Comply with all requirements for permits, licenses, fees and Code. Permits, licenses, fees, inspections and arrangements required for the Work shall be obtained by the Contractor at his expense, unless otherwise specified.
    b. Comply with the requirements of the applicable utility companies serving the Project. Make all arrangements with the utility companies for proper coordination of the Work.

F. Shop Drawings and Submittals: Submittals on all material prior to installation.

1. Shop drawings shall be submitted on, but not limited to, the following:
2. Equipment Wiring Connections
3. Medium Voltage Cables
4. Low Voltage Electrical Power Conductors and Cables
5. Grounding and Bonding for Electrical Systems
6. Hangers and Supports for Electrical Systems
7. Raceway and Boxes for Electrical Systems
8. Underground Ducts and Raceways for Electrical Systems
9. Vibration and Seismic Controls for Electrical Systems
10. Identification for Electrical Systems
11. Short Circuit and Overcurrent Protective Device Coordination Study
12. Web Based Power Monitoring Communications System
13. Lighting Control Devices
14. Network Lighting Control Systems
15. Medium Voltage Transformers
16. Metal Clad Switchgear (VacClad) B Medium Voltage
17. 34.5 kV Metering Switchgear
18. Low Voltage Transformers
19. Switchboards
20. Panelboards
21. Motor Control Centers
22. Enclosed Bus Assemblies
23. Electrical Cabinets and Enclosures
24. Wiring Devices
25. Fuses
26. Enclosed Switches
27. Enclosed Circuit Breakers
28. Enclosed Transfer Switches
29. Enclosed Controllers
30. Variable Frequency Motor Controllers
31. Engine Generators

32. Resistive Load Banks
33. Emergency Generators and Distribution Switchgear
34. Battery Equipment (Inverter)
35. Static Uninterruptible Power Supply
36. Emergency Circuit Conductors and Cable.
37. Metal Clad Drawout Switchgear B Low Voltage
38. Transient Voltage Suppression for Low Voltage Electrical Power Circuits
39. Interior Lighting
40. Exterior lighting
41. Fire Detection and Alarm
42. 3@ scale drawings of outdoor 34.5 kV switchgear yard, indoor 34.5 kV electrical vaults, all low voltage electrical rooms comply with all applicable LADWP, CEC and LA City requirements for equipment layout and installation. Also include associated grounding system grid drawings and details.
43. 1/8@ drawings for underground duct bank installation for normal and emergency feeders from main electrical rooms to sub electrical rooms with necessary conduit bank cross section details and equipment terminations.

G. Cutting and Patching:

1. Obtain written permission from LAWA before core drilling or cutting any structural members. Exact method and location of conduit penetrations and/or openings in concrete walls, floors, or ceilings shall be as approved by LAWA.
2. Use care in piercing waterproofing. After the part piercing the waterproofing has been set in place, seal openings and make absolutely watertight.
3. Seal all openings to meet the fire rating of the particular wall floor or ceiling.

H. Miscellaneous:

1. LED control lights shall be used in all switchgear, switchboards, motor control centers and similar equipment.
2. Outdoor equipment enclosures shall be NEMA 4.

1.3 JOB CONDITIONS

A. Existing Conditions:

1. The contractor shall visit the site and verify existing conditions.
2. Electrical circuits affecting work shall be de energized while working on or near them.
3. Arrange the work so that electrical power is available to all electrical equipment within existing facility at all times. Schedule all interruptions at the convenience of LAWA, including exact time and duration, in accordance with LAWA's power shut down procedures. Provide temporary power during all periods of interruption, which are deemed excessive by LAWA.

B. Protection:

1. Protection of apparatus, materials and equipment. Take such precautions as

necessary to properly protect all apparatus, fixtures, appliances, material, equipment and installations from damage of any kind. LAWA may reject any particular piece or pieces of material, apparatus or equipment scratched, dented or otherwise damaged.

2. Seal equipment or components exposed to the weather and make watertight and insect proof. Protect equipment outlets and conduit openings with temporary plugs or caps at all times that work is not in progress.
3. Provide weather protection, with heaters, for equipment stored outdoors.

1.4 POWER SHUTDOWN PROCEDURES

A. The contractor's construction schedule shall indicate dates of proposed electrical power shutdowns required to perform the installation. The contractor shall notify LAWA a minimum of thirty (30) days prior to each shutdown. All shutdown coordination meetings shall be arranged by the contractor for each shutdown.

B. Power shutdowns shall occur between the hours of 12:00 am and 4:00 am.

C. Only one switchboard shall be shutdown at any one time. Shutdowns shall be scheduled a minimum of three (3) days apart.

D. No interruptions to airport operations shall be allowed during periods deemed by LAWA as Holiday Construction Restriction Periods. These periods are typically from the Friday before the week of the Thanksgiving Holiday to the following Monday after the Thanksgiving Holiday (~9 calendar days), and the Friday before the week of the Christmas Holiday to the Monday following New Years Day (~16 calendar days). Contractor shall verify the Holiday Construction Restriction Periods with LAWA prior to preparing the construction schedule.

NOTE: Refer to the LAWA Utility Shutdown Procedures for additional information.

1.5 TESTING AND ADJUSTMENT

A. Upon completion of all Electrical Work, the contractor shall provide all testing as follows:

1. Operational Test: Test all circuit breakers, receptacles and all other electrical equipment. Replace all faulty devices and equipment discovered during testing with new devices and equipment at no additional cost, and that part of the system (or devices or equipment) shall then be retested.
2. Secondary Grounding Resistance: Perform ground continuity test between main ground system and equipment frame, system neutral and/or derived neutral point.
3. Ground Fault System Test: Measure system neutral insulation resistances to ensure no shunt ground paths exist.
4. All grounding resistance and ground fault test procedures shall be performed by an independent testing firm.

1.6 MAINTENANCE, SERVICING AND INSTRUCTION MANUALS, AND WIRING DIAGRAMS

A. Prior to substantial completion, the contractor shall submit 4 copies of operating and maintenance and servicing instructions, as well as an equal number of copies of complete wiring diagrams all neatly bound in hard cover 3 ring binders with table of contents and tabs for the following items or equipment:

1. Lighting Control Devices System
2. Medium Voltage Transformers
3. Medium Voltage Vacuum Circuit Breakers
4. Medium Voltage Metering Switchgear
5. Low Voltage Transformers
6. Switchboards
7. Panelboards
8. Motor Control Centers
9. Enclosed Bus Assemblies
10. Wiring Devices
11. Fuses
12. Enclosed Switches
13. Enclosed Circuit Breakers
14. Enclosed Transfer Switches
15. Enclosed Controllers
16. Variable Frequency Motor Controllers
17. Engine Generators
18. Resistive Load Banks
19. Emergency Generators and Distribution Switchgear
20. Battery Equipment (Inverter)
21. Static Uninterruptible Power Supply
22. Transient Voltage Suppression for Low Voltage Electrical Power Circuits
23. Interior Lighting
24. Exterior Lighting
25. Fire Detection and Alarm
26. Web Based Power Monitoring System

B. All wiring diagrams shall specifically cover the installed system indicating zones, wiring, and components added to the system.

C. Include Product and calculations data with maintenance and Operations manuals. Include all testing reports with Maintenance and Operation manuals.

1.7 FINAL INSPECTION AND ACCEPTANCE

A. After all requirements of the specifications and/or the drawings have been fully completed, representatives of LAWA will inspect the Work. The Contractor shall provide competent personnel to demonstrate the operation of any item of system, to the full satisfaction of each representative. The Contractor shall provide 8 hours of minimum scheduled operation and maintenance training to staff to be trained on each system indicated above. See specific sections for additional training/operation hours required.

B. Provide manuals for attendees.

C. Final acceptance of the work will be made by LAWA after receipt of approval and recommendation of acceptance from each representative.

D. The Contractor shall furnish Record Drawings before final payment of retention.

1.8 WARRANTIES

A. Guarantee all materials, equipments, apparatus and workmanship to be free of defective material and faulty workmanship for period of one year unless extended guarantee periods are specified in individual sections.

B. Special Warranties:

1. All 34.5kV Electrical Equipment, Switchgear and Accessories for 3 years (parts and labor).

C. During the period between Substantial Completion and Partial Acceptance (Final Acceptance of a defined area of the work), the Contractor shall provide the necessary services to Operate and Maintain the equipment in proper working order including, but not limited to:

1. Operation and Maintenance Response:

a. Provide twenty (24) hour emergency service during this period consisting of:

(1) Critical Issue: A prompt response (within 15 minutes) to emergency request by telephone or otherwise from LAWA or designated representative. Onsite within 30 minutes of notification to triage and assess the situation.

(2) Non Critical Issues: A prompt response (within 15 minutes) to request by telephone or otherwise from LAWA or designated representative. Onsite within one (1) hour after receiving notice from LAWA representative or having knowledge of a need to service the system. If event occurs after business hours, weekends or holidays, response shall be within one (1) hour of commencement of next business day.

(3) Scheduled Operational Needs: 24 hour notice of scheduled operational need. Failure to respond to scheduled operational need render need as a Critical Issue.

b. For Critical issues, on site response shall be within 30 minutes of notification. Repair or service of respective components and/or system shall be commenced immediately upon arrival on site. This requirement shall include after business hours, weekends, and holidays. Critical issues are defined as complete system failure, failure of controls, entrapments, and/or potential injury to persons, or other item that LAWA

deems a critical operational need.

c. For Noncritical issues, on site response shall be within one (1) hour of notification. If event occurs after business hours, weekends, or holidays, response shall be within one (1) hour of commencement of next business day. Repair or service of respective components and/or system shall be commenced within (4) hours of the arrival on site.

2. Maintenance:

   a. Inspection of completed installation and periodic testing to maintain equipment in completely operable, like new condition.
   b. Perform any necessary regulatory testing to ensure system(s) are compliant with applicable code, all to the satisfaction of the Authority Having Jurisdiction.
   c. Periodic lubrication of parts, filter changes and equipment components as per OEM's recommendation. Documentation to be provided for each piece of equipment when services are provided.
   d. Spare Parts: The Contractor shall maintain adequate supply of spare parts during this period. Any spare parts utilized during this period that are part of the contractually obligated inventory of spare parts for Final Acceptance shall be replenished prior to Final Acceptance.

3. Operation:

   a. All necessary work to operate/maintain the equipment in proper working order.
   b. Perform daily maintenance and system health checks as applicable, and any necessary system backups, failover/failback testing.
   c. Routinely monitoring equipment and systems for anomalies and respond or report to system maintenance team to respond and resolve.
   d. Perform configuration changes as needed to support project, airport, tenant operations, etc.
   e. Maintain logs of configuration changes.

4. Perform work without removing equipment from service during peak traffic periods (unless emergency and/or unless specifically authorized by LAWA) and those peak periods have been determined by LAWA as 7:00 a.m. to 12:00 a.m. (midnight) daily.
5. Unlimited regular time callbacks are included with the applicable response time. Regular time will be Monday through Friday, 8:00am to 4:30pm, exclusive of holidays. Overtime\Premium time call backs originating from an operational error related to the performance requirements of the equipment shall be borne by the Contractor.

END OF SECTION 26 05 02

SECTION 26 05 03-EQUIPMENT WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes electrical connections to equipment.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA WD 1 - General Requirements for Wiring Devices.
2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

A. Product Data: Submit wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

B. Manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

1.5 COORDINATION

A. Obtain and review shop drawings, product data, manufacturer’s wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

B. Determine connection locations and requirements.

C. Sequence rough-in of electrical connections to coordinate with installation of equipment.

D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 - PRODUCTS

2.1 CORD AND PLUGS

A. Manufacturers:

1. **Hubbell.**
2. **Leviton.**
3. **Pass & Seymour.**

B. Attachment Plug Construction: Conform to NEMA WD 1.

C. Configuration: NEMA WD 6; match receptacle configuration at outlet furnished for equipment.

NOTE: Specify cord type SJO for normal use and type SO for heavy duty use.

D. Cord Construction: Type SO or SJO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

E. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.2 EXISTING WORK

A. Remove exposed abandoned equipment wiring connections, including abandoned connections above accessible ceiling finishes.

B. Disconnect abandoned utilization equipment and remove wiring connections. Remove abandoned components when connected raceway is abandoned and removed. Install blank cover for abandoned boxes and enclosures not removed.

C. Extend existing equipment connections using materials and methods compatible with existing electrical installations, or as specified.

3.3 INSTALLATION

A. Make electrical connections.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. nstall receptacle outlet to accommodate connection with attachment plug.

E. Install cord and cap for field-supplied attachment plug.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

3.4 ADJUSTING

A. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

END OF SECTION 26 05 03

SECTION 26 05 13 - MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Medium voltage cable.
2. Cable terminations.
3. Fireproofing tape.
4. Underground cable markers.
5. Bedding and cover materials.

1.2 REFERENCES

A. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

B. Institute of Electrical and Electronics Engineers.

1. IEEE 48 – Standard Test Procedures and Requirements for Alternating Current Cable Terminations 2.5 kV thru 765 kV
2. IEEE C2 – National Electrical Safety Code.

C. National Electrical Manufacturers Association

1. NEMA WC3 – Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
2. NEMA WC 5 – Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
3. NEMA WC 7 – Cross Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electric Energy.
4. NEMA WC 8 – Ethylene Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

1.3 SUBMITTALS

A. Product Data: Submit for cable, terminations, and accessories.

B. Test Reports: Indicate results of cable test in tabular form and in plots of current versus voltage for incremental voltage steps, and current versus time at 30 second intervals at maximum voltage.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual sizes and locations of cables.

B. Operation and Maintenance Data: Submit instructions for testing and cleaning cable and accessories.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience, and with service facilities within 100 miles of Project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cable ends from entrance of moisture.

PART 2 - PRODUCTS

2.1 MEDIUM VOLTAGE CABLE

A. Manufacturers:

1. The Okonite Company
2. Pirelli Cable Corporation
3. Rome Cable Corporation

B. Voltage: 38 kV.

C. Insulation Level: 133 percent of operating voltage.

D. Cable Continuous Operating Temperature Rating: MV-105.

E. Configuration: Single conductor.

F. Conductor Material: Copper

G. Conductor Construction: Compact stranded

H. Conductor Shield: Ethylene propylene (EP) or ethylene propylene rubber (EPR)

I. Non-Armor Jacket: PVC with red extruded identification stripe.

2.2 CABLE TERMINATIONS

A. Voltage: 38 kV.

B. Location: Indoor or Outdoor

C. Conductor Quantity: Single core

D. Type: Dual extrusion thick wall heat shrink

2.3 FIREPROOFING TAPE

A. Manufacturers:

1. 3M Electrical Products Division
2. Plymouth Rubber Co., Bishop Division

B. Product Description: Flexible, conformable fabric, coated on one side with flame retardant, flexible polymeric or chlorinated elastomer. Non-corrosive to and compatible with cable sheaths jackets. It does not support combustion.

C. Width: Approximately 3 inches

D. Thickness: Not less than 0.03 inch

E. Weight: Not less than 2.5 pounds per square yard

2.4 UNDERGROUND CABLE MARKERS

A. Trace Wire: Magnetic detectable conductor, red colored plastic covering, imprinted with "Medium Voltage Cable" in large letters.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

B. Verify conduit, duct, trench, and manholes are ready to receive cable.

C. Verify routing and termination locations of cable prior to rough-in.

3.2 PREPARATION

A. Use swab to clean conduits and ducts before pulling cables.

3.3 EXISTING WORK

A. Remove abandoned medium-voltage cable.

B. Maintain access to existing medium-voltage cable and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Extend existing medium-voltage cable installations using materials and methods as specified.

D. Clean and repair existing medium-voltage cable to remain or to be reinstalled.

3.4 INSTALLATION

A. Avoid abrasion and other damage to cables during installation.

B. Use suitable manufacturer approved lubricants and pulling equipment.

C. Sustain cable pulling tensions and bending radii below manufacturer's recommended limits.

D. Ground cable shield at each termination and splice.

E. Install cables in manholes along wall providing longest route.

F. Arrange cable in manholes to avoid interference with duct entrances.

3.5 FIREPROOFING

A. Apply fireproofing tape to cables when installed in manholes, cable rooms, pull boxes, or other enclosures.

B. Smooth out irregularities, at splices or other locations, with insulation putty before applying fireproofing tape.

C. Apply fireproofing tape tightly around cables spirally in half-lapped wrapping or in butt jointed wrapping with second wrapping covering joints first.

D. Extend fireproofing 1 inch into conduit or duct.

E. Install tape with coated side toward cable.

F. Install random wrappings of plastic tape around fireproofing tape to prevent unraveling.

G. Install fireproofing to withstand a 200 Ampere arc for 30 seconds.

3.6 FIELD QUALITY CONTROL

A. Inspect exposed cable sections for physical damage.

B. Inspect cable for proper connections.

C. Inspect shield grounding, cable supports, and terminations for proper installation.

D. Tests as per applicable NETA standards.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Protect installed cables from entrance of moisture.

END OF SECTION 26 05 13

SECTION 26 05 16 – EMERGENCY CIRCUIT CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices and terminations for emergency or critical circuits rated 600 V and less.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. CONDUCTORS AND CABLES

1. Manufacturers:

   a. Draka USA
   b. AEI Cables.
   c. Pyrotenax.

B. CONDUCTORS SPLICES

1. 3M Company-Interam E-5 Series Mat with Metal Pull Boxes.
2. O-Z/Gedny; EGS Electrical Products Division.
3. Factory-fabricated connectors and splices of size, ampacity rating, material, type and class for application required.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Fire Pump and Emergency Smoke Control System Conductors: 600V RHH Power Cable

1. Cables must be Ul Classified Circuit Protective System with a 2-Hour fire rating when installed in the conduit.
2. Conduit supports shall be spaced no further than every 5' on center.
3. The cable shall utilize silicone ceramification technology in order to Maintain circuit integrity.
4. Cables shall be tested to Ul Standard 2196 - Fire Resistive Cables.
5. Cables shall comply to Ul Subject #44 for Rubber Insulated Type RHH.
6. Cables shall meet the requirements of Article 700 of the NEC-Emergency Systems.
7. Cables shall comply to the International Building Code and "protect against exposure to temperatures in excess of 10000 F (5380 C) for a period of not less than 15 minutes.

3.2 INSTALLATION

A. Run smoke control system evacuation cable/conduit in accordance with applicable sections of these specifications. Install fire pump conduits.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and side wall pressure valves.

C. Use pulling means, including fish tape, cable rope and basket-weave wire/cable grips, that will not damage cable of raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to the applicable UL Listing for each product type being installed.

F. Seal around cables penetrating fire-rated elements.

G. Identify and color-code conductors and cables.

H. Comply with UL electrical circuit protective system FHIT #25.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess

equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field-quality control testing:

1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance and requirements.
2. Perform electrical and visual and mechanical inspection. Certify compliance with test parameters.

B. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with the construction documents.
3. Test results that do not comply with the construction documents and corrective action taken to achieve contract compliance.

END OF SECTION 26 05 16

SECTION 26 05 19-LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

NOTE: This section pertains to **600v class** power conductors and cabling.

1.1 SUMMARY

A. Section includes building wire and cable; service entrance cable; armored cable; and wiring connectors and connections.

1.2 REFERENCES

A. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

B. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.
2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

C. Underwriters Laboratories, Inc.:

1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.3 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:

1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
2. Stranded conductors for control circuits.
3. Conductor not smaller than 12 AWG for power and lighting circuits.
4. Conductor not smaller than 14 AWG for control circuits.
5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.

B. Wiring Methods: Provide the following wiring methods:

1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.

3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN insulation, in raceway.
4. Wet or Damp Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
5. Exterior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
6. Underground Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
7. Other Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
8. Metal clad cables shall not be used.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and circuits.

1.5 QUALITY ASSURANCE

A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Manufacturers:

1. General Cable Co.
2. Southwire Co.
3. **Rome Cable Co**.

B. Product Description: Single conductor insulated wire.

C. Conductor: Copper.

D. Insulation Voltage Rating: 600 volts.

E. Insulation Temperature Rating: 75 degrees C.

F. Insulation Material: Thermoplastic.

2.2 ARMORED CABLE

A. Manufacturers:

1. General Cable.
2. Southwire Cable.

3. **Rome Cable.**

2.3 TERMINATIONS

A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.

B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

PART 3 - EXECUTION

3.1 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.2 INSTALLATION

A. Neatly train and lace wiring inside boxes, equipment, and panelboards.

B. Identify and color code wire and cable as described herein. Identify each conductor with its circuit number or other designation indicated.

C. Special Techniques--Building Wire in Raceway:

1. Pull conductors into raceway at same time.
2. Install building wire 4 AWG and larger with pulling equipment.

D. Special Techniques - Cable:

1. Protect exposed cable from damage.
2. Support cables above accessible ceiling, using spring metal clips or metal plastic cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.

E. Special Techniques - Wiring Connections:

1. Clean conductor surfaces before installing lugs and connectors.
2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

F. Install solid conductors for branch circuits 10 AWG and smaller. Do not place bare stranded conductors directly under screws.

G. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.

H. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.

I. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.3 WIRE COLOR

A. General:

1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:

   a. Black and red for single phase circuits at 120/240 volts.
   b. Black, red, and blue for circuits at 120/208 volts single or three phase.
   c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.

2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:

   a. Black and red for single phase circuits at 120/240 volts.
   b. Black, red, and blue for circuits at 120/208 volts single or three phase.
   c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.

B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.

C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.

D. Feeder Circuit Conductors: Uniquely color code each phase.

E. Ground Conductors:

1. For 6 AWG and smaller: Green.
2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.4 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION 26 05 19

SECTION 26 05 27 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rod electrodes.
2. Wire.
3. Grounding well components.
4. Mechanical connectors.
5. Exothermic connections.

1.2 REFERENCES

A. Institute of Electrical and Electronics Designers:

1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

1.3 SYSTEM DESCRIPTION

A. Grounding systems use the following elements as grounding electrodes:

1. Metal underground water pipe.
2. Metal building frame.
3. Concrete-encased electrode.
4. Rod electrode.
5. Plate electrode.

1.4 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms maximum.

1.5 SUBMITTALS

A. Product Data: Submit data on grounding electrodes and connections.

B. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

C. Manufacturer's Installation Instructions: Submit for active electrodes.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and grounding electrodes.

1.7 QUALITY ASSURANCE

A. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum 5 years documented experience and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.10 COORDINATION

A. Complete grounding and bonding of building reinforcing steel prior concrete placement.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES

A. Manufacturers:

1. Erico, Inc.
2. O-Z Gedney Co.
3. Thomas & Betts.

B. Product Description:

1. Material: Copper-clad steel.
2. Diameter: 3/4 inch
3. Length: 10 feet

C. Connector: Connector for exothermic welded connection.

2.2 WIRE

A. Material: Stranded copper.

B. Foundation Electrodes: 5 AWG.

C. Grounding Electrode Conductor: Copper conductor bare.

D. Bonding Conductor: Copper conductor bare.

2.3 GROUNDING WELL COMPONENTS

A. Well Pipe: 8 inches NPS (DN200) by 24 inches long fiberglass pipe with belled end.

B. Well Cover: Cast iron with legend "GROUND" embossed on cover.

2.4 MECHANICAL CONNECTORS

A. Manufacturers:

1. Erico, Inc.
2. ILSCO Corporation
3. O-Z Gedney Co.

B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.5 EXOTHERMIC CONNECTIONS

A. Manufacturers:

1. Copperweld, Inc.
2. ILSCO Corporation
3. O-Z Gedney Co.

B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 INSTALLATION

A. Install rod electrodes as required. Install additional rod electrodes to achieve specified resistance to ground.

B. Install grounding and bonding conductors concealed from view.

C. Install grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.

D. Install 4/0 AWG bare copper wire in foundation footing.

E. Install grounding electrode conductor and connect to reinforcing steel in foundation footing.

F. Bond together metal siding not attached to grounded structure; bond to ground.

G. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

H. Install continuous grounding using underground cold water system and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.

I. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.

J. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.

K. Permanently attach equipment and grounding conductors prior to energizing equipment.

L. The Ufer ground grounding electrode shall consist of a 50-foot length of bare #4/0 copper wire extended its full length below ground level and embedded along the bottom of the concrete foundation footing which is in direct contact with the foundation earth and supported in such a manner that it cannot be less than 3 inches from the bottom or side of the concrete when the foundation concrete is poured.

A loop at the approximate center of this grounding electrode shall be brought out at the top of the foundation and a #4/0 copper ground conductor shall connect the ground electrode to the main ground electrode bus in the equipment room. The conductor shall be connected to the ground electrode by exothermic welding.

3.4 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

C. Perform ground resistance testing in accordance with IEEE 142.

D. Perform leakage current tests in accordance with NFPA 99.

E. Perform continuity testing in accordance with IEEE 142.

F. When improper grounding is found on receptacles, check receptacles in entire project and correct.

G. Perform retest.

END OF SECTION 26 05 27

SECTION 26 05 30 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Conduit supports.
2. Formed steel channel.
3. Spring steel clips.
4. Sleeves.
5. Mechanical sleeve seals.
6. Firestopping relating to electrical work.
7. Firestopping accessories.
8. Equipment bases and supports.

1.2 REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

B. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

D. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

A. Firestopping Materials: Achieve fire ratings for adjacent construction, but not less than 1 hour fire rating.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to applicable code FM, UL, and WH for fire resistance ratings and surface burning characteristics.

B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

A. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

B. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

C. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

D. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.

E. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.7 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire F-Ratings and temperature T¬Ratings, but not less than 1-hour.

1. Wall Penetrations: Fire F-Ratings, but not less than 1-hour.
2. Floor and roof penetrations: Fire F-Ratings and temperature T-Ratings , but not less than 1-hour.

a. Floor Penetrations Within Wall Cavities: T-Rating is not required.

B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.

1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating for assembly in which joint is installed.

D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire resistant rating for floor assembly.

E. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

F. Maintain one copy of each document on site.

G. Comply with CBC Seismic and Gravity Design Criteria.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum 5years documented experience and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical

damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).

B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

A. Manufacturers:

1. **Allied Tube & Conduit Corp.**
2. **Powerstrut.**
3. **Unistrut.**

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.

F. Cable Ties: High strength nylon temperature rated to 185 degrees F (85 degrees C). Self locking.

2.2 FORMED STEEL CHANNEL

A. Manufacturers:

1. **Allied Tube & Conduit Corp.**
2. **Unistrut Corp.**
3. **Powerstrut.**

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

A. Furnish materials in accordance with standards.

B. Sleeves for conduits through Non-fire Rated Floors: 18 gage (1.2 mm) thick galvanized steel.

C. Sleeves for conduits through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18gage thick galvanized steel.

D. Sleeves for conduits through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing:

1. Prefabricated fire rated sleeves including seals, UL listed.

E. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 MECHANICAL SLEEVE SEALS

A. Manufacturers:

1. Thunderline Link-Seal, Inc.
2. NMP Corporation.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.5 FIRESTOPPING

A. Manufacturers:

1. Dow Corning Corp.
2. Hilti Corp.
3. 3M fire Protection Products

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.

5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: Dark gray

2.6 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:

1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL listed products or products tested by independent testing laboratory.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing materials to arrest liquid material leakage.

D. Obtain permission from Designer before using powder-actuated anchors.

E. Do not drill or cut structural members.

F. Obtain permission from Designer before drilling or cutting structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:

1. Concrete Structural Elements: Provide precast inserts systems, expansion anchors, powder actuated anchors and preset inserts.
2. Steel Structural Elements: Provide beam clamps with spring steel clips, steel ramset fasteners, and welded fasteners.
3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
6. Sheet Metal: Provide sheet metal screws.
7. Wood Elements: Provide wood screws.

B. Inserts:

1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:

1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install

spring lock washers under nuts.
2. Install surface mounted cabinets and panelboards with minimum of four anchors.
3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
4. Support vertical conduit at every floor.

3.4 INSTALLATION – FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

F. Place intumescent coating in sufficient coats to achieve rating required.

G. Remove dam material after firestopping material has cured. Dam material to remain.

H. Fire Rated Surface:

1. Seal opening at floor, wall, partition, ceiling, and roof as follows:

    a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
    b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
    c. Pack void with backing material.
    d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

2. Where cable tray and conduits penetrate fire rated surface, install firestopping product in accordance with manufacturer's instructions.

    a. Non-Rated Surfaces:

3. Seal opening through non-fire rated wall, floor, ceiling, and roof opening as follows:

    a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
    b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve

and building element.

c. Install type of firestopping material recommended by manufacturer.

4. Install escutcheons floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
5. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 12 inches beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with adjustable interlocking rubber links.

B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

C. Set sleeves in position in forms. Provide reinforcing around sleeves.

D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

E. Extend sleeves through floors 1inch above finished floor level. Caulk sleeves.

F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

G. Install stainless steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 26 05 30

SECTION 26 05 33-RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
4. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
5. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

A. Raceway and boxes at locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

B. Underground More than 5 feet outside Foundation Wall: Provide concrete encased PVC Schedule 40 conduit. Provide cast metal boxes or nonmetallic pullboxes.

> **NOTE:** All permanent underground conduits shall be concrete encased.

C. Underground Within 5 feet from Foundation Wall: Provide rigid steel conduit, plastic coated conduit or thickwall nonmetallic conduit. Provide cast metal or nonmetallic boxes.

D. In or Under Slab on Grade: Provide rigid steel conduit, plastic coated conduit or thickwall nonmetallic conduit. Provide cast or nonmetallic metal boxes.

E. Outdoor Locations, Above Grade: Provide rigid galvanized steel conduit. Electrical metallic tubing may be used in areas 10’ above finished grade. Provide cast metal or nonmetallic outlet, pull, and junction boxes.

NOTE: For conduit at all tug drives, provide rigid galvanized steel with galvanized supports. EMT conduit is **not** allowed at tug drives.

F. In Slab Above Grade: Provide rigid steel conduit, electrical metallic tubing and thickwall nonmetallic conduit. Provide cast sheet metal nonmetallic boxes.

G. Wet and Damp Locations: Provide rigid galvanized steel conduit. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.

H. Exposed Dry Locations: Provide rigid galvanized steel conduit. Electrical metallic tubing may be used 10' above finished grade. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

I. Concealed Dry Locations: Provide electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

NOTE: EMT conduit is restricted to interior use only. PVC conduit is restricted to underground use and shall be concrete encased.

1.4 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 3/4 inch unless otherwise specified.

1.5 SUBMITTALS

A. Product Data - Submit for the following:

1. Flexible metal conduit.
2. Liquidtight flexible metal conduit.
3. Nonmetallic conduit.
4. Raceway fittings.
5. Conduit bodies.
6. Surface raceway.
7. Wireway.
8. Pull and junction boxes.

B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

A. Manufacturers:

1. **Allied Tube & Conduit Corp.**
2. **Wheatland Tube.**
3. **Thomas & Betts.**

B. Rigid Steel Conduit: ANSI C80.1.

C. Intermediate Metal Conduit (IMC): Rigid steel.

D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 PVC COATED METAL CONDUIT

A. Manufacturers:

1. **Ocal-Blue.**
2. **Permacote.**
3. **Plastibond.**

B. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick.

C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.3 FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. **AFC Cable.**
2. **Allied Tube & Conduit.**
3. **Thomas & Betts.**

B. Product Description: Interlocked steel construction.

C. Fittings: NEMA FB 1.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. **AFC Cable.**

2. **Allied Tube & Conduit.**
3. **Thomas & Betts.**

B. Product Description: Interlocked steel construction with PVC jacket.

C. Fittings: NEMA FB 1.

2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

1. **Allied Tube Corp.**
2. **Wheatland Tube.**
3. **Thomas & Betts**.

B. Product Description: ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression type.

2.6 NONMETALLIC CONDUIT

A. Manufacturers:

1. **PW Eagle.**
2. **Carlon Electrical Products.**
3. **Raco.**

B. Product Description: NEMA TC 2; Schedule 40 or 80 PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.7 SURFACE METAL RACEWAY

A. Manufacturers:

1. **Walker Systems Inc.**
2. **The Wiremold Co.**

B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.

C. Finish: Gray or Buff enamel. Stainless steel.

D. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories; match finish on raceway.

2.8 WIREWAY

A. Manufacturers:

1. **Hubbell.**
2. **Walker Systems Inc.**
3. **The Wiremold Co.**

B. Product Description: General purpose, Oiltight and dust-tight, Raintight type wireway.

C. Cover: Hinged or Screw cover.

D. Connector: Slip-in or Flanged.

E. Fittings: Lay-in type with removable top, bottom, and side; captive screws drip shield.

F. Finish: Rust inhibiting primer coating with gray enamel finish.

2.9 OUTLET BOXES

A. Manufacturers:

1. **Raco.**
2. **Appleton.**
3. **Steel City.**

B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
2. Concrete Ceiling Boxes: Concrete type.

C. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.

D. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.10 PULL AND JUNCTION BOXES

A. Manufacturers:

1. **Raco.**
2. **Appleton.**
3. **Steel City.**

B. Sheet Metal Boxes: NEMA OS 1, galvanized steel. NEMA 4 for exterior.

C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:

1. Material: Galvanized cast iron.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.

B. Remove concealed abandoned raceway to its source.

C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.

D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.

E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.

F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

A. Ground and bond raceway and boxes.

B. Fasten raceway and box supports to structure and finishes.

C. Identify raceway and boxes.

D. Arrange raceway and boxes to maintain headroom and present neat appearance.

NOTE: All conduit shall be concealed from public view unless approved by LAWA.

3.4 INSTALLATION - RACEWAY

A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

B. Arrange raceway supports to prevent misalignment during wiring installation.

C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

D. Group related raceway; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional raceways.

E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports

F. Do not attach raceway to ceiling support wires or other piping systems.

G. Construct wireway supports from steel channel.

H. Route exposed raceway parallel and perpendicular to walls.

> **NOTE:** Conduit routed at 45 degree angles is **not** allowed at any time.

I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.

J. Route conduit in and under slab from point-to-point.

K. Maintain clearance between raceway and piping for maintenance purposes.

L. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.

M. Cut conduit square using saw or pipe cutter; de-burr cut ends.

N. Bring conduit to shoulder of fittings; fasten securely.

O. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

P. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

Q. Install no more than equivalent of four 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than 2 inch size.

R. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

S. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.

T. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

U. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

V. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.

W. Close ends and unused openings in wireway.

NOTE: All conduit shall be routed above any mechanical ductwork **not** below.

3.5 INSTALLATION - BOXES

A. Install wall mounted boxes at elevations to accommodate mounting heights specified in section for outlet device.

B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.

C. Orient boxes to accommodate wiring devices oriented.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.

H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

I. Install stamped steel bridges to fasten flush mounting outlet box between studs.

J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

K. Install adjustable steel channel fasteners for hung ceiling outlet box.

L. Do not fasten boxes to ceiling support wires or other piping systems.

M. Support boxes independently of conduit.

N. Install gang box where more than one device is mounted together. Do not use sectional box.

O. Install gang box with plaster ring for single device outlets.

3.6 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation.

C. Locate outlet boxes within 6’ of luminaires.

D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused openings in boxes.

3.8 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

NOTE: Refer to Identification for Electrical Systems for information pertaining to conduit labeling.

END OF SECTION 26 05 33

SECTION 26 05 34-FLOOR BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes floor boxes; floor box service fittings; and access floor boxes.

> **NOTE:** Verify the existing floor assembly construction and its ability to accommodate any additional floor penetrations without compromising structural integrity and any required fire rating.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

1.3 SUBMITTALS

A. Product Data: Submit catalog data for floor boxes service fittings.

B. Samples: Submit two of each service fitting illustrating size, material, configuration, and finish.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of each floor box and poke-through fitting.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 – PRODUCTS

> **NOTE:** Pedestal type and poke thru type boxes are **not** allowed without written LAWA approval.

2.1 FLOOR BOXES

A. Manufacturers:

1. **Wiremold Co.**
2. **Walker, Inc.**
3. **Hubbell.**

B. Floor Boxes: NEMA OS 1.

C. Adjustability: Fully adjustable or semi-adjustable.

D. Material: Cast metal or Formed steel.

2.2 FLUSH-COVER-TYPE COMBINATION FITTING

A. Manufacturers:

1. **Walker, Inc.**
2. **Wiremold Co.**

B. Material: Brass or Aluminum.

> **NOTE:** The specified material for the floor box cover shall be aesthetically compatible with the adjacent floor finish and be approved by LAWA.

2.3 FLUSH-COVER-SERVICE FITTING ACCESSORIES

A. Protective Ring: Brass or Aluminum finish.

B. Split Nozzle: Brass or Aluminum finish.

C. Carpet Ring: Brass or Aluminum finish.

2.4 ACCESS FLOOR BOX

A. Manufacturers:

1. **Wiremold, Inc.**
2. **Tate.**
3. **Thomas & Betts Steel City.**

B. Product Description: Sheet metal box suitable for mounting in access floor system.

PART 3 – EXECUTION

> **NOTE:** In order to avoid severing any existing structural reinforcement, use ground penetrating radar to survey the existing concrete slab before cutting or drilling any new floor penetrations.

3.1 EXAMINATION

A. Verify locations of floor boxes and outlets in offices, and work areas prior to rough-in.

B. Verify openings in access floor are in proper locations.

3.2 EXISTING WORK

A. Disconnect abandoned service fitting devices and remove service fittings. Fill in hole for abandoned floor boxes. Remove abandoned boxes, fill in hole and restore to adjacent finished area.

B. Maintain access to existing floor boxes remaining active and requiring access. Modify installation or provide access panel.

C. Extend existing service fitting installations using materials and methods compatible with existing electrical installations, or as specified.

D. Clean and repair existing service fittings to remain or to be reinstalled.

3.3 INSTALLATION

A. Floor Box Requirements: Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

B. Set floor boxes aligned with adjacent floor finish.

> **NOTE:** When aligning floor boxes note that most of the existing floor within the terminals are not level. Align all new floor boxes totally flush with the adjacent floor finish on all sides.

C. Install boxes and fittings to preserve fire resistance rating of slabs and other elements, using materials and methods.

3.4 ADJUSTING

A. Adjust floor box flush with finish flooring material.

3.5 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

END OF SECTION 26 05 34

SECTION 26 05 44 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Ducts in concrete-encased duct banks.
2. Handholds and hand hole accessories.
3. Manholes and manhole accessories.

1.2 REFERENCES

A. ANSI C2

B. NFPA 70

C. City of Los Angeles Electrical Code (LAEC)

D. ASTM 478

E. UL 651

F. NEMA TC-2, TC-3

G. ASTM 615

H. ASTM C990

I. AASHTO HS20

1.3 SUBMITTALS

A. Product Data: For the following:

1. Manhole and hand hole hardware.
2. Conduit and ducts, including elbows, bell ends, bends, fittings, and solvent cement.
3. Duct-bank materials, including spacers and miscellaneous components.
4. Warning tape. Detectable type.

B. Shop Drawings: Show fabrication and installation details for underground ducts and utility structures and include the following:

1. For manholes:

    a. Duct sizes and locations of duct entries.
    b. Reinforcement details.
    c. Manholes cover design and engraving.
    d. Step details.
    e. Grounding details.
    f. Dimensioned locations of cable rack inserts, pulling-in irons, and sumps.

2. For precast manholes and hand holes, Shop Drawings shall be signed and sealed by a qualified Professional Engineer, and shall show the following:

    a. Construction of individual segments.
    b. Joint details.
    c. Design calculations.

C. Coordination Detailing Activity Drawings: Show duct profiles and coordination with other utilities and underground structures. Include plans and sections drawn to scale, and show all bends and location of expansion fittings.

D. Product Certificates: For concrete and steel used in underground precast manholes, according to ASTM C 858.

E. Product Test Reports: Indicate compliance of manholes with ASTM C 857 and ASTM C 858, based on factory inspection.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the LAWA's Representative, and marked for intended use.

B. Comply with ANSI C2.

C. Comply with California Electric Code (NFPA 70) and City of Los Angeles Electrical Code (LAEC).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete units at Project site as recommended by manufacturer to prevent physical damage.

C. Arrange so identification markings are visible.

D. Lift and support precast concrete units only at designated lifting or supporting points.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving occupied facilities unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.

1. Comply with LAWA power shut-down procedures.
2. Do not proceed with utility interruptions without LAWA's Representative written permission.

1.7 COORDINATION

A. Coordinate layout and installation of ducts, manholes, and handholes with final arrangement of other utilities and site grading, as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes and handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure duct runs drain to manholes and handholes, and as approved by the LAWA Representative.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Underground Precast Concrete Utility Structures:

   a. Jensen Precast.
   b. Utility Vault Co.
   c. Brooks

2. Frames and Covers:

   a. Alhambra Foundry

b. Campbell Foundry Co.
c. East Jordan Iron Works, Inc.

3. Nonmetallic Ducts and Accessories:

a. Carlon Electrical Products.
b. Cantex, Inc.
c. Certainteed Corp.; Pipe & Plastics Group.

2.2 DUCTS

A. Rigid Nonmetallic Conduit: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.3 HAND HOLES

A. Cast-Metal Boxes: Cast aluminum, with outside flanges and recessed, gasketed cover for flush mounting and with nonskid finish and legend on cover. Unit, when buried, shall be designed to support AASHTO H10 loading for sidewalk and landscaped areas and HS20 for roadways, parking lots and loading docks.

B. Precast Handholes: Reinforced concrete, monolithically poured walls and bottom, with steel frame and access door assembly as the top of hand hole. Duct entrances and windows shall be located near corners to facilitate racking. Pulling-in irons and other built-in items shall be installed before pouring concrete. Cover shall have nonskid finish and legend. Unit, when buried, shall be designed to support AASHTO H10 loading for sidewalk and landscaped areas and HS20 for roadways, parking lots and loading docks. Cover Legend: All underground pullbox covers shall have the following cast-in or bead welded and galvanized identification label permanently affixed to the exterior:

1. "ELEC-LV" for electrical power circuits 600 volts or less.
2. "ELEC-HV" for electrical power circuits over circuits over 600 volts.
3. "COMM" for communications circuits. A custom 3-digit number shall be added to the cover.
4. Contact the LAWA Engineer for number assignment. The minimum letter height shall be one (1) inch.

2.4 PRECAST MANHOLES

A. Precast Units: Interlocking mating sections, complete with accessories, hardware, and features as indicated. Include concrete knockout panels for conduit entrance and sleeve for ground rod.

B. Entry way diameter: 36 inches minimum.

C. Design and fabricate structure according to ASTM C 858.

D. Structural Design Loading: ASTM C 857, Class A-16 (AASHTO HS20).

E. Base section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.

F. Riser Sections: 4-inch minimum thickness, and lengths to provide required depth.

G. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings. Custom configuration for eccentric manhole locations to align with corridors.

H. Steps: ASTM A 615, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 36 inches. Adjust to custom manhole locations.

I. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.

J. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

K. Protective Coating: Plant-applied, coal-tar, epoxy-polyamide paint 15-mil minimum thickness applied to exterior and interior surfaces.

L. Source Quality Control: Inspect structures according to ASTM C 1037.

M. Provide custom top section for offset manhole location for alignment with corridor for below building installation.

N. Access Ladder: Provide permanent metal access ladder.

2.5 ACCESSORIES

A. Duct Spacers: Rigid PVC interlocking spacers, selected to provide minimum duct spacings and cover depths indicated while supporting ducts during concreting and backfilling; produced by the same manufacturer as the ducts.

B. Manhole Frames and Covers: Comply with AASHTO loading specified for manhole; Ferrous frame 36 inch clear ID by 6 inch minimum riser with 4-inch-minimum width flange and 38 -inch-diameter cover.

1. All manhole and underground pullbox covers shall have the following cast-in or bead welded and galvanized identification label permanently affixed to the exterior:

a. "ELEC-LV" for electrical power circuits 600 volts or less.
b. "ELEC-HV" for electrical power circuits over circuits over 600 volts.
c. "COMM" for communications circuits.
d. A custom 3-digit number shall be added to the cover. Contact the LAWA Engineer for number assignment. The minimum letter height shall be one (1) inch.

2. Cast iron with cast-in legend as indicated above subsection 1. Milled cover-to-frame bearing surfaces.
3. Manhole Frames and Covers: ASTM A 48; Class 30B gray iron, 36-inch size, machine-finished with flat bearing surfaces.
4. All square or rectangular covers rated for aircraft traffic up to 200,000lbs shall have torsion spring assist assembly, stainless steel for 75% assist of lift effort.

C. Sump Frame and Grate: ASTM A 48, Class 30B gray cast iron.

D. Pulling Eyes in Walls: Eyebolt with reinforcing-bar fastening insert 2-inch- diameter eye and 1-by-4¬inch bolt.

1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.

E. Pulling and Lifting Irons in Floor: 7/8-inch- diameter, hot-dip-galvanized, bent steel rod; stress relieved after forming; and fastened to reinforced rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

F. Bolting Inserts for Cable Stanchions: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

G. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

H. Cable Stanchions: Hot-rolled, hot-dip-galvanized, T-section steel; 2-1/4-inch size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.

I. Cable Arms: 3/16-inch- thick, hot-rolled, hot-dip-galvanized, steel sheet pressed to channel shape; 12 inches wide by 14 inches long and arranged for secure mounting in horizontal position at any location on cable stanchions.

J. Cable-Support Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

K. Duct-Sealing Compound: Non-hardening, safe for contact with human skin, not

deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and of adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

L. Warning Tape: Provide underground-line warning tape specified under section "Identification for Electrical Systems."

2.6 CONSTRUCTION MATERIALS

A. Seal manhole section joints with sealing compound recommended by the manhole manufacturer.

B. Damp proofing: Comply with "Bituminous Damp proofing."

C. Mortar: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.

D. Brick for Manhole Chimney: Sewer and manhole brick, ASTM C 32, Grade MS.

E. Concrete: Use 3000-psi- minimum, 28-day compressive strength and 1-inch maximum aggregate size.

F. Provide red dye added to concrete during batching.

PART 3 - EXECUTION

3.1 APPLICATION

A. Underground Ducts for Electrical Cables Higher than 600 V: Type EPC-40-PVC, concrete-encased duct bank.

B. Manholes: Underground precast concrete utility structures.

C. Manholes: Cast-in-place concrete.

3.2 EARTHWORK

A. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Soil compaction at all locations shall be as specified by civil and structural specifications.

B. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

C. Restore disturbed pavement.

3.3 CONDUIT AND DUCT INSTALLATION

A. Exercise care in excavating, trenching, and working near existing utilities. Locate any existing buried utilities before excavating.

B. Duct bank trench shall be shored, framed and braced for installing ducts. Frames, forms, and braces shall be either wood or steel. Variations in outside dimensions of the installed duct bank shall not exceed 2 inches on the vertical or the horizontal from the design. Remove forms and bracing after 24 hours and before backfilling.

C. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions. Duct banks shall be laid to a minimum grade slope of 4 inches per 100 feet. This slope may be from one manhole to the next or both ways from a high point between manholes, depending upon the contour of the finished grade.

D. Duct banks shall be installed so that the top of the concrete encasement shall be no less than 36 inches below grade or pavement for primary power. As a general rule, depths shall be a minimum of three feet, but not more than six feet.

E. Curves and Bends: Use manufactured 48 inches minimum elbows for stub-ups at equipment, and enclosures, and at building entrances. Use manufactured long sweep bends with a minimum radius of 4 feet minimum, both horizontally and vertically, at other locations. Manufactured long radius bends may be used in runs of 100 feet or less on approval from the LAWA's representative. Vertical feeder sweep into buildings shall be coated steel. Multiple conduit sweeps shall be concentric and maintain spacing throughout. Medium-voltage conduit sweeps shall be 12' minimum radius sweeps.

F. Use solvent-cement joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

G. Duct Entrances to Manholes and Handholes: Space end bells approximately 10 inches o.c. for 5-inch ducts and vary proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances. Where connection to bulkhead of duct bank is made to vaults or existing duct banks, the concrete encasement shall be doweled with on No. 4 reinforcement rod 36 inches long per conduit to the existing encasement.

H. Building Entrances: Make a transition from underground duct to rigid steel conduit 5 feet outside the building wall. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below:

1. Concrete-Encased Ducts: Install reinforcement in duct banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building wall. Expand duct bank at building entry to provide 6" spacing between sealing system sleeves. Coordinate sleeve placement

with structural reinforcement bar placement.

2. Provide methane penetration EYS sealing fitting at each conduit penetration into building – both vertical and horizontal. Arrange so that sealant parts remain accessible.
3. Waterproofed Wall and Floor Penetrations: Install a watertight entrance-sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight. Seals shall be Link Seal Assembly with precast 'CS" model – non-metallic sleeve by Link Seal or equal.

NOTE: All permanent underground ducts are to be concrete encased as described herein.

I. Concrete-Encased, Nonmetallic Ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator Installation: Space separators 6'-0" O.C. to prevent sagging and deforming of ducts and secure separators to earth and to ducts to prevent floating during concreting. Stagger spacers approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Duct joints in concrete may be placed side by side horizontally, but shall be staggered at least 6 inches vertically. Joints shall be made in accordance with manufacturer's recommendations for the particular type of duct and coupling selected. In the absence of specific recommendations, plastic duct connections shall be made by brushing a plastic solvent cement on the inside of a plastic coupling fitting and on the outside of duct's ends. The duct and fitting shall then be slipped together with a quick one-quarter turn to set the joint.
3. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application. Pour each run of envelope between manholes or other terminations in one continuous operation. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope. At connection to manholes, dowel concrete encasement with on No. 4 reinforcing bar 36 inches long per duct.
4. Reinforcement: Reinforce duct banks where they cross disturbed earth and where indicated.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Clearances between Ducts: 3 inches between ducts and exterior

envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.

7. Depth: Install top of duct bank at least 24 inches below finished grade in no traffic areas and at least 30 inches below finished grade in vehicular traffic areas, unless otherwise indicated.

NOTE: Direct-Buried Ducts are for temporary construction only as determined by LAWA.

J. Direct-Buried Ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator Installation: Space separators not more than 4 feet center-to-center along entire length of duct bank including top pipes.
2. Install expansion fittings as required.
3. Trench Bottom: Continuous, firm, and uniform support for duct bank. Prepare trench bottoms for pipes less than 6 inches in nominal diameter.
4. Backfill: Install backfill. After installing first tier of ducts, backfill and compact. Repeat backfilling after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, complete backfilling normally. Do not place backfill for a period of at least 24 hours after pouring of concrete.
5. Minimum Clearances between Ducts: 3 inches between ducts for like services and 6 inches between power and signal ducts.
6. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.

K. Warning Tape: Bury metal backed warning tape approximately 12 inches above all concrete-encased duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank.

L. Stub-ups: Use rigid steel conduit for stub-ups to equipment. For equipment mounted on outdoor concrete bases, extend steel conduit a minimum of 5 feet from edge of base. Install insulated grounding bushings on terminations. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete. Galvanized steel conduits installed below grade shall be painted with two coats of Koppers Bitumastic paint before installing in ground.

M. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

N. Pulling Cord: Install 100-lbf- test nylon cord in all ducts, including spares. Identify opposite terminal points of duct.

3.4 MANHOLE AND HANDHOLE INSTALLATION

A. Elevation: Install manholes with rooftop at least 15 inches below finished grade. Install handholes with depth as required. Cast hand hole cover frame directly into roof of hand hole and set roof surface 1 inch above grade. Place and align precast manholes to provide horizontal tolerance of 2 inches in any direction and vertical alignment with not greater than 1/8 inch maximum tolerance for 6 foot of depth. Completed manhole shall be rigid, true to dimensions and alignment, and shall be watertight.

B. Drainage: Install drains in bottom of units where indicated. Coordinate with drainage provisions indicated. Sumps shall be knocked out at time of installation.

C. Access: Install cast-iron frame and cover.

1. Install precast collars and rings to support frame and cover and to connect cover with roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.
2. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1 inch above finished grade.

D. Waterproofing: Apply waterproofing to exterior surfaces of units after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole and hand hole chimneys after brick mortar has cured at least three days. Seal manhole section joints with sealing compound recommended by the manhole manufacturer. Penetration into manholes and/or boxes shall be sealed. Provide conduit duct plugs for unused terminator openings of spare conduits in manhole. Do not water seal top removable cover until cable pulling has been completed.

E. Damp proofing: Apply damp proofing to exterior surfaces of units after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, damp proof joints and connections and touch up abrasions and scars. Damp proof exterior of manhole and hand hole chimneys after brick mortar has cured at least three days.

F. Interior walls and ceiling shall be primed and painted with two coats flat white paint.

G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

H. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

I. Grounding: Install ground rod through floor in each structure with top protruding 6 inches above floor.

1. Seal floor opening against water penetration with waterproof nonshrink grout. Ground exposed metal components and hardware with bare-copper ground

conductors. Train conductors neatly around corners. Use cable clamps secured with expansion anchors to attach ground conductors.

J. Precast Concrete Manhole Installation: comply with ASTM C 891.

1. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
2. Unless otherwise indicated, support units on a 12" level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth. Provide a minimum 6-inch level base of ¾ inch crushed rock under manhole to ensure uniform distribution of soil pressure on floor.
3. Manholes below building floor shall have all earth work compacted to match compaction required by structural specifications.

3.5 FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

B. Grounding: Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance .

C. Duct Integrity: Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of the duct. If obstructions are indicated, remove obstructions and retest.

D. Correct installations if possible and retest to demonstrate compliance. Remove and replace defective products and retest.

3.6 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

C. After the duct line has been completed, a brush with stiff bristles shall be pulled through each duct to make certain that no particles of earth, sand or gravel have been left in the line. (Mandrels not less than 12 inches long, having a diameter approximately 1/4 inch less than inside diameter of the duct, shall be pulled through each duct). Leave a 3/8"-inch minimum polypropylene pull rope in each duct for future use.

END OF SECTION 26 05 44

SECTION 26 05 49 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes seismic restraints and other earthquake-damage-reduction measures for electrical components. It complements optional seismic construction requirements in the various electrical component Sections.

1.2 REFERENCES

A. ASTM A325, A570, A36, A576

B. CBC

C. IC80

D. MSS SP-69

1.3 DEFINITIONS

A. CBC: California Building Code. (sections 1704 through 1708), IBC: International Building Code.

B. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.

C. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independent of other mobile structural elements during an earthquake.

1.4 SUBMITTALS

A. Product Data: Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic restraint component used.

1. Anchor Bolts and Studs: Tabulate types and sizes, complete with report numbers and rated strength in tension and shear as evaluated by ICBO Evaluation Service.

B. Shop Drawings: Provide for anchorage and bracing not defined by details and charts. Indicate materials, and show designs and calculations signed and sealed by a professional Engineer.

1. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
2. Details: Detail fabrication and arrangement. Detail attachment of restraints to both structural and restrained items. Show attachment locations, methods, and spacing, identifying components and listing their strengths. Indicate direction and value of forces transmitted to the structure during seismic events.
3. Preapproval and Evaluation Documentation: By ICBO Evaluation Service, or an agency approved by LAWA's Representative, showing maximum ratings of restraints and the basis for approval (tests or calculations).

C. Coordination Drawings: Plans and sections drawn to scale and coordinating seismic bracing for electrical components with other systems and equipment, including other seismic restraints, in the vicinity.

D. Product Certificates: Signed by manufacturers of seismic restraints certifying that products furnished comply with requirements.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

F. Material Test Reports: From a qualified testing agency indicating and interpreting test results of seismic control devices for compliance with requirements indicated.

1.5 QUALITY ASSURANCE

A. Comply with seismic restraint requirements in California Building Code/Code of Regulations, unless requirements in this Section are more stringent.

B. Professional Engineer Qualifications: A professional Engineer who is legally qualified to practice in California and who is experienced in providing seismic engineering services, including the design of seismic restraints.

C. Testing Agency Qualifications: An independent testing agency, acceptable to LAWA with minimum of 5 years experience.

1.6 PROJECT CONDITIONS

A. Project Seismic Zone and Zone Factor as Defined in CBC: Zone 4, Zone Factor 0.40.

B. Occupancy Category as Defined in CBC: I=1.5 critical occupancy.

1.7 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structural system and Architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.

B. Coordinate concrete bases with building structural system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Caldyn
2. Powerstrut.
3. Unistrut Corporation.

2.2 MATERIALS

A. Use the following materials for restraints:

1. Indoor Dry Locations: Steel, zinc plated.
2. Outdoors and Damp Locations: Galvanized steel.
3. Corrosive Locations: Stainless steel.

2.3 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to LAWA's Representative.

1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.

C. Concrete Inserts: Steel-channel type.

D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

E. Welding Lugs: Comply with MSS SP-69, Type 57.

F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.4 SEISMIC BRACING COMPONENTS

A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch-thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.

1. Materials for Channel: ASTM A 570, GR 33.
2. Materials for Fittings and Accessories: ASTM A 575, ASTM A 576, or ASTM A 36.
3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.

B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.

C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.

1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
2. Wire Rope Cable: Comply with ASTM 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.

D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install seismic restraints according to applicable codes and regulations and as approved by the LAWA's Representative, unless more stringent requirements are indicated.

3.2 STRUCTURAL ATTACHMENTS

A. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses in accordance with the structural Engineer of record approval.

B. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.

C. Attachments to Existing Concrete: Use expansion anchors.

D. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.

E. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.

F. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.

G. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

3.3 ELECTRICAL EQUIPMENT ANCHORAGE

A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.

B. Anchor panel boards, motor-control centers, motor controls, switchboards, switchgear, transformers, unit substations, fused power-circuit devices, transfer switches, busways, battery racks, static uninterruptible power units, power conditioners, capacitor units, communication system components, and electronic signal processing, control, and distribution units as follows:

1. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
2. Concrete Bases for Floor-Mounted Equipment: Use female expansion anchors and install studs and nuts after equipment is positioned.
3. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.
4. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
5. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

3.4 SEISMIC BRACING INSTALLATION

A. Install bracing according to spacing and strengths indicated by approved analysis.

B. Expansion and Contraction: Install to allow for thermal movement of braced components.

C. Cable Braces: Install with maximum cable slack recommended by manufacturer.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Make flexible connections in raceways, cables, wire ways, cable trays, and busways where they cross expansion and seismic control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform the following field quality-control testing:

B. Testing: Test pull-out resistance of seismic anchorage devices.

1. Provide necessary test equipment required for reliable testing.
2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to LAWA's Representative.
3. Schedule test with the LAWA Representative before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
4. Obtain Structural Engineer's approval before transmitting test loads to the structure. Provide temporary load-spreading members.
5. Test at least four of each type and size of installed anchors and fasteners selected by LAWA's Representative.
6. Test to 90 percent of rated proof load of device.
7. If a device fails the test, modify all installations of same type and retest until satisfactory results are achieved.
8. Record test results.

END OF SECTION 26 05 49

SECTION 26 05 54 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Labels.
3. Wire markers.
4. Conduit markers.
5. Stencils.
6. Underground Warning Tape.
7. Lockout Devices.

1.2 SUBMITTALS

A. Product Data:

1. Submit manufacturer’s catalog literature for each product required.
2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

B. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept identification products on site in original containers. Inspect for damage.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 - PRODUCTS

2.1 NAMEPLATES ON EQUIPMENT

A. All new distribution switchboards and panels shall have Engraved Plastic Nameplates and Signs:

1. Engraving stock, melamine plastic laminate, minimum 1116 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 Inch (3.2 mm) thick for larger sizes. Engraved legend with white letters on black face for normal power, white letters on red face for emergency power.

    a. Punched or drilled for mechanical fasteners.
    b. Text is at ½ -inch (13 mm) high lettering.

B. With the following Information for each panel:

1. PANEL Name (Including voltage, phase, and wire)
2. LAWA or CONCESSIONS or AIRLINE
3. FED FROM (Source Panel Name)

C. Nameplates shall be secured to equipment front using stainless steel screws or rivets.

D. Nameplates shall adequately describe the function of the particular equipment involved. Inscription and size of letters shall be as shown and shop drawing submitted for approval. Nameplates for panelboards and switchboards shall include the panel designation, voltage, phase and wire. For example, "PANEL A. 120/208V, 3PH, 4W". In addition, provide phenolic label in panel to describe where the panel is fed from. For example, "FED FROM MS". The name of the machine on the nameplates for a particular machine shall be the same as the one used on all motor starters, disconnect and push button station nameplates for that machine.

E. The following Items shall be equipped with nameplates: All motors, motor starters, motor-control centers. Push button stations, control panels, switches, disconnect switches, transformers, panelboards, circuit breakers (i.e. all 2 pole, 3 pole C.B.'s). contractors or relays in separate enclosures, power receptacles where the nominal

voltage between any pair of contacts is greater than 150V, wall switches controlling outlets that are not located within sight of the controlling switch, high voltage boxes and cabinets, large electrical systems Junction and pull boxes (larger than 4 11/16"), terminal cabinets, terminal boards, and equipment racks. Nameplates shall also describe the associated panel and circuit number (if applicable).

F. Stamped metal master nameplates shall be installed by the manufacturer on each distribution section, switchboard section, panelboard, and motor control center indicating the ampere rating, short-circuit rating, manufacturer's name. Paper stickers are not acceptable. For example:

ABE Switchboard Co.

Ampere Rating 15000A

Short Circuit bracing; 100KA

Date: 01/01/2001

G. Arc Flash Nameplates with PPE category information.

2.2 PERMANENT MARKINGS

A. All conduits, busways, cable trays and pullboxes shall be identified with permanent stenciled black letters and numbers which indicate the source panel (feeder supply source), circuit numbers and designated panel or load. For example,"PA-1, 3, 5 TO MG." For conduits, the letter height shall be one-third (1/3) the conduit size with ¼ inch minimum height. For pullboxes and busways, the letter height shall be ½ inch minimum height and not larger than ¾ inch in height.

B. The identifications for conduits, busways and cable trays shall be placed at every 50 feet intervals and within 10 feet of wall and floor penetrations, pullboxes, panels, distribution boards, switchboards and electrical equipment.

C. Spare conduits, pullboxes, busways, and abandoned raceways (that are to remain) shall be identified as described above (A,B).

D. The permanent marking identifications on the raceways and pullboxes shall be visible after the installations are made.

2.3 LABELS

A. Labels: Embossed adhesive tape, with 3/16 inch black letters on white background for normal power; white letters on red background for emergency power.

2.4 WIRE MARKERS

A. Description: Cloth tape, split sleeve, or tubing type wire markers.

B. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number.
2. Control Circuits: Control wire number.

2.5 CONDUIT AND RACEWAY MARKERS

A. Description: Permanent, detectable, red colored, continuous printed, polyethylene tape with suitable warning legend describing burial electrical lines. Taps shall be minimum 6 inches wide by 4 mils thick.

B. Color:

1. (Normal Power) : Black lettering on white background;
2. (Emergency Power): White lettering on red background.

C. Legend:

1. Medium Voltage System: 5k, 15kV or 35kV as applicable.
2. 480 Volt System: 480 VOLTS.
3. 208 Volt System: 208 VOLTS.

2.6 UNDERGROUND WARNING TAPE

A. Description: 6 inch wide plastic tape, detectable type, colored yellow with suitable warning legend describing buried electrical lines.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:

1. Install nameplate parallel to equipment lines.
2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners.
3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners.
4. Secure nameplate to equipment front using screws, or rivets.
5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
6. Install nameplates for the following:

    a. Switchgear.
    b. Switchboards.
    c. Panelboards.
    d. Transformers.
    e. Disconnect Switches
    f. Motor Control Centers.
    g. Pushbutton Stations,
    h. Terminal Cabinets.
    i. Control Panels.
    j. Enclosed circuit breakers.
    k. Generators.
    l. Transfer Switches.
    m. Enclosed Controllers.
    n. Variable-Frequency Controllers.

7. Install nameplate to maintain NEMA rating of enclosure.

C. Label Installation:

1. Install label parallel to equipment lines.
2. Install label for identification of individual control device stations.
3. Install labels for permanent adhesion and seal with clear lacquer.
4. Wire Marker Installation:

    a. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
    b. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
    c. Install labels at data outlets identifying patch panel and port designation.

D. Underground Warning Tape Installation:

1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION 26 05 54

SECTION 26 05 73 – SHORT CIRCUIT AND OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes computer-based, fault current and overcurrent protective devices coordination including ground fault protection and arc fault hazard analysis studies to be performed by the contractor. Protective devices shall be set based on the result of the protective device coordination study. Arc fault hazard analysis warning nameplates shall be printed and affixed to the electrical system equipment after the final protective relay settings have been applied and confirmed operational. Settings and adjustments of the relays shall be performed by an independent qualified agency familiar with this work and the agency is to be retained by the contractor. The person performing this work shall have a minimum of five years experience.

> **NOTE:** This coordination study shall include the existing distribution equipment that feeds the new equipment and is in addition to the short circuit study performed by the Electrical Engineer of Record during the course of preparing his design.

B. Contractor shall retain a 3rd party independent consultant to perform the study indicated in this section.

C. It is the responsibility of the entity performing the Short Circuit and Coordination Study to collect all data to fully perform the study, including but not limited to engine generator data, motor data, circuit breakers, utility company short circuit, available new and existing device ratings, conductor data, transformer ratings, etc.

D. The study shall present an organized time-current analysis of each protective device in series from the individual device back to the source. The study shall reflect the operation of each device ratings, conductor data, transformer ratings, etc.

E. The short circuit portion of the study shall be submitted prior to or along with the switchgear submittal, and shall include all equipment which has an AIC rating. The short circuit study shall reflect that all equipment with an AIC rating is properly rated for its specific application. The submitted switchgear (including all equipment which has and AIC rating) shall reflect the findings of short circuit study (i.e, the AIC ratings of the equipment shall exceed the available short circuit current and any required derating factors at each point in the system). Series ratings are not acceptable.

1.2 REFERENCES

A. Institute of Electrical and Electronics Designers:

1. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).

B. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

1.3 DESIGN REQUIREMENTS

A. Complete Short Circuit and Protective Device Coordination Study to meet requirements of NFPA 70.

B. Report Preparation:

1. Prepare study prior to ordering distribution equipment to verify equipment ratings required.
2. Perform study with aid of computer software program.
3. Calculate short circuit interrupting and, when applicable, momentary duties for assumed 3-phase bolted fault short circuit current and phase to ground fault short circuit current at each of the following:

    a. Utility supply bus.
    b. Medium voltage air interrupter switchgear.
    c. Automatic transfer switch.
    d. Manual transfer switch.
    e. Engine generator.
    f. Medium voltage motor controllers.
    g. Low-voltage switchgear.
    h. Switchboards.
    i. Motor control centers.
    j. Distribution panelboards.
    k. Branch circuit panelboards.

4. Each other significant equipment location throughout system.

C. Report Contents (similar to SKM Power Tools):

1. Include the following:

    a. Calculation methods and assumptions.
    b. Base per unit value selected.
    c. One-line diagram, with short circuit values, arc flash values, feeder values and lengths.
    d. Source impedance data including power company system

available power and characteristics.

e. Typical calculations.

(1) Fault impedance.
(2) X to R ratios.
(3) Asymmetry factors.
(4) Motor fault contribution.
(5) Short circuit kVA.
(6) Symmetrical and asymmetrical phase-to-phase and phase-to-ground fault currents.
(7) Tabulations of calculation quantities and results.

f. One-line diagram revised by adding actual instantaneous short circuits available.

g. State conclusions and recommendations.

(1) Prepare time-current device coordination curves graphically indicating coordination proposed for system, centered on conventional, full-size, log-log forms.
(2) Prepare with each time-curve sheet complete title and one-line diagram with legend identifying specific portion of system covered by that particular curve sheet.
(3) Prepare detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
(4) Plot device characteristic curves at point reflecting maximum symmetrical fault current to which device is exposed. Include on curve sheets the following:

h. Power company relay characteristics.
i. Power company fuse characteristics.
j. Medium voltage equipment protective relay characteristics.
k. Medium voltage equipment protective fuse characteristics.
l. Low voltage equipment circuit breaker trip device characteristics.
m. Low voltage equipment fuse characteristics.
n. Cable damage point characteristics.
o. Pertinent transformer characteristics including:

(1) Transformer full load current.
(2) Transformer magnetizing inrush.
(3) ANSI transformer withstand parameters.
(4) Significant symmetrical fault current.

p. Pertinent motor characteristics.
q. Generator characteristics including:

(1) Phase and ground coordination of generator protective devices.
(2) Decrement curve and damage curve.
(3) Operating characteristic of protective devices.
(4) Actual impedance value.
(5) Time constants.
(6) Current boost data.
(7) Do not use typical values for generator.

r. Transfer switch characteristics.
s. Other system load protective device characteristics.

1.4 SUBMITTALS

A. Qualifications Data: Submit the following for review prior to starting study.

1. Submit qualifications and background of firm.
2. Submit qualifications of Professional Engineer performing study.

B. Software: Submit for review information on software proposed to be used in performing study.

C. Product Data: Submit the following:

1. Report: Summarize results of study in report format including the following:

a. Descriptions, purpose, basis, and scope of study.
b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
d. Fault current calculations including definition of terms and guide for interpretation of computer printout.

D. Submit copies of final report signed by Professional Engineer, and software live file for future use by LAWA. Make additions or changes required by review comments.

E. Short Circuit Study:

1. Systematically calculate the fault impedance to determine the available short circuit and ground fault currents at each bus. Incorporate the motor contribution in determining the momentary and interrupting ratings of the protective devices.
2. Entire system shall be modeled under both normal and emergency power. If any closed transition transfer switches are used, normal and

emergency power shall be combined.

3. The short circuit study shall incorporate the actual feeder types, sizes and lengths proposed to be used by the Professional Engineer.
4. The calculations may be prepared by means of a digital computer. All pertinent data and the rationale employed in developing the calculations shall be incorporated in the introductory remarks of the study.
5. Present the data determined by the short circuit study in a table format. Include the following:

    a. Device identification.
    b. Operating voltage.
    c. Protective device.
    d. Device rating.
    e. Calculated short circuit current, indicating worst-case fault current incorporating all system models as outlined above.

F. Coordination Curves:

1. Prepare the coordination curves to determine the required settings of protective devices to assure selective coordination. Graphically illustrate on log-log paper that adequate time separation exists (where possible) between series devices, including the utility company upstream device. Plot the specific time-current characteristics of each protective device in such a manner that all upstream devices will be clearly depicted on one sheet. Where a switchboard or panelboard has multiple devices of different sizes, it is not necessary to plot curves for each device when coordination for one device is demonstrated graphically and it is intuitively obvious that the other devices coordinate as well.
2. The following specific information shall also be shown on the coordination curves:

    a. Device identification.
    b. Voltage and current ratio for curves.
    c. 3-phase and 1-phase ANSI damage points for each transformer.
    d. No-damage, melting, and clearing curves for fuses.
    e. Cable damage curves.
    f. Transformer inrush points.
    g. Maximum short circuit cutoff point.
    h. Short-time withstand capability of main 480V circuit breakers.
    i. Coordination between the directional overcurrent relays and the main 480V breaker.

3. Develop a table to summarize the settings selected for the protective devices. Include in the table the following:

    a. Device identification.
    b. Relay CT ratios, tap, time dial, and instantaneous pickup.
    c. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.

d. Fuse rating and type.
e. Ground fault pickup and time delay.

1.5 QUALITY ASSURANCE

A. Maintain one copy of each document on site.

B. Use commercially available software, designed specifically for short circuit and protective device coordination studies with minimum of three years documented availability approved by LAWA.

C. Perform study in accordance with IEEE 242.

1.6 QUALIFICATIONS

A. Study Preparer: Company specializing in performing work of this section with minimum five years documented experience and having completed projects of similar size and complexity within the past three years.

B. Perform study under direct supervision of Professional Engineer experienced in design of this Work and licensed at in State of California with minimum of five years experience in power system analysis.

C. Demonstrate company performing study has capability and experience to provide assistance during system start up.

1.7 SEQUENCING

A. The short circuit portion of the study shall be submitted prior to or along with the switchgear submittal, and shall include all equipment which has an AIC rating. The short circuit study shall reflect that all equipment with an AIC rating is properly rated for its specific application. The submitted switchgear (including all equipment which has an AIC rating) shall reflect the findings of short circuit study (i.e., the AIC ratings of the equipment shall exceed the available short circuit current and any required derating factors at each point in the system.). No series rated devices will be allowed.

B. When formal completion of study will cause delay in equipment manufacturing, obtain approval from LAWA for preliminary submittal of study data sufficient in scope to ensure selection of device ratings and characteristics will be satisfactory.

1.8 SCHEDULING

A. Schedule work to expedite collection of data to ensure completion of study for

final approval of distribution equipment shop drawings prior to release of equipment for manufacturing.

1.9 COORDINATION

A. Coordinate work with local power company.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Provide assistance to electrical distribution system equipment manufacturer during start up of electrical system and equipment.

B. Select each primary protective device for delta-wye connected transformer so device's characteristic or operating band is within transformer characteristics, including point equal to 58 percent of ANSI withstand point to provide secondary line-to-ground fault protection.

C. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by 16 percent current margin to provide proper coordination and protection in event of secondary line-to-line faults.

D. Separate medium-voltage relay characteristic curves from curves for other devices by at least 0.4 second time margin.

E. Analyze the short circuit calculations, and highlight any equipment that is determined to be underrated as specified. Propose approaches to effectively protect the underrated equipment. Provide minor modifications to conform with the study (Examples of minor modifications are trip sizes within the same frame, the time curve characteristics of induction relays, CT ranges, etc.).

F. After developing the coordination curves, highlight areas lacking coordination. Present a technical valuation with a discussion of the logical compromises for best coordination.

3.2 ADJUSTING

A. Protective devices shall be set based on the results of the protective device coordination study.

B. Arc fault hazard analysis warning labels shall be printed and affixed to the electrical system equipment after the final protective relay settings have been applied and confirmed operational.

C. Settings and adjustments of the relays shall be performed by and independent qualified agency familiar with this work and the agency is to be retained by the contractor. The person performing this work shall have a minimum of five years experience.

D. Accomplish necessary field settings, adjustments, and minor modifications to conform with the study without cost to LAWA.

END OF SECTION 26 05 73

SECTION 26 09 13 – WEB-BASED POWER MONITORING COMMUNICATIONS SYSTEM

PART 1 - GENERAL

NOTE: For compatibility purposes, throughout LAX, all new web based power monitoring systems shall match the installation at Bradley West.

1.1 SUMMARY

A. This section describes the metering, communications, and visualization requirements for a modular, scalable Web-based Power Monitoring Communications System. The goal of this system is to provide the user the ability to monitor and manage their power system without the installation of any software other than an internet browser. This system may require the user to store web links in their browser to each of the web enabled devices; however the intent of this approach is to significantly reduce installation, configuration and operational costs of the system.

1. The PMCS shall comply with new construction installations utilizing web-based components to function independently or to co-exist with other Eaton Cutler-Hammer IMPACC system components or other Modbus RTU communicating devices in a heterogeneous environment.

B. The Contractor shall furnish and install the equipment specified herein. The equipment shall be as outlined below.

C. This section includes the supply and installation of a complete Power Monitoring Communications System (PMCS) as described in this specification. The PMCS is defined to include, but not to be limited to, remote devices for metering, monitoring, control and protection, a network time server, all Ethernet communications gateways, intercommunication wiring, ancillary equipment, startup and training services, and ongoing technical support.

NOTE: All Tenant power feeders are to be metered by this web based monitoring system.

1.2 REFERENCES

A. The PMCS shall comply with the applicable portions of ANSI/IEEE 802.3 and NEMA standards. In addition, the master control unit shall comply with FCC Emission Standards specified in Part 15, Subpart J for Class A application.

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. System description including an overview of the system provided with detailed

description of system architecture. A customized system diagram showing location of computers, repeaters, gateways and assemblies/devices to be connected to the system, as well as types of wiring required (twisted pair, coax, fiber), and a general layout of wiring referencing the specific building/facility layout shall also be part of this description

2. Bill of material including a complete listing of all hardware, software, training, software configuration, and startup services.
3. Hardware and software description shall be provided in detail for all communications hardware, software, including sensor devices and gathering data to be transmitted over the network, and master display unit. This description will include a list of all the communicating devices to be connected to the network.
4. Typical software screen displays shall be provided in printout form and/or on disk.

1.4 SUBMITTALS – FOR INFORMATION

A. The Contractor shall provide a submittal for information to include a detailed listing of customer required actions, with timetable, to insure trouble-free startup of the PMCS. This information shall include any equipment access requirement, office requirements and manpower requirements. This submittal shall include the projected system startup time-line, including training dates. In addition, a proposed detailed wiring specification in compliance with these plans and specifications shall be included. The communication wiring specification shall include proposed communication cable, including general cable ratings, communication characteristics, cable routing proposed, termination requirements, and splicing/connections proposed to be made.

1.5 SUBMITTALS – FOR CONSTRUCTION

A. In addition, the systems operation manual shall include the following information:

1. A system description overview, descriptive bulletins and/or sales aids covering all components in the system
2. A maintenance section including all instruction leaflets and technical data necessary to set up, change setup parameters and maintain the communicating devices and sensors

B. A section on communication wiring which includes:

1. Type of communication wire utilized.
2. General cable ratings and communications characteristics.
3. Cable routing diagram including terminations and splicing connections made.

C. A detailed startup report, including a list of trained customer personnel shall be provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cutler-Hammer

B. Square D

C. General Electric

2.2 GENERAL

A. The PMCS is defined to include, but not to be limited to, remote devices for metering, monitoring, control and protection, a network time server, all Ethernet communications gateways, intercommunication wiring, printer, ancillary equipment, startup and training services, and ongoing technical support.

2.3 WEB-ENABLED POWER MONITORING COMMUNICATION SYSTEM

A. The web-enabled power monitoring communication system shall use Ethernet as the primary communication backbone between the equipment and the users or legacy systems.

B. The web-enabled power monitoring communication system shall support multiple protocols over Ethernet to ensure the system can easily be integrated into existing systems. These protocols shall include:

1. HTML web pages to display data to users using a browser
2. Modbus TCP/IP to support integration into third party systems
3. BacNet Web Services to support integration into third party systems
4. SNMP to support integration into Data Center management systems

C. The web enabled power monitoring communication system shall provide connectivity to the actual power system in one of two ways:

1. Web enabled meters that measure the critical power system parameters as described herein.
2. Web enabled gateways that communicate to power system devices over device specific communication links as described herein. Web enabled gateways will support the following device communication protocols:

    a. Eaton's INCOM protocol
    b. ModBus RTU over RS-485
    c. Eaton's QC Port over RS-485

3. The web enabled gateway shall support devices as required.
4. The devices connected to the Web enabled gateway shall communicate using the protocols described in Section 2.03 F2 over a local area network Interconnected with #18 gauge twisted pair shielded cable, 600 V Class Belden 9463 family, in properly sized conduit (when run outside of factory assembled

equipment for the communication channel).

D. The web enabled power monitoring communication system shall provide support for configuration of all web enabled meters and gateways directly via the web pages on the device. No additional software shall be required.

1. To support the configuration of legacy devices on the device networks connected to the gateway, the gateway shall support a "pass thru mode" to allow the legacy configuration software to connect from any computer on the users network to the device via the gateway.

E. All devices in the web enabled power monitoring communication system that are connected directly to Ethernet shall support the ability to synchronize their time clock using NTP. The purpose for this support is to ensure all device clocks are accurate so that event sequences can be adequately analyzed.

1. For devices that support clock synchronization and are on the device networks connected to the gateways, they shall support the ability to sync their clock to the clock in the gateway.

F. A User Guide shall be provided with the web enabled equipment to describe the commissioning process for setting the equipment's Ethernet address, and ensuring trouble-free data access from any computer on the network, using a standard Internet browser.

G. In all web enable devices, a common user interface shall be implemented across all types of power equipment, from Medium-Voltage Switchgear to Low-Voltage Switchgear, Switchboards, Motor Control Centers (MCCs), Power Distribution Units (PDUs) and Uninterruptible Power Supplies (UPSs). The purpose of this is to reduce end user training time and improve system usability.

2.4 ETHERNET SWITCHES

A. A single web access point: 4 or 6 port Ethernet switch shall be provided in the equipment to allow a single access point for the user and the ability to connect more than one network device directly on the customer's Ethernet Local Area Network (LAN).

B. Ethernet switch shall support standard copper RJ45 connectors and/or 100BaseFX Fiber-Optic via ST connectors.

PART 3 - EXECUTION

3.1 WARRANTY

A. The manufacturer shall warrant the equipment supplied hereunder. The warranty shall include:

1. Two (2) year free telephone technical support
2. Warranty on all hardware supplied under this system shall be for two (2) years.

3.2 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section:

1. Configure and load all software
2. Test and operate computer and software in a simulated system mode for minimum of 24 hours
3. Demonstrate full system functionality

3.3 INSTALLATION

A. The Contractor shall furnish, install and terminate all communication conductors and associated conduits external to any factory supplied equipment.

B. All communication conductor wiring and routing shall be per the manufacturer's recommendations.

3.4 FIELD QUALITY CONTROL

A. The contractor shall furnish the services of a manufacturer's representative to assist LAWA in starting up and programming the system. The manufacturer's representative shall be factory-trained and shall have a thorough knowledge of the software, hardware, and system programming. The manufacturer's representative shall provide the following services:

1. Setting all the addresses of all devices in the equipment
2. Verifying and troubleshooting the integrity of the data line (run by others)
3. Assisting LAWA in correcting any data line problems
4. Coordinating any possible warranty problems with the PMCS
5. Configure the PMCS software to match the field devices

3.5 FIELD ADJUSTMENTS

3.6 FIELD TESTING

A. Verify complete system operation including all hardware, software and communication devices.

B. Verify networking performance with all interfacing systems by other manufacturers.

3.7 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. The Contractor shall provide five (5) copies of the manufacturer's representative's certification.

3.8 TRAINING

A. The Contractor shall furnish the services of a manufacturer's representative for a period of one (1) 8-hour days to train the LAWA's personnel in operation and programming of the system. The manufacturer's representative shall be factory-trained and shall have a thorough knowledge of the software, hardware and system programming. The training session shall include:

1. Hands-on training of site personnel
2. Explanation of system operation
3. Explanation of devices
4. Explanation of LAWA's system

3.9 AFTER STARTUP SUPPORT

A. The PMCS manufacturer shall provide a 24-hour 800 telephone number manned with Engineers/Technicians expert in PMCS devices, software and communication system troubleshooting or capable of providing technical information.

B. The PMCS Manufacturer shall provide a 1 year service contract to maintain the software and system devices. The contract shall be renewable on an annual basis at a fixed charge and shall include a minimum of 2 site visits yearly to perform system maintenance. The service contract shall include as a minimum:

1. Installation of Software patches and Upgrades to System Operating Software as required
2. Anti-Virus Software upgrades as required
3. PMCS Software upgrades as required.
4. Database maintenance and archiving of data

END OF SECTION 26 09 13

SECTION 26 09 23 – LIGHTING CONTROL DEVICES AND CONTROL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Remote control lighting relays.
2. Lighting contactors.
3. Switches.
4. Switch plates.
5. Occupancy sensors.
6. Photocells.
7. Photocell control unit.

NOTE: The devices are to be connected to the Network Lighting Control System.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contractors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.
5. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
6. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
7. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

1.3 SYSTEM DESCRIPTION

A. Distributed switching control using self contained individually mounted lighting relays.

1.4 SUBMITTALS

A. Shop Drawings: Indicate dimensioned drawings of lighting control system components and accessories.

1. One Line Diagram: Indicating system configuration indicating panels, number

and type of switches or devices.
2. Include typical wiring diagrams for each component.

B. Product Data: Submit manufacturer's standard product data for each system component.

C. Manufacturer's Installation Instructions: Submit for each system component.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record the following information:

1. Actual locations of components and record circuiting and switching arrangements.
2. Wiring diagrams reflecting field installed conditions with identified and numbered, system components and devices.

B. Operation and Maintenance Data:

1. Submit replacement parts numbers.
2. Submit manufacturer's published installation instructions and operating instructions.
3. Recommended renewal parts list.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with standard.

B. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept components on site in manufacturer's packaging. Inspect for damage.

B. Protect components by storing in manufacturer's containers indoor protected from weather.

1.9 WARRANTY

A. Furnish five year manufacturer warranty for components.

PART 2 - PRODUCTS

2.1 REMOTE CONTROL LIGHTING RELAYS

A. Manufacturers:

1. LC & D
2. Lutron
3. General Electric.

B. Product Description: Heavy duty, single-coil momentary contact mechanically held remote control relays.

C. Contacts: Rated 20 amperes at 120 or 277 volts. Rated for lighting applications with high intensity discharge (HID), quartz halogen, tungsten, or fluorescent lamps.

D. Line Voltage Connections: Clamp type screw terminals.

E. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4.

2.2 LIGHTING CONTACTORS

A. Manufacturers:

1. Cutler-Hammer.
2. Square D.
3. General Electric.

B. Product Description: NEMA ICS 2, magnetic lighting contactor.

C. Configuration: Mechanically held, 3 wire control.

D. Coil Operating Voltage: 120 or 277 volts, 60 Hertz.

E. Poles: To match circuit configuration and control function.

F. Contact Rating: 20A

G. Accessories:

1. Cover Mounted Pilot Devices: NEMA ICS 5, standard-duty heavy-duty oiltight type with Form Z contacts, rated A150.
2. Pushbutton: ON/OFF function, with unguarded recessed covered configuration.
3. Selector Switch: ON/OFF/AUTOMATIC function, with rotary action.
4. Auxiliary Contacts: One field convertible in addition to seal-in contact.
5. Relays: NEMA ICS 2.
6. Control Power Transformers: 120 volt secondary, in each enclosed contactor. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

H. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4.

2.3 SWITCHES

A. Manufacturers:

1. Hubbell Incorporated.
2. Leviton Manufacturing Co., Inc.
3. Pass and Seymour.

B. Wall Switch: Specification Grade unlighted, momentary pushbutton type for overriding relays.

1. Material: Plastic.
2. Color: White.

C. Wall Switch: Industrial Grade non-pilot light toggle switches for overriding relays.

1. Color: White

D. Key Switch: Cylinder lock type. Match non-key switch ratings.

2.4 SWITCH PLATES

A. Manufacturers:

1. Hubbell Incorporated.
2. Leviton Manufacturing Co., Inc.
3. Pass and Seymour.

B. Product Description: Specification Grade.

1. Material: Stainless steel, type 302.
2. Color: to be selected by Designer.

2.5 OCCUPANCY SENSOR

A. Manufacturers:

1. LC & D.
2. Novitas.
3. Watt Stopper.

B. Compatible with modular relay panels. Capable of being wired directly to Class 2 wiring without auxiliary components or devices.

C. Separate sensitivity and time delay adjustments with LED indication of sensed movement. User adjustable time-delay: 30 seconds to 12 minutes.

D. Furnish with manual override.

E. Operation: Silent.

F. Room Sensors: Dual Technology.

G. Corridor and Hallway Sensors:

1. Capable of detecting motion 14 feet wide and 80 feet long with one sensor mounted 10 feet above floor.
2. Capable of detecting motion in warehouse aisle 10 feet wide and 60 feet long or 100 feet long when mounted 22 feet above floor.
3. Capable of being wired in master-slave configuration to extend area of coverage.

2.6 PHOTOCELLS

A. Manufacturers:

1. LC & D.
2. Novitas.
3. Watt Stopper.

B. General: Consist of sensor mounted with separate control-calibration module. Sensor connected to control-calibration module via single shielded conductor with maximum distance of 500 feet (150 m).

C. Control-Calibration Module: Furnish with the following:

1. Capable of being switched between 4 measurement ranges.

2. Separate trip points for high and low response settings.
3. Momentary contact device to override photocell relays.
4. Three minute time delay between switching outputs to avoid nuisance tripping.

D. Sensor Devices: Each sensor employs photo diode technology to allow linear response to daylight within illuminance range.

1. Exterior Lighting: Hooded sensor, horizontally mounted, employing flat lens, and working range 1-10 footcandles in 10 percent increments. Entire sensor encased in optically clear epoxy resin.
2. Indoor Lighting: Sensor with Fresnel lens providing for 60 degree cone shaped response area to monitor indoor office lighting levels.
3. Atriums: Sensor with translucent dome with 180 degree field of view and respond in range of 100-1,000 footcandles.
4. Skylights: Sensor with translucent dome with 180 degree field of view and respond in range of 1,000-10,000 footcandles.

2.7 PHOTOCELL CONTROL UNIT

A. Manufacturers:

1. LC & D.
2. Novitas.
3. Watt Stopper.

B. Product Description: Photodiode control unit with PHOTOCELL ENABLE and MASTER OVERRIDE inputs for remote control, 3 minute time delay, and with selectable ranges for 1-10 footcandle, 10-100 footcandle, 100-1000 footcandle, and 1000-10,000 footcandle.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount switches, occupancy sensors, and photocells.

B. Use only properly color coded, stranded wire, installed in conduit.

C. Label each low voltage wire clearly indicating connecting relay panel.

D. Mount relays. Provide wiring to numbered relays in panel to control each load.

E. Install relays to be accessible. Allow space around relays for ventilation and circulation of air.

F. Identify power wiring with circuit breaker number controlling load. When multiple

circuit breaker panels are feeding into relay panel, label wires to indicate originating panel designation.

G. Label each low voltage wire with relay number at each switch or sensor.

3.2 MANUFACTURER'S FIELD SERVICES

A. Furnish services for minimum of one day for check, test, and start-up. Perform the following services:

1. Check installation of panelboards.
2. Test operation of remote controlled devices.
3. Repair or replace defective components.

3.3 ADJUSTING

A. Test each system component after installation to verify proper operation.

B. Test relays, contactors, switches and sensors after installation to confirm proper operation.

C. Confirm correct loads are recorded on directory card in each panel.

3.4 DEMONSTRATION

A. Demonstrate operation of the following system components to staff to be trained:

1. Operation of switches.
2. Operation of each type of occupancy sensors.
3. Operation of each type of photocell.

B. Furnish 4 hours to instruct LAWA's personnel in operation and maintenance of system. Schedule training with LAWA, provide at least 7 days notice to Designer of training date.

C. Provide manuals for attendees.

END OF SECTION 26 09 23

SECTION 26 09 43 – NETWORK LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

> **NOTE:** This system controls those devices specified in Lighting Control Devices and Control Panels.

1.1 SUMMARY

A. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system. All Labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section.

B. Furnish and install a complete system for the control of lighting and other equipment and as further defined herein.

C. The system shall include but not be limited by the following list: Pre-wired, microprocessor controlled relay panels with electrically held, electronically latched relays controlled via a complete list of communications based accessories including digital switches, digital photocells, Digital Time Clock (DTC) and interface cards to dimming systems, building automation systems, thermostats, and any contact closure or analog based device. The type of lighting control equipment and wiring specified in this section is covered by the description: Microprocessor Controlled Digital Relay Lighting Control system with RS 485 Bus communications. Requirements are indicated elsewhere in these specifications for work including, but not limited to, raceways and electrical boxes and fittings required for installation of control equipment and wiring. They are not the work of this section.

1.2 SUBMITTALS

A. Shop Drawings: Submit dimensioned drawings of lighting control system and accessories including, but not necessarily limited to, relay panels, switches, DTC, photocells and other interfaces.

B. Product Data: Submit for approval 6 copies of manufacturer's data on the specific lighting control system and components. Submittal shall be in both electronic and hard copy formats. To prevent departures from approved system operation, electronic file submitted shall be able to be directly downloaded to the specified system at manufacturer facility. Submit a complete bill of materials with part numbers, description and voltage specifications.

C. One Line Diagram: Submit a one-line diagram of the system configuration indicating the

type, size and number of conductors between each component. Submittals that show typical riser diagrams are not acceptable. Provide completely filled out control schedules, switch engraving schedules and panel schedules.

1.3 QUALITY ASSURANCE

NOTE: Verify the BMS protocol with your designated LAWA Representative. This protocol may involve providing a connection to the Central Utility Plant (CUP).

A. Manufacturers:

1. LC&D
2. Lutron

B. Control wiring shall be in accordance with the NEC requirements for Class 2 remote control systems, Article 725 and manufacturer specification.

C. A licensed electrician shall functionally test each system component after installation, verify proper operation and confirm that all relay panel and switch wiring conform to the wiring documentation, and as per manufacturer recommendations.

D. Comply with NEC and all local and state codes as applicable to electrical wiring work.

E. Lighting control panels shall be ETL listed to UL 916. LCPs controlling emergency circuits shall be ETL listed to UL 924.

F. The lighting control system shall also be listed or approved by all national, state and local energy codes to include but not limited to California Title 24 and Los Angeles Building Code.

G. System shall have open software protocol to interface with BMS and central utility plant monitoring systems.

H. Specifications are based on LC&D system. Lutron shall comply with the compatibility and functionality to achieve the design intent.

1.4 MAINTENANCE MATERIALS

A. Execution Requirements: Spare parts and maintenance products.

B. Provide 8 spare relays per LCP, 4 Micro panels.

C. Provide extra CD version of manufacturers operating software to include graphical interface software.

D. Provide 2 extra sets of as-built and operating manuals.

1.5 SUBSTITUTIONS

A. No substitutions are permitted.

PART 2 - PRODUCTS

2.1 MATERIAL AND COMPONENTS

A. Smart Panelboards shall be made up of the following components:

1. NEMA rated enclosure with hinged door, available with main lug or main breaker and in voltages of 120/240, 208Y/120 and 480Y/277. Continuous main current ratings as indicated on the panelboard schedule. Minimum AIC rating to be 10,000. NEMA4 rating for outdoor installation.
2. Control electronics mounted internally to each smart panelboard shall be capable of driving up to 42 controllable breakers, control any individual or group of breakers, store all programming in non-volatile memory, after power is restored return system to current state, provide programmable blink warn timers for each breaker and every zone and be able to control a Micro Relay panel located downstream of non-controllable breaker.
3. Lighting control system shall be digital and consist of a Master LCP with up to 31 controllable, Slave LCPs with up to 42 controllable breakers in each panel, a Micro LCP with up to 4 individual relays, digital switches and digital interface cards (see interfaces). One individual bus network each for North Concourse + North Core and South Concourse + South Core. All system components shall connect and be controlled via a single Category 5, 4 twisted pair cable, providing real time two-way communication with each system component. Analog systems are not acceptable.
4. Lighting control system shall have the capability to output 4 independent 0v to 10v signals in a Micro LCP. Micro LCP shall control 4 independent 20a fluorescent lighting circuits. Each circuit shall have an adjustable fade rate and take inputs from a wall device, DTC system controller or a digital photocell.
5. Quantity and rating of breakers as required.
6. 16 AWG steel barrier shall separate the high voltage and low voltage compartments of the panel and separate 120v and 277v.

B. Controllable Breakers

1. Solenoid operated thermal magnetic breakers.
2. Ratings of 120/240V AC; 15, 20 and 30 Amp; 1- and 2-pole, 277/480V AC, 15, 20 and 30 amp: 1 and 2-Pole.
3. Rated at 20 Amp, 277VAC Ballast, Tungsten, HID, 1 HP at 120 Vac, 2 HP at 240 Vac.

C. Standard Output Relays

1. Electrically held, electronically latched SPST relay.
2. Relays shall be individually replaceable. Relay terminal blocks shall be capable of accepting two

   a. #10AWG wires on both the line and the load side. Systems that do not allow for individual relay replacement or additions are not acceptable.

3. Rated at 20 Amp, 277VAC Ballast, Tungsten, HID, 1 HP at 120 Vac, 2 HP at 240 Vac.
4. Relays to be rated for 250,000 operations minimum at 20a lighting load, use Zero Cross circuitry and be Normally Closed (NCZC). All incandescent circuits shall be energized by use of a Normally Closed SoftStart™ (NCSS) relay rated at 100,000 operations at full 20a load. No exceptions.
5. Optional relay types available shall include: Normally Open (NO) relay rated for 100,000 operations, a 600v 2-pole NO and NC and a Single Pole, Double Throw (SPDT) relay.

D. Switches

1. All switches shall be digital and communicate via RS 485. Contact closure style switches shall not be acceptable. Any switch button function shall be able to be changed locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet.
2. Switches shall be available in 1 through 6-button version with engraveable buttons, red LED annunciation for each button and a constantly on green LED locator.
3. Switches may be programmed to be Momentary ON, Momentary OFF, Toggle or Maintained. These functions shall be able to be changed locally (at the DTC or a PC) or remotely, via modem.
4. Contractor to verify all switch types and quantities per plans and specifications.
5. Accessories available to include digital key switch and digital key enable switch.

E. DTC - Digital Electronic Time Clock:

1. A Digital Time Clock (DTC) shall control and program the entire lighting control system and supply all time functions and accept interface inputs.
2. DTC shall be capable of up to 32 schedules. Each schedule shall consist of one set of On and Off times per day for each day of the week and for each of two holiday lists. The schedules shall apply to any individual relay or group of relays.
3. The DTC shall be capable of controlling up to 126 digital devices on a single bus and capable of interfacing digitally with other individual busses using manufacturer supplied interface cards.
4. The DTC shall accept control locally using built in button prompts and use of a 8 line 21-letter display or from a computer or modem via an on-board RS 232 port. All commands shall be in plain English. Help pages shall display on the DTC screen.

5. The DTC shall be run from non-volatile memory so that all system programming and real time clock functions are maintained for a minimum of 15 years with loss of power.
6. Software pre-installed to accept standard Unity Graphical Management Software (GMS) pages. GMS software shall provide via local or remote PC a visual representation of each device on the bus, show real time status and the ability to change the status of any individual device, relay or zone.
7. Pre-Installed modem that allows for remote programming from any location using a PC. Modem to include all necessary software for local or remote control.
8. DTC shall provide system wide timed overrides. Any relay, group or zoned that is overridden On, before or after hours, shall automatically be swept Off by the DTC a maximum of 2 hours later.

F. Interfaces: For future expansion capability, system to have available all of the following interfaces. Verify and install only those interfaces indicated on the plans.

1. A dry contact input interface card that provides 14 programmable dry contact closure inputs. Use shielded cable to connect input devices to interface card.
2. Interface card providing digital communication from one system bus to another system bus, allowing up to 12,000 devices to communicate.
3. An exterior (PCO) or interior (PCI) photocell that provides readout on the DTC screen in number values analogous to foot-candles. Each photocell shall provide a minimum of 14 trigger points. Each trigger can be programmed to control any relay or zone. Each trigger shall be set through programming only. Photocells which requires the use of setscrews or which must be programmed at the photocell control card shall be not acceptable.
4. An interface card that allows the DTC to control up to 32 digital XCI brand thermostats. Programming of thermostats to be able to done locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet.
5. A voice prompted telephone override interface module. Interface module shall accept up to 3 phone lines and allow up to 3 simultaneous phone calls. Voice prompted menu and up to 999 unique pass codes shall be standard with each interface module.
6. Software pre-installed to run Unity GX Graphical Management Software (GMS-GX) pages. GMS-GX software shall provide via local or remote PC a visual representation of a specific area or the total area of the project. GMS full graphic pages shall be designed to the LAWA's specifications. Provide 2 GMS pages.
7. Direct digital interface to Smart Panelboards. Smart Panelboard circuits shall appear on the system software as distinct items and maintain all functions and features of the system software to include GMS pages.
8. Direct digital interface to DMX 512 based systems. Lighting control system shall provide 14 global DMX commands, each of which can be modified locally or remotely using lighting controls manufacturer supplied software. DMX interface shall be integral to the system bus and shall connect and be controlled via a single Category 5, 4 twisted pair cable, providing real time two¬way communication between lighting control system and a DMX based system.
9. BMS interface to be provided and coordinated with mechanical controls contractor as required.

2.2 MODES OF OPERATIONS

A. DTC – Digital Electronic Time Clock: DTC shall control any relay or group of relays by the following modes: ON only, OFF only, Maintained, Maintained with timer and OFF sweep warning (Blink warn), maintained with timer (No blink warning). Timers adjustable from 1 minute to 4 hours. When the scheduled program in the DTC is ON the associated timers are disabled. When the scheduled program in the DTC is off and a relay or zone is overridden, the DTC will put that relay or zone into the timer mode and automatically sweep off at the end of the programmed timer period (Maximum 2-Hour Timed Override). All DTC settings, schedules, photocell trip points, temperature settings, longitude and latitude, time zone offset to sunrise and sunset and any other LAWA settings shall be able to be changed though software locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet. No exceptions.

B. Switches: All system switches shall be digital and daisy chained on a single category 5, 4 twisted pair cable with all LCPs. Any switch button shall be able to control any relay or group of relays anywhere on the system in the following modes: ON, OFF, Mixed (Some relays ON some OFF), Toggle (first push ON, next OFF etc.) Maintain. Timer ON with a time set from 1 minute to 4 hours. Timer ON with Off sweep warning, (Blink warning 5 min or as programmed prior to OFF sweep.) Timer ON with Horn Warning (Horn output turns ON for the warning 5 min or as programmed prior to OFF sweep.) Any switch function shall be able to changed locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet. Any relay, group or zoned that is overridden On, before or after hours, shall automatically be swept Off by the DTC a maximum of 2 hours later.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Mount smart breaker panelboards to wall. Attach to backing or structure similar to standard panelboards. Locate strategically to allow access to low and live voltage compartments. Vacuum all construction debris prior to installing electronics.

B. Switches: Provide outlet boxes, single or multi-gang, as shown on the plans for the low voltage digital switches. Mount switches as per plans. Supply faceplates per plans and specifications. EC is specifically responsible to supply and install the required low voltage cable, Category 5, 4 twisted pair, with pre-assemble RJ45 connectors and snagless boots (commonly referred to as a Cat 5 patch cable) between all switches and panels. Field-test all Cat 5 patch cable with a recognized cable tester. All low voltage wire to be run in conduit, per local codes.

C. Wiring

1. Do not mix low voltage and high voltage conductors in the same conduit. No exceptions.
2. Ensure low voltage conduits or control wires do not run parallel to current carrying conduits.

3. Place manufacturer supplied "terminators" at each end of the system bus per manufacturer instructions.
4. Neatly lace and rack wiring in cabinets.
5. Plug in Category 5, 4-twisted pair patch cable that has been field tested with a recognized cable tester at the indicated RJ45 connector provided with each lighting control device, per manufacturer instructions.
6. Use Category 5, 4 twisted pair patch cable for all system low voltage connections. Additional conductors may be required to compensate for voltage drop with specific system designs. Contact LC&D or refer to the GR2400 manual for further information. Use shielded cable for dry contact inputs to lighting control system.
7. Do not exceed 4000ft-wire length for the system bus.
8. All items on the bus shall be connected in sequence (daisy chained). Star and spur topologies are not acceptable.
9. The specified lighting control system shall be installed by the electrical contractor who shall make all necessary wiring connections to external devices and equipment, to include photocell. EC to wire per manufacturer instructions.

3.2 DOCUMENTATION

A. Each Smart breaker Panelboard shall have properly filled up directory. Provide a point-to-point wiring diagram for the entire lighting control system. Diagram must indicate exact mounting location of each system device. This accurate "as built" shall indicate the loads controlled by each relay and the identification number for that relay, placement of switches and location of photocell. Original to be given to LAWA, copies placed inside the door of each LCP.

3.3 SERVICE AND SUPPORT

A. Start Up: EC shall contact manufacturer at least 7 days before turnover of project. Manufacturer will remotely dial into the lighting control system, run diagnostics and confirm system programming. EC shall be available at the time of dial in to perform any corrections required. EC is responsible for coordinating with GC and LAWA the installation of a dedicated telephone line or a shared phone line with A/B switch. Phone jack to be mounted within 12" of Master LCP. Label jack with phone number. EC to connect phone line from jack to Master LCP.

B. Telephone factory support shall be available at no additional cost to the LAWA both during and after the warranty period. Factory to pre-program the lighting control system per plans and approved submittal, to the extent data is available. The specified manufacturer, at no added cost, shall provide additional programming via modem as required by LAWA for the operation life of the system. Manufacturer warrants that the DTC software can be upgraded and monitored remotely. Upon request manufacturer to provide remote dial up software at no added cost to LAWA. No exceptions.

C. Provide a factory technician for on-site training of the LAWA's representatives and maintenance personnel. Coordinate timing with General Contractor. Provide 2 days of

factory on-site training for a minimum of ten people.

D. On Call Service

1. Control contractor shall perform monthly system diagnostics (viewing system log files and review of performance/error data logged in the system).
2. Provide one technician for 120 hours total (duration of site visit determined on time required to perform the system review) for a period of six (6) months after final acceptance of the project. Time may also be utilized by LAWA to provide as-needed modifications, troubleshooting, and/or clarifications to the system. Use of time is as the sole discretion of LAWA.

3.4 CLEANING

A. Execution Requirements: Final cleaning.

B. Remove dirt and debris from all LCP enclosures.

C. Clean photocell lens as recommended by manufacturer.

D. Clean all switch faceplates.

3.5 WARRANTY

A. Two (2) years parts and labor.

B. Five (5) years limited parts and labor warranty for repair and replace of defective system components.

END OF SECTION 26 09 43

SECTION 26 13 13 – METAL-CLAD SWITCHGEAR (VACCLAD) – MEDIUM VOLTAGE

PART 1 - GENERAL

NOTE: This section applies to any electrical new work at Terminal 1 due to the existing 4160V System that is exclusive to this Terminal.

1.1 SUMMARY

A. The Contractor shall furnish and install the equipment as specified herein.

1.2 REFERENCES

A. The metal-clad switchgear and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA SG-4 and SG-5, and but not limited to, ANSI/IEEE 37.20.2.

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to LAWA:

1. Master drawing index
2. Front view elevation
3. Floor plan
4. Top view
5. Single line diagram
6. Nameplate schedule
7. Component list
8. Conduit entry/exit locations
9. Assembly ratings including:
10. Short-circuit rating
11. Voltage
12. Continuous current
13. Basic impulse level for equipment over 600 volts
14. Major component ratings including:

    a. Voltage
    b. Continuous current
    c. Interrupting ratings

15. Cable terminal sizes
16. Product data sheets

B. Where applicable, the following additional information shall be submitted to LAWA:

1. Busway connection

2. Connection details between close-coupled assemblies
3. Composite floor plan of close-coupled assemblies
4. Key interlock scheme drawing and sequence of operations
5. Descriptive bulletins

C. Submit shop drawings after Short Circuit and Overcurrent Protective Device Coordination Study is approved. Shop drawings submitted without approved study will be returned and not reviewed.

D. The AIC ratings of all submitted equipment must conform to the approved Short Circuit and Overcurrent Protective Device Coordination Study.

E. The electrical contractor shall submit ¼"=1'0" scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

1.4 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Paragraph 1.3, and shall incorporate all changes made during the manufacturing process.
2. Wiring diagrams
3. Certified production test reports
4. Installation information including equipment anchorage provisions
5. Seismic certification as specified

1.5 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of twenty-five (25) years. When requested by LAWA, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. Provide Seismic tested equipment as follows:

1. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the International Building Code (IBC) & California Building Code (CBC) Sections 1704 through 1708 for Site Classification D application and highest 1.5 importance factor. Guidelines for

the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, IBC: a peak of 2.45g's (3.2-11 Hz), and a ZPA of 0.98g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz. The certificate of compliance with the requirements shall show that the shake table tested forces that the equipment can withstand exceed the Site Classification D requirements by a 15% margin. Equipment must utilize the shake table test method; computer modeling, calculations or historical data are not acceptable.

2. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

   a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
   b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
   c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

E. All switchgear shall have Los Angeles Department of Building and Safety approved lab test certification.

1.6 REGULATORY REQUIREMENTS

1.7 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

B. Shipping groups shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately.

C. Split shipping packages are a must to accommodate designed access hatchway.

D. Switchgear shall be equipped to be handled by crane. Where cranes are not available, switchgear shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.

NOTE: All new switchgear delivered to the jobsite, shall be stored in a covered and conditioned area where it is protected from the corrosive marine environment at the airport.

E. Switchgear being stored prior to installation shall be stored so as to maintain the equipment in a clean and dry condition. If stored outdoors, indoor gear shall be covered and heated, and outdoor gear shall be heated.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component. Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals. It shall also include original shop drawings, and recommended maintenance, Manufacturer's Certification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cutler-Hammer

B. Square D

C. General Electric

D. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.2 RATINGS

A. The switchgear described in this specification shall be designed for medium voltage, three-phase, 3 wire, solidly grounded, 60-hertz system.

B. Each circuit breaker shall have the following ratings:

Maximum Voltage	5 kV
BIL Rated	170 kV Peak
Continuous Current	1200A for mains and tie. Feeders – 600 A.
Short-Circuit Current at rated Maximum kV	40 kA RMS sym
Rated Voltage Range Factor K	1.0
Closing and Latching Capability	108 kA Crest
Maximum Symmetrical Interrupting and 3-Second Rating	40 kA RMS SYM
Rated Interrupting Time	Cycle 3

NOTE: Values in this table are to be verified by the engineer of reocord and compared to the specific voltage requirements for any new terminal improvement work at the airport.

2.3 CONSTRUCTION

A. The switchgear assembly shall consist of individual vertical sections housing various combinations of circuit breakers and auxiliaries, bolted to form a rigid metal-clad switchgear assembly. Metal side sheets shall provide grounded barriers between adjacent structures and solid removable metal barriers shall isolate the major primary sections of each circuit. Hinged rear doors, complete with provisions for padlocking, shall be provided.

B. The stationary primary contacts shall be silver-plated and recessed within insulating tubes. A steel shutter shall automatically cover the stationary primary disconnecting contacts when the breaker is in the disconnected position or out of the cell. The circuit breakers shall be a roll-out design to allow withdrawal for inspection and maintenance without the use of a separate lifting device.

2.4 BUS

A. The main bus shall be copper with fluidized bed epoxy flame-retardant and track-resistant insulation. The bus supports between units shall be flame-retardant, track-resistant, cycloaliphatic epoxy for medium voltage class. The switchgear shall be constructed so that all buses, bus supports and connections shall withstand stresses that would be produced by currents equal to the momentary ratings of the circuit breakers.

Insulated copper main bus shall be provided and have provisions for future extension. All bus joints shall be plated, bolted and insulated with easily installed boots. The bus shall be braced to withstand fault currents equal to the close and latch rating of the breakers. The temperature rise of the bus and connections shall be in accordance with ANSI standards and documented by design tests.

B. A copper ground bus shall extend the entire length of the switchgear.

2.5 WIRING/TERMINATIONS

A. The switchgear manufacturer shall provide suitable terminal blocks for secondary wire terminations and a minimum of 10% spare terminals shall be provided. One control circuit cutout device shall be provided in each circuit breaker housing. Switchgear secondary wire shall be #14 AWG, type SIS rated 600 volt, 90 degrees C, furnished with wire markers at each termination. Wires shall terminate on terminal blocks with marker strips numbered in agreement with detailed connection diagrams.

B. Incoming line and feeder cable lugs of the type and size indicated elsewhere shall be furnished.

2.6 CIRCUIT BREAKERS

A. The circuit breakers shall be horizontal drawout type, capable of being withdrawn on rails. The breakers shall be operated by a motor-charged stored energy spring mechanism, charged normally by a universal electric motor and in an emergency by a manual handle. The primary disconnecting contacts shall be silver-plated copper.

B. Each circuit breaker shall contain three vacuum interrupters separately mounted in a self-contained, self-aligning pole unit, which can be removed easily. The vacuum interrupter pole unit shall be mounted on cycloaliphatic epoxy supports for medium voltage class. A contact wear gap indicator for each vacuum interrupter, which requires no tools to indicate available contact life, shall be easily visible when the breaker is removed from its compartment. The current transfer from the vacuum interrupter moving stem to the breaker main conductor shall be a non-sliding design. The breaker front panel shall be removable when the breaker is withdrawn for ease of inspection and maintenance.

C. The secondary contacts shall be silver-plated and shall automatically engage in the breaker operating position, which can be manually engaged in the breaker test position.

D. Interlocks shall be provided to prevent closing of a breaker between operating and test positions, to trip breakers upon insertion or removal from housing and to discharge stored energy mechanisms upon insertion or removal from the housing. The breaker shall be secured positively in the housing between and including the operating and test positions.

E. The breakers shall be electrically operated by the following control voltages: 240 volt AC close and AC capacitor trip.

F. Each breaker shall be complete with control switch and red and green indicating lights to indicate breaker contact position.

G. AC control voltage shall be derived from control transformers mounted in the switchgear. A separate control transformer shall be provided on each side of the tie breaker. An automatic throwover control scheme shall be provided and factory wired to provide reliable control power to the entire lineup when one incoming source has failed, but the other source is available. Each control transformer shall be sized to handle the control load of the entire lineup.

2.7 PROTECTIVE RELAYS

A. The switchgear manufacturer shall furnish and install, in the metal-clad switchgear, the quantity, type and rating of protection relays and described hereafter in this specification.

B. Microprocessor-Based Protective Relay

C. FP-5000 Protective Relay

1. The protective relays for the Mains/Tie & Feeder circuit protection shall be a single multifunction, microprocessor-based relay that provides three-phase and ground instantaneous and time overcurrent protection, ANSI 50/51, 50/51G, or 50/51N, and voltage protection, metering and control functions as described below. The relay shall be Cutler-Hammer device type FP-5000 or approved equal having all the features and functions herein specified.
2. The relay shall be a solid-state microprocessor-based multifunctional type that operates from the 5 ampere secondary output of current transformers. The relay shall provide ANSI 50/51 protective functions for each of the three (3) phases, and ANSI 50/51N or 50/51G ground fault protection functions as shown on the plans or as determined by the coordination study. The relay shall be true rms sensing of each phase and ground. Ground element shall be capable of being utilized in residual, zero sequence, ground source connection schemes, or deactivated.
3. The relay shall provide the following protection functions:

    a. Phase overcurrent (forward/ reverse (67) or both (50/51)): Two inverse time overcurrent (51P-1, 51P-2) functions and two instantaneous overcurrent (50P-1, 50P-2) functions with adjustable time delay
    b. Directional Ground inverse time overcurrent and two instantaneous overcurrent functions from calculated values with adjustable time delay (forward/reverse (67G), or both (51G, 50G-1, 50G-2))
    c. Directional Ground inverse time overcurrent and two instantaneous overcurrent functions from measured values with adjustable time delay (forward/reverse (67G), or both (51X, 50X-1, 50X-2))
    d. Ground directional option for Zero Sequence Voltage Polarizing, Negative Sequence Polarizing or Ground Current Polarizing
    e. Negative sequence overcurrent protection with adjustable time delay (46)

f. Three-phase overvoltage protection with adjustable time delay (59)
g. Three-phase undervoltage protection with adjustable time delay (27)
h. Overfrequency protection with adjustable time delay (81O)

(1) Negative sequence overvoltage protection with adjustable time delay (47)

i. Underfrequency protection with adjustable time delay (81U)
j. Breaker failure protection with adjustable time delay (50BF).
k. Reverse/Forward Power (32-1, 32-2)
l. Sync Check (25)
m. Power Factor (55)

(1) The primary current transformer ratings being used for phase and ground protection feeding the device shall be programmable for current transformers with primary current ratings from 1 through 6,000 amperes, in 1 ampere steps.
(2) The ground current input and ground protection elements shall be independent of the phase inputs and shall be capable of being connected to the phase residual current transformer connection or to a zero sequence current transformer.
(3) Both the phase and ground protection curves shall be independently field selectable and programmable with or without load. Curves shall be selectable from the following:
ANSI/IEEE: Moderately inverse, very inverse, and extremely inverse
IEC: A, B or C
Thermal:
Flat, It, I2t, I4t
Thermal curves shall be similar to those on low voltage trip units for close coordination with downstream devices.
(4) The relay shall have six trip rated contact outputs that may be programmed for any protection function operation output.
(5) The relay shall have a front panel display of relay condition, breaker status and trip condition.
(6) The relay shall have a built-in alphanumeric display capable of displaying the following information with metering accuracy phase current +/- 0.5% or +/- 0.025A from 0.02 to 20.0 per unit, ground current +/- 0.5% of full scale (In) from 0.2 to 2.0 per unit.

n. Individual phase and ground currents with phase angles
o. Phase-to-ground and phase-to-phase voltages with phase angles
p. Watts
q. Vars
r. VA
s. Frequency
t. Power factor – apparent and displacement

u. Demand and Peak demand (ampere, Watt, VAR, and VA) with date and time stamp since last reset

(1) Forward, reverse and net watthours with start date and time stamp

v. Lead, lag and net var hours with start date and time stamp
w. VA-hours with start date and time stamp
x. Minimum/maximum values of current, voltage, watts, vars, VA, frequency, apparent pf and displacement pf with date and time stamping
y. Percent THD of voltage and current
z. Positive, negative and zero sequence components of voltage and current with phase angles.

4. Relay shall have the following features:

a. Integral manual testing capability for both phase and ground overcurrent protection functions
b. Zone selective interlocking capability for phase and ground fault protection. This function shall be provided and factory wired. Where zone selective interlocking is not an integral part of the protective device, a full bus differential scheme shall be required for both phase and ground, in addition to specified time overcurrent and instantaneous overcurrent phase and ground fault protection. Bus differential scheme shall be provided with separate differential current transformers for all incoming and outgoing loads, as well as appropriate differential relays (ANSI 87 and 87G) as approved by LAWA.
c. Real-time clock for stamping of events, trips and minimum/maximum values with 1 mS time resolution
d. Trip coil-monitoring circuits
e. User interface for programming and retrieving data from the front of the unit without additional equipment
f. Eight (8) contact inputs that are user programmable
g. Continuous self-testing of internal circuitry
h. Self-diagnostic capability and a relay healthy alarm output
i. Integral test program for testing the relay operation by simulating current and voltage conditions internally
j. Unit failure alarm contact for customer use
k. Programmable lockout/self-reset after trip function
l. Programmable set points for device curve selection
m. Programmable inputs, such as current transformer ratios
n. Access to program and test modes shall be via sealable hinged cover and password protected for security.

5. Relay shall record information on the last 16 faults including:

a. Date, time, currents and voltages at the time of fault
b. Waveforms of the voltages and currents.

6. Relay shall record the last 100 events into an event log with date and time stamping
7. Relay shall have programmable logic control functions including logic gates and timer for control of auxiliary functions
8. Relay shall provide and retain relay communication address and check sum setting verification in non-volatile memory chip within the permanently installed case.
9. Relay shall be suitable for operating temperatures from -30 degrees to 55 degrees C. Relay shall be suitable for operating with humidity from 0 to 95% relative humidity (non-condensing).
10. Relay shall have the following communications ports:

    a. A rear communication port that is FSK based and supports local area network compatible to Cutler-Hammer PowerNet or IMPACC systems.
    b. A rear communication port that is RS-485 based and supports the Modbus RTU protocol.
    c. A front communication port supporting ASCI communications to a personal computer or laptop computer.
    d. Relay shall be capable of the following over the communication network: Ability to transmit all information contained in the relay such as currents, set points, cause of trip, magnitude of trip current, waveforms and open-close trip status. Ability to close and open the associated breaker with proper access code from remote location over the communication network when the relay is configured in remote close/open mode.

11. Relay shall have communication ability to open and close the breaker remotely via password protected access or locally from the front of the relay.
12. Relay shall store four setting groups which can be called for via communications, front panel operation or contact input.
13. Relay trip contacts shall not change state if power is lost or an undervoltage occurs. These contacts shall only cause a trip upon detection of an overcurrent or fault condition based upon programmed settings.
14. A relay healthy alarm output shall be normally energized and shall drop out if a relay failure is detected in the self-test function or if control power is lost.
15. The relay shall be suitable for operating on control power with a nominal input voltage of 125 Vac or 250 Vac (60 Hz). When AC control power schemes required, in addition to control power transformer or remote control power are specified, a single-phase uninterruptable power supply shall be included to supply control power to protective devices.

2.8 AUXILIARY DEVICES

A. Ring type current transformers shall be furnished. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their accuracy rating shall be equal to or higher than ANSI standard requirements. Shorting terminal blocks shall be furnished on the secondary of all the current transformers.

B. Voltage and control power transformers of the quantity and ratings indicated in the detailed specification shall be supplied. Voltage transformers shall be mounted in drawout drawers contained in an enclosed auxiliary compartment. Control power transformers up to 15 kV, 15 kVA, single-phase shall be mounted in drawout drawers. Rails shall be provided as applicable for each drawer to permit easy inspection, testing and fuse replacement. Shutters shall isolate primary bus stabs when drawers are withdrawn.

C. A mechanical interlock shall be provided to require the secondary breaker to be open before the CPT drawer or CPT primary fuse drawer can be withdrawn.

2.9 AUTOMATIC THROWOVER SYSTEM – OPEN TRANSITION

A. Dual Source, With Tie, Open Transition Automatic Transfer Control System

1. Provide an automatic transfer control system for control of three circuit breakers. The logic of the transfer control system functions shall be provided via a microprocessor. The set points shall be field adjustable without the use of special tools
2. The transfer control system shall be provided with a local display. The display shall show the status of the system as it is operating. When timers are functioning, the display shall show the timer counting down. All time delays shall be capable of being set from the front of the display using a timer setting screen
3. The transfer control system includes the following features:

    a. Time delay to transfer on loss of Source 1, adjustable.
    b. Time delay to transfer on loss of Source 2, adjustable.
    c. Time delay re-transfer to Source 1, adjustable.
    d. Time delay re-transfer to Source 2, adjustable.
    e. Time delay neutral (main and tie open), adjustable.
    f. The local system display shall show the following: Main- Tie- Main one line diagram; main and tie breaker status (open, closed, tripped, out of cell); readout marked “Source 1” and “Source 2” to indicate that respective source voltages are available; automatic/manual mode select pushbutton; pushbuttons for manual breaker control; and alarm information (loss of source, breaker trip).

4. Sequence of Operation – Automatic Mode

    a. Under normal conditions, the main breakers are closed and the tie breaker is open.
    b. Upon phase loss or loss of phase-to-phase voltage of either utility source to between 80% and 100% of nominal, and after a time delay, adjustable from 1 to 60 seconds to override momentary dips and outages the transfer control system shall open the affected main breaker and close the tie breaker.
    c. When normal voltage has been restored after a time delay, adjustable

from 10 to 600 seconds (to ensure the integrity of the source), the transfer control system shall open the tie breaker. The transfer control system shall have an adjustable neutral position timer (0-10 seconds) to allow voltage to decay sufficiently before the affected main breaker is then closed (open transition retransfer).

d. If Source 2 should fail while carrying the load, transfer to Source 1 shall be made instantaneously upon restoration of Source 1 to satisfactory conditions.
e. If both sources should fail simultaneously, no action shall be taken.
f. If the main or tie breakers trip due to a fault, the transfer control system shall be reset to manual mode and manual operation of that breaker shall be prevented until its overcurrent trip switch is reset.

5. Sequence of Operation – Manual Mode

a. While in manual mode, breakers shall be capable of being opened and closed using control switches or pushbuttons on the transfer control system display. Electrical interlocking shall be provided to prevent the closing of both mains and the tie simultaneously.

6. Provide a control power transformer for each source with control power transfer scheme
7. Provide electrically operated main and tie circuit breakers
8. Provide a programmable logic controller with 24 volts dc ride-through power supply
9. Provide an industrial display panel

2.10 LAWA **METERING**

A. Provide a separate LAWA metering devices and compartment with front hinged doors. Include associated instrument transformers.

B. Provide current transformers for metering. Current transformers shall be wired to shorting type terminal blocks.

C. Provide potential transformers including primary and secondary fuses with disconnecting means for metering.

D. Microprocessor-based metering system. Power Xpert 8000

1. Provide a microprocessor based line of Power Quality complete 8000 Meters, designated PX-M consisting of a Power Quality Meter Base(s) designated PX-B along with an integrally mounted Power Quality Meter Display designated PX-D. The PX-M shall be equal to Cutler-Hammer type PowerXpert 8000 as herein specified. PX-B shall be NEMA 1 rated and PX-D shall be NEMA 12 rated.
2. Complete PX-8000 shall be have the following minimum listings and/or certifications:

a. Safety: UL 61010A-1, EN 610101.
b. Accuracy: ANSI C12.20 Class 0.2, IEC/EN60687 0.2 for revenue meters.
c. EMC: FCC Part 15 Subpart B Class A immunity.
d. IEC Standards: 50081-2, 61000-3, 61000-4, and 61000-6.

3. Meter shall be supplied suitable for standard 120/240 Vac as required.
4. Current inputs for each channel shall be from standard instrument current transformers.

   a. The analog current input shall be converted to 1024 samples per cycle with a delta-sigma converter digitally filtered down to 256 samples per cycle for anti-aliasing.
   b. Meter burden shall be less than 10 milliohms.
   c. Overload withstand capability shall be a minimum of 500A for 1 second, non-repeating.
   d. Input range capability shall be 0.005 to 20 amperes.

5. Voltage inputs for each channel shall allow for connection into circuits with the following parameters:

   a. Input range of 600V L-L, 347V L-N direct connected.
   b. PT primary input of 120 volts to 500,000 volts.
   c. Nominal full-scale value of 700 volts rms.
   d. Input impedance of 2 mega ohms.
   e. The analog voltage input shall be converted to 1024 samples per cycle by means of a delta sigma converter and digitally filtered down to 256 samples per cycle for anti-phasing.

6. The PX-Metering series shall be capable of monitoring, displaying, and communicating the below true rms minimum information where applicable with the accuracy as indicated of read or calculated values based on 3 to 300% full scale. The PX-Metering series shall be suitable for installation in single phase, two or three wire systems or in three phase, three or four wire systems

   a. AC current (amperes) in A, B and C phase, 3-phase average, Neutral (N) and Ground (G). A total of five (5) current inputs shall be provided. Accuracy of all current inputs shall be 0.05% reading, +/- 0.01% of full scale. Provide neutral and ground current transformers. The 5 ampere current inputs shall withstand 40 amperes continuous and 300 amperes for 1 second. Current transformer ratios shall be selectable.
   b. AC voltage (volts) for A-B, B-C and C-A, phase average, A-N, B-N and C-N, average phase to N, and N to G. Accuracy of all voltage inputs shall be +/- 0.1% reading, +/-0.05% maximum of full scale. Capable of metering up to 600 volt without external Potential Transformers (PTs) and up to 500 kV with appropriate PTs.
   c. Real Power (Watts), Reactive Power (vars), Apparent Power (VA), for each phase and system. Accuracy +/- 0.10% reading and +/- 0.0025% full scale. Forward/Reverse indication shall be provided.

d. Accumulated, Incremental and conditional measurement for Real Energy (WH), Reactive Energy (VARH), Apparent Energy (VAH) for each phase and system. Accuracy +/- 0.10% reading and +/- 0.0025% full scale. Forward/Reverse and Net difference indication shall be provided.
e. Frequency (Hz) Accuracy +/- 0.01 hertz.
f. Demand values including present, running average, last complete interval and peak for System Current (Amperes). Demand values including present, running average, last complete interval, peak and coincident with peak kVA and kW demand for System Real Power (Watts), System Reactive Power (vars), and System Apparent Power (VA).
g. Power Factor for both Displacement only 60-cycle fundamental Watts to VA and Apparent total Watts to total vars including harmonics for A, B and C phase and 3 phase average. Accuracy +/- 0.10% at unity PF and +/-0.30% at 0.5 PF.
h. Current percent Total Harmonic Distortion (THD) in A, B and C phase and N.
   (1) Voltage percent THD in A-B, B-C and C-A phase, A-N, B-N and C-N.
i. K-Factor (sum of the squares of harmonic currents times the square of their harmonic numbers).
j. Transformer Derating Factor (1.414 divided by the Crest Factor).
k. Crest Factor (ratio of peak current to rms current).
l. CBEMA (ITIC) curve data
m. Flicker data
n. Nines (9's) availability data.
o. Power Quality Index

7. The PX series shall provide the following sampling capabilities:

   a. A/D technology, sampling at 1024 samples per cycle.
   b. Over-sampling and quantizing filtering to eliminate false signal noise.
   c. ITIC representation of power events.
   d. DV/dt triggers for sub-cycle oscillatory transients. Both dv/dt and absolute threshold triggering shall be supported on all voltage inputs, including N-G voltage.
   e. Six (6) MHz/ one (1) MHz capture of impulsive transients. 20 ms of data shall be captured at six (6) MHz or 120 ms of data shall be captured at one (1) MHz.
   f. Waveform recorded at 100,000 high rate samples per cycle. Waveforms shall be displayed on standard web browser without requiring separately purchased and installed software.
   g. Three-phase voltage and neutral-to-ground fast transient capture.
   h. Absolute threshold and dV/dt triggering.

8. The PX series shall provide the following advanced analysis features:

   a. Calculation of harmonic magnitudes and phase angle for each phase voltage and current through the 85th harmonic.

b. Waveforms shall be available in non-volatile memory and retrievable via file transfer protocol (FTP) in COMTRADE file format over the Internet network. No special software shall be required to download or view waveforms. Waveforms shall be viewable within standard web browser.

c. Historical Trending: Historical trend logging for graphical viewing from the Local PX-D display or from an embedded WEB server. The graphical views of historical data shall support both pan and zoom functions. All standard metering parameters shall be logged as part of the standard meter functionality including minimum, maximum and average for each metered parameter. The minimum and maximum readings shall be based on 200ms calculations. The averages shall be calculated over the user selected time interval period. Minimum storage capacity for standard trend plots shall be as follows:

(1) One-minute intervals for 9 days.
(2) Sixty-minute intervals for 540 days.
(3) Data storage up to 512 MB.

d. Time of Use Monitoring: Time of use monitoring shall include:

(1) Four rate periods for time of use revenue metering.
(2) Total rate independent of time of use.
(3) Up to 4 rate schedules (weekdays and weekends).

e. Energy Profile: Energy profile data shall include recording of real and reactive energy forward, reverse, net and absolute sum as well as apparent energy (KVAH). Up to eight (8) status inputs shall be configurable as energy accumulators for counting KYZ pulse inputs. These readings shall be stored over a configurable interval from 1 to 60 minutes as well as in daily and weekly totals. Storage capacity shall be as follows:

(1) Sixty-two (62) days of fifteen (15) minute interval energy and pulse interval data. (Fixed interval capacity shall equal 5,952 intervals configurable from 1 to 60 minutes).
(2) Three hundred and seventy-two (372) days of 1 day accumulated energy and pulse interval data.
(3) Two Hundred and eight (208) weeks of one (1) week accumulated energy and pulse interval data.

f. Event Triggers: The PX-M shall have a quantity of five (5) types of configurable event triggers configurable using a web browser consisting of 1) Out of limits, 2) Demand overload, 3) ITIC, 4) Sub-Cycle disturbance and 5) Fast Transient. The web browser shall not require any user-installed software. These triggers shall permit pickup, reset and pickup delay to be user configurable. When a trigger occurs, actions shall include Performance monitoring (Nines (9s) analysis, Capturing Waveform, Capture all metered parameters, and ability to send by email and/or activate a relay output. The meter graphic display PX-MD shall

flash an LED to annunciate the alarm condition and an audible alarm shall be available. The following trigger options shall be included:

(1) Out of limits – one hundred and five (105) triggers.
(2) Demand overload – Ten (10) triggers.
(3) ITIC curve display sag or swell voltage events – Eight (8) triggers.
(4) Fast transient – dV/dt and absolute per phase.
(5) Sub-cycle disturbance – dV/dt and absolute.

g. Event Logging: The PX-M or embedded WEB Server shall allow the user to view a list of triggered events along with any captured parameters, event details, and triggered waveforms. In addition, a separate event log shall include logging of activities including acknowledged triggers, new minimum and maximum events, and systems operations, such as resets. The size of each event log shall be virtually unlimited based only on the memory option selected.

h. ITIC Analysis Plot: The PX-M or embedded WEB Server shall include a graphic display of the Information Technology Industry Council (ITIC) plot with counts of disturbances and transients that have occurred. The ITIC plot shall organize events into eight (8) distinct disturbance zones corresponding to the severity of the event and a ninth (9th) zone for transients. A pass/fail count shall be displayed to indicate how many events are outside the ITIC limits. Operator clicking of any counter, or the event itself in the ITIC WEB page shall link the user to the event view and display all triggered events in the selected zone making it easy to view disturbance waveforms associated with the ITIC plot.

i. Sag/Swell and Waveform recording: Sixty (60) cycles of waveform shall be recorded at 256 samples per cycle including 30 cycles of pre and post event data. The embedded WEB server shall be capable of supporting viewing of all triggered waveforms one channel at a time and shall include the ability to zoom and to scroll horizontally using a slider bar. Waveforms shall be stored in non-volatile flash memory using industry standard COMTRADE format. Waveforms shall be automatically sent out as COMTRADE attachments to an email following an event, or shall be retrievable from an FTP directory structure from the meter's memory.

j. Minimum and Maximum values for the following parameters:

(1) Voltage L-L and L-N
(2) Current per phase
(3) Apparent Power Factor and Displacement Power Factor
(4) Real, Reactive, and Apparent total Power
(5) THD voltage L-L and L-N
(6) THD Current per phase
(7) Frequency

9. The PX-8000 meter base and display shall have a digital Input/Output (I/O) card which shall include:

a. Eight (8) digital inputs – self sourced 24 Vdc. These shall be interrupt driven, allowing for 1ms accuracy of digital events time stamps when utilizing local NTP server. Inputs shall be configurable for demand synch, and pulse counting. Inputs selected for pulse counting shall be scalable. Interval by interval pulse recordings shall be maintained in the PX-M/PX-B profile memory and shall be capable of being displayed graphically.

b. Three (3) relay outputs – 5A maximum form C continuous, 380Vac maximum, 125Vdc maximum. Outputs shall be suitable for KYX or alarm annunciation. Relay outputs shall have the following minimum ratings:

(1) Make: 30A, 30 Vdc, 120-240 Vac.
(2) Break: 5A, 30 Vdc, 120-240 Vac.
(3) Resistive load: 0.5A, 125Vdc; 0.25A, 250 Vdc.
(4) Mechanical Operations: 1,000,000 no-load and100,000 under rated voltage and current.
(5) Output Relay when event triggered shall be capable of operating in timed, normal or latched mode.

c. Two (2) solid state outputs – 80 mA maximum continuous, 30 Vdc maximum.

10. The PX-8000 base and display shall be provided with multiple communications ports and protocols, including the following minimum capability:

a. RS-232
b. RS-485
c. RJ-45 10/100 Base-T Local Ethernet Configuration Port for local WEB server connection
d. Modbus RTU
e. Modbus TCP
f. HTML web pages
g. File transfer protocol (FTP)
h. Ethernet TCP/IP

11. The PX-8000 graphically display shall utilize a simple “twist and click” navigation control dial to easily navigate the menus, select links to related pages, and to drill down into increasing levels of further details. A “back” key shall be provided for easy navigation to higher level screens. The graphical display shall have the following features:

a. Backlight LCD remote graphics display with 320 x 240 pixels. This display must supporting reviewing, displaying and scrolling through waveform captures without requiring a separate computer or separately purchased software.
b. Capable of being mounted to the Meter base unit or remote mounting of display up to 2000 ft away with capability of displaying up to 16 base units or complete Meters.

c. A set of screens including real time data, trend lots, waveform views and ITIC plot.
d. Allow basic device setup and password protected resets.
e. An audible alarm to annunciate alarm conditions.

12. The WEB server shall provide the user with remote WEB access to all the metered, trend and waveform information. The WEB server shall include real time monitored information in both numeric and graphical visual formats.
13. The meter shall be cable of providing the graphically display of the following Main Meter Menu Screens:

a. Meter Screen providing:

(1) Volts: L-L and L-N, and average
(2) Frequency
(3) Current and average phase A, B, and C, N & G

b. Power Screen providing:

(1) Energy
(2) Demand
(3) Power Factor

c. Quality Screen providing:

(1) Total Harmonic Distortion (THD) of volts and current
(2) Flicker
(3) Percent Nines (9s) reliability

d. Events screen providing:

(1) Latest events
(2) Enabled Triggers
(3) Historical Events

e. Set-up screen providing:

(1) View set-up
(2) Edit set-up
(3) Login
(4) Logout

14. A tool bar for screen selection which is always present and viewable shall be provided along the bottom of the graphical display. Selection of one of the main screens shall be by turning the navigation knob and highlighting the desired screen. Once selected, pressing the knob shall make the selection.

2.11 ENCLOSURES

A. The switchgear described in these specifications shall be indoor construction.

2.12 NAMEPLATES

NOTE: Refer to Identification for Electrical Systems for information pertaining to nameplates on equipment.

A. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2.13 FINISH

A. The finish shall consist of a coat of gray (ANSI-61), thermosetting, polyester powder paint applied electrostatically to pre-cleaned and phosphatized steel and aluminum for internal and external parts. The coating shall have corrosion resistance of 600 hours to 5% salt spray.

2.14 ACCESSORIES

A. The switchgear manufacturer shall furnish accessories for test, inspection, maintenance and operation, including:

1. One – Maintenance tool for manually charging the breaker closing spring and manually opening the shutter
2. One – Levering crank for moving the breaker between test and connected positions
3. One – Test jumper for electrically operating the breaker while out of its compartment
4. One – Breaker lifting yoke used for attachment to breaker for lifting breaker on or off compartment rails, when applicable
5. One – Set of rail extensions and rail clamps, when applicable
6. One – Test cabinet for testing electrically operated breakers outside housing
7. One – Electrical levering device

2.15 CORONA FREE DESIGN

A. The switchgear shall be corona free by design and shall be tested for partial discharges in accordance with EEMAC standard G11-1. The corona discharges measured during the tests shall be less than 100 picocoulombs.

2.16 PARTIAL DISCHARGE SENSING EQUIPMENT

A. The switchgear shall be equipped with factory installed partial discharge sensors and relay for continuous monitoring of the partial discharges under normal operation. The purpose of partial discharge sensing is to identify potential insulation problems (insulation degradation) by trending of PD data over time so that corrective actions can be planned and implemented before permanent insulation deterioration develops.

B. The PD sensing and monitoring system shall consist of sensors and relay specifically developed for such applications, such as Eaton's RFCT sensor and InsulGard relay, or equivalent. One RFCT sensor shall be installed over floating stress shields of specially designed bus or line side primary bushings, at every two vertical section for detection of partial discharges within the switchgear compartments. An RFCT sensor shall also be provided for installation around ground shields of the incoming or outgoing power cable termination for detection of PD activity in the cables up to 100 feet from the switchgear. Output signals from each RFCT shall be factory wired to PD monitoring relay for continuous monitoring.

2.17 CONTROLS & CONTROL TRANSFORMERS

A. The metal-clad switchgear auxiliary section for control and instrumentation shall include the following:

1. Line-to-line voltage transformers.
2. Current transformers.
3. Single-phase control power transformers with automatic throwover system. The size of the transformers shall be determined by the VacClad lineup manufacturer and each transformer shall handle the full control power load of the lineup (tie breaker closed, single source available).
4. Microprocessor-based PowerXpert 8000 metering system

2.18 SOURCE QUALITY CONTROL

A. Furnish shop inspection and testing in accordance with NEMA PB 2.

B. Make completed switchboard available for inspection at manufacturer's factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. The following standard factory tests shall be performed on the circuit breaker element provided under this section. All tests shall be in accordance with the latest version of

ANSI standards.

1. Alignment test with master cell to verify all interfaces and interchangeability
2. Circuit breakers operated over the range of minimum to maximum control voltage
3. Factory setting of contact gap
4. One-minute dielectric test per ANSI standards
5. Final inspections and quality checks

B. The following production test shall be performed on each breaker housing:

1. Alignment test with master breaker to verify interfaces
2. One-minute dielectric test per ANSI standards on primary and secondary circuits
3. Operation of wiring, relays and other devices verified by an operational sequence test
4. Final inspection and quality check

C. The manufacturer shall provide three (3) certified copies of factory test reports.

D. Factory tests as outlined above under 3.02.B shall be witnessed by LAWA.

1. The manufacturer shall notify LAWA two (2) weeks prior to the date the tests are to be performed.
2. The manufacturer shall include the cost of transportation and lodging for up to three (3) LAWA's representatives. The cost of meals and incidental expenses shall be LAWA's responsibility.

3.2 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and startup of the equipment specified under this section for a period of 5 working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. The Contractor shall provide three (3) copies of the manufacturer's field startup report.

3.3 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

3.4 TRAINING

A. The Contractor shall provide a training session for up to ten (10) LAWA's representatives for 3 normal workdays at a job site location determined by LAWA.

B. The training session shall be conducted by a manufacturer's qualified representative. Training program shall include instructions on the assembly, circuit breaker, protective devices, and other major components.

3.5 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and contract drawings.

B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

3.6 FIELD ADJUSTMENTS

A. The relays shall be set in the field by:

1. A qualified representative of the manufacturer, retained by the Contractor, in accordance with settings designated in a coordinated study of the system as required elsewhere in the contract documents.

END OF SECTION 26 13 13

SECTION 26 22 00 – LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SCOPE

A. Section includes two-winding transformers; K- factor rated shielded transformer.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA ST 1 - Specialty Transformers (Except General Purpose Type).
2. NEMA ST 20 - Dry Type Transformers for General Applications.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Product Data: Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

B. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

C. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of transformers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

A. Manufacturers:

1. Cutler Hammer
2. General Electric.
3. Square D.

B. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers.

C. Primary Voltage: 480 volts, 3 phase or unless otherwise noted.

D. Secondary Voltage: 208Y/120 volts, 3 phase or unless otherwise noted.

E. Insulation system and average winding temperature rise for rated kVA as follows:

1. 1-15 kVA: Class 185 with 115 degrees C rise.
2. 16-500 kVA: Class 220 with 115 degrees C rise.

F. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.

G. Winding Taps:

1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
2. Transformers 15 kVA and Larger: NEMA ST 20.

H. Sound Levels: NEMA ST 20. Maximum sound levels are as follows:

1. 1-5 kVA: 30 dB.
2. 6-25 kVA: 40 dB.
3. 26-150 kVA: 42 dB.
4. 151-225 kVA: 43 dB.
5. 226-300 kVA: 47 dB.
6. 301-500 kVA: 51 dB.

I. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

J. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.

K. Mounting:

1. 1-15 kVA: Suitable for wall mounting.
2. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
3. Larger than 75 kVA: Suitable for floor mounting.

L. Coil Conductors: Continuous copper windings with terminations brazed or welded.

M. Enclosure: NEMA ST 20, Type 1 indoor, dry locations and Type 3R for wet locations. Furnish lifting eyes or brackets.

N. Isolate core and coil from enclosure using vibration-absorbing mounts.

O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.2 K-FACTOR TRANSFORMERS

A. Manufacturers:

1. Cutler-Hammer
2. General Electric
3. Square D.

B. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers. K- factor 13 rated, 220 degree C insulation.

C. Primary Voltage: 480 volts, 3 phase or unless otherwise noted.

D. Secondary Voltage: 208Y/120 volts, 3 phase or unless otherwise noted.

E. 200% neutral.

F. Insulation system and average winding temperature rise for rated kVA as follows:

1. 16-500 kVA: Class 220 with 115 degrees C rise.

G. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.

H. Winding Taps:

1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full

capacity taps on primary winding.

2. Transformers 15 kVA and Larger: NEMA ST 20.

I. Sound Levels: NEMA ST 20. Maximum sound levels are as follows:

1. 6-25 kVA: 40 dB.
2. 26-150 kVA: 42 dB.
3. 151-225 kVA: 43 dB.
4. 226-300 kVA: 47 dB.
5. 301-500 kVA: 51 dB.

J. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

K. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.

L. Mounting:

1. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
2. Larger than 75 kVA: Suitable for floor mounting.

M. Coil Conductors: Continuous copper windings with terminations brazed or welded.

N. Enclosure: NEMA ST 20, Type 1 indoor, dry locations and Type 3R for wet locations. Furnish lifting eyes or brackets.

O. Isolate core and coil from enclosure using vibration-absorbing mounts.

P. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

Q. Provide an electrostatic shield.

2.3 Source Quality Control

A. Production test each unit according to NEMA ST20.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.2 INSTALLATION

A. Set transformer plumb and level.

B. Use flexible conduit, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

C. Support transformers.

1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.
2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
3. Mount trapeze-mounted transformers.

D. Provide seismic restraints.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.4 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION 26 22 00

SECTION 26 23 00 - METAL-ENCLOSED DRAWOUT SWITCHGEAR - LOW VOLTAGE

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish and install, a deadfront type, low voltage metal-enclosed switchgear assembly utilizing drawout power circuit breakers.

1.2 REFERENCES

A. The low voltage metal-enclosed switchgear assembly and all components shall be designed, manufactured and tested in accordance with the following latest applicable standards:

1. ANSI-C37.20 - Switchgear assemblies
2. ANSI-C37.13 - Low voltage power circuit breakers
3. ANSI-C37.17 - Trip devices
4. NEMA SG-5 - Switchgear assemblies
5. NEMA SG-3 - Low voltage power circuit breakers
6. UL 1558
7. UL 819

1.3 SUBMITTALS - FOR REVIEW/APPROVAL

A. The following information shall be submitted to LAWA:

1. Master drawing index
2. Front view and plan view of the assembly
3. Three-line diagram
4. Schematic diagram
5. Nameplate schedule
6. Component list
7. Conduit space locations within the assembly
8. Assembly ratings including:

    a. Short-circuit rating
    b. Voltage
    c. Continuous current rating

9. Major component ratings including:

    a. Voltage
    b. Continuous current rating
    c. Interrupting ratings

10. Cable terminal sizes

11. Product data sheets

B. Where applicable, the following additional information shall be submitted to LAWA:

1. Busway connection
2. Composite front view and plan view of close-coupled assemblies
3. Key interlock scheme drawing and sequence of operations
4. Mimic bus size and color

C. Submit shop drawings after Short Circuit and Overcurrent Protective Device Coordination Study is approved. Shop drawings submitted without approved study will be returned and not reviewed.

D. AIC ratings of all submitted equipment must conform to the approved Short Circuit and Overcurrent Protective Device Coordination Study, minimum 100,000AIC.

E. The electrical contractor shall submit ¼"=1'0" scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

1.4 SUBMITTALS - FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
2. Wiring diagrams
3. Certified production test reports
4. Installation information
5. Seismic certification as specified

1.5 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of twenty-five (25) years. When requested by LAWA, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. Provide Seismic tested equipment as follows:

E. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC) through Site Classification D. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, CBC: a peak of 2.15g's, and a ZPA of 0.86g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.

F. The manufacturer may certify the equipment based on a detailed computer analysis of the entire assembly structure and its components. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment

G. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
3. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.6 REGULATORY REQUIREMENTS

A. The switchgear shall bear a UL 1558 label.Certified copies of production test reports shall be supplied demonstrating compliance with these standards.

1.7 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete

assembly and each major component. Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals. It shall also include original shop drawings, and recommended maintenance, Manufacturer's Certification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cutler-Hammer

B. Square D

C. General Electric

D. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.2 RATINGS

A. The entire assembly shall be suitable for 600 volts maximum ac service.

B. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of 100,000 amperes symmetrical at rated voltage.

C. The bus system shall have a minimum ANSI short-circuit withstand rating of 100,000 amperes symmetrical tested in accordance with ANSI C37.20.1 and UL1558.

D. All circuit breakers shall have a minimum symmetrical interrupting capacity of 100,000 amperes. To ensure a fully selective system, all circuit breakers shall have 30 cycle short-time withstand ratings equal to their symmetrical interrupting ratings through 85,000 amperes, regardless of whether equipped with instantaneous trip protection or not.

E. All ratings shall be tested to the requirements of ANSI C37.20.1, C37.50 and C37.51 and UL witnessed and approved.

2.3 CONSTRUCTION

A. The switchgear shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide ventilators located on the top of the switchgear over the breaker and bus compartments to ensure adequate ventilation within the enclosure. Hinged rear doors, complete with provisions for padlocking, shall be provided.

B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to the floor without the use of floor sills providing the floor is level to 1/8 inch per 3-foot distance in any direction. Provisions shall be made for jacking of shipping groups, for removal of skids or insertion of equipment rollers. Base of assembly shall be suitable for rolling directly on pipes without skids. The base shall be equipped with slots in the base frame members to accommodate the use of pry bars for moving the equipment to its final position.

C. Each vertical steel unit forming part of the switchgear line-up shall be a self-contained housing having one or more individual breaker or instrument compartments, a centralized bus compartment and a rear cable compartment. Each individual circuit breaker compartment, or cell, shall be segregated from adjacent compartments and sections by means of steel barriers to the maximum extent possible. It shall be equipped with drawout rails and primary and secondary disconnecting contacts. Removable hinge pins shall be provided on the breaker compartment door hinges. Current transformers for feeder instrumentation, where shown on the plans, shall be located within the appropriate breaker cells and be front accessible and removable.

D. The stationary part of the primary disconnecting devices for each power circuit breaker shall be breaker mounted and consist of a set of contacts extending to the rear through a glass polyester insulating support barrier; corresponding moving finger contacts, suitably spaced, shall be furnished on the power circuit breaker studs which engage in only the connected position. The assembly shall provide multiple silver-tosilver full floating high pressure point contacts with uniform pressure on each finger maintained by springs. Each circuit shall include the necessary three-phase bus connections between the section bus and the breaker line side studs. Load studs shall be equipped with insulated copper load extension buses terminating in solderless type terminals in the rear cable compartment of each structure. Bus extensions shall be silver-plated where outgoing terminals are attached.

E. The circuit breaker door design shall be such that the following functions may be performed without the need to open the circuit breaker door: lever circuit breaker between positions, operate manual charging system, close and open circuit breaker, examine and adjust trip unit, and read circuit breaker rating nameplate.

F. The secondary disconnecting devices shall consist of floating terminals mounted on the stationary unit and engaging mating contacts at the front of the breaker. The secondary disconnecting devices shall be gold-plated and engagement shall be maintained in the “connected” and “test” positions.

G. The removable power circuit breaker element shall be equipped with disconnecting contacts and interlocks for drawout application. It shall have four positions, “connected”, “test”, “disconnected” and “removed”. The breaker drawout element shall contain a worm gear levering “in” and “out” mechanism with removable lever crank. Levering shall be accomplished via the use of conventional tools. Mechanical interlocking shall be provided so that the breaker is in the tripped position before levering “in” or “out” of the cell. The breaker shall include an optional provision for key locking open to prevent manual or electric closing. Padlocking shall provide for securing the breaker in the connected, test, or disconnected position by preventing levering.

H. An insulating flash shield shall be mounted above each circuit breaker to prevent flashover from the arc chutes to ground.

1. The switchgear shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

I. Provide a rear compartment barrier between the cable compartment and the main bus to protect against inadvertent contact with main or vertical bus bars.

J. Provide in the cell when the circuit breaker is withdrawn, a safety shutter which automatically covers the line and load stabs and protects against incidental contact.

1. Provide a metal barrier full height and depth between adjacent vertical structures in the cable compartment.

K. Provide a glass polyester full height and depth barrier between adjacent vertical structures in the bus compartment with appropriate slots for main bus.

2.4 BUS

A. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on ANSI standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).

B. Provide a full capacity neutral bus.

C. A copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchgear. The ground bus short-time withstand rating shall meet that of the largest circuit breaker within the assembly.

D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with Belleville-type washers.

E. Provide bus extensions on ends for future sections.

2.5 WIRING/TERMINATIONS

A. Small wiring, necessary fuse blocks and terminal blocks within the switchgear shall be furnished as required. Control components mounted within the assembly shall be suitably marked for identification corresponding to the appropriate designations on manufacturer’s wiring diagrams.

B. Provide a front accessible, isolated vertical wireway for routing of factory and field wiring. Factory provisions shall be made for securing field wiring without the need for adhesive wire anchors.

C. Front access to all circuit breaker secondary connection points shall be provided for ease

of troubleshooting and connection to external field connections without the need of removing the circuit breaker for access.

D. All control wire shall be type SIS. Control wiring shall be 16 ga for control circuits and 14 ga for shunt trip and current transformer circuits. Wire bundles shall be secured with nylon ties and anchored to the assembly with the use of pre-punched wire lances or nylon non-adhesive anchors. All current transformer secondary leads shall first be connected to conveniently accessible shorting terminal blocks before connecting to any other device. Shorting screws with provisions for storage shall be provided. All groups of control wires leaving the switchgear shall be provided with terminal blocks with suitable numbering strips and provisions for #10 AWG field connections. Each control wire shall be marked to the origin zone/wire name/destination zone over the entire length of the wire using a UV cured ink process. Plug-in terminal blocks shall be provided for all shipping split wires. Terminal connections to remote devices or sources shall be front accessible via doors above each circuit breaker. Terminal blocks shall be of the latched pull-apart type.

E. NEMA 2-hole mechanical- type lugs shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size.

F. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided.

G. Provide 25% spare terminals.

2.6 CIRCUIT BREAKERS

A. All protective devices shall be low voltage power circuit breakers. All breakers shall be UL listed for application in their intended enclosures for 100% of their continuous ampere rating.

B. All power circuit breakers shall be constructed and tested in accordance with ANSI C37.13, C37.16, C37.17, C37.50, UL 1066 and NEMA SG-3 standard. The breaker shall carry a UL label.

C. Breakers shall be provided in drawout configuration. The 800, 1600, 2000 and 3200 ampere frame power circuit breakers shall be provided in the same physical frame size, while 4000, 5000 and 6000 ampere frame power circuit breakers shall be provided in a second physical frame size. Both physical frame sizes shall have a common height and depth.

D. Power circuit breakers shall utilize a two-step stored-energy mechanism to charge the closing springs. The closing of the breaker contacts shall automatically charge the opening springs to ensure quick-break operation.

E. Breakers shall be electrically operated (EO).

F. Electrically operated breakers shall be complete with 120 Vac motor operators. The charging time of the motor shall not exceed 6 seconds. Control power for all switchgear

control circuits shall be provided by a factory-sized control power transformer wired on the line side of the main breaker(s).

G. To facilitate lifting, the power circuit breaker shall have integral handles on the side of the breaker.

H. The power circuit breaker shall have a closing time of not more than 3 cycles.

1. The primary contacts shall have an easily accessible wear indicator to indicate contact erosion.

I. The power circuit breaker shall have three windows in the front cover to clearly indicate any electrical accessories that are mounted in the breaker. The accessory shall have a label that will indicate its function and voltage. The accessories shall be plug and lock type and UL listed for easy field installation. They shall be modular in design and shall be common to all frame sizes and ratings.

J. The breaker control interface shall have color-coded visual indicators to indicate contact open or closed positions, as well as mechanism charged and discharged positions. Manual control pushbuttons on the breaker face shall be provided for opening and closing the breaker. The power circuit breaker shall have a "Positive On" feature. The breaker flag will read "Closed" if the contacts are welded and the breaker is tripped or opened.

1. The current sensors shall have a back cover window that will permit viewing the sensor rating on the back of the breaker. A rating plug will offer indication of the rating on the front of the trip unit.

K. A position indicator shall be located on the faceplate of the breaker. This indicator shall provide color indication of the breaker position in the cell. These positions shall be Connect (Red), Test (Yellow), and Disconnect (Green). The levering door shall be interlocked so that when the breaker is in the closed position, the breaker levering-in door shall not open.

L. Each power circuit breaker shall offer sixty (60) front-mounted dedicated secondary wiring points. Each wiring point shall have finger safe contacts, which will accommodate #10 AWG maximum field connections with ring tongue or spade terminals or bare wire.

2.7 TRIP UNITS

A. Each low voltage power circuit breaker shall be equipped with a solid-state tripping system consisting of three current sensors, microprocessor-based trip device and flux-transfer shunt trip. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached. Interchangeable current sensors with their associated rating plug shall establish the continuous trip rating of each circuit breaker.

B. The trip unit shall have an information system that utilizes battery backup LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip. A test pushbutton shall energize a LED to indicate the battery status.

C. The trip unit shall be provided with a display panel, including a representation of the time/current curve that will indicate the protection functions. The unit shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.

D. The trip unit shall be provided with a making-current release circuit. The circuit shall be armed for approximately two cycles after breaker closing and shall operate for all peak fault levels above 25 times the ampere value of the rating plug.

E. Trip unit shall have selectable powered and unpowered thermal memory for enhanced circuit protection.

F. Complete system selective coordination shall be provided by the addition of the following individually adjustable time/current curve shaping solid-state elements:

1. All circuit breakers shall have adjustments for long delay pickup and time.
2. All circuit breakers shall have individual adjustments for short delay pickup and time, and include I^2t settings.
3. All circuit breakers shall have an adjustable instantaneous pickup.
4. All circuit breakers shall have individually adjustable ground fault current pickup and time, and include I^2t settings.

G. The trip unit shall have provisions for a single test kit to test each of the trip functions.

H. The trip unit shall provide zone interlocking for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream breaker and allow the breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after the present time delay. Factory shall wire for zone interlocking for the power circuit breakers within the switchgear.

I. The trip unit shall include a power/relay module which shall supply control to the readout display. Following an automatic trip operation of the circuit breaker, the trip unit shall maintain the cause of trip history and the mode of trip LED indication as long as its internal power supply is available.

J. The trip unit shall include a voltage transformer module, suitable for operation up to 600V, 50/60 Hz. The primary of the voltage transformer module shall be connected internally to the line side of the circuit breaker through a dielectric test disconnect plug.

K. Provide a trip unit with Arc Reduction Module built into the trip unit, which includes multiple instantaneous trip set points, a normal/maintenance mode switch and indicating light to remind maintenance personel when the switch is in the maintenance mode B all

integral to the breaker trip unit. The ARMS reduction feature shall also have provisions for remote setting of the breaker into a maintenance mode.

L. For emergency Circuit breakers, provide individually adjustable ground fault alarm only.

M. The trip unit shall be equipped to permit communication via a network twisted pair for remote monitoring and control.

N. The trip unit shall include a power/relay module which shall supply control to the readout display. Following an automatic trip operation of the circuit breaker, the trip unit shall maintain the cause of trip history and the mode of trip LED indication as long as its internal power supply is available. An internal relay shall be programmable to provide contacts for remote ground alarm indication.

O. The trip unit shall include a voltage transformer module, suitable for operation up to 600V, 50/60 Hz. The primary of the voltage transformer module shall be connected internally to the line side of the circuit breaker through a dielectric test disconnect plug.

P. The display for the trip units shall be a 24-character LED display.

Q. Metering display accuracy of the complete system, including current sensors, auxiliary CTs, and the trip unit, shall be +/- 1% of full scale for current values. Metering display accuracy of the complete system shall be +/- 2% of full scale for power and energy values.

R. The unit shall be capable of monitoring the following data:

1. Instantaneous value of phase, neutral and ground current
2. Instantaneous value of line-to-line voltage
3. Minimum and maximum current values
4. Watts, vars, VA, watthours, varhours and VA hours

S. The energy-monitoring parameter values (peak demand, present demand, and energy consumption) shall be indicated in the trip unit's alphanumeric display panel.

T. The trip unit shall display the following power quality values: crest factor, power factor, percent total harmonic distortion, and harmonic values of all phases through the 31st harmonic.

U. An adjustable high load alarm shall be provided, adjustable from 50 to 100% of the long delay pickup setting.

V. The trip unit shall contain an integral test pushbutton. A keypad shall be provided to enable the user to select the values of test currents within a range of available settings. The protection functions shall not be affected during test operations. The breaker may be tested in the TRIP or NO TRIP test mode.

W. Programming may be done via a keypad at the faceplate of the unit or via the communication network.

X. System coordination shall be provided by the following microprocessor-based programmable timecurrent curve shaping adjustments. The short-time pickup adjustment shall be dependant on the long delay setting.

1. Programmable long-time setting
2. Programmable long-time delay with selectable I^2t or I^4t curve shaping
3. Programmable short-time setting
4. Programmable short-time delay with selectable flat or I^2t curve shaping, and zone selective interlocking
5. Programmable instantaneous setting
6. Programmable ground fault setting trip or ground fault setting alarm
7. Programmable ground fault delay with selectable flat or I^2t curve shaping and zone selective interlocking

Y. The trip unit shall offer a three-event trip log that will store the trip data, and shall time and date stamp the event.

Z. The trip unit shall have the following advanced features integral to the trip unit:

1. Adjustable undervoltage release
2. Adjustable overvoltage release
3. Reverse load and fault current
4. Reverse sequence voltage alarm
5. Underfrequency
6. Overfrequency
7. Voltage phase unbalance and phase loss during currect detection

2.8 MISCELLANEOUS DEVICES

A. Key interlocks shall be provided. These interlocks shall keep the circuit breakers trip-free when actuated.

B. Fused control power transformers shall be provided as required for proper operation of the equipment. A manual disconnect shall be provided ahead of the primary fuses. Control power transformers shall have adequate capacity to supply power to all the control circuits within the lineup.

2.9 LAWA METERING

A. Provide a separate LAWA metering compartment with front hinged door, where required.

B. Provide current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.

C. Provide potential transformers including primary and secondary fuses with disconnecting means for metering.

D. Microprocessor-Based Digital Metering Unit (DMU) shall include branch circuit

metering utilizing Eaton IQ-260 meters and main circuit metering utilizing IQ-2270 meters. All meters shall utilize RS-485 daisy-chained factory-supplied connection and a PowerXpert 600 Gateway per lineup for customer/contractor supplied network cable between lineups.

2.10 ENCLOSURES

A. NEMA 1 Enclosure for indoors, or NEMA 3R for outdoors.

2.11 NAMEPLATES

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits. Refer to Electrical Identification for additional information.

B. Furnish master nameplate giving switchgear designation, voltage ampere rating, short-circuit rating, and manufacturer's name.

C. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's drawings.

2.12 FINISH

A. All exterior and interior steel surfaces of the switchgear shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchgear shall be ANSI 61.

2.13 ACCESSORIES

A. Provide a floor running portable circuit breaker transfer truck with manual lifting mechanism, one for each concourse main electrical room.

2.14 SOURCE QUALITY CONTROL

A. Furnish shop inspection and testing in accordance with NEMA PB 2.

B. Make completed switchboard available for inspection at manufacturer's factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. The switchgear shall be completely assembled, wired, adjusted and tested at the factory. After assembly, the complete switchgear shall be tested to ensure the accuracy of the wiring and the functioning of all equipment. The main bus system shall be given a dielectric test of 2200 volts for one minute between live parts and ground and between opposite polarities.

B. The wiring and control circuits shall be given a dielectric test of 1500 volts for one minute, or 1800 volts for one second, between live parts and ground, in accordance with ANSI C37.20.1.

C. A certified test report of all standard production tests shall be shipped with each assembly.

D. Factory test as outlined above shall be witnessed by LAWA's representative.

1. The manufacturer shall notify LAWA two (2) weeks prior to the date the tests are to be performed
2. The manufacturer shall include the cost of transportation and lodging for up to three (3) LAWA's representatives. The cost of meals and incidental expenses shall be LAWA's responsibility

3.2 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section for a period of 5 working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. The Contractor shall provide three (3) copies of the manufacturer's field startup report.

3.3 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification before final payment.

3.4 TRAINING

A. The Contractor shall provide a training session for up to ten (10) LAWA's representatives for 2 normal workdays at a job site location determined by LAWA.

B. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers, and major components within the assembly.

3.5 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer's recommendations.

B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

C. The equipment shall be installed and checked in accordance with the manufacturer's recommendations. This shall include but not limited to:

1. Checking to ensure that the pad location is level to within 0.125 inches per three foot of distance in any direction
2. Checking to ensure that all bus bars are torqued to the manufacturer's recommendations

D. Assembling all shipping sections, removing all shipping braces and connecting all shipping split mechanical and electrical connections

E. Securing assemblies to foundation or floor channels

F. Measuring and recording Megger readings phase-to-phase, phase-to-ground, and neutral-to-ground (four wire systems only)

G. Inspecting and installing all circuit breakers in their proper compartments

END OF SECTION 26 23 00

SECTION 26 24 13-SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes main and distribution switchboards.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI C12.1 - Code for Electricity Metering.
2. ANSI C39.1 - Requirements, Electrical Analog Indicating Instruments.

B. Institute of Electrical and Electronics Engineers:

1. IEEE C57.13 - Standard Requirements for Instrument Transformers.
2. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

C. National Electrical Manufacturers Association:

1. NEMA FU 1 - Low Voltage Cartridge Fuses.
2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
3. NEMA PB 2 - Deadfront Distribution Switchboards.
4. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.

D. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

E. Underwriters Laboratories Inc.:

1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.3 SUBMITTALS

A. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars for each phase, neutral, and ground; and switchboard instrument details.

B. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.

C. The electrical contractor shall submit ¼”=1’0” scale drawings including interior elevations of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. These drawings shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches will be returned and not reviewed.

> **NOTE:** The equipment depicted on the plans and interior elevations shall match the equipment indicated on the shop drawings.

D. Test Reports: Indicate results of factory production and field tests.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations, configurations, and ratings of switchboards and their components on single line diagrams and plan layouts.

B. Operation and Maintenance Data: Submit spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. The manufacturer of the switchboard assembly shall be the same as the manufacturer of the circuit breakers installed within the assembly.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept switchboards on site. Inspect for damage.

B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle in accordance with NEMA PB 2.1. Lift only with lugs provided. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Conform to NEMA PB 2 service conditions during and after installation of switchboards.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 DISTRIBUTION SWITCHBOARDS

A. Manufacturers:

1. Cutler-Hammer.
2. GE Electrical.
3. Square D.

B. Product Description: NEMA PB 2, enclosed switchboard.

C. Switchboards shall be “fully-rated” for the available short circuit current. “Series-rated” equipment is not acceptable. Main 480 volt service switchboards in the terminals shall be rated 100kAIC.

D. Device Mounting:

1. Main Section: Panel mounted.
2. Distribution Section: Panel mounted.

E. Bus:

1. Material: Copper with silver or tin plating standard size.
2. Connections: Bolted, accessible from front for maintenance.
3. Provide bus extensions on ends for future sections.

F. Ground Bus: Extend length of switchboard.

G. Line and Load Terminations: Accessible from front only of switchboard, suitable for conductor materials.

H. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, insulated and braced for short circuit currents. Leave space in design for one spare section to be added. Provide footprint area for future expansion.

I. Switchboard Height: 90 inches, excluding floor sills, lifting members and pull boxes.

J. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

2.2 MOLDED CASE CIRCUIT BREAKER

NOTE: Molded Case Circuit Breakers are for typical frame sizes ranging from 110A to 2500A.

A. Manufacturers:

1. **Cutler-Hammer.**
2. **General Electric.**
3. **Square D.**

B. Product Description: UL 489, molded-case circuit breaker.

C. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for adjusting long time short time continuous current; short time long time pickup current setting for automatic operation.

D. Field-Changeable Ampere Rating Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have changeable trip units.

E. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing instantaneous trip; and adjustable short time trip.

F. Accessories:

1. Shunt Trip Device.
2. Undervoltage Trip Device.
3. Auxiliary Switch.
4. Alarm Switch.
5. Electrical Operator.
6. Handle Lock: Provisions for padlocking.
7. Grounding Lug: In each enclosure.

2.3 INSULATED CASE CIRCUIT BREAKER

NOTE: Molded Case Circuit Breakers are for typical frame sizes ranging from 800A to 6000A.

A. Manufacturers:

1. **Cutler-Hammer.**
2. **General Electric.**
3. **Square D.**

B. Product Description: UL 489, enclosed, insulated-case circuit breaker.

C. Trip Unit: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing instantaneous trip; and adjustable short time trip.

NOTE: Incorporating any of the below accessories is dependent on the design of the new electrical system.

D. Accessories:

1. Shunt Trip Device.
2. Undervoltage Trip Device.
3. Auxiliary Switch.
4. Alarm Switch.
5. Electrical Operator.
6. Handle Lock: Provisions for padlocking.
7. Grounding Lug: In each enclosure.

2.4 POWER METERS

NOTE: Power meters are to meter the entire switchboard. Tenant sub metering may be required.

A. Provide electronic power meter to indicate the following parameters.

1. Voltage: Phase-Phase and Phase-Neutral.
2. Current in Each Phase.
3. KW.
4. KVA.
5. KVAR.
6. Power Factor.
7. Current Demand.
8. Maximum Demand.
9. Kwhour.

2.5 SOURCE QUALITY CONTROL

A. Furnish shop inspection and testing in accordance with NEMA PB 2.

B. Make completed switchboard available for inspection at manufacturer's factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with NEMA PB 2.1.

B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.

C. Install engraved nameplates.

D. Install breaker circuit directory.

E. Ground and bond switchboards.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.1.

3.3 ADJUSTING

A. Adjust operating mechanisms for free mechanical movement.

B. Tighten bolted bus connections.

C. Adjust circuit breaker trip and time delay settings to values as indicated on short circuit study. Refer to Overcurrent Protective Device Coordination Study.

NOTE: These above adjustments shall be performed by a third party. These adjustments shall include but are not limited to, the following studies: short circuit study, coordination study and arc flash study.

END OF SECTION 26 24 13

SECTION 26 24 16-PANELBOARDS

PART 1 – GENERAL

> **NOTE:** For all panelboards above 800A, use switchboards.

1.1 SUMMARY

A. Section includes distribution and branch circuit panelboards.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
6. NEMA PB 1 - Panelboards.
7. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

E. Underwriters Laboratories Inc.:

1. UL 67 - Safety for Panelboards.
2. UL 1283 - Electromagnetic Interference Filters.
3. UL 1449 - Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

B. Product Data: Submit catalog data showing specified features of standard products.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

B. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. The manufacturer of the panelboard shall be the same manufacturer of the major components within the assembly, including circuit breakers and fusible switches.

1.6 MAINTENANCE MATERIALS

A. Furnish two of each panelboard key. Panelboards keyed alike to LAWA's current keying system.

PART 2 - PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

NOTE: Due to the corrosive exterior environment at the airport, all panelboards are to be located indoors, as much as possible. In the event that an exterior installation is the only option, all exterior panelboards are to be a **NEMA Type 4 or better.**

A. Manufacturers:

1. **Cutler-Hammer.**
2. **GE Electrical.**
3. **Square D.**

B. Product Description: NEMA PB 1, circuit breaker type panelboard.

C. Panelboard Bus: Copper, current carrying components, and furnish copper ground bus in each panelboard.

D. Minimum integrated short circuit rating: Amperes rms symmetrical shall be 42,000A rms symmetrical. Panelboards shall be fully rated; series rated equipment is not acceptable.

E. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

F. Circuit Breaker Accessories: Trip units and auxiliary switches.

G. Enclosure: NEMA PB 1, Type 1 for indoors, Type 4, or better for outdoors.

H. Cabinet Front: Surface door-in-door type, fastened with screws, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel – NC16.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers:

1. **Cutler-Hammer.**
2. **GE Electrical.**
3. **Square D.**

B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Panelboard Bus: Copper, current carrying components. Furnish copper ground bus in each panelboard with full sized neutral; furnish insulated ground bus.

D. For non-linear load applications subject to harmonics furnish 200 percent rated, plated copper, solid neutral.

E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208 volt panelboards; 42,000 amperes min, rms symmetrical for 480 volt panelboards.

F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers. Do not use tandem circuit breakers.

G. Enclosure: NEMA PB 1, Type 1 or for indoor, or NEMA 4 or better for outdoors.

H. Cabinet Box: 6 inches deep, 20 inches inches wide for 240 volt and less panelboards, 20 inches inches wide for 480 volt panelboards. Surface mounted.

I. Cabinet Front: Flush or Surface cabinet, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel. No concealed trim clamps.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Install panelboards plumb.

C. Install recessed panelboards flush with wall finishes.

D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

E. Install filler plates for unused spaces in panelboards.

F. Provide typed circuit directory for each branch circuit panelboard. Refer to LAWA standard before revising directory to reflect circuiting changes to balance phase loads.

G. Directory shall list each circuit load and area or room number in which each load is located. Changes to existing directories shall be made with a P-Touch or other label machine.

H. Install engraved nameplates per LAWA standards.

I. Install spare conduits out of each recessed panelboard to accessible location above ceiling or below floor. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.

J. Ground and bond panelboard enclosure. Connect equipment ground bars of panels in accordance with NFPA 70.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

C. Perform switch inspections and tests listed in NETA ATS, Section 7.5.

D. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION 26 24 16

SECTION 26 24 19-MOTOR-CONTROL CENTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes motor control centers.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers.
5. NEMA ICS 3 - Industrial Control and Systems: Factory Built Assemblies.
6. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
7. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.
8. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.
9. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars for each phase, neutral, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time and current curves of equipment and components.

B. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.

C. Submit dimensioned room layout complete with all equipment shown to scale.

D. Submit control schematics for each starter within.

E. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations, configurations, and ratings of motor control centers and major components.

B. Operation and Maintenance Data: Submit replacement parts list for controllers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

PART 2 - PRODUCTS

2.1 MOTOR CONTROL CENTER

A. Manufacturers:

1. **Cutler-Hammer.**
2. **GE Electrical.**
3. **Square D.**

B. Product Description: NEMA ICS 3, Class I, Type B heavy duty, industrial grade motor control center.

C. Service Conditions: NEMA ICS 2.

D. Main Overcurrent Protection: Molded case circuit breaker.

E. Feeder Tap Units: Molded case thermal-magnetic circuit breakers.

F. Voltage Rating: 480 or 120/208 volts, three phase, three or four wire, 60 Hertz.

G. Horizontal Bus: Copper, with continuous current rating. Include copper ground bus entire length of control center.

H. Vertical Bus: Copper.

I. Configuration: Units front mounting only, accessible from front only.

J. Enclosure: NEMA ICS 6, Type 1 or 3R, non-walk-in or 3R, walk-in or 12.

K. Finish: Manufacturer's standard gray enamel.

L. All indicating and pilot lights shall be LED with metal housing and easily replaceable parts.

M. All control wiring shall be installed in Panduit wiring ducts. Control wiring shall be stranded copper.

2.2 FULL-VOLTAGE NON-REVERSING CONTROLLERS

A. Manufacturers:

1. Cutler-Hammer.
2. GE Electrical.
3. Square D.

B. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

C. Overload Relay: NEMA ICS 2; bimetal or melting alloy.

D. Product Options and Features:

1. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact.
2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty type.
3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
4. Pushbuttons: Unguarded type.
5. Indicating Lights: LED type.
6. Selector Switches: Rotary type, Hand-Off-Auto.
7. Relays: NEMA ICS 5.
8. Control Power Transformers: In each motor controller as scheduled. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

2.3 TWO-SPEED CONTROLLERS

A. Manufacturers:

1. Cutler-Hammer.
2. GE Electrical.
3. Square D.

B. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Include integral time delay transition between FAST and SLOW speeds.

C. Control Voltage: As required.

D. Overload Relay: NEMA ICS 2; bimetal or melting alloy.

E. Product Options and Features:

1. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact.
2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty type.
3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
4. Pushbuttons: Unguarded type.
5. Indicating Lights: LED type.
6. Selector Switches: Rotary type, with “High-Low”.
7. Relays: NEMA ICS 5.
8. Control Power Transformers: In each motor controller as scheduled. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

2.4 FULL-VOLTAGE REVERSING CONTROLLERS

A. Manufacturers:

1. Cutler-Hammer.
2. GE Electrical.
3. Square D.

B. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Include electrical interlock and integral time delay transition between FORWARD and REVERSE rotation.

C. Control Voltage: As required.

D. Overload Relay: NEMA ICS 2; bimetal or melting alloy.

E. Product Options and Features:

1. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact.
2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty type.
3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
4. Pushbuttons: Unguarded type.
5. Indicating Lights: LED type.
6. Selector Switches: Rotary type.
7. Relays: NEMA ICS 5.

8. Control Power Transformers: In each motor controller as scheduled. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

2.5 MOLDED CASE CIRCUIT BREAKER

A. Manufacturers:

1. Cutler-Hammer.
2. GE Electrical.
3. Square D.

B. Product Description: NEMA AB 1, molded-case circuit breaker.

C. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for adjusting long time, short time, continuous current and long time pickup current setting for automatic operation.

2.6 SOURCE QUALITY CONTROL

A. Shop inspect and perform standard productions tests for each controller in accordance with manufacturer's standards.

B. Make completed motor control center available for inspection at manufacturer's factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify surfaces are suitable for motor control center installation.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.16.

C. Inspect and test variable frequency controllers according to NEMA ICS 7.1.

3.3 INSTALLATION

A. Install engraved nameplates.

B. Neatly type label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, voltage rating, and phase rating. Place label in clear plastic holder.

C. Ground and bond motor control centers.

D. Provide wire markers or tags for all control wiring at all termination points. See Identification for Electrical Systems.

E. Each plug-in unit shall control only one motor, no dual starters.

F. Provide a circuit breaker for the unit disconnect device, not a fusible switch.

G. Provide side mounted, latched pull-apart terminal blocks for all remote control wiring. Provide 25% spare terminals.

H. No interlock for A-B motor configuration.

I. Overload reset button shall be operable without wires blocking access.

END OF SECTION 26 24 19

SECTION 26 25 00 - ENCLOSED BUS ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes busway and fittings.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA BU 1 - Busways.
3. NEMA BU 1.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Busway Rated 600 Volts or Less.
4. NEMA FU 1 - Low Voltage Cartridge Fuses.
5. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
6. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
7. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Shop Drawings: Indicate ratings, dimensions and finishes. Include dimensioned layout diagram; installation details; locations of supports and fittings; and firestops and weatherseals at penetrations. Include details of wall and floor penetrations. Include isometric layouts/views of bus duct configuration.

B. Product Data: Submit catalog data for components.

C. Coordination Drawings: Indicate busway layout and support locations.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of busway routing.

B. Operation and Maintenance Data: Submit joint re-tightening schedule.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience.

C. All busway components shall be of the same manufacturers as the busway.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle in accordance with NEMA BU 1.1 and manufacturer's written instructions.

B. Protect from moisture by using appropriate coverings. Store in dry interior locations.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install indoor busway until building is closed in and suitable temperature conditions are controlled.

B. Conform to NEMA BU 1 service conditions during and after installation of busway.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 SEQUENCING

A. Sequence Work to avoid interferences with building finishes and installation of other products.

PART 2 - PRODUCTS

2.1 BUSWAY

A. Manufacturers:

1. **Cutler Hammer.**
2. **General Electric.**
3. **Square D.**

B. Product Description: NEMA BU1, 3 phase, 4wire enclosed busway. Indoor: Sprinkler proof. Outdoor; NEMA4. Feeder type or plug-in type as applicable or as required.

1. Voltage: 277/480 volts, 60 Hz, or as required.
2. Ampere Ratings: As required.
3. Full neutral.
4. Insulated ground bus.

C. Conductors: Copper bars, fully insulated except at joints.

D. Joints: Single bolt type, with silver-plated contact surface for bus and splice plate.

E. Fittings: According to manufacturer's recommendations.

F. Finish: Manufacturer's standard gray enamel.

2.2 SOURCE QUALITY CONTROL

A. Inspect and test according to NEMA BU1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with NEMA BU1.1.

B. Tighten joints using torque wrench, to manufacturer's specified values.

C. Install busway length with expansion fitting at each location where busway run crosses building expansion joint.

D. Support busway at maximum 10 feet intervals or as recommended by manufacturer. Support vertical riser at each floor.

E. Install busway with integral fire stops located where busway penetrates fire-rated walls and floors. Seal around opening to maintain fire-rating equal to wall or floor rating.

F. Install concrete curb around interior floor penetrations.

G. Install engraved nameplates.

H. Ground and bond busway.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.4.

END OF SECTION 26 25 00

SECTION 26 27 16 - ELECTRICAL CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes hinged cover enclosures, cabinets, terminal blocks, and accessories.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.

B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.5 EXTRA MATERIALS

A. Furnish two of each key.

PART 2 - PRODUCTS

NOTE: Due to the corrosive exterior environment at the airport, all electrical cabinets and enclosures are to be located indoors, as much as possible. In the event that an exterior installation is the only option, these items are to be a **NEMA Type 4x – Stainless Steel.**

2.1 HINGED COVER ENCLOSURES

A. Manufacturers:

1. **Hoffman Electrical Products.**
2. **Square D**
3. **General Electric**

B. Construction: NEMA 250, Type 1 for indoors or **4X stainless steel enclosure** for outdoor installations.

C. Covers: Continuous hinge, held closed by flush latch operable by key.

D. Furnish interior plywood panel for mounting terminal blocks and electrical components; finish with white enamel.

E. Enclosure Finish: Manufacturer's standard enamel.

2.2 CABINETS

A. Manufacturers:

1. **Hoffman Electrical Products.**
2. **Square D.**
3. **General Electric.**

B. Boxes: Galvanized steel with removable end walls.

C. Backboard: Furnish 3/4 inch thick plywood backboard for mounting terminal blocks. Paint matte white.

D. Fronts: Steel, flush or surface type with screw cover front, door with concealed hinge. Finish with gray baked enamel.

E. Knockouts: as required for conduit entry.

F. Furnish metal barriers to form separate compartments wiring of different systems and voltages.

G. Furnish accessory feet for free-standing equipment.

2.3 TERMINAL BLOCKS

A. Terminal Blocks: NEMA ICS 4.

B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

C. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.

D. Furnish ground bus terminal block, with each connector bonded to enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.

B. Install cabinet fronts plumb.

3.2 CLEANING

A. Clean electrical parts to remove conductive and harmful materials.

B. Remove dirt and debris from enclosure.

C. Clean finishes and touch up damage.

END OF SECTION 26 27 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wall switches; wall dimmers; receptacles; multioutlet assembly; and device plates and decorative box covers.

> **NOTE:** The colors for all new wiring devices shall be compatible with the interior design aesthetic established for the public areas of the terminal.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA WD 1 - General Requirements for Wiring Devices.
2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.

B. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.5 EXTRA MATERIALS

A. Furnish two of each style, size, and finish wall plate.

PART 2 - PRODUCTS

> **NOTE:** All wiring devices for emergency circuits shall be red.

2.1 WALL SWITCHES

A. Manufacturers:

1. Leviton.
2. Hubbell.
3. Pass & Seymour.

B. Product Description: NEMA WD 1 Industrial, Heavy-Duty, AC only general-use snap switch, Leviton Decora, or similar.

C. Indicator Light: Lighted handle type switch.

D. Locator Light: Lighted handle type switch; clear color handle.

E. Ratings:

1. Voltage: 120-277 volts, AC.
2. Current: 20 amperes.

2.2 WALL DIMMERS

A. Manufacturers:

1. Hubbell.
2. Leviton.
3. Lutron.

B. Product Description: NEMA WD 1, Type I semiconductor dimmer for incandescent lamps and for fluorescent lamps. Coordinate ballast type with dimmable fluorescent lamps.

C. Voltage: 120V or as required for application.

D. Power Rating: As required for application.

E. Accessory Wall Switch: Match dimmer appearance.

2.3 RECEPTACLES

A. Manufacturers:

1. Hubbell.
2. Leviton.
3. Pass & Seymour.

B. Product Description: NEMA WD 1, industrial, Heavy-duty and general-duty general-use receptacle, Leviton Decora or similar.

C. Configuration: NEMA WD 6, type as required.

D. Convenience Receptacle: Type 5-20.

E. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.4 WALL PLATES

A. Manufacturers:

1. Hubbell.
2. Pass & Seymour.
3. Leviton.

B. Indoor Cover Plate: Stainless Steel, for indoor switches, dimmers and receptacles.

C. Weatherproof Cover Plate: Gasketed cast metal plate with hinged and gasketed device cover for outdoor wiring devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify outlet boxes are installed at proper height.

B. Verify wall openings are neatly cut and completely covered by wall plates.

C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install devices plumb and level.

B. Install switches with OFF position down.

C. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

D. Do not share neutral conductor on load side of dimmers.

E. Install receptacles with grounding pole on top.

F. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

G. Install cover plates on switch, dimmer, receptacle, and blank outlets in all areas.

H. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.

1. Use jumbo size plates for outlets installed in masonry walls.

I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas and above accessible ceilings.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes to obtain required mounting heights.

B. Install wall switch 48 inches above finished floor, unless otherwise noted.

C. Install convenience receptacle 18 inches above finished floor, unless otherwise noted.

D. Install convenience receptacle 6 inches above back splash of counter.

E. Install dimmer 48 inches above finished floor, unless otherwise noted.

3.5 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify each receptacle device is energized.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fuses.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.3 DESIGN REQUIREMENTS

A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for the following components: wire, cable, bus structures, and other equipment. Design system to maintain component damage within acceptable levels during faults.

B. Select fuses to coordinate with time current characteristics of other overcurrent protective elements, including other fuses, circuit breakers, and protective relays. Design system to maintain operation of device closest to fault operates.

1.4 FUSE PERFORMANCE REQUIREMENTS

A. Motor Load Feeder Switches: Class RK1 (time delay).

B. General Purpose Branch Circuits: Class RK1 (time delay).

C. Motor Branch Circuits: Class RK1 (time delay).

1.5 SUBMITTALS

A. Product Data: Submit data sheets showing electrical characteristics, including time-current curves.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual sizes, ratings, and locations of fuses.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.8 MAINTENANCE MATERIALS

A. Furnish two fuse pullers for each type of fuses.

PART 2 - PRODUCTS

2.1 FUSES

A. Manufacturers:

1. Bussman
2. Gould.
3. Littlefuse.

B. Dimensions and Performance: NEMA FU 1, Class as required.

C. Voltage: Rating suitable for circuit phase-to-phase voltage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuse with label oriented so manufacturer, type, and size are easily read.

B. Install spare fuse cabinet.

END OF SECTION 26 28 13

SECTION 26 28 19 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fusible and nonfusible switches.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA FU 1 - Low Voltage Cartridge Fuses.
2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
2. Underwriters Laboratory, Inc. (UL).

a. 98 B Enclosed and Dead-Front Switches,
b. 198C B High Interrupting Capacity Fuses, Current Limiting Types.
c. 198E B Class R Fuses.
d. 512 B Fuseholders.

1.3 SUBMITTALS

A. Product Data: Submit switch ratings and enclosure dimensions.

B. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:

1. General Electric.
2. Cutler Hammer.
3. Square D.

B. Product Description: NEMA KS 1, Type HD, quick-make/quick break with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Fuse clips: Designed to accommodate NEMA FU 1.

D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4 or better.

E. Furnish switches with entirely copper current carrying parts.

2.2 NONFUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:

1. General Electric.
2. Cutler Hammer.
3. Square D.

B. Product Description: NEMA KS 1, Type HD quick make/quick-break with externally operable handle interlocked to prevent opening front cover with switch in ON position enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4 or better.

D. Furnish switches with entirely copper current carrying parts.

2.3 SWITCH RATINGS

A. Switch Rating: Number of poles, voltage, current and horsepower rating as required for particular installation.

B. Short Circuit Current Rating: UL listed for 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed switches plumb. Provide supports.

B. Height: 5 feet to operating handle.

C. Install fuses for fusible disconnect switches.

D. Install engraved nameplates.

E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION 26 28 19

SECTION 26 28 23 - ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes molded-case and insulated-case circuit breakers in individual enclosures.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Submit shop drawings after Short Circuit and Overcurrent Protective Device Coordination Study, is approved. Shop drawings submitted without approved study will be returned and not reviewed.

B. AIC ratings shown on the single line diagrams are approximate values only. The AIC ratings of all submitted equipment must conform to the approved Short Circuit and Overcurrent Protective Device Coordination Study.

C. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

D. Product Data: Submit catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and continuous current ratings of enclosed circuit breakers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 MOLDED CASE CIRCUIT BREAKER

A. Manufacturers:

1. General Electric.
2. Cutler Hammer.
3. Square D.

B. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1 and FS-W-C

C. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 400 amperes and larger have mechanism for adjusting long time, short time, continuous current setting for automatic operation.

D. Field-Changeable Ampere Rating Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have changeable trip units.

E. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing; instantaneous trip; and adjustable short time trip.

F. Accessories: Conform to NEMA AB 1.

NOTE: Accessories will be dependent on the system design.

1. Shunt Trip Device: 120 volts, AC.
2. Undervoltage Trip Device: 120 volts, AC.
3. Auxiliary Switch: 120 volts, AC.
4. Alarm Switch: 120 volts, AC.
5. Electrical Operator: 120 volts, AC.
6. Handle Lock: Provisions for padlocking.

G. Enclosure: NEMA AB 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4 or better.

H. Series Rating: Series rated breakers shall not be used.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field measurements.

C. Verify that required utilities are available, in proper location and ready for use.

D. Beginning of installation means that installer accepts conditions.

3.2 INSTALLATION

A. Install enclosed circuit breakers plumb. Provide supports.

B. Height: 5 feet to operating handle.

C. Locate and install engraved nameplates.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1.

3.4 ADJUSTING

A. Adjust trip settings to coordinate circuit breakers with other overcurrent protective devices in circuit.

B. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

END OF SECTION 26 28 23

SECTION 26 28 26 - ENCLOSED TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes transfer switches in individual enclosures.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. Underwriters Laboratories Inc.:

1. UL 1008 - Transfer Switch Equipment.

1.3 SUBMITTALS

A. Submit shop drawings after Short Circuit and Overcurrent Protective Device Coordination Study, is approved. Shop drawings submitted without approved study will be returned and not reviewed.

B. AIC ratings shown on the single line diagrams are approximate values only. The AIC ratings of all submitted equipment must conform to the approved Short Circuit and Overcurrent Protective Device Coordination Study.

C. The electrical contractor shall submit 3@=1=0@ scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

D. Product Data: Submit catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, control schematics, short circuit ratings, dimensions, and enclosure details.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of enclosed transfer switches.

B. Operation and Maintenance Data: Submit routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

B. Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience.

1.6 MAINTENANCE SERVICE

A. Furnish service and maintenance of transfer switches for one year from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCH

A. Manufacturers:

1. Russelectic Inc.
2. ASCO.
3. Onan.

B. Manufacturer

1. The combination transfer bypass/isolation switch manufacturer shall employ a nationwide factorydirect, field service organization, available on a 24-hour a day, 365 days a year, call basis.
2. The manufacturer shall maintain records of each combination transfer bypass/isolation switch, by serial number, for a minimum 20 years.

C. Product Description: Automatic transfer switch with by-pass isolation switches.

D. Rating: State voltage and current rating and number of poles.

E. Interrupting Capacity: As required from coordination study.

2.2 CONSTRUCTION

A. General

1. The automatic transfer switch (ATS) and its associated bypass/isolation (BPS) shall be furnished. Voltage and continuous current ratings and number of poles shall be as required.
2. All ATS shall be a true 4-pole switch supplied with all four poles mounted on a common shaft as a 3 pole switch. The continuous current rating and the closing and withstand rating of the fourth pole shall be identical to the rating of the main poles.
3. The combination automatic transfer bypass/isolation switch shall be mounted in a freestanding NEMA 1 enclosure, unless otherwise indicated. Enclosures shall be fabricated from 12-gauge steel. The enclosure shall be sized to exceed minimum wire bending space required by UL 1008.
4. Both units shall be bused together with silver plated copper bus and/or cable interconnection bus to provide a complete pre-tested assembly. Construction shall be such that the contractor needs to install only the power and control connections.
5. Bypass/isolation switches shall provide a safe and convenient means for manually bypassing and isolating the automatic transfer switch, regardless of the condition or position of the ATS, with the ability to be used as an emergency back-up system in the event the transfer switch should fail. In addition, the bypass/isolation switch shall be utilized to facilitate maintenance and repair of the automatic transfer switch.
6. The automatic transfer switch shall be completely isolated from the bypass/isolation switch by means of insulating barriers and separate access doors to positively prevent hazard to operating personnel while servicing the automatic transfer switch.
7. The combination automatic transfer bypass/isolation switch shall be top and bottom accessible.
8. The main contacts shall be capable of being replaced without removing the main power cables.
9. The main contacts shall be visible for inspection without any major disassembly of the transfer switch.
10. When a solid neutral is required, a fully rated bus bar with required AL-CU neutral lugs shall be provided.
11. The complete combination automatic transfer bypass/isolation switch assembly shall be factory tested to ensure proper operation and compliance with the specification requirements. A copy of the factory test report shall be available upon request.

B. Bypass/Isolation Construction

1. All main contacts and operating linkages of the bypass/isolation section shall be identical to the ATS, except that the operation shall be manual.
2. The bypass/isolation switch shall be load break type and shall have the same electrical ratings of ampacity, voltage, short circuit withstand, and temperature rise capability as the associated ATS. The bypass/isolation switch shall be the load-break type. The main contacts of the bypass switch shall be mechanically locked in both the normal bypass and emergency bypass positions without the use of hooks, latches, magnets, or springs and shall be silver-tungsten alloy,

protected by arcing contacts with magnetic blowouts on each pole. The switching mechanism shall provide "quick-make", "quick-break" operation of the contacts.

3. The primary buss work of the draw-out automatic transfer switch shall be connected to the stationary bus stabs in the freestanding cubicle by silver plated, segmented, self-aligning, primary disconnect fingers to facilitate proper alignment between the removable draw-out when the ATS is withdrawn and shall be available for inspection without disturbing or de-energizing the main bus.
4. The secondary control disconnect contacts mounted on the ATS shall be self-aligning and shall plug into the stationary elements mounted on the freestanding cubicle. Separate, manual, secondary control disconnect plugs are not acceptable.
5. The isolating portion of the bypass/isolation shall allow the automatic transfer switch to be disconnected from all sources of power and control without opening the enclosure door. The transfer switch shall have a true draw-out configuration that does not require disconnection of any electrically or mechanical device by maintaining personnel. The automatic transfer switch shall be provided with rollers or casters to allow it to be removed from its enclosure simply by rolling it out. Positive mechanical interlocks shall be provided to insure that the bypass/isolation functions can be accomplished without the danger of a short circuit. Overlapping contact bypass/isolation switches, that are dependent upon the position of the automatic transfer switch for proper operation, are not acceptable.
6. A fourth pole, switched neutral shall be provided if the associated automatic transfer switch is designed as 4-pole. Basic 4-pole, bypass/isolation switch construction shall be identical to the associated automatic transfer switch construction.
7. Necessary controls shall be provided to ensure that the "engine run" circuit remains closed when the switch is in the bypass-to-emergency position, even though the associated transfer switch is in the "normal" position or completely removed from the enclosure.

C. Automatic Transfer Switch

1. The transfer switch shall be double throw, actuated by two electric operators momentarily energized, and connected to the transfer mechanism by a simple over center type linkage. Minimum transfer time shall be 400 milliseconds.
2. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in both the normal and emergency positions without the use of hooks, latches, magnets, or springs, and shall be silver-tungsten alloy. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches. Interlocked, molded case circuit breakers or contactors are not acceptable.
3. The transfer switch shall be equipped with a safe external manual operator, designed to prevent injury to operating personnel. The manual operator shall provide the same contact to contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly. The external

manual operator shall be safely operated from outside of the transfer switch enclosure while the enclosure door is closed.

D. Automatic Transfer Switch Controls

1. The transfer switch shall be equipped with a microprocessor based control system, to provide all the operational functions of the automatic transfer switch. The controller shall have two asynchronous serial ports. The controller shall have a real time clock with NiCad battery back up.
2. The CPU shall be equipped with self diagnostics which perform periodic checks of the memory I/O and communication circuits, with a watchdog/power fail circuit
3. The controller shall use industry standard open architecture communication protocol for highspeed serial communications via multi-drop connection to other controllers and to a master terminal with up to 4000 ft of cable, or further, with the addition of a communication repeater. The serial communication port shall be RS422/485 compatible.
4. The serial communication port shall allow interface with the manufacturer field service representative and BMS network.
5. The controller shall have password protection required to limit access to qualified and authorized personnel.
6. The controller shall include a 20 character, LCD display, with a keypad, which allows access to the system.
7. The controller shall include three-phase over/under voltage, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.
8. The controller shall be capable of storing the following records in memory for access either locally or remotely:

    a. Number of hours transfer switch is in the emergency position (total since record reset).
    b. Number of hours emergency power is available (total since record reset).
    c. Total transfer in either direction (total since record reset).
    d. Date, time, and description of the last four source failures.
    e. Date of the last exercise period.
    f. Date of record reset.

9. The controller shall also be capable of monitoring, logging and trending power data and shall include the following:

    a. The controller shall be accurate to 1% measured. Voltage and current for all phases shall be sampled simultaneously to assure high accuracy in conditions of low power factor or large waveform distortions (harmonics). The controller shall be capable of operating at nominal frequencies of 45 to 66 Hz.
    b. The controller shall accept inputs from industry standard current transformers (5A secondary). Direct phase voltage connections, 600 VAC and under, shall be possible without the use of PT=s.
    c. The controller shall be capable of being applied in single or 3-phase, three and four wire circuits.

d. The controller shall use industry standard open architecture communication protocol for serial communications via multi-drop connection to other controllers and to a master terminal with up to 4000 feet of cable, or further, with the addition of a communication repeater. The serial communication port shall be RS422/485 compatible.

e. All setup parameters required by the controller for power monitoring shall be stored in nonvolatile memory and retained in the event of a control power interruption.

f. The following metered readings shall be communicated by the Controller, via local display and serial communication. And to the master Control Cubicle at the Emergency Generator Control and Distribution Switch Gear:

(1) Current, per phase RMS and neutral
(2) Current Unbalance %
(3) Voltage, phase-to-phase and phase-to-neutral
(4) Voltage Unbalance %
(5) Real power (KW), per phase and 3-phase total
(6) Apparent power (KVA), per phase and 3-phase total
(7) Reactive power (KVAR), per phase and 3-phase total
(8) Power factor, 3-phase total & per phase
(9) Frequency
(10) Accumulated Energy, (KWH, KVAH, and KVARH)

g. Displaying each of the metered quantities shall be accomplished through the use of menu scroll buttons.

h. Setup for systems requirements shall be allowed through the local access display. Setup provisions shall include:

(1) CT rating
(2) System type (single; three phase, 3 or 4 wire)

i. Reset of the following electrical parameters shall also be allowed from the local access display:

(1) Real Energy (KWH)
(2) Apparent Energy (KVAH)
(3) Reactive Energy (KVARH)

j. All reset and setup functions shall have a means for protection against unauthorized/accidental changes.

k. The Controller shall be capable of storing records in memory for access either locally or remotely for up to 100 events. The reports shall include date, time and a description of the event and shall be maintained in a non volatile memory.

E. Sequence of Operation

1. When the voltage on any phase of the normal source drops below 80% or increases to 120%, or frequency drops below 90%, or increase to 110%, or 20%

voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds factory set at 3 seconds to allow for momentary dips, the engine starting contacts shall close to start the generating plant.

2. The transfer switch shall transfer to emergency when the generating plant has reached specified voltage and frequency on all phases.
3. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source.
4. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds, factory set at 300 seconds.

F. Automatic Transfer Switch Accessories

1. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.
2. Programmable three phase sensing of the emergency source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases set at 20%, and phase sequence monitoring.
3. Time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation). Programmable 0-9999 seconds. Factory set at 3 seconds, if not otherwise specified.
4. Time delay to control contact transition time on transfer to either source. Programmable 0-9999 seconds, factory set at 3 seconds.
5. Time delay on retransfer to normal, programmable 0-9999 seconds, factory set at 300 seconds if not otherwise specified, with overrun to provide programmable 0-9999 second time delay, factory set at 300 seconds, unloaded engine operation after retransfer to normal.
6. Time delay on transfer to emergency, programmable 0-9999 seconds, factory set at 3 seconds.
7. A maintained type load test switch shall be included to simulate a normal power failure.
8. A remote type load test switch shall be included to simulate a normal power failure, remote switch initiated.
9. A time delay bypass on retransfer to normal shall be included. Keypad initiated.
10. Contact, rated 10 Amps 30 volts DC, to close on failure of normal source to initiate engine starting.
11. Contact, rated 10 Amps 30 volts DC, to open on failure of normal source for customer functions.
12. Light emitting diodes shall be mounted on the microprocessor panel to indicate:

switch is in normal position, switch is in emergency position and controller is running.

13. A plant exerciser shall be provided with (10) 7-day events, programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise generating
14. Provision to select either "no commit" or "commit" to transfer operation in the event of a normal power failure shall be included. In the "no commit position," the load will transfer to the emergency position unless normal power returns before the emergency source has reach 90% of it's rated values (switch will remain in normal). In the "commit position" the load will transfer to the emergency position after any normal power failure. Keypad initiated.
15. Four auxiliary contacts rated 10 Amp, 120 volts AC (for switches 100 to 800 amps) 15 amp, 120 volts AC (for switches 1000 to 4000 amps), shall be mounted on the main shaft, two closed on normal, two closed on emergency. All contacts will be wired to a terminal strip for ease of customer connections.
16. A three phase digital LCD voltage readout, with 1% accuracy shall display all three separate phase to phase voltages simultaneously, for both the normal and emergency source.
17. A digital LCD frequency readout with 1% accuracy shall display frequency for both normal and emergency source.
18. An LCD readout shall display normal source and emergency source availability.
19. Include two time delay contacts that open simultaneously just (milliseconds) prior to transfer in either direction. These contacts close after a time delay upon transfer. Programmable 0-9999 seconds after transfer.
20. A block transfer function shall be included, energized from a 24 VDC signal from the generator control switchgear, to allow transfer to emergency.
21. A load-shed function shall be included, energized from a 24 VDC signal from the generator control switchgear, to disconnect the load from the emergency source when an overload condition occurs.

G. Bypass/Isolation Switch

1. Operation of the bypass/isolation shall be assured, regardless of the position of the automatic transfer switch.
2. Light emitting diodes shall be provided to indicate: bypass position, fully isolated position, and source availability.
3. Positive sequencing of all contacts, with no possible intermediate position, shall be accomplished through the manual operators from a dead front location. Electrical testing during maintenance of the automatic transfer switch shall be possible in the bypass position.
4. Inherent double-throw (break-before-make) operation shall provide positive assurance against accidental short circuitry of the normal and emergency power sources. Arrangements utilizing interlocking of single-throw devices are not acceptable. The operating speed of the contacts shall be independent of the speed at which the handle is moved.
5. The switch shall be fully manually operated and shall not be dependent upon electrical operators, relays, or interlocks for operation.
6. The bypass/isolation switch shall be listed by Underwriters= Laboratories, Inc., Standard UL-1008 and meet the identical withstand ratings of its associated

transfer switch.

7. Both the automatic transfer switch and bypass/isolation switch shall be supplied by the same manufacturer. The manufacturer shall verify that the design has been in continuous production for not less than 10 years, with at least 100 similar installations operating continuously and successfully for that period of time.
8. Bypass/isolation switch must have mechanical separation of normal and emergency to assure against accidental connection of unsynchronized sources. Electrical interlocking will not be considered acceptable.

H. Approval

1. As a condition of approval, the manufacturer of the combination automatic transfer bypass/isolation switches shall verify that their switches are listed by Underwriters Laboratories, Inc., Standard UL-1008 with 3 cycle short circuit closing and withstand higher than available fault and minimum ratings as follows:

RMS Symmetrical Amperes 480 VAC

Current Limiting	Closing and Withstand Fuse Rating
Amperes 100 - 400	42,000
600 - 800	200,00
1000 - 1200	0
1600 - 4000	65,000
	200,00
	0
	85,000
	200,00
	0
	100,000
	200,00
	0

2. The AIC ratings of automatic transfer switch shall exceed the available fault current.
3. During the 3 cycle closing and withstand tests, there shall be no contact welding or damage. The 3 cycle tests shall be performed without the use of current limiting fuses. The test shall verify that contact separation has not occurred, and there is contact continuity across all phases. Test procedures shall be in accordance with UL-1008, and testing shall be certified by Underwriters' Laboratories, Inc.
4. When conducting temperature rise tests to UL-1008, the manufacture shall include post-endurance temperature rise tests to verify the ability of the combination transfer bypass/isolation switch to carry full rated current after completing the overload and endurance tests.
5. The microprocessor controller shall meet the following requirements:

    a. Storage conditions - 25 degrees C to 85 degrees C
    b. Operation conditions - 20 degrees C to 70 degrees C ambient
    c. Humidity 0 to 99% relative humidity, non-condensing
    d. Capable of withstanding infinite power interruptions
    e. Surge withstand per ANSI/IEEE C-37.90A-1978

6. Manufacturer shall provide copies of test reports upon request.

2.3 SOURCE QUALITY CONTROL

A. Furnish shop inspection and testing of each transfer switch.

B. Make completed transfer switch available for inspection at manufacturer's factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install 4" concrete housekeeping pads.

B. Install engraved nameplates.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.22.3.

3.3 MANUFACTURER'S FIELD SERVICES

A. Check out transfer switch connections and operations and place in service.

3.4 ADJUSTING

A. Adjust control and sensing devices to achieve specified sequence of operation.

3.5 TRAINING

A. Demonstrate operation of transfer switch in normal and emergency modes to LAWA's staff to be trained.

B. Provide manuals for attendees.

C. Training shall be provided at times for each of 3 shifts.

END OF SECTION 26 28 26

SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes manual and magnetic motor controllers in individual enclosures.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
5. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
6. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, control schematics, dimensions, and enclosure details.

B. Test Reports: Indicate field test and inspection procedures and test results.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and ratings of enclosed controllers.

B. Operation and Maintenance Data: Submit Replacement parts list for controllers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section

with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 MANUAL MOTOR CONTROLLER

A. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller with overload element, red pilot light, one NO and one NC auxiliary contact, and toggle operator.

B. Enclosure: NEMA ICS 6, Type 1 or to meet conditions of installation. NEMA Type 4 or better for outdoor installations.

2.2 FRACTIONAL-HORSEPOWER MANUAL CONTROLLER

A. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light and toggle operator.

B. Enclosure: NEMA ICS 6, Type 1 or to meet conditions of installation.

2.3 MOTOR STARTING SWITCH

A. Product Description: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, with red pilot light and toggle operator.

B. Enclosure: NEMA ICS 6, Type 1 or to meet conditions of installation. NEMA Type 4 or better for outdoor installations.

2.4 FULL-VOLTAGE AND REDUCED VOLTAGE NON-REVERSING CONTROLLERS

A. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

B. Control Voltage: as required.

C. Overload Relay: NEMA ICS 2; melting alloy.

D. Product Features:

1. Auxiliary Contacts: NEMA ICS 2, with 4 each normally closed field convertible contacts in addition to seal-in contact.
2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty oiltight type.
3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.

4. Pushbuttons: Shielded, Covered and Lockable type.
5. Indicating Lights: LED type.
6. Selector Switches: Rotary type.
7. Relays: NEMA ICS 2.
8. Control Power Transformers: 120 volt secondary. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
9. Reduced-Voltage starters to have delta/wye wiring arrangement.

E. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole.

F. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4 or better.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed controllers plumb. Provide supports.

B. Height: 5 feet to operating handle.

C. Install fuses for fusible switches.

D. Select and install overload heater elements in motor controllers to match installed motor characteristics.

E. Install engraved nameplates.

F. Neatly type label and place inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION 26 29 13

SECTION 26 32 13 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes engine generator set, exhaust silencer and fittings, fuel fittings and sub base tank, remote control panel, battery, and charger.

> **NOTE:** All generators shall be located outdoors. New underground fuel tanks are **not** allowed at the airport.

1.2 REFERENCES

A. National Electrical Manufacturers Association

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
3. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment.
4. NEMA MG 1 - Motors and Generators.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. National Fire Protection Association:

1. NFPA 30 - Flammable and Combustible Liquids Code.
2. NFPA 110 - Standard for Emergency and Standby Power Systems.

1.3 SYSTEM DESCRIPTION

A. Description: Engine generator assembly and accessories to provide source of power for Level 1 and 2 applications in accordance with NFPA 110.

B. Capacity: As required with standby rating using specified engine cooling scheme.

C. Diesel generator muffler, flex and mounting hardware.

D. 8 hour minimum fuel capacity with dual wall sub-base fuel storage tank. Tank shall be constructed of corrosion resistance steel material.

E. Provide engine generators approved by SCAQMD and local environmental agency for use as emergency backup and Tier 4 regulations compliance.

1.4 SUBMITTALS

A. Shop Drawings: Indicate electrical characteristics and connection requirements. Include plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.

B. Product Data: Submit data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, transfer switch, battery, battery rack, battery charger, exhaust silencer, vibration isolators, day tank, and remote radiator.

C. Test Reports: Indicate results of performance testing.

D. Manufacturer's Field Reports: Indicate inspections, findings, and recommendations.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions and service manuals for normal operation, routine maintenance, oil sampling and analysis for engine wear, and emergency maintenance procedures. Include list of spare parts.

1.6 FACTORY PROTOTYPE TESTING

A. The system manufacturer must certify that engine, generator and controls have been tested as a complete system of representative engineering models (not on equipment sold). The manufacturer shall supply equipment that is a current factory standard production model.

B. Prototype testing shall include:

1. Fuel consumption at 1/4, 1/2, 3/4 and full load.
2. Exhaust emissions.
3. Mechanical and exhaust noise.
4. Governor speed regulation at 1/4, 1/2, 3/4 and full load; and during transients
5. Motor starting kVA.
6. Generator temperature rise in accordance with NEMA MG1-22.40 and 16.40
7. Harmonic analysis, voltage waveform deviation and telephone influence factor.
8. Generator short circuit capability.
9. Cooling system performance.
10. 3 phase short circuit tests.
11. Maximum power (kW)
12. Generator revolving field assembly for 2 hours at 2700 rpm (150% overspeed) and 70 degrees C and each production unit tested at 2250 rpm (125% overspeed) at room temperature.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of project.

B. Supplier: Authorized distributor of specified manufacturer with minimum ten years documented experience.

1.8 WARRANTY

A. Five Year Manufacturer Warranty: The manufacturer's standard warranty shall in no event be for a period of less than five years form date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall not be a limiting factor for the system warranty by either the manufacturer or servicing distributor. An extended warranty for an additional five years shall be offered as an option. Submittals received without written warranties as specified will be rejected in their entirety.

1.9 MAINTENANCE SERVICE

A. Furnish service and maintenance of engine generators for five years from Date of Substantial Completion.

1.10 MAINTENANCE MATERIALS FOR EACH ENGINE GENERATOR

A. Furnish one set of tools required for preventative maintenance of engine generator system. Package tools in adequately sized metal tool box.

B. Furnish two of each fuel, oil and air filter element.

PART 2 - PRODUCTS

2.1 ENGINE

A. Manufacturers:

1. Caterpillar.
2. Kohler.
3. Cummins.

B. Product Description: Air-cooled in-line or V-type, four-stroke cycle, compression ignition Diesel internal combustion engine.

C. Rating: Sufficient to operate under 10 percent overload for one hour in ambient of 90 ° F.

D. Fuel System: No. 2 fuel oil.

E. Engine speed: 1800 rpm.

F. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer.

G. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Furnish remote starting control circuit, with MANUALOFF-REMOTE selector switch on engine-generator control panel.

H. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F, and suitable for operation on 120 or 208 volts AC.

I. Radiator: Radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F. Radiator air flow restriction 0.5 inches of water maximum.

J. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-driven water pump. Furnish fuel pressure gage, water temperature gage, and lube oil pressure gage on engine/generator control panel.

K. Mounting: Furnish unit with suitable spring-type vibration isolators and mount on structural steel base.

2.2 GENERATOR

A. Manufacturers:

1. As provided by engine generator manufacturer.

B. Product Description: NEMA MG1, three phase, four pole, reconnectable brushless synchronous generator with brushless exciter.

> **NOTE:** Generator voltage, ampere and power factor ratings are required to be shown on the drawings.

C. Insulation: The insulation material shall meet NEMA standards for Class H insulation and be vacuum impregnated with epoxy varnish to be fungus resistant. Temperature rise of the rotor and stator shall not exceed NEMA class F. The excitation system shall be of brushless construction.

D. Temperature Rise: 80 degrees C Standby, maximum as measured by resistance and based on 40 degrees C ambient temperature.

E. Enclosure: NEMA MG1, open drip proof

F. Total Harmonic Distortion (THD): Not to exceed three percent.

G. Telephone Influence: Below 50.

H. Exciter (Self-Excited): The self-excited, brushless exciter shall consist of a three-phase armature and a three-phase full wave bridge rectifier mounted on the rotor shaft. Surge suppressors shall be included to protect the diodes from voltage spikes.

I. Automatic Voltage Regulator: The digital automatic voltage regulator (DVR) shall maintain generator output voltage within +/- 0.5% for any constant load between no load and full load. The regulator shall be a totally solid state design, which includes electronic voltage buildup, volts per Hertz regulation, three phase sensing, over excitation protection, loss of sensing protection, temperature compensation, shall limit voltage overshoot on startup, and shall be environmentally sealed.

2.3 GOVERNOR

A. Manufacturers:

1. As provided by engine generator manufacturer.

B. Product Description: Isochronous governor to maintain engine speed within 0.5 percent, steady state, and 5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Equip governor with means for manual operation and adjustment.

2.4 CIRCUIT BREAKER

A. Circuit Breaker Specifications: Provide a generator mounted circuit breaker, molded case or insulated case construction, rating as indicated. Breaker shall itilze a thermal megneic trup unit and 24VDC shunt trip. The breaker shall be UL listed with shunt trip device connected to engine/generator safety shutdowns. Breaker shall be set to protect the generator from short circuit damage. Breaker shall be housed in an extension terminal box mounted on the side of the generator. Mechanical type lugs, sized for the circuit breaker feeders, shall be supplied on the load side of breaker.

B. Provide an additional circuit breaker for the radiator mounted load bank.

2.5 CONTROL PANEL

A. Generator Mounted Control Panel: Provide a generator mounted control panel for

complete control and monitoring of the engine and generator set functions. Panel shall include automatic start/stop operation; adjustable cycle cranking, digital AC metering (0.5% true rms accuracy) with phase selector switch, digital engine monitoring, shutdown sensors and alarms with horn and reset, adjustable cool down timer and emergency stop push-button. Panel shall incorporate self-diagnostics capabilities and fault logging. Critical components shall be environmentally sealed to protect against failure from moisture and dirt. Components shall be housed in a NEMA 1/IP22 enclosure with hinged lid.

B. Digital Readouts: Provide the following digital readouts:

1. Engine oil pressure
2. Coolant temperature
3. Engine RPM
4. System DC Volts
5. Engine running hours
6. Generator AC volts
7. Generator AC amps
8. Generator frequency
9. KW meter
10. Percentage of rated Power
11. KVA meter
12. KVAr meter
13. Power Factor meter
14. KWHR meter

C. Alarm NFPA 110: Provide the following indications for protection and diagnostics according to NFPA 110 level 1:

1. Low oil pressure
2. High water temperature
3. Low coolant level
4. Overspeed
5. Over crank
6. Emergency stop depressed
7. Approaching high coolant temperature
8. Approaching low oil pressure
9. Low coolant temperature
10. Low voltage in battery
11. Control switch not in auto. position
12. Low fuel main tank
13. Battery charger ac failure
14. High battery voltage
15. EPS supplying load
16. Basemounted tank low fuel level
17. Basemounted tank high fuel level
18. Spare

D. Remote Annunciator NFPA 110: Provide one remote annunciator to meet the requirements of NFPA 110, Level 1. The annunciator will be installed by contractor.

The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.

NOTE: The location of the remote annunciator shall be clearly identified on the electrical and architectural drawings.

E. Programmable Control Panel: Provide programmable protective relay functions inside the control panel to include the following:

1. Undervoltage
2. Overvoltage
3. Over frequency
4. Under frequency
5. Reverse power
6. Overcurrent (phase and total)
7. KW level (overload)
8. Three spare LED's
9. Four spare inputs

2.6 FUEL SYSTEM

A. Fuel Filter: Filter/Separator - In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine.

B. Fuel Piping: All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted.

C. Fuel Line Rating: Flexible fuel lines rated 300 degrees F and 100 PSI.

D. Sub-Base Fuel Tank.

2.7 SUB-BASE FUEL TANK

A. Manufacturers:

1. IBI
2. International Supply Co.
3. Tramont

A. Provide a sub-base concrete encased fuel tank for the generator set, sized to allow 8 hours of operation.

1. All Protected Base Tanks are UL Secondary Containment list and labeled. It is comprised of a UL142 steel tank, surrounded by a minimum of 6” light weighted insular concrete, enclosed by a UL142 steel outer shell with a interstitial monitoring tube. All steel tanks are tightness tested at the manufacturer’s facility,

in accordance with testing procedures specified by UL142 for AST's, and meet UL requirements for standard and emergency venting. The interior of the primary tank has been cleaned and free of any loose material, mill scale, or debris. Sub base tanks are UL 2085 listed for the UL 2 hour fire burn test. Tanks must be ballistic and impact rated per UL 2085 specification.

2. The base tank shall be furnished as a complete, factory assembled and tested assembly and listed as an assembly by Underwriters Laboratories, to UL 142 and UL 2085 factory installed.
3. Primary tanks shall be of minimum thickness per UL 142. Inner tanks will be of rectangular configuration per UL standard 142. All welds must comply with AWS, and ASME IX and ASME B31.1.
4. Secondary containment consists of UL 142 primary tank, completely enclosed by a UL 142 secondary containment tank, which is 110% of the primary. Primary and secondary tank will be Rectangular in configuration. Both tanks are pressure tested to between 3PSI and 5PSI per UL requirements. Insulation material will be of a lightweight concrete design. Concrete will be poured in a monolithic method to eliminate voids. The minimum insulation thickness will be 6". The exterior of the tank will be steel.
5. All tank systems and sub-assemblies shall be installed in strict accordance with the manufacturer's recommendations and applicable fire and environmental codes.
6. All tanks are primed with a Rustoleum Shop Coat Enamel. Top coat is an Alkyd High Gloss Enamel paint (Sherwin WilliamsSW6004 Mink.)
7. All tanks to be installed on reinforced engineered concrete slab. Protective barriers shall be installed as required by state and local codes.
8. Tanks shall be marked on a visible side with "Flammable", "Combustible", and "No Smoking", product identification, and other signs as required by state and local codes.
9. The system installation (end user) shall be inspected and approved by the system installer or its certified contractor. The system installer shall submit a comprehensive checklist of quality and safety items associated with the installation of the system and its sub-assemblies to verify that the installation is in compliance with applicable local fire and environmental codes.

B. Features

1. Emergency tank and basin vents.
2. Mechanical level gauge.
3. Fuel supply and return lines, connected to generator set with flexible fuel lines as recommended by the engine manufacturer and in compliance to UL2200 and NFPA requirements.
4. Leak detection provisions, wired to the generator set control for local and remote alarm indication.
5. High and low level float switches to indicate fuel level. Wire switches to generator control for local and remote indication of fuel level.
6. Basin drain.
7. Integral lifting provisions

2.8 TIER 4 COMPLIANT CATALYTIC EXHAUST TREATMENT SYSTEM

A. Provide and install as per manufacturer recommendations.

B. Silencer: A critical type silencer, companion flanges, and flexible stainless steel exhaust fitting properly sized shall be furnished and installed according to the manufacturer's recommendation. Mounting shall be provided by the contractor. The silencer shall be mounted so that its weight is not supported by the engine nor will exhaust system growth due to thermal expansion be imposed on the engine. Exhaust pipe size shall be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the engine manufacturer.

C. Exhaust System: The muffler and all indoor exhaust piping shall be "lagged" by the contractor to maintain a surface temperature not to exceed 150 degrees F. The insulation shall be installed so that it does not interfere with the functioning of the flexible exhaust fitting.

D. Muffler shall be critical type similar to Nelson-300 or equal. Provide engine exhaust roof thimbles with flexible tubes and pipes as required.

2.9 STARTING SYSTEM

A. Starting Motor: The engine shall be started by two 24 V DC electric starting motors. Crank termination switch and 24 V DC fuel solenoid valve shall be provided for remote automatic start/stop capability.

B. Jacket Water Heater: A unit mounted forced circulation type water heater. The heater Watt rating shall be sized by the manufacturer to maintain jacket water temperature at 90 degrees F, and shall be a 480 volt, three phase, 60 hertz.

C. Batteries: Lead acid batteries of sufficient capacity for four 15 second crank periods with 10 second rest intervals shall be furnished. Battery voltage of 24 V DC shall be derived from four 12 V DC, 205 amp hour high performance batteries, dry charged. Two battery interconnection cables and four battery-tostarter cables.

1. Battery Trays: A battery tray shall be provided for the batteries and shall conform to NEC 480-7(b). It shall be treated to be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil-over battery electrolyte shall be contained within the tray to prevent a direct path to ground.
2. Battery Charger: A current limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input. Ac input voltage shall be 120 volts, single phase. Charger shall have LED annunciation for low DC volts, rectifier failure, loss of AC power, high DC volts. Amperage output shall be no less than ten (10) amperes. Charger shall be wall-mounting type in NEMA 1 enclosure.

2.10 RADIATOR MOUNTED LOAD BANK

A. Furnish a continuous duty load bank, complying with UL 508A, mounted directly on the skid base, on the exhaust side of the radiator, complete with all necessary pilot and power control, wiring and devices to furnish a functional system for the intended use. Load bank shall comply with all applicable NEMA, NEC and ANSI Standards. Load bus configuration and load terminations shall be clearly identified.

B. The load bank shall have the capability of maintaining a constraint load for the Emergency Power Supply Source (EPSS), during both exercising and actual use condition. Rating shall be a minimum of 100% of the generator output rating and matched to the EPSS voltage. Load steps at a minimum of three (3) incremental loads, manually controlled.

C. Enclosure shall be suitable for installation on the exhaust side of the engine radiator. It shall match dimensionally the radiator's duct flange height and width without adaptive duct work. The control section shall have a hinged and gasketed access door(s).

D. Manufacturer shall be Avtron load bank K-711 Series, or equal.

E. Construction shall be aluminum or galvanized steel. All fasteners shall be stainless steel. Load elements shall be helically wound and rated to operate at 50% of the maximum continuous wire rating. Each 50 kW element shall have current limiting fuses. (Furnish three (3) sets of three (3) fuses as spares.)

2.11 VIBRATION ISOLATORS FOR EACH ENGINE GENERATOR

A. For unit to base provide spring type with neoprene acoustical pads, leveling devices and vertical limit stops. Minimum static deflection shall be 1 inch.

B. For base to concrete pad spring mountings, provide adjustable type to provide minimum clearance of 4 inches between structural base and floor, with alignment and lift off restraints.

C. Provide for engine-generator set base, engine-generator set base and remote radiator and silencer and exhaust pipe.

2.12 SPARE PARTS

A. Deliver 1 set of filter elements (air, fuel and oil), complete set of fuses, for each size used and one belt for every belt drive to LAWA at final acceptance.

2.13 ENCLOSURE

A. Provide a weather proof enclosure.

NOTE: Acoustic mitigation measures may be required due to the generator's proximity to acoustically sensitive areas such as, but not limited to, office areas, conference rooms, etc..

2.14 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Make completed engine-generator assembly available for inspection at manufacturer's factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's recommendations, and all applicable codes.

B. Install engraved plastic nameplates.

C. Ground and bond generator and other electrical system components.

3.2 START-UP AND TESTING

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.22.

C. Coordinate all start-up and testing activities with LAWA.

D. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:

1. Verify that the equipment is installed properly.
2. Check all auxiliary devices for proper operation, including battery charger, jacket water heater(s), generator space heater, remote annunciator, etc.
3. Test all alarms and safety shutdown devices for proper operation and annunciation.
4. Check all fluid levels.
5. Start engine and check for exhaust, oil, fuel leaks, vibrations, etc.
6. Verify proper voltage and phase rotation at the transfer switch before

connecting to the load.

7. Perform a 4-hour load bank test at .80 power factor at full nameplate load using a reactive load bank and cables supplied with the generator. Observe and record the following data at 15-minute intervals:

    a. Service meter hours
    b. Volts AC - All phases
    c. Amps AC - All phases
    d. Frequency
    e. Power factor or Vars
    f. Jacket water temperature
    g. Oil Pressure
    h. Fuel pressure
    i. Ambient temperature

8. Connect the generator to building load and verify that the generator will start and run all designated loads in the building.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.22.

3.4 MANUFACTURER'S FIELD SERVICES

A. Prepare and start up engine-generator assembly.

3.5 ADJUSTING

A. Adjust generator output voltage and engine speed to meet specified ratings.

3.6 CLEANING

A. Clean engine and generator surfaces. Replace oil and fuel filters with new.

3.7 TRAINING

A. Furnish eight hours of instruction to be conducted at project site with manufacturer's representative to LAWA choice of staff to be trained. Provide training session for each of 3 shifts.

B. Describe loads connected to emergency and standby system and restrictions for future load additions.

C. Simulate power outage by interrupting normal source, and demonstrate system operates to provide emergency and standby power.

D. Provide manuals for attendees.

END OF SECTION 26 32 13

SECTION 26 33 00 - BATTERY EQUIPMENT (INVERTER)

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes emergency power supplies and accessories.

1.2 REFERENCES

A. National Fire Protection Association:

1. NFPA 111 - Standard on Stored Electrical Energy Emergency and Standby Power Systems.

1.3 SUBMITTALS

A. Product Data: Submit catalog and data sheets showing electrical characteristics and connection requirements. Include unit ratings, dimensions, and finishes. Include performance data for batteries.

B. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit battery maintenance and unit testing procedures.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NFPA 111.

B. Maintain two copies of document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience, and with service facilities within 100

miles of project.

1.7 WARRANTY

A. Furnish five year manufacturer warranty for batteries.

PART 2 - PRODUCTS

2.1 EMERGENCY POWER SUPPLY

A. Manufacturers:

1. Lithonia
2. Chloride
3. Dual Lite

B. Product Description: NFPA 111 Type A, Class 1.5 stored emergency power supply system designed for Level 1 applications and consisting of rectifier/charger unit, storage battery, and solid state inverter with static transfer switch, in one or several enclosures, unit suitable for operating HID lamps without extinguishing lamp on transfer.

C. Input Voltage:

D. Output Power:

E. Output Voltage:

F. Inverter Output Frequency: 60 Hz plus 1 percent.

G. Efficiency: 90 percent minimum.

H. Maximum Recharge Time: 12 hours following 1.5 hour discharge.

I. Total Harmonic Distortion: Less than 10 percent at full resistive load.

J. Battery: Nickel cadmium sealed type battery.

K. Charger: Dual rate, designed to maintain battery in full-charge condition during normal conditions.

L. Furnish remote trouble monitor in enclosure with manufacturer's standard finish.

M. Accessories: Provisions for remote battery alarm.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units plumb and level.

3.2 FIELD QUALITY CONTROL

A. Verify operation of each unit by simulating outage.

3.3 DEMONSTRATION AND TRAINING

A. Demonstrate normal operation of unit.

END OF SECTION 26 33 00

26 33 53-STATIC UNINTERRUPTIBLE POWER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This specification defines the electrical and mechanical characteristics and requirements for a continuous-duty three-phase, solid-state, uninterruptible power system (UPS). The UPS shall provide high-quality AC power for sensitive electronic equipment loads.

> **NOTE:** A static UPS is mandatory for all systems that require memory or control retention such as those found in baggage handling and building management systems.

1.2 STANDARDS

A. The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents.

1. ANSI C62.41 (IEEE 587)
2. ASME
3. CSA 22.2, No. 107.1
4. FCC Part 15, Class A
5. ISO 9001
6. National Electrical Code (NFPA-70)
7. NEMA PE-1
8. OSHA
9. UL Standard 1778

B. The UPS shall be ETL listed per UL Standard 1778 Uninterruptible Power Supplies.

1.3 SYSTEM DESCRIPTION

A. Design Requirements - UPS Module

1. Voltage. Input/output voltage specifications of the UPS shall be:

   a. Rectifier Input: As required.
   b. Bypass Input (for dual-input modules): As required.
   c. Output: Three-phase, 4-wire-plus-ground, as required.

2. Output Load Capacity. Specified output load capacity of the UPS shall be as required at 0.8 lagging power factor.

B. Design Requirements - Matching Battery Cabinet

1. Battery Cells: Sealed, lead-acid, valve-regulated.
2. Reserve Time: 30 minutes at full load, 0.8 power factor, with ambient temperature between 20° and 30°C.
3. Recharge Time: to 95% capacity within ten (10) times discharge time.

C. Modes of Operation

1. The UPS shall be designed to operate as an on-line, double-conversion, reverse-transfer system in the following modes:
   a. Normal - The AC equipment is to be continuously powered by the UPS inverter. The rectifier/charger derives power from a utility AC source and supplies DC power to the inverter while simultaneously float-charging a power reserve battery.
   b. Emergency - Upon failure of utility AC power, AC equipment is to be powered by the inverter, which without any switching obtains its power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.
   c. Recharge - Upon restoration of utility AC power, after a utility AC power outage, the rectifier/charger shall automatically restart, walk-in, and gradually resume providing power to the inverter and also recharge the battery system.
   d. Bypass - If the UPS must be taken out of service for maintenance or repair, or should the inverter overload capacity be exceeded, the static bypass transfer switch shall perform a reverse transfer of the connected equipment from the inverter to the bypass source without interruption in power to the mission critical AC equipment.

D. Performance Requirements

1. AC Input to UPS DD
   a. Voltage Configuration for Standard Units: three-phase, 4-wire plus ground.
   b. Voltage Range: +10%, -20% of nominal.
   c. Frequency: Nominal frequency +/-5%.
   d. Power Factor: Up to 0.96 lagging at nominal input voltage and full rated UPS output with input filter.
   e. Inrush current: 800% of full load current maximum.
   f. Current Limit: 115% of nominal AC input current maximum and 100% of nominal for optional generator operation.
   g. Input Current Walk-In: 15 seconds to full rated input current maximum. Field selectable 5 or 20 seconds.
   h. Current Distortion: 10% reflected input THD maximum at full load with the optional input filter; 30% reflected input THD maximum at full load without the optional input filter.

i. Surge Protection: The UPS shall be able to sustain input surges without damage per criteria listed in ANSI C62.41 Category A and B.

2. AC Output, UPS Inverter

a. Voltage Configuration: three-phase, 4-wire plus ground
b. Voltage Regulation:
+/- 0.5% three-phase RMS average for a balanced three-phase load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.
+/- 1.0% three-phase RMS average for a 100% unbalanced load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.
c. Frequency: Nominal frequency +/-0.1%.
d. Frequency Slew Rate: 5.0 Hertz per second maximum. Field selectable from 0.1 to 5.0 Hz per second.
e. Phase Displacement:
+/- 0.5 degree for balanced load,
+/- 1.0 degrees for 100% unbalanced load.
f. Bypass Line Sync Range:
+/- 0.5 Hertz,
Field selectable +/- 0.5 to 5.0 Hz.
g. Voltage Distortion:
1% total harmonic distortion (THD) for linear loads.
2.5% THD for 100% nonlinear loads (3:1 crest factor) without kVA/kW derating.
h. Load Power Factor Range: 1.0 to 0.7 lagging without derating.
i. Output Power Rating: Rated kVA at 0.8 lagging power factor.
j. Overload Capability:
125% for ten minutes (without bypass source).
150% for one minute (without bypass source).
200% for 10 cycles, pulse paralleling with the static switch.
k. Inverter Output Voltage Adjustment: +/-5% manual adjustment.
l. Voltage Transient Response:

100% load step	+/- 5.0%.
Loss or return of AC input power	+/- 1.0%.
Manual transfer of 100% load	+/- 3.0%.

m. Transient Recovery Time: to within 1% of output voltage within one cycle.
n. Voltage Unbalance: 100% unbalanced load +/- 1%.
o. Fault Clearing: Sub-cycle current of at least 300%.

1.4 ENVIRONMENTAL CONDITIONS

A. The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:

1. Operating Ambient Temperature
   UPS Module: 32°F to 104°F (0°C to 40°C).
   Battery: 77 +/-9°F (25 +/-5°C).
2. Storage/Transport Ambient Temperature
   UPS Module: -4°F to 158°F (-20°C to 70°C).
   Battery: -4°F to 92□F (-20°C to 33°C)
3. Relative Humidity
   0 to 95%, non-condensing.
4. Altitude
   Operating: to 6,600 ft. (2,000 meters) above Mean Sea Level. Derated for higher altitude applications.
   Storage/Transport: to 40,000 ft. (12,200 meters) above Mean Sea Level.
5. Audible Noise
   Noise generated by the UPS under any condition of normal operation shall not exceed 65 dBA measured 1 meter from surface of the UPS.

1.5 SUBMITTALS

A. Proposal Submittals

1. Submittals with the proposal shall include:

   a. System configuration with single-line diagrams.
   b. Functional relationship of equipment including weights, dimensions, and heat dissipation.
   c. Descriptions of equipment to be furnished, including deviations from these specifications.
   d. Size and weight of shipping units to be handled by installing contractor.
   e. Detailed layouts of customer power and control connections.
   f. Detailed installation drawings including all terminal locations.

B. UPS Delivery Submittals

1. Submittals upon UPS delivery shall include a complete set of submittal drawings and one (1) instruction manual that shall include a functional description of the equipment with block diagrams, safety precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

C. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

1.6 WARRANTY

A. UPS Module

1. The UPS manufacturer shall warrant the UPS module against defects in materials and workmanship for 12 months after the installation is accepted by LAWA.

B. Battery

1. The battery manufacturer's standard warranty shall be passed through to the end user.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. A minimum of twenty year's experience in the design, manufacture, and testing of solid-state UPS systems is required. The system shall be designed and manufactured according to world-class quality standards. The manufacturer shall be ISO 9001 certified.

B. Factory Testing

1. Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the specification.

PART 2 - PRODUCT

2.1 FABRICATION

A. Manufacturers:

1. **Liebert.**

B. Materials

1. All materials of the UPS shall be new, of current manufacture, high grade and free from all defects and shall not have been in prior service except as required during factory testing.
2. The maximum working voltage, current, and di/dt of all solid-state power components and electronic devices shall not exceed 75% of the ratings established by their manufacturer. The operating temperature of solid-state component sub-assembly shall not be greater than 75% of their ratings. Electrolytic capacitors shall be computer grade and be operated at no more than 95% of their voltage rating at the maximum rectifier charging voltage.

C. Wiring

1. Wiring practices, materials and coding shall be in accordance with the requirements of the National Electrical Code (NFPA 70). All bolted connections of bus bars, lugs, and cables shall be in accordance with requirements of the National Electrical Code and other applicable standards. All electrical power connections are to be torqued to the required value and marked with a visual indicator.
2. Provision shall be made for power cables to enter or leave from the top or bottom of the UPS cabinet.

D. Construction and Mounting

1. The UPS unit, comprised of input transformer (if required), rectifier/charger with input filter, inverter, static transfer switch, output transformer and maintenance bypass switch, shall be housed in a single free-standing NEMA type 1 enclosure. Cabinet doors/covers shall require a tool for gaining access. Casters and stops shall be provided for ease of installation. Front access only shall be required for expedient servicing, adjustments, and installation. The UPS cabinet shall be structurally adequate and have provisions for hoisting, jacking, and forklift handling.
2. The UPS cabinet shall be cleaned, primed, and painted with the manufacturer's standard color. The UPS shall be constructed of replaceable subassemblies. Printed circuit assemblies shall be plug connections. Like assemblies and like components shall be interchangeable.

E. Cooling

1. Cooling of the UPS shall be by forced air. Low-velocity fans shall be used to minimize audible noise output. Fan power shall be provided by the UPS output.
2. The thermal design, along with all thermal and ambient sensors, shall be coordinated with the protective devices before excessive component or internal cabinet temperatures are exceeded.

F. Grounding

1. The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for local bonding shall be provided.

2.2 COMPONENTS

A. Input Transformer

1. When required, the input transformer shall be factory installed inside the UPS module cabinet without increasing the standard footprint.

B. Rectifier/Charger

1. General

a. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to the inverter and for battery charging. The rectifier/charger shall be a phase-controlled, solid-state SCR type with constant voltage/current limiting control circuitry.

2. AC Input Current Limiting

a. The rectifier/charger unit shall be provided with AC input current limiting whereby the maximum input current shall be limited to 115% of the full input current rating. The rectifier/charger shall operate at a reduced current limit mode whenever the critical load is powered from the UPS static bypass circuit such that the maximum UPS input current will not exceed 115% of full load input current. In addition, the rectifier/charger shall have a separate battery current limit, adjustable from 0 to 15% of the full load input current. An optional second circuit shall limit the battery recharge current to zero when activated by a customer-supplied contact closure to signal a customer function such as generator operation.

3. Input Current Walk-In

a. The rectifier/charger shall contain a timed walk-in circuit that causes the unit to gradually assume the load over a 15-second time interval after input voltage is applied. Walk-in time shall be field selectable for 5 or 20 seconds.

4. Fuse Failure Protection

a. Power semiconductors in the rectifier/charger shall be fused with fast-acting fuses, so that loss of any one-power semiconductor shall not cause cascading failures.

5. DC Filter

a. The rectifier/charger shall have an output filter to minimize ripple voltage into the battery. Under no conditions shall ripple voltage into the battery exceed 1% RMS. The filter shall be adequate to insure that the DC output of the rectifier/charger will meet the input requirements of the inverter. The inverter shall be able to operate from the rectifier/charger with the battery disconnected.

6. Automatic Rectifier Restart

a. Upon restoration of utility AC power, after a utility AC power outage and prior to a UPS automatic end-of-discharge shutdown, the rectifier/charger shall automatically restart, walk-in, and gradually

resume providing power to the inverter and also recharge the battery system.

7. Battery Recharge

   a. In addition to supplying power for the inverter load, the rectifier/charger shall be capable of producing battery charging current sufficient to replace 95% of the battery discharge power within ten (10) times the discharge time. After the battery is recharged, the rectifier/charger shall maintain the battery at full charge until the next emergency operation.

8. DC Over Voltage Protection

   a. There shall be DC over-voltage protection so that if the DC voltage rises to the pre-set limit, the UPS is to shut down automatically and initiate an uninterrupted transfer of the connected equipment to the static bypass line.

C. Inverter

1. General

   a. The term inverter shall denote the solid-state equipment and controls to convert DC power from the rectifier/charger or battery to regulated AC power for supporting the critical load. The inverter shall use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.

2. Overload Capability

   a. The inverter shall be capable of supplying current and voltage for overloads exceeding 100% and up to 200% of full load current. A status indicator and audible alarm shall indicate overload operation. The UPS shall transfer the load to bypass when overload capacity is exceeded.

3. Fault Clearing and Current Limit

   a. The inverter shall be capable of supplying an overload current of 150% of its full-load rating for one minute. For greater currents or longer time duration, the inverter shall have electronic current-limiting protection to prevent damage to components. The critical load will be transferred to the static bypass automatically and uninterrupted. The inverter shall be self-protecting against any magnitude of connected output overload. Inverter control logic shall sense and disconnect the inverter from the critical AC load without the requirement to clear protective fuses.

4. Step Load Response

a. The output voltage shall be maintained to within ☐ 5.0% with a 0-to-100% step load change or a 100%-to-0 step load change. The output voltage shall recover to within 1% of nominal voltage within 1 cycle.

5. Voltage Distortion

a. For linear loads, the output voltage total harmonic distortion (THD) shall not be greater than 1%. For 100% rated load of 3:1 crest factor nonlinear loads, the output voltage total harmonic distortion shall not be greater than 2.5%. The output rating is not to be derated in kVA or kW due to the 100% nonlinear load with 3:1 crest factor.

6. Output Power Transformer

a. A dry-type power transformer shall be provided for the inverter AC output. It shall have copper wiring exclusively. The transformers hottest spot winding temperature shall not exceed the temperature limit of the transformer insulation class of material when operating at full load at maximum ambient temperature.

7. Phase Balance

a. Electronic controls shall be provided to regulate each phase so that an unbalanced loading will not cause the output voltage to go outside the specified voltage unbalance or phase displacement. With 100% load on one phase and 0% load on the other 2 phases or 100% load on 2 phases and 0% load on the other phase, the voltage balance is to be within 1% and the phase displacement is to be 120 degrees within ☐ 1 degree.

8. Fuse Failure Protection

a. Power semiconductors in the inverter shall be fused with fast-acting fuses, so that loss of any one-power semiconductor will not cause cascading failures.

9. Inverter Shutdown

a. For rapid removal of the inverter from the critical load, the inverter control electronics shall instantaneously turn off the inverter transistors. Simultaneously, the static transfer switch shall be turned on to maintain continuous power to the critical load.

10. Inverter DC Protection

a. The inverter shall be protected by the following disconnect levels:

(1) DC Over voltage Shutdown
(2) DC Under voltage Warning (Low Battery Reserve), user adjustable from 1 to 99 minutes

(3) DC Under voltage Shutdown (End of Discharge)

11. Over Discharge Protection

a. To prevent battery damage from over discharging, the UPS control logic shall automatically raise the shutdown voltage set point as discharge time increases beyond fifteen (15) minutes.

12. Inverter Output Voltage Adjustment

a. The inverter shall use a software control to adjust the output voltage from +/- 5% of the nominal value.

13. Output Frequency

a. An oscillator shall control the output frequency of the inverter. The oscillator shall be temperature compensated and hold the inverter output frequency to +/- 0.1% for steady state and transient conditions. Frequency drift shall not exceed 0.1% during a 24-hour period. Total frequency deviation, including short time fluctuations and drift, shall not exceed 0.1% from the rated frequency.

D. Display and Controls

1. Monitoring and Control

a. The UPS shall be provided with a microprocessor based unit status display and controls section designed for convenient and reliable user operation. A graphical display shall be used to show a single-line diagram of the UPS, and shall be provided as part of the monitoring and controls sections of the UPS. All of the operator controls and monitors shall be located on the front of the UPS cabinet. The monitoring functions such as metering, status and alarms shall be displayed on the graphical LCD display. Additional features of the monitoring system shall include:

(1) Menu-driven display with pushbutton navigation
(2) Real time clock (time and date)
(3) Alarm history with time and date stamp
(4) Battery backed-up memory

2. Metering

a. The following parameters shall be displayed:
(1) Input AC voltage line-to-line
(2) Input AC current for each phase
(3) Input frequency
(4) Battery voltage
(5) Battery charge/discharge current

(6) Output AC voltage line-to-line and line-to-neutral for each phase
(7) Output AC current for each phase
(8) Output frequency
(9) Percent of rated load being supplied by the UPS
(10) Battery time left during battery operation

3. Alarm Messages

a. The following alarm messages shall be displayed:

(1) Input Line Fault
(2) Input Phase Rotation Error
(3) Input Over/Under Frequency
(4) Input Current Limit
(5) Rectifier Fail
(6) Battery Test Failed
(7) Battery Low Warning (Adjustable 1 To 99 Minutes)
(8) Battery Low Transfer
(9) DC Over Voltage Steady State
(10) Bypass Frequency Error
(11) Load On Bypass
(12) Excessive Auto Retransfers
(13) SBS SCR Shorted
(14) Bypass Sync Error
(15) Input Phase Loss
(16) I DC Peak
(17) Output Under Voltage Transfer
(18) Output Over Voltage Transfer
(19) Inverter Overload
(20) SBS Overload
(21) Inverter Overload Transfer
(22) Transfer Failed Shutdown
(23) Hardware Shutdown
(24) Output Power Supply Fail
(25) Inverter Control Fault Transfer
(26) EPO Latched (remote EPO activated)
(27) System Fan Fail
(28) Ambient Over Temperature Limit
(29) Over Temperature Timeout Shutdown

b. An audible alarm shall be provided and activated by any of the above alarm conditions.

4. Status Messages

a. The following UPS status messages shall be displayed:

(1) Normal operation

(2) On SBS
(3) Load on UPS
(4) Load on bypass
(5) User Shutdown
(6) Battery Discharging

5. Controls

a. UPS start-up, shutdown, and bypass operations shall be accomplished through the front-panel pushbutton controls. Menu-driven user prompts shall be provided to guide the operator through system operation without the use of additional manuals. Pushbuttons shall be provided to display the status of the UPS and to test and reset visual and audible alarms. A mimic diagram screen shall be available on the LCD screen to depict a single-line diagram of the UPS and indicate switch positions and power flow.

6. On-Line Battery Test

a. The UPS shall be provided with a menu-driven On-Line Battery Test feature. The test shall ensure the capability of the battery to supply power to the inverter while the load is supplied power in the normal mode. If the battery fails the test, the system shall automatically do the following:

(1) Maintain the load through the UPS
(2) Display a warning message
(3) Sound an audible alarm

b. The battery test feature shall have the following user selectable options:

(1) Interval between tests (2 to 9 weeks)
(2) Date and time of initial test
(3) Enable/disable test

E. Static Transfer Switch

1. General

a. A static transfer switch and bypass circuit shall be provided as an integral part of the UPS. The static switch shall be a naturally commutated high-speed static (SCR-type) device rated to conduct full load current continuously. The switch shall have an overload rating of 110% rated load continuously, 200% rated load for five seconds. The static transfer switch shall also have fault-clearing capabilities of 1100 amperes for 1 second, 3000 amperes for 10 cycles, and 6000 amperes peak for the first half cycle.

b. The static transfer switch control logic shall contain an automatic transfer control circuit that senses the status of the inverter logic signals, and operating and alarm conditions. This control circuit shall provide an uninterrupted transfer of the load to an alternate bypass source, without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS, or for bypassing the UPS for maintenance.

2. Uninterrupted Transfer

a. The transfer control logic shall automatically turn on the static transfer switch, transferring the critical AC load to the bypass source, after the transfer logic senses any of the following conditions:

(1) Inverter overload capacity exceeded
(2) AC output over voltage or under voltage
(3) Battery protection period expired
(4) UPS fault condition

b. The transfer control logic shall inhibit an automatic transfer of the critical load to the bypass source if any of the following conditions are present:

(1) Inverter/bypass voltage difference exceeding preset limits
(2) Bypass frequency out of limits
(3) Bypass out-of-synchronization range with inverter output

3. Uninterrupted Retransfer

a. Retransfer of the mission critical AC equipment from the bypass source to the inverter output shall be automatically initiated unless inhibited by manual control. The transfer control logic shall inhibit an automatic retransfer of the critical load to the inverter if one of the following conditions exists:

(1) Bypass out of synchronization range with inverter output
(2) Inverter/bypass voltage difference exceeding preset limits
(3) Overload condition exists in excess of inverter full load rating
(4) UPS fault condition present

F. Internal Maintenance Bypass Switch

1. General

a. A manually operated maintenance bypass switch shall be incorporated into the UPS cabinet to directly connect the critical load to the bypass AC input power source, bypassing the rectifier/charger, inverter, and static bypass transfer switch.

2. Isolation

   a. All energized terminals shall be shielded to ensure that maintenance personnel do not inadvertently come in contact with energized parts or terminals. A means to de-energize the static bypass switch shall be provided when the UPS is in the maintenance bypass mode of operation.

3. Maintenance Capability

   a. With the critical load powered from the maintenance bypass circuit, it shall be possible to check out the operation of the rectifier/charger, inverter, battery, and static bypass transfer switch.

4. Battery Cabinet System

   a. The matching battery cabinet shall include sealed, lead-acid valve regulated battery cells housed in a separate cabinet that matches the UPS cabinet styling to form an integral system line-up. Battery cells shall be mounted on slide-out trays for ease of maintenance. A battery disconnect circuit breaker with under voltage release (UVR) shall be included for isolation of the battery system from the UPS module. The UPS shall automatically be disconnected from the battery by opening the breaker when the battery reaches the minimum discharge voltage level. Casters and leveling feet shall also be provided with the battery cabinet for ease of installation. When the application calls for the battery cabinet to be bolted to the UPS cabinet, the interconnecting cables are to be provided, precut to the correct length and cable lugs installed, by the UPS manufacturer.

G. Accessories

NOTE: Specific accessories will be dependent on design.

1. Input Filter

   a. The rectifier/charger shall include an input filter to reduce reflected input current distortion to 10% THD at full load with nominal input voltage. Another benefit of the input filter shall be to maintain the input power factor at 0.90-0.96 lagging minimum from full load to half load with nominal input voltage.

2. External Maintenance Bypass Cabinet

   a. A matching external maintenance bypass cabinet shall be provided to enable the UPS module to be completely isolated from the electrical system while the critical load is powered through the external maintenance bypass line. This optional cabinet shall provide make-before-break operation for transfers to and from the external maintenance bypass line with a single rotary switch. The following components shall be standard: single rotary switch with auxiliary

contacts, inter-cabinet wiring, casters, and leveling feet. The following components shall be optional: input circuit breaker, shielded isolation transformer, and output circuit breaker. This matching cabinet shall bolt to the side of the UPS module with a barrier shield to separate the two cabinets. Only front access shall be required for installation and service.

3. Slim-Line Distribution Cabinet

   a. A matching distribution cabinet shall be provided for flexible cable distribution of power from the UPS output to the critical loads. The distribution cabinet shall include one or two 42-pole panel boards. Both plug-in and bolt-in style panel boards shall be available to accommodate specific site requirements. A main circuit breaker shall be provided with each panel board.
   b. The Slim-Line distribution cabinet shall be designed as a bolt-on section to the UPS module or Maintenance Bypass cabinet for field installation by the installing contractor. The Slim-Line distribution cabinet shall add no more than ten (10) inches to the width of the UPS system.

4. 1+1 Redundant Paralleling

   a. The UPS shall be available in a version capable of parallel-redundant operation. Two modules with the paralleling option board shall be connected to a simple parallel cabinet requiring no system-level controls or displays. The parallel cabinet shall include two module isolation circuit breakers and one system output breaker. All control and load-sharing logic shall be independent and contained within each module. The only control connection between the two modules shall be a single Category 5 Ethernet cable. The UPS modules shall load share within 1% when the Ethernet cable is attached. As a fail-safe operating mode, the UPS modules shall be capable of load sharing within 5% even if the Ethernet cable is removed or damaged after system start-up. In like manner, the system shall be capable of operating normally (including overload and fault handling, manual transfers and automatic transfers to bypass) for an indefinite period with no inter-module signals available.

5. Load Bus Synchronization

   a. The Load Bus Sync® circuit shall synchronize the output of two independent UPSs even if the UPSs are operating from asynchronous bypass sources (e.g. backup generator sets) or on battery power. The Load Bus Sync (LBS) circuit shall consist of a control enclosure and an option card inside each UPS module. The LBS control enclosure shall enable the operator to designate which bypass source will be the Designated Master source, and both UPS systems will synchronize their outputs to that source.

6. Programmable Relay Board

a. Eight sets of isolated Form C contacts shall be provided to indicate a change of status of any of the alarm conditions. Any of the UPS alarms can be programmed onto any channel of the programmable relay board.

7. Remote Status Panel

a. A remote status panel shall be provided and shall include the following:

(1) Load on UPS LED
(2) Load On Bypass LED
(3) Battery Discharge LED
(4) Low Battery Reserve LED
(5) UPS Alarm Condition LED
(6) New Alarm Condition LED (for a second UPS alarm condition)
(7) Audible Alarm with Reset pushbutton
(8) Lamp Test/Reset pushbutton

b. The remote status panel shall be provided in a NEMA Type 1 enclosure for wall mounting.

8. Battery Circuit Breaker

a. A battery circuit breaker shall be provided to isolate the battery from the UPS. This breaker shall have an under voltage release (UVR) and auxiliary contacts, and shall be in a separate wall mounted NEMA-1 enclosure. The battery breaker provides a manual disconnecting means, short circuit protection, and over current protection for the battery system. When opened, there shall be no battery voltage in the UPS enclosure. The UPS shall be automatically disconnected from the battery by opening the breaker when the battery reaches the minimum discharge voltage level.

9. Internal Modem

a. The UPS shall come with an internal modem capable of dialing out from the UPS to notify up to two remote computers, terminals, PC's, or pocket pagers when important events occur. The modem will also be capable of accepting incoming calls, with the appropriate security, and connecting to a remote terminal, computer or PC, to perform all those functions normally available on the front panel including viewing monitoring screens.

10. SNMP

a. The UPS shall come equipped with an internal SNMP adapter, which will connect the UPS directly to any I.P. based network using Ethernet communications. The UPS will become a managed device on the network. From a network management station the system administrator

shall be capable of monitoring important system measurements, alarm status and alarm history data. In the event of a utility failure the SNMP shall continue with live communication without the requirement of additional or separate UPS equipment until such time as the UPS shuts down for Low battery. On resumption of Utility power the SNMP shall resume full SNMP communication automatically.

11. IBM* AS/400* UPS Signal

    a. The following isolated normally open contacts shall be provided for user connection to an IBM AS/400 UPS signal interface:

        (1) UPS on (UPS is supplying power)
        (2) Bypass active (bypass is supplying power)
        (3) Utility failure (battery is discharging)
        (4) Battery low (limited battery time remaining)

    b. A 50-foot shielded cable, compliant with NEMA Class 2 for plenum applications, with sub-miniature 9-pin D-type connector, shall be provided for connection to the signal interface.

12. IBM* AS/400* Multi-Interface System

    a. An AS/400 Multi-Interface System shall be provided where a single UPS is powering multiple AS/400 units (up to 8). The MultiInterface Unit (MIU) shall provide the required UPS status information to each AS/400 so it can perform an automatic unattended orderly shutdown when necessary. Each AS/400 includes the software required to interface with the UPS. The following status messages are activated in the IBM system:

        (1) UPS on (UPS is supplying power)
        (2) Bypass active (bypass is supplying power)
        (3) Utility failure (battery is discharging)
        (4) Battery low (limited battery time remaining)

    b. Each AS/400 individually monitors the UPS status to determine when to initiate a quick power down to preserve data and protect hardware during a utility power outage. This system requires the optional remote contact board to provide isolated contacts. This system shall include a shielded primary cable with a 9-pin subminiature D-shell connector, the AS/400 Multi-Interface Unit (MIU), and shielded secondary cables with RJ11 and 9-pin subminiature D-shell connectors. Cables shall be available in selected lengths from 25 to 300 feet.

    c. IBM and AS/400 are trademarks of International Business Machines Corporation.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Factory-trained field service personnel shall perform the following inspections and test procedures during the UPS startup.

1. Visual Inspection

   a. Inspect equipment for signs of damage
   b. Verify installation is correct
   c. Inspect cabinets for foreign objects
   d. Verify neutral and ground conductors are properly sized and configured
   e. Inspect battery cases
   f. Inspect battery for proper polarity
   g. Verify all printed circuit boards are configured properly

2. Mechanical Inspection

   a. Check all control wiring connections for tightness
   b. Check all power wiring connections for tightness
   c. Check all terminal screws, nuts, and/or spade lugs for tightness

3. Electrical Inspection

   a. Check all fuses for continuity
   b. Confirm input voltage and phase rotation is correct
   c. Verify control transformer connections are correct for voltages being used
   d. Assure connection and voltage of the battery string(s)

3.2 MANUFACTURER'S FIELD SERVICE

A. Service Personnel

1. The UPS manufacturer shall directly employ a nationwide service organization, consisting of factory trained field service personnel dedicated to the start-up, maintenance, and repair of UPS and power equipment. The organization shall consist of regional and local offices.
2. The manufacturer shall provide a fully automated national dispatch center to coordinate field service personnel schedules. One toll-free number shall reach a qualified support person 24 hours/day, 7 days/week, and 365 days/year. If emergency service is required, response time shall be 20 minutes or less.
3. An automated procedure shall be in place to insure that the manufacturer is dedicating the appropriate technical support resources to match escalating customer needs.

B. Replacement Parts Stocking

1. Parts shall be available through an extensive network to ensure around-the-clock parts availability throughout the country.
2. Recommended spare parts shall be fully stocked by local field service personnel with back-up available from national parts center and the manufacturing location. The national parts center Customer Support Parts Coordinators shall be on-call 24 hours/day, 7 days/week, and 365 days/year for immediate parts availability. Parts from the national parts center shall be shipped within 4 hours on the next available flight out and delivered to the customer's site within 24 hours.

C. UPS Operator Training

1. Operator training courses for customer employees shall be available by the UPS manufacturer. The training course shall cover UPS theory, safety, battery considerations and UPS operational procedures.
2. Training and materials shall be provided for LAWA personnel.

D. Maintenance Contracts

1. A complete offering of preventive and full service maintenance contracts for both the UPS system and battery system shall be available. An extended warranty and preventive maintenance package shall be available. Factory-trained service personnel shall perform warranty and preventive maintenance service.

END OF SECTION 26 33 53

SECTION 26 43 13 - TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes transient voltage surge suppressors for low-voltage power, control, and communication equipment

1.2 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. SVR: Suppressed voltage rating.

C. TVSS: Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

1.3 SUBMITTALS

A. Product Data: For each type of product. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

B. Product Certificates: For TVSS devices, from manufacturer.

C. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:

D. Maintenance Data: For transient voltage suppression devices.

E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

1. Comply with NEMA LS 1.
2. Comply with UL 1283 and UL 1449.
3. Comply with NFPA 70.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Warranty for Cord-Connected, Plug-in Surge Suppressors: Manufacturer's standard form in which manufacturer agrees to repair or replace electronic equipment connected to circuits protected by surge suppressors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Manufacturers of a Broad Line of Suppressors:

1. Cutler-Hammer, Inc.
2. Square D Co.
3. General Electric

C. Manufacturers of Category A and Telephone/Data Line Suppressors:

1. MCG Electronics, Inc.
2. NTE Electronics, Inc.
3. Telebyte Technology, Inc.

2.2 SERVICE ENTRANCE SUPPRESSORS

A. Surge Protective Device Description: Non-modular type with the following features and accessories:

1. LED indicator lights for power and protection status Copper lugs.
2. Audible alarm, with silencing switch, to indicate when protection has failed.
3. One set of dry contacts rated at 5 a, 250-V ac, for remote monitoring of protection status.

B. Surge Protective Device Description: Modular design with field-replaceable modules

and the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring Copper lugs.
3. Integral disconnect switch.
4. Arrangement with copper busbars and for bolted connections to phase buses, neutral bus, and ground bus.
5. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
6. Red and green LED indicator lights for power and protection status.
7. Audible alarm, with silencing switch, to indicate when protection has failed.
8. One set of dry contacts rated at 5 a and 250-V ac, for remote monitoring of protection status.
9. Surge-event operations counter.

C. Peak Single-Impulse Surge Current Rating: 240kA per phase.

D. Connection Means: Permanently wired.

E. Protection modes and UL 1449 clamping voltage for grounded wye circuits with voltages of 480Y/277 and 208Y/120; 3-phase, 4-wire circuits, shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 and 400 V for 208Y/120 .
2. Line to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.
3. Neutral to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.

F. Protection modes and UL 1449 clamping voltage for 240/120 V, single-phase, 3-wire circuits, shall be as follows:

1. Line to Neutral: 400 V.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

G. Protection modes and UL 1449 clamping voltage for 240/120 V, 3-phase, 4-wire circuits, with high leg shall be as follows:

1. Line to Neutral: 400 V, 800 V from high leg.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

H. Protection modes and UL 1449 clamping voltage for voltages of 240, 480, 3-phase, 3-wire, delta circuits shall be as follows:

1. Line to Line: 2000 V for 480 V and 1000 V for 240 V.
2. Line to Ground: 2000 V for 480 V and 1000 V for 240 V.

2.3 PROJECT CONDITIONS

A. Service Conditions: Rate TVSS devices for continuous operation under the following conditions unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.

2. Operating Temperature: 30 to 120 deg F

3. Humidity: 0 to 85 percent, noncondensing.

4. Altitude: Less than 20,000 feet above sea level.

2.4 PANELBOARD SUPPRESSORS

A. Surge Protective Device Description: Non-modular type with the following features and accessories:

1. LED indicator lights for power and protection status Copper lugs.
2. Audible alarm, with silencing switch, to indicate when protection has failed.
3. One set of dry contacts rated at 5 a, 250-V ac, for remote monitoring of protection status.
4. Fuses, rated at 200-kA interrupting capacity.
5. Fabrication using bolted compression lugs for internal wiring.
6. Integral disconnect switch.
7. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
8. Red and green LED indicator lights for power and protection status.
9. Audible alarm, with silencing switch, to indicate when protection has failed.
10. One set of dry contacts rated at 5 A, 250-V, ac, for remote monitoring of protection status.
11. Surge-event operations counter.

B. Peak Single-Impulse Surge Current Rating: 120 kA per phase.

C. Protection modes and UL 1449 clamping voltage for grounded wye circuits with voltages of 480Y/277 and 208Y/120; 3-phase, 4-wire circuits, shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 and400 V for 208Y/120.
2. Line to Ground: 800 V for 480Y/277 and400 V for 208Y/120.
3. Neutral to Ground: 800 V for 480Y/277 and400 V for 208Y/120.

D. Protection modes and UL 1449 clamping voltage for 240/120 V, single-phase, 3-wire circuits, shall be as follows:

1. Line to Neutral: 400 V.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

E. Protection modes and UL 1449 clamping voltage for 240/120 V, 3-phase, 4-wire circuits, with high leg shall be as follows:

1. Line to Neutral: 400 V, 800 V from high leg.
2. Line to Ground: 400 V.

3. Neutral to Ground: 400 V.

F. Protection modes and UL 1449 clamping voltage for voltages of 240, 480, 3-phase, 3-wire, delta circuits shall be as follows:

1. Line to Line: 2000 V for 480 V and1000 V for 240 V.
2. Line to Ground: 1500 V for 480 V and800 V for 240 V.

2.5 ENCLOSURES

A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.

B. Install devices for panelboard with conductors between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

C. Provide multipole, 15-A circuit breaker as a dedicated disconnect for the suppressor, unless otherwise indicated, or direct bus mounted, internal to electrical equipment.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field assembled components and equipment installation, including piping and electrical connections. Report results in writing.

B. Verify that electrical wiring installation complies with manufacturer's installation requirements.

3.4 TRAINING

A. Engage a factory-authorized service representative to train LAWA maintenance ersonnel

to adjust, operate, and maintain surge protective devices.

B. Train LAWA maintenance personnel on procedures and schedules for maintaining suppressors.

C. Review data in maintenance manuals.

D. Schedule training with LAWA with at least seven days' advance notice.

E. Training to include minimum of 15 personnel for 40 hours training, 16 hours shall be classroom training and 24 hours shall be hands-on training.

END OF SECTION 26 43 13

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes interior luminaires, lamps, ballasts, and accessories.

> **NOTE:** Consider the use of pendant lighting that may make the fixture more accessible for routine maintenance. Linear lighting is preferred over typical "can" down lights.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI C82.1 - American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
2. ANSI C82.4 - American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

B. Illuminating Engineering Society of North America

C. UL Underwriters Laboratories

D. ETL Intertek Testing Services

E. NEC National Electric Code

F. NEMA National Electrical Manufacturers Association

G. CBM Certified Ballast Manufacturers

1.3 DEFINITIONS

A. BF: Ballast Factor

B. CCT: Correlated Color Temperature

C. HID: High Intensity Discharge

D. LED: Light Emitting Diode

E. LER: Luminaire Efficiency Rating

F. Lumen: Measured output of luminaire, lamp, or both.

G. Luminaire: Complete lighting fixture, including driver or ballast if included

1.4 SUBMITTALS

A. Shop Drawings: Indicate dimensions and components for each luminaire not standard product of manufacturer.

B. Product Data: Submit dimensions, ratings, and performance data.

C. Samples: Submit two color chips 3 x 3 inch in size illustrating luminaire finish color where indicated in luminaire schedule.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum two years documented experience.

B. Photometric Data: For qualified agencies providing photometric data for lighting fixtures.

1.6 QUALITY ASSURANCE

A. Provide Luminaire Data Photometric Testing performed by an independent agency complying with IESNA Lighting Measurement Testing and Calculation Guides.

B. Comply with NFPA 70.

1.7 MOCK-UP

A. Quality Requirements: Mock-up requirements.

1.8 FIELD MEASUREMENTS

A. Verify all critical measurements in the field prior to fabrication.

1.9 COORDINATION

A. Coordinate layout and installation of light fixtures with other construction.

1.10 MAINTENANCE MATERIALS

A. Execution and Closeout Requirements: Spare parts and maintenance products.

1.11 WARRANTIES

A. All fixtures and workmanship shall be guaranteed free of defects and fully operational for the duration of the warranty period. Defective fixtures or workmanship will be replaced by the Contractor at no cost to the Owner.

B. Ballasts for fluorescent fixtures, transformers for low voltage fixtures, and drivers for LED fixtures shall be warranted against defects in workmanship or material. Warranty to provide for replacement of fluorescent ballasts, transformers for low voltage fixtures, and LED drivers at no cost to the Owner.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES

NOTE: Highly efficient LED fixtures with consistent color temperature (tight binning), high Color Rendering Index (85+ CRI), and rated life greater than 50,000 hours are preferred.

A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.

2.2 LED LIGHTING FIXTURES AND COMPONENTS

A. Manufacturers:

1. Lighting Science Group.
2. Con-Tech Lighting.
3. Bega Lighting.
4. Lunera Lighting.

B. Product Testing: Comply with U.L. 1598 and 8750. Test according to IES LM-79 and LM-80.

C. Drivers: Operation to be at standard rated voltage of driver, and not “over-driven.”.

NOTE: T5 and compact fluorescent lamps/ballasts are recommended for use on the project. Minimize the lamp types for stocking and purchasing purposes.

FLUORESCENT BALLASTS

D. Manufacturers:

1. Philips.
2. Osram.
3. General Electric.

2.3 FLUORESCENT DIMMING BALLASTS AND CONTROLS

A. Manufacturers:

1. Philips.
2. General Electric.
3. Lutron.

B. Product Description: Electrical assembly of control unit and ballast to furnish smooth dimming of fluorescent lamps.

C. Control Unit: Selected for energy efficiency and daylight harvesting capability.

D. Ballast: Selected by dimming system manufacturer as suitable for operation with control unit and suitable for lamp type and quantity specified for luminaire.

2.4 LED LAMPS

A. Manufacturers:

1. Lighting Science Group.
2. OptiLED.
3. Con-Tech Lighting.

NOTE: Incandescent or halogen lamps **not** recommended for use on the project unless the lamp life exceeds 10,000 hours.For fluorescent lamps, a color rendering of 80+ CRI, and color temperatures of 2800-3500 Kelvin are preferred.

2.5 INCANDESCENT LAMPS

A. Manufacturers:

1. Tivoli.
2. Ushio.

2.6 FLUORESCENT LAMPS

A. Manufacturers:

1. Philips.
2. Osram.
3. General Electric.

2.7 LIGHTING CONTROL SYSTEM

A. Product Description: Complete programmable system allowing for daylight harvesting, DMX-512 fixture control, and interfacing with existing Building Automation Control system in accordance with LEED guidelines.

B. System Commissioning: Provide labor and temporary equipment as required to commission lighting control system in accordance with LEED guidelines.

C. Level Setting: Provide labor and temporary equipment necessary to set and program dimmed and DMX-controlled lighting levels under the Lighting Consultant's supervision.

D. Owner Training: Schedule and provide user training sessions for designated LAWA personnel.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned luminaires, lamps, and accessories.

B. Extend existing interior luminaire installations using materials and methods compatible with existing installations, or as specified.

C. Clean and repair existing interior luminaires to remain or to be reinstalled.

3.2 INSTALLATION

A. Provide labor and materials to install and structurally support fixtures in accordance with all applicable codes and safety practices.

NOTE: Provide additional labor and materials necessary to install color and/or diffusion media in light fixtures as determined by a professional lighting designer. Locate lamps so that they are accessible utilizing standard ladders and lifts.

3.3 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

A. Provide labor and materials for aiming and adjustment of all fixtures, color and/or diffusion media, and accessories under the Lighting Consultant's supervision.

3.5 CLEANING

A. Remove dirt and debris from enclosures.

B. Clean photometric control surfaces as recommended by manufacturer.

C. Clean finishes and touch up damage.

3.6 PROTECTION OF FINISHED WORK

A. Re-lamp all luminaires that have failed lamps at Substantial Completion.

NOTE: The recommended illumination levels (in footcandles) for the public areas of the Terminals are as follows:

- Arrival (Exterior) = 5-10FC
- Artwork and Displays = 40-50FC
- Back of House Areas
  - General illumination for working areas = 25-35FC
  - Corridors and stairways = 5-10FC
- Baggage Handling = 35-45FC
- Concessions and Food Courts
  - General illumination = 15-20FC
  - Work surfaces = 35-45FC
- Concourse = 10-15FC
- Departure (Exterior) = 5-10FC
- Information Desks = 30-40FC
- Restrooms = 10-15FC
- Retail
  - General illumination = 20-25FC
  - Accenting = 40-50FC
- TSA / Security
  - General illumination = Per current TSA guideline
- Ticketing
  - General illumination = 15-20FC
  - Work Surfaces = 35-45FC

END OF SECTION 26 51 00

SECTION 27 50 00 – BASIC TELECOMMUNICATION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor shall include in the Bid all labor, materials, tools, plant, transportation, storage costs, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational systems shown and described in the Specifications.

B. The Contractor is responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.

C. The Contractor shall coordinate interfaces to existing systems that are being extended in the Project in order to minimize disruption to the existing systems operations. Any systems outages shall be approved in advance and scheduled with LAWA (refer to Section 270505 – Selective Demolition Telecommunication Systems).

D. The Contractor shall coordinate specialty electronic, ACAMS, Information Technology (IT) data networks, common use and flight information systems and displays, CCTV, public address and any other IT infrastructure systems.

E. Related documents:
   1. LAWA Information Technology Group Infrastructure, Standards of Practice, dated 10/22/04.
   2. LAWA IT Requirements for New Concessions Model.

1.2 GLOSSARY

A. ANSI American National Standards Institute

B. ASTM American Society for Testing Materials

C. BFU Board of Fire Underwriters

D. BICSI Building Industry Consulting Services International

E. CSA Canadian Standards Association

F. DEC Department of Environmental Conservation

G. EIA Electronics Industry Association

H. ER Equipment Room

I.	FCC	Federal Communications Commission
J.	FM	Factory Mutual
K.	IEEE	Institute of Electrical and Electronics Engineers
L.	ISO	International Standards Organization
M.	NEC	National Electrical Code
N.	NEMA	National Electrical Manufacturers' Association
O.	NESC	National Electrical Safety Code
P.	NFPA	National Fire Protection Association
Q.	OSHA	Occupational Safety and Health Administration
R.	TIA	Telecommunications Industry Association
S.	TR	Telecommunications Room
T.	TWC	Tenant Wiring Closet
U.	UFBC	Uniform Fire Prevention and Building Code
V.	UL	Underwriter's Laboratories, Inc.

1.3 SUBMITTALS

A. Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

B. Submit a letter of approval or other certification from the manufacturer indicating that the Bidder is a manufacturer certified installer of the proposed cabling system(s) (submit with Bid).

C. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project. Submit a two-foot length sample of each fiber cable type/count to be installed.

D. Submit manufacturers' data sheets for proposed racks and cabinets, termination equipment, cable management or support hardware, power and grounding equipment, and labeling material.

E. Submit manufacturers' instructions for storage, handling, protection, examination, preparation, operation, and installation of all products. Include any application conditions or limitations of use stipulated by any product testing agency.

F. Submit all applicable Material Safety Data Sheets.

G. Submit all factory test information of cables prior to installation of the product.

H. Submit a complete test plan (and subsequent test data) per ANSI/TIA/EIA-568-C and ANSI/TIA/EIA TSB-67 for all cabling.
   1. Submit (5) hardbound copies of all cable test results and one electronic compact disc

I. Submit calibration reports for all test equipment, the calibration shall be performed by a manufacturer certified calibration facility and be dated no more than sixty (60) days prior to the start of testing.

J. Submit all proposed labeling materials and nomenclature for approval.

K. Coordination Drawings:
   1. Indicate locations where space is limited for installation and access.
   2. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.
   3. Layout of Telecommunication Rooms: Within thirty (30) days before beginning installation, the Contractor shall furnish a telecommunications room drawing showing the initial layout design and plans for the proposed equipment, cable routings, and termination locations for all cable and equipment.

L. Maintenance Manuals: Manuals including maintenance instructions and other descriptive material as received from the manufacturers shall be provided that will enable LAWA personnel to maintain equipment and test equipment. The Contractor shall make reasonable effort to obtain specified maintenance documentation for all third party equipment. This documentation shall include descriptions, specifications, theory of operation (where applicable), layout drawings (showing component types and positions), and back-panel and assembly wiring diagrams. In addition to hardcopies, electronic copies, in a Design Consultant approved format, shall be provided.

M. Preventative Maintenance: Instructions shall be provided for preventive maintenance procedures that include examinations, tests, adjustments, and periodic cleaning. The manuals shall provide guidelines for isolating the causes of hardware malfunctions and for localizing faults. The manuals shall provide thorough instructions on the use of any specialized test equipment needed for hardware maintenance. In addition to hardcopies, electronic copies, in a Design Consultant approved format, shall be provided.

N. Maintenance Schedule: A recommended schedule for preventative, routine, and emergency maintenance indicating frequency and response time. Preventative maintenance services during peak activity periods shall be avoided. The Contractor shall coordinate with LAWA to define peak activity periods. The Contractor shall submit a finalized preventative maintenance schedule for Design Consultant approval.

O. Project Record Documents required include:
   1. Marked-up copies of Contract Drawings
   2. Marked-up copies of Shop Drawings
   3. Newly prepared Drawings
   4. Marked-up copies of Specifications, Addenda and Change Orders
   5. Marked-up Project Data submittals

6. Record Samples
7. Field records for variable and concealed conditions
8. Record information on Work that is recorded only schematically
9. As-built drawings
10. Record drawings
11. Electronic as-built and LAWA LUSAD requirements

P. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. Design Consultant will periodically review Project Record Documents to assure compliance with this requirement.

Q. At every quarter, submit Project Record Documents to Design Consultant for LAWA's records.
1. Upon completion of the as built drawings, the Design Consultant will review the as built work with the Contractor.
2. If the as built work is not complete, the Contractor will be so advised and shall complete the work as required.

R. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

1.4 CODES, STANDARDS AND REFERENCES

A. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the following:

B.
1. ANSI C80.1 Rigid Steel Conduit, Zinc-Coated
2. ANSI C80-3 Electrical Metallic Tubing, Zinc-Coated
3. ICEA S-83-596 Optical Fiber Premises Distribution Cable
4. TIA-455-107 FOTP-107 Determination Of Component Reflectance Or Link/System Return Loss Using A Loss Test Set
5. ANSI/TIA/EIA-455 Test Procedures For Fiber Optic Fibers, Cables, TR
6. ANSI/TIA/EIA 455-57 Optical Fiber End Preparation and Examination
7. ANSI/TIA/EIA 455-59 Optical Time Domain Reflectometry
8. ANSI/TIA/EIA 455-60 OTDR Measurement Of Fiber Optic Cable Length
9. ANSI/TIA/EIA -526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
10. ANSI/TIA/EIA 526-14 OFSTP-14 Optical Power Loss Measurements Of Installed Multimode Fiber Cable Plant
11. ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 02/02/09
12. ANSI/TIA/EIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling Components and Standards, April, 2010
13. ANSI/TIA/EIA-568-C.3 Optical Fiber Cabling Components Standard, June, 2008

14. ANSI/TIA/EIA –569-B Commercial Building Standard for Telecommunications Pathways and Spaces, May 2009
15. ANSI/TIA/EIA 598-C Optical Fiber Cable Color Coding, 2005
16. ANSI/TIA/EIA -604-1 Fiber Optic Connector Intermateability Standard, 2002
17. ANSI/TIA/EIA -606-A Administration Standard for Commercial Telecommunications Infrastructure, 11/24/08
18. ANSI/TIA/EIA -607 Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994
19. ANSI/TIA/EIA –758-A Customer-Owned Outside Plant Telecommunications Infrastructure Standard 2004
20. ANSI/TIA/EIA – 854 A Full Duplex Ethernet Specification for 1000Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling, 2001
21. ANSI/TIA/EIA – 862 Building Automation Systems Cabling Standard for Commercial Buildings, 2002
22. ANSI/TIA/EIA-4750000B Generic Specifications for Fiber Optic Connectors
23. ASTM E814 Standard Test Method For Fire Tests Of Penetration Firestop Systems
24. BICSI Telecommunications Distribution Methods Manual (Tenth Edition)
25. FCC 47 Part 68 Code of Federal Regulations, Title 47, Telecommunications
26. IEEE National Electrical Safety Code (NESC); 2007
27. ISO/IEC 11801 Information Technology - Generic Cabling For Customer Premises
28. LADBS Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code
29. NEMA 250 Enclosures for Electrical Equipment (1000 V Maximum)
30. NFPA-70 National Electric Code; 2008
31. TIA/EIA TSB 67 Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems
32. TIA/EIA TSB 72 Centralized Optical Fiber Cabling Guidelines
33. TIA/EIA TSB 75 Additional Horizontal Cabling Practices for Open Offices
34. TIA/EIA TSB 95 Additional Transmission Performance Guidelines For 4-Pair 100 Ohm Category 5 Cabling
35. UL 1459 Underwriters Laboratories Standard for Safety – Telephone Equipment
36. UL 1863 Underwriters Laboratories Standard for Safety – Communications Circuit Accessories

C. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

1.5 QUALITY ASSURANCE

A. Contractor Experience: The Contractor or approved sub-contractor shall be a Certified Cable Installer, with the capability of providing a manufacturer's certification of not less than fifteen (15) years for the horizontal and backbone cabling and associated termination equipment. The Contractor shall offer proof of certification by submitting a copy of certification with the Bid.

B. The Contractor shall have at least one (1) Registered Communications Distribution Designer (RCDD) on staff. The Contractor shall offer proof of RCDD certification by submitting a copy of the certification with the Bid. The Contractors RCDD shall be part of the Contractors team

throughout the duration of the project to assist on shop drawings and other related technical issues.

C. The Contractor's Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with the LAWA's and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the Design Consultant. The Design Consultant shall be notified by the Contractor of any inspection(s) and the Design Consultant may elect to participate in any inspection(s). All QC information shall be provided to LAWA for input into the CMMS (refer to paragraph 3.13).

1.6 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids Specification requirements.

B. Under no circumstances shall the LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to Engineer all evidence to support the contention that the item proposed for substitution is equal to the specified item. The Owner's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor.

1.7 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

B.

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.
2.
3. Equipment shall meet all applicable FCC Regulations.
4.
5. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.
6.

7. The listing of a manufacturer as “acceptable” does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.
8.
9. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

C. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.
   1. All components of an assembled unit need not be products of the same manufacturer.
   2. Constituent parts, which are alike, shall be from a single manufacturer.
   3. Components shall be compatible with each other and with the total assembly for intended service.
   4. The Contractor shall guarantee for a minimum of fifteen (15) years, the performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

D. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

E. Major items of equipment that serve the same function must be the same make and model.

F. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

G. Maximum standardization of components shall be provided to reduce spare part requirements.

1.8 WARRANTY

A. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of fifteen (15) years from Final Acceptance. Cable integrity and associated termination’s shall be thoroughly inspected, fully tested and guaranteed as free from defects, transpositions, opens-shorts, tight kinks, damaged jacket insulation, etc.
   1. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.
   2. The Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

B. The Bidder shall submit a copy of all manufacturer warranty information.

C. The structured cabling system manufacturer of the cable products to be submitted shall provide a minimum fifteen (15) year extended product warranty and application assurance (system performance warranty). The warranty shall provide the following:
   1. Ensure against all product defects.

2. Ensure that all copper and fiber approved cabling and components meet or exceed the specifications of ANSI/TIA/EIA-568-C and ISO/IEC IS 11801, meet or exceed the NEXT requirements of ANSI/TIA/EIA TSB-67, TSB-95 and ISO/IEC IS 11801 for cabling links/channels.
3. Ensure that the installation of copper and fiber components will meet or exceed the loss and bandwidth requirements of ANSI/TIA/EIA TSB-67, TSB-95 and ISO/IEC IS 11801 for a fifteen year period.
4. Cover the repair or replacement of defective products, and the labor for repair or replacement of such defective products.
5. Application assurance which shall cover the failure of the cabling system to support the application which it was designed to support, as well as additional applications introduced in the future by recognized standards or user forums that use the ANSI/TIA/EIA-568-C or ISO/IEC IS 11801 component and link/channel specifications.

D. The Bidder shall submit a letter of approval or other certification from the manufacturer indicating that the Bidder is a manufacturer certified installer of the proposed cabling system (submit with bid).

1.9 ON-SITE PERSONNEL REQUIREMENTS

A. Installation and testing crews shall have completed all appropriate training in copper and fiber cabling installation as required by the manufacturer.

B. The Contractor shall employ the maintenance contractor with whom LAWA has a maintenance contract to perform the disconnection, connection, re-connection or configuration of ACAMS or other existing systems that might be affected by this Work.

C. The Contractor shall provide all new UTP cable, optical fiber cable, innerduct, racks, cabinets, patch panels, cover plates, outlet boxes, related hardware, distribution, termination equipment, and any other appurtenances and equipment associated with this project.

D. The Contractor shall be responsible for the proper placement of all cabling, racks, cabinets, patch panels, cover plates, outlet boxes, and related hardware, as well as all distribution, and termination equipment.

E. The Contractor shall obtain the approval of Engineer or Design Consultant for the final layout of telecommunications rooms and tenant wiring closets prior to the installation of any materials or equipment. Shop drawings showing proposed room layouts shall be submitted for approval before beginning installation (refer to Paragraph 1.2).

F. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of the LAWA.

G. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

H. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

I. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

J. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

K. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of the Engineer so the area can be appropriately noted.

L. Following each day's work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

PART 2 - PRODUCTS

2.1 EQUIPMENT CABINETS

A. LAWA standard telecommunications room equipment cabinet is 28"W x 38"D x 84"H DAMAC MODEL CSN1284Z22477-3 (part number includes cooling fans, enclosure light, power strips, cable managers).
   1. For raised floor applications provide DAMAC raised floor seismic support kit
   2. Some applications (blade servers or data switches) require deep (42") cabinets. Refer to Drawings.

B. Relay Racks
   1. 19-inch rack mounting space.
   2. 84 inches high.
   3. Lightweight aluminum construction.
   4. Black polyurethane finish.
   5. 15-inch deep base with four (4) ¾-inch bolt down holes.

C. Each rack shall have double-sided tapped holes with standard EIA hole pattern.

D. Each rack shall be equipped with a 12-position power strip. Power strip:
   1. Shall be 20 amp, 120V.
   2. Shall be rack mounted.
   3. Shall be non-switched.

4. Shall be surge suppressed.
5. Shall have a minimum of twelve (12) outlets – transformer spaced.
6. Power shall be hardwired.

E. Relay racks shall meet UL 1363 and 1449 requirements.

F. Vertical Cable Channel
1. Each rack will have an integral vertical cable channel with a minimum of 6 inches by 4 inches of channel space to facilitate the management of the cables entering the rack from the cable tray.

G. There shall be horizontal and vertical cable management associated with all cabinets and racks.

H. The cable management products shall meet the following requirements:
1. Cable management panels shall be metal or plastic with integral wire retaining fingers.
2. Cable management panels shall have removable covers.

2.2 CABLE TRAY

A. Cable management and routing in all Telecommunications Rooms will be via 6 inch deep cable tray (Chalfant Series 6 or equivalent) in widths as indicated on Drawings.
1. Cable tray shall be UL Classified as an equipment grounding conductor and shall meet NEC Article 318-5.
2. Cable tray shall be louvered ventilated construction with louvered openings minimum 3 inches wide. Cable bearing surface shall be 3 inches wide. Openings shall be on 6-inch centers with metal drawn downward so cables can drop out at any location along tray without cutting or gasketing the openings.
3. All cable tray 90 degree elbows, cross fittings and tees shall have 3-inch diameter holes punched out in them at a minimum spacing of 6 inches on center to allow for dropping cables down at corners and tees to equipment below. Holes shall have rubber or hard plastic gaskets installed inside the punched hole to protect cables from sharp edges.
4. Cable tray material shall be 304 stainless steel.
5. Cable tray hardware shall be 3/8 inch by 3/4 inch 302 stainless steel round head shoulder bolts with serrated neck, SS hex nuts shall have an integral lock washer.
6. Cable tray shall be supported as follows:
    a. Where tray is adjacent to TR wall it will be supported by Unistrut mounting brackets as indicated in construction Drawings.
    b. Where tray is suspended above equipment cabinets it shall be supported by a single center support consisting of ½-inch threaded rod suspended from structure above as indicated in construction Drawings.
        1) Thread rod shall be fitted with a 6-inch PVC tube where it resides in cable tray to protect cables.

2.3 UNSHIELDED TWISTED PAIR CABLE

A. Provide CMP rated 4-pair Category 6 UTP cable (orange in color) GENERAL 7131719 or equivalent.

B. Provide 4-port wall mount face plates (almond in color) AMP 1479446-1 or equivalent

C. Provide Category 6 SL 110 modular jacks (with orange inserts) AMP 1375055-5 or equivalent

D. Patch cables shall be Belkin A3L980-XX-BLK-S or equivalent

E. Transmission Characteristics:
   1. The UTP connector module shall meet the transmission technical specifications performance when measured at 100 MHz:
      a. Parameters Value (dB)
         1) NEXT 55.1
         2) PSNEXT 52.0
         3) FEXT 49.8
         4) PSFEXT 46.9
         5) Attenuation 0.10
         6) Return Loss 27.0

2.4 UTP PATCH PANELS

A. Category 6 patch panels shall meet or exceed the following specifications:
   1. Category 6 standard.
   2. T568A wired.
   3. Have sufficient ports to provide at least 25% growth, per patch panel.
   4. Have a paired punch down sequence to allow pair-twist within ½-inch of the termination.
   5. Rack mounted.
   6. UL listed File # E129878.
   7. Made of rolled edge black anodized aluminum construction.
   8. Provide orange inserts
   9. AMP 1375015-2 plus 1479450-1 or equivalent

B. From the same manufacturer as the other connectivity products (jacks, faceplates, etc.) used for this project.

C. Acceptable Manufacturers:
   1. ADC
   2. Tyco/AMP
   3. Nordx/CDT
   4. Ortronics
   5. Panduit
   6. Systimax

2.5 OPTICAL FIBER CABLE

A. Singlemode Fiber
   1. Shall be class IVa Dispersion-Unshifted single mode optical fibers complying with ANSI/EIA/TIA-492BA00 with fiber counts as indicated on drawings.

2. The zero dispersion wavelength shall be between 1300 nm and 1324 nm. The ANSI/EIA/TIA-455-168 maximum value of the dispersion slope shall be no greater than 0.093 ps/km-nm2. Dispersion measurements shall be made in accordance with ANSI/EIA/TIA-455-169 or ANSI/EIA/TIA-455-175.
3. The nominal core diameter shall be 8.7 µm to 10.0 µm with a tolerance of +/- 0.5 um at 1300 nm when measured in accordance with ANSI/EIA/TIA-455-164 or ANSI/EIA/TIA-455-167.

B. Physical Characteristics:
1. Optical fiber riser cable shall have an Underwriters Laboratory rating that meets or exceeds the requirements of UL-1666.
2. The designation "UL®" and either "OFNP" or "OFNR" shall be printed every two (2) feet on the cable jacket.
3. Strength members shall be FGE/Aramid yarn with extruded PVC sub-cable jacket.
4. The cable shall have individual fiber tube colors per TIA/EIA-606 and overall black jacket.
5. The cable shall contain a stiff central member with cables stranded around center.
6. The cable shall contain a ripcord for the outside jacket.
7. The cable shall be suitable for temperatures of -40o to +75o C.

C. Acceptable Manufacturers:
1. Berk-Tek
2. Nordx/CDT
3. CommScope
4. Corning
5. General
6. Systimax

2.6 OPTICAL FIBER PATCH PANELS

A. Patch panels shall be BEJED MODEL BJ-1940A-001 with:
1. BJ-1742C-011 Splice Pads
2. BJ-1646-047 Coupler Plates
3. MIC Cable Furcation Fan-out cable assemblies with SC angled PC Connectors

2.7 INNERDUCT

A. Innerduct shall be installed in all conduits in which fiber cabling is to be installed.

B. All optical fiber cables shall be placed within the innerduct.

C. The innerduct shall have the following characteristics:
1. Be constructed of PE rated plastic if outdoor application
2. Meet NEC 770-53 requirements
3. Be one (1) inch diameter
4. Be orange in color
5. Have a maximum flame rating of UL 910

D. Acceptable Manufacturers:
   1. Arnco
   2. Carlon
   3. Dura-Line
   4. Endot
   5. Pyramid Industries

2.8 OPTICAL FIBER CABLE TESTER

A. The Contractor shall test all strands of optical fiber cable with an approved Power Meter and Light Source.

B. The tester shall have been calibrated by a manufacturer certified calibration facility. The calibration shall be dated no more than sixty (60) days prior to the start of testing.

C. Acceptable Manufacturers:
   1. Corning
   2. Fluke
   3. Noyes
   4. Other approved equal

2.9 HORIZONTAL UNSHIELDED TWISTED PAIR CABLE TESTER

A. Shall perform all tests necessary to certify the horizontal UTP cabling to the requirements of Category 6.

B. Shall be a UL certified Level IV test set calibrated by a manufacturer certified calibration facility. The calibration shall be dated no more than sixty (60) days prior to the start of testing.

C. Acceptable Manufacturers:
   1. Fluke
   2. WaveTek
   3. MicroTest
   4. Other approved equal

2.10 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Provide plastic warning tape 6 inches wide continuously printed and bright colored 18” above all direct buried services, underground conduits and duct-banks.

F. Acceptable Manufacturers:
1. W.H. Brady
2. Ideal
3. Panduit
4. Other equal

2.11 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 3 - EXECUTION

3.1 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.
1. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

C. Before construction work commences, the Contractor shall visit the site and identify the exact routing for all horizontal and backbone pathways.

D. The maximum allowable Category 6 UTP cable distance (as measured by electronic UTP Test Equipment) between the wall outlet and the serving "Port" on the Ethernet switch in the serving Telecommunications Room is 90 meters. Planned horizontal cable conduit runs that will result in a cable run that exceeds 90 meters shall be pointed out to Engineer before they are installed for appropriate redesign or waiver.

E. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable tray, conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical,

Baggage Handling and Electrical Drawings. Verify with Design Consultant the exact location and mounting height of all equipment in finished areas, such as equipment racks and telecommunications devices.

F. The Contractor shall use existing conduit and surface raceway where possible and practicable. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, Engineer shall be notified before starting that part of the work. In areas with no ceilings, install only after Design Consultant reviews and comments on arrangement and appearance.

G. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. There will be no priority schedule for trades. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and/or furnish other equipment as required for ample maintenance space. Any changes in the size or location of the material or equipment supplied or proposed that may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of Engineer and approval received before such alterations are made.

H. Provide easy, safe, and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation. All TR cabinets and racks shall be mounted a minimum of 36-inches from the wall, any wall mounted equipment, other cabinets, equipment or power panels (or per NEC for voltages exceeding 120VAC).

I. Where required, the Contractor shall be responsible for cutting, patching, coring and associated work for the complete cabling system at no additional cost to the Owner. Cut and drill from both sides of walls to eliminate splaying. Patch adjacent existing work disturbed by installation of new work. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

J. All conduit and sleeve openings used by the Contractor shall be waterproofed or fireproofed in compliance with State and Local Building and Fire Codes. Strict adherence to National, State, and Local Fire Codes, particularly fire stopping will be required.

K. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

L. All building conduits and sleeves installed and/or used under these Specifications shall be fire stopped, or re-fire stopped, upon cable placement through such passageways.

M. Fire stopping for Openings through Fire and Smoke Rated Wall and Floor Assemblies:
1. To be used inside all conduits and sleeves. Caulk on exterior of conduit penetration.

2. Provide fire stop system seals at all locations where conduit, fiber, cable trays, cables/wires, and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire stop seal between sleeve and wall for drywall construction.

3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire stop system. The installation shall provide an air and watertight seal.
4. The methods used shall incorporate qualities that permit the easy removal or addition of conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating. Typical rating:
    a. Floors – three (3) hours
    b. Corridor walls – two (2) hours
    c. Offices – three-quarters (0.75) hour
    d. Smoke partitions – three-quarters (0.75) – one (1) hour
5. Provide fire stop pillows for existing cable tray penetrations through firewalls.

N. Manufacturer's recommended installation standards must be closely followed (i.e. minimum depth of material, use of ceramic fiber and installation procedures).

O. The Contractor shall seal all foundation penetrating conduits and all service entrance conduits and sleeves to eliminate the intrusion of moisture and gases into the building. This requirement also includes spare conduits designated for telecommunications use.

P. Spare conduits shall be plugged with expandable plugs.

Q. All service entrance conduits through building shall be sealed or resealed upon cable placement.

R. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support work. Supports shall meet the approval of Design Consultant.

S. Fiber and Copper Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.
1. Cables shall be combed and each strand shall run parallel with the other strands.
2. After combing and straightening strands, Contractor shall separate strands into bundles according to routing requirements and termination points.
3. Bundles shall be secured with hook-and-loop cable strap material.
    a. Cable ties manufactured from a hard polymer material, such as plastic or nylon, shall not be used.
    b. Hook-and-loop material shall be low life cycle, back-to-back type, black in color, and ½ inch wide.
4. Contractor shall begin to bundle and strap cables within 6 inches of exit from conduit, and bundles shall have cable straps applied at intervals not greater than 10 feet for entire length of vertical and horizontal run.

3.2 PHASES OF IMPLEMENTATION

A. Provide a consolidated and integrated schedule.

3.3 INSPECTIONS

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit installation drawings for LAWA review and approval.

3.4 FLOOR MOUNTED CABINETS AND RACKS

A. All racks shall be securely anchored to the floor (slab, not floor tile) with a minimum of 1/2-inch drop in anchors and shall be seismically braced to structure to prevent toppling. Mounting shall comply with Seismic Zone 4 requirements. Contractor shall submit proposed mounting method for approval prior to beginning installation. Proposed mounting method submitted shall be stamped by Contractor's Structural Engineer that it meets local codes and Seismic Zone 4 mounting requirements.

B. Provide vertical and horizontal cable management for all cabling installed by this Contractor.

C. Mount with a minimum of 36 inches of clear access behind and in front of cabinets unless otherwise noted on Construction Drawings. Submit all proposed Telecommunications Rooms layouts with dimensions for approval prior to beginning installation.

D. Ground the cabinets and racks to the equipment ground busbar with an insulated #6 copper wire, green in color. Refer to Construction Drawing grounding details for specific requirements.

3.5 CABLE TRAY

A. Cable tray shall be appropriately secured as indicated in Construction Drawings. Mounting shall comply with Seismic Zone 4 requirements. Contractor shall submit proposed mounting method for approval prior to beginning installation. Proposed mounting method submitted shall be stamped by Contractor's Structural Engineer that it meets local codes and Seismic Zone 4 mounting requirements.

3.6 GROUNDING

A. General: Grounding systems and ground busbars are to be installed in each Telecommunications Room. All equipment cabinets, racks, termination frames, conduits, sleeves, cable tray and other conductive materials shall be bonded to the grounding busbar with #6 AWG insulated conductor. Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements.

B. Braided Type Bonding Jumpers: Use for flexible bonding and grounding connections.

C. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

D. Bond all adjacent sections of overhead cable tray with # 6 AWG conductor.

E. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot tin coated materials to assure high conductivity and make contact points closer in order of galvanic series.
   2. Make connections with clean bare metal at points of contact.
   3. Aluminum-to-steel connections shall be with stainless steel separators and mechanical clamps.
   4. Aluminum-to-galvanized steel connections shall be with tin plated copper jumpers and mechanical clamps.
   5. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

F. Exothermic Welded Connections: Use for connections to structural steel or grounding busbar. Comply with manufacturer's written recommendations. Welds that are puffed up or show convex surfaces indicating improper cleaning are not acceptable and will be re-done at Contractor’s expense.

G. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

H. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torque tightening requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

3.7 SYSTEM STARTUP

A. The Contractor shall not apply power to the system until after:
   1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.
   2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
   3. System wiring has been tested and verified as correctly connected as indicated.
   4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.
   5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.8 OPTICAL FIBER TESTING

A. Factory Test: Prior to shipment of the optical fiber cable, 100 percent of the fibers shall be tested with an optical time domain reflectometer.
   1. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum.
   2. Copies of the traces shall be furnished as part of the submittals.

B. Pre-installation Test: An optical time domain reflectometer test of every fiber of each cable on the reel prior to installation.
   1. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum.
   2. Copies of the traces shall be furnished to Architect/Engineer.

C. Contractor's Field Test: The Contractor shall verify the integrity of the installed fiber ring by testing the installed fiber with an optical time domain reflectometer.
   1. Tests shall be performed on 100 percent of the fibers and repeated from the opposite end of each fiber.
   2. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum.
   3. Copies of the traces shall be furnished as part of the submittals.
   4. Installed cable optical time domain reflectometer test:
      a. Prior to installation Contractor shall perform onsite, on reel testing under the supervision of Engineer or Design Consultant.
      b. An optical time domain reflectometer test of all fibers shall be performed on the fiber optic cable after it is installed.
      c. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum.
      d. If the optical time domain reflectometer test results are unsatisfactory, the cable segment is unacceptable.

e. The unsatisfactory segments of cable shall be replaced with a new segment of cable at Contractor's expense.
f. The new segment of cable shall then be tested to demonstrate acceptability.
g. Copies of the traces for each circuit shall be furnished as part of the submittals.

D. The Contractor shall provide end-to-end attenuation testing using an approved Power Meter and Light Source per ANSI/EIA/TIA 455-53A.

E. Backbone singlemode fiber shall be tested in both directions at both 1310 nm and 1550 nm in accordance with ANSI/EIA/TIA-526-14A method B.

F. Perform optical attenuation measurements for each optical fiber after both ends of an optical cable have been connectorized, dressed, and mounted into outlets, panels, or frames to show losses of the optical cable, connectors, and couplers. Acceptable link attenuation for backbone cabling shall be as follows:

G. Optical Fiber cable type Wavelength (nm) , Maximum allowed attenuation (dB/km) and Minimum information transmission capacity for overfilled launch (MHz/km) are shown in the following table:

H.

I.

J.

K.

L.

M.

Optical Fiber Cable Type	Wavelength (nm)	Maximum attenuation (dB/km)	Minimum information transmission capacity for overfilled launch (MHz/km)
62.5/125 µm multimode	850	3.5	200
	1300	1.5	500
Singlemode ISP cable	1310	1.0	N/A*
	1550	1.0	N/A*
Singlemode 8.0 OSP cable	1310	0.5	N/A*
	1550	0.5	N/A*
*Note – The information capacity of the fiber, as measured by the fiber manufacturer, can be used by the contractor to demonstrate compliance with this requirement.			

N. General: Cables and components that fail performance tests shall be replaced and retested until they meet the required performance standards.

O. Fiber Optic Cable:
1. Record cable length from either length markings on cable or through OTDR test.
2. After installing connectors perform OTDR on all fibers to evaluate connector loss and validate connector.
   a. Loss shall not exceed manufacturer's listed maximum loss for connector type installed.
   b. Connector shall be replaced at Contractors expense if it fails test.

3.9 HORIZONTAL UNSHIELDED CABLE TESTING

A. Test all new UTP cables.

B. Testing shall conform to ANSI/TIA/EIA TSB-67 Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems and ANSI/TIA/EIA-568-C.2, Propagation Delay and Delay Skew Specification for 100 Ohm 4-Pair Cable.

C. Testing shall be accomplished using a UL certified Level III tester.

D. Notify Owner of any cable failing the prescribed certification testing.

E. The Contractor shall provide Category 6, 100 MHz channel test results on all pairs of cable, including but not limited to cable length, wire map, NEXT, Power Sum NEXT, ACR, Power Sum ACR, ELFEXT, Power Sum ELFEXT, Return Loss, Propagation Delay and Delay Skew. Results shall be provided in an electronic format.

3.10 BACKBONE CABLE TESTING

A. Testing shall be according to device manufacturer’s specification. Testing for cable integrity after installation shall be performed to include as a minimum, DC resistance, opens or shorts.

3.11 TEST RESULTS

A. Fiber Optic Cables:
   1. The Contractor shall test all fiber optic cables and submit all fiber test result data in an electronic format and provide five (5) hard copies of the test results showing graphically, the entire length of the fiber.
      a. Reports shall show circuit ID, cursor marks, total attenuation, date of installation and test used.
   2. The Contractor shall submit one (1) copy of software capable of viewing the electronic test result files.
   3. Contractor shall create and provide a spreadsheet or database summary report of all fiber links to include origin, destination, patch panel, designations, OTDR distances, OTDR and return loss results.

B. Horizontal Copper Cabling:
   1. The Contractor shall test all cables and submit all horizontal copper cable test result data in electronic format, with the resulting file formatted with one test result per 8.5-inch x 11-inch page.
      a. Files exported and saved as *.txt files shall NOT be acceptable.
   2. The Contractor shall submit (1) copy of software capable of viewing the electronic test result files and (1) hardcopy.

3.12 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

D. All outdoor cables shall be labeled with ACP FT-LAWAATAG-2.5X4 plastic tags and pre-printed with permanent ink, outdoor cables shall be labeled (and secured with heavy duty straps) in every manhole and handhole within 12 inches of where the cable enters and exits the manhole or handhole and on the slack coil.

E. Backbone cables shall be marked at each endpoint and at all intermediate pull/ access points or junction boxes. Label shall indicate origination and destination TR ID’s, sheath ID and strand or pair range.

F. Copper and Optical Patch Panels:
   1. Patch panels shall be marked using adhesive labels indicating the range of circuits installed to it.
   2. Each port shall be labeled with the origination, destination and the individual strand ID.

3.13 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. LAWA is in the process of procuring and implementing a CMMS. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.14 FINAL INSPECTION AND ACCEPTANCE

A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA management system and successful performance of the cabling system for a two-week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

END OF SECTION 27 05 00

SECTION 27 05 05 – SELECTIVE DEMOLITION TELECOMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

2. Demolition and removal of selected site elements and/or Information Technology (IT), Security or other Special Systems or infrastructure.

3. Salvage of existing items to be reused or recycled.

B. Contractor shall include in the Bid all labor, materials, tools, plant, transportation, storage costs, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete demolition and cutover of existing telecommunication systems shown and described in the Specifications.

C. The Contractor is responsible for providing and coordinating phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.

D. The Contractor shall coordinate interfaces to existing systems that are being demolished in order to minimize disruption to the existing systems operations. Any systems outages shall be approved in advance and scheduled with LAWA.

E. The Contractor shall coordinate specialty electronic, ACAMS, IT data networks, common use and flight information systems and displays, CCTV, public address and any other IT infrastructure systems.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner [ready for reuse].

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PRE-DEMOLITION MEETING

A. Conduct a pre-demolition meeting at Project Site with LAWA and all affected stakeholders.

1. Inspect and discuss condition of construction to be selectively demolished.

2. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.

3. Existing telecommunications rooms that have demolition work may involve electrical, mechanical and architectural demolition. Review and coordinate requirements of work performed by other trades.

4. Review areas where existing construction is to remain and requires protection.

5. Review procedures to be followed when critical systems are inadvertently interrupted.

1.5 SUBMITTALS

A. Comply with all LAWA submittal procedures given in other Sections.

B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, dust control and for noise control. Indicate proposed locations and construction of barriers.

C. Submit a Schedule of selective demolition and cutover activities which indicates the following as a minimum:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's and tenants' on-site operations are uninterrupted.

2. How long IT and security services will be interrupted and when systems cannot be disabled and temporary parallel service is required submit how this is proposed to be accomplished.

3. The contractor’s plan for coordination of shutoff, capping, and continuation of IT and all other utility services.

4. Use of elevator and stairs.

5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

6. Phone tree and procedures to be followed when critical systems are inadvertently interrupted (for each shift).

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

E. Pre-demolition Photographs or Video: Submit before Work begins.

F. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

G. Closeout Submittals:

1. Submit a list of items that have been removed and salvaged

2. Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

3. Submit as-built documentation of all remaining IT and security systems conduit and cabling that remains.

1.6 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:

a. <Insert items to be removed by Owner>.

C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.

2. If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1.7 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

1. <Insert warranted system>.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SELECTIVE DEMOLITION, GENERAL

A. Demolition and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level. Remove all abandoned cable from origin to destination.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and/or portable fire-suppression devices during flame-cutting operations.

5. Maintain adequate ventilation when using cutting torches.

6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

9. Dispose of demolished items and materials promptly.

C. Work in Historic Areas: Selective demolition may be performed only in areas of the Project that are not designated as historic. In historic spaces, areas, and rooms or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling".

D. Removed and Salvaged Items:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery to Owner.

4. Transport items to Owner's designated storage area.

5. Protect items from damage during transport and storage.

E. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.

2. Pack or crate items after cleaning and repairing. Identify contents of containers.

3. Protect items from damage during transport and storage.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

5. Perform testing on reinstalled active systems and get sign-off by a LAWA approved inspector that systems are re-connected and working properly.

F. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.2 EXAMINATION

A. Verify that utilities have been disconnected and capped per LAWA approved procedures before starting selective demolition operations.

B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing condition of all IT related conduits and cables from origin to destination and correlate with requirements indicated to determine extent of selective demolition required.

D. Label all conduits and cables with origin, destination and what system they serve.

E. Consult with LAWA to determine whether systems can be disabled or whether a new parallel system needs to be installed.

F. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Engineer.

G. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

2. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

H. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions.

2. When temporary bypass systems are installed, test and get approval from Engineer before proceeding with demolition of existing systems.

3. For existing equipment cabinets with active components in them, provide an air tight dust seal around the cabinet and circulate cooling air with a portable air conditioning unit or other means to ensure equipment does not overheat.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.

2. Arrange to shut off indicated utilities with utility companies.

3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.

c. Equipment to Be Removed: Disconnect and cap services and remove equipment.

d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.4 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

4. Cover and protect furniture, furnishings, and equipment that have not been removed.

5. Comply with requirements for temporary enclosures, dust control, heating, and cooling.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 27 05 05

SECTION 27 13 33 – COMMUNICATION SYSTEMS INTERFACES (LEGACY SYSTEMS)

PART 1 - GENERAL

1.1 SUMMARY

A. This Section describes requirements for interface to and/or connection to existing Terminal systems that are to remain.

B. Contractor shall include in the Bid all labor, materials, tools, plant, transportation, storage costs, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational systems shown and described in the Specifications.

C. The Contractor is responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.

D. The Contractor shall coordinate interfaces to existing systems that are being extended in the Project in order to minimize disruption to the existing systems operations. Any systems outages shall be approved in advance and scheduled with LAWA (refer to Section 270505 – Selective Demolition Telecommunication Systems).

E. Related documents:

1. Section 27 51 13 - Paging Systems

2. Section 28 13 00 – Access Control and Alarm Monitoring System (ACAMS)

3. Section 27 05 00 – Basic Telecommunication Requirements

1.2 GLOSSARY

A.	ANSI	American National Standards Institute
B.	ASTM	American Society for Testing Materials
C.	BFU	Board of Fire Underwriters
D.	CSA	Canadian Standards Association
E.	DEC	Department of Environmental Conservation
F.	EIA	Electronics Industry Association
G.	ER	Equipment Room
H.	FCC	Federal Communications Commission
I.	FM	Factory Mutual
J.	IEEE	Institute of Electrical and Electronics Engineers
K.	ISO	International Standards Organization
L.	NEC	National Electrical Code
M.	NEMA	National Electrical Manufacturers' Association

N. NESC National Electrical Safety Code
O. NFPA National Fire Protection Association
P. OSHA Occupational Safety and Health Administration
Q. TIA Telecommunications Industry Association
R. TR Telecommunications Room
S. TWC Tenant Wiring Closet
T. UFBC Uniform Fire Prevention and Building Code
U. UL Underwriter's Laboratories, Inc.

1.3 SUBMITTALS

A. Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

B. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.

C. Submit all proposed labeling materials and nomenclature for approval.

D. Coordination Drawings:

1. Indicate locations where space is limited for installation and access.

2. Submit floor plans, elevations, and details indicating major equipment and end device locations of equipment to be provided by this contractor to interface to existing systems.

E. Project Record Documents required include:

1. Marked-up copies of Contract Drawings

2. Marked-up copies of Shop Drawings

3. Newly prepared Drawings

4. Marked-up copies of Specifications, Addenda and Change Orders

5. Marked-up Project Data submittals

6. Record Samples

7. Field records for variable and concealed conditions

8. Record information on Work that is recorded only schematically

9. As-built drawings

10. Record drawings

11. Electronic as-built and LAWA LUSAD requirements

F. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. Design Consultant will periodically review Project Record Documents to assure compliance with this requirement.

G. At every quarter, submit Project Record Documents to Design Consultant for LAWA's records.

1. Upon completion of the as built drawings, the Design Consultant will review the as built work with the Contractor.

2. If the as built work is not complete, the Contractor will be so advised and shall complete the work as required.

H. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

1.4 CODES, STANDARDS AND REFERENCES

A. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the following:

1. ANSI C80.1 Rigid Steel Conduit, Zinc-Coated

2. ANSI C80-3 Electrical Metallic Tubing, Zinc-Coated

3. ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 02/02/09

4. ANSI/TIA/EIA –569-B Commercial Building Standard for Telecommunications Pathways and Spaces, May 2009

5. ANSI/TIA/EIA -606-A Administration Standard for Commercial Telecommunications Infrastructure, 11/24/08

6. ANSI/TIA/EIA -607 Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994

7. ANSI/TIA/EIA – 862 Building Automation Systems Cabling Standard for Commercial Buildings, 2002

8. ASTM E814 Standard Test Method For Fire Tests Of Penetration Firestop Systems

9. FCC 47 Part 68 Code of Federal Regulations, Title 47, Telecommunications

10. IEEE National Electrical Safety Code (NESC); 2007

11. ISO/IEC 11801 Information Technology - Generic Cabling For Customer Premises

12. LADBS Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code

13. NEMA 250 Enclosures for Electrical Equipment (1000 V Maximum)

14. NFPA-70 National Electric Code; 2008

15. UL 1459 Underwriters Laboratories Standard for Safety – Telephone Equipment

16. UL 1863 Underwriters Laboratories Standard for Safety – Communications Circuit Accessories

B. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

1.5 QUALITY ASSURANCE

A. The Contractor's Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with the LAWA's and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the Design Consultant. The Design Consultant shall be notified by the Contractor of any inspection(s) and the Design Consultant may elect to participate in any inspection(s). All QC information shall be provided to LAWA for input into the CMMS (refer to paragraph 3.13).

1.6 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids Specification requirements.

B. Under no circumstances shall the LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to Engineer all evidence to support the contention that the item proposed for substitution is equal to the specified item. The Owner's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor.

1.7 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

2. Equipment shall meet all applicable FCC Regulations.

3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.

4. The listing of a manufacturer as “acceptable” does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.

5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.

1. All components of an assembled unit need not be products of the same manufacturer.

2. Constituent parts, which are alike, shall be from a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for intended service.

4. The Contractor shall guarantee for a minimum of fifteen (15) years, the performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

C. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model.

E. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

F. Maximum standardization of components shall be provided to reduce spare part requirements.

1.8 WARRANTY

A. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of fifteen (15) years from Final Acceptance.

1. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.

2. The Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

B. The Bidder shall submit a copy of all manufacturer warranty information.

1.9 ON-SITE PERSONNEL REQUIREMENTS

A. The Contractor shall employ the maintenance contractor with whom LAWA has a maintenance contract to perform the disconnection, connection, re-connection or configuration of existing systems that might be affected by this Work.

B. The Contractor shall be responsible for the proper placement of all cabling, racks, cabinets, patch panels, cover plates, outlet boxes, and related hardware, as well as all distribution, and termination equipment.

C. The Contractor shall obtain the approval of Engineer or Design Consultant for the final layout of equipment to be installed in existing or new telecommunications rooms and tenant wiring closets prior to the installation of any materials or equipment. Shop drawings showing proposed room layouts shall be submitted for approval before beginning installation (refer to Paragraph 1.2).

D. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of the LAWA.

E. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

F. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

G. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

H. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the

Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

I. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of the Engineer so the area can be appropriately noted.

J. Following each day's work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

1.10 LEGACY SYSTEMS

A. In addition to Systems listed in paragraph 1.1.E above, LAWA requires that provisions be made for extension or interface to the following legacy systems:

1. Common Antenna Television System (CATV)

2. Telephone Systems

B. CATV Systems:

1. Cable television service is provided in existing LAX terminal buildings by the Time Warner Cable. LAWA Commercial Development manages this service contract for LAWA.

2. Contractor shall provide all cable, conduit, equipment and connection to bring "last mile" service to required areas from the Time Warner Cable fiber cabinet in existing or new telecommunications rooms to the tenant, concession or other required space.

3. Coordinate with Time Warner Cable to ensure all necessary cable and active and passive components are provided to provide cable television ready outlets where required.

4. Submit proposed installation plans and details for approval.

C. Telephone Systems:

1. Telephone service is provided in existing LAX terminal buildings by various vendors.

2. Contractor shall provide all cable, conduit, equipment and connection to bring "last mile" service to required areas from the incoming service in the existing or new telecommunications rooms to the tenant, concession or other required space.

3. Coordinate with tenant or concession to ensure all necessary cable and active and passive components are provided to provide voice ready outlets where required.

4. Provide Category 6 UTP cabling to all outlets to enable future conversion to voice over Internet Protocol voice services.

5. Submit proposed installation plans and details for approval.

PART 2 - PRODUCTS

2.1 GENERAL

A. Interface to existing or legacy systems shall be accomplished with products of the same manufacturer, currently available fully compatible make and model. Verify with equipment manufacturer what model or part number is recommended for the intended interface or extension of the existing system.

2.2 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Provide plastic warning tape 6 inches wide continuously printed and bright colored 18” above all direct buried services, underground conduits and duct-banks.

F. Acceptable Manufacturers:

1. W.H. Brady

2. Ideal

3. Panduit

4. Other equal

2.3 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 3 - EXECUTION

3.1 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.

1. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

C. Before construction work commences, the Contractor shall visit the site and identify the exact routing for all horizontal and backbone pathways.

D. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable tray, conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with Design Consultant the exact location and mounting height of all equipment in finished areas, such as equipment racks and telecommunications devices.

E. The Contractor shall use existing conduit and surface raceway where possible and practicable. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, Engineer shall be notified before starting that part of the work. In areas with no ceilings, install only after Design Consultant reviews and comments on arrangement and appearance.

F. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. There will be no priority schedule for trades. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and/or furnish other equipment as required for ample maintenance space. Any changes in the size or location of the material or equipment supplied or proposed that may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of Engineer and approval received before such alterations are made.

G. Provide easy, safe, and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation. All TR cabinets and racks shall be mounted a minimum of 36-inches from the wall, any wall mounted equipment, other cabinets, equipment or power panels (or per NEC for voltages exceeding 120VAC).

H. Where required, the Contractor shall be responsible for cutting, patching, coring and associated work for the complete cabling system at no additional cost to the Owner. Cut and drill from both sides of walls to eliminate splaying. Patch adjacent existing work disturbed by installation of new work. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

I. All conduit and sleeve openings used by the Contractor shall be waterproofed or fireproofed in compliance with State and Local Building and Fire Codes. Strict adherence to National, State, and Local Fire Codes, particularly fire stopping will be required.

J. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

K. All building conduits and sleeves installed and/or used under these Specifications shall be fire stopped, or re-fire stopped, upon cable placement through such passageways.

L. Fire stopping for Openings through Fire and Smoke Rated Wall and Floor Assemblies:

1. To be used inside all conduits and sleeves. Caulk on exterior of conduit penetration.

2. Provide fire stop system seals at all locations where conduit, fiber, cable trays, cables/wires, and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire stop seal between sleeve and wall for drywall construction.

3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire stop system. The installation shall provide an air and watertight seal.

4. The methods used shall incorporate qualities that permit the easy removal or addition of conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating. Typical rating:

    a. Floors – three (3) hours

    b. Corridor walls – two (2) hours

    c. Offices – three-quarters (0.75) hour

    d. Smoke partitions – three-quarters (0.75) – one (1) hour

5. Provide fire stop pillows for existing cable tray penetrations through firewalls.

M. Manufacturer's recommended installation standards must be closely followed (i.e. minimum depth of material, use of ceramic fiber and installation procedures).

N. The Contractor shall seal all foundation penetrating conduits and all service entrance conduits and sleeves to eliminate the intrusion of moisture and gases into the building. This requirement also includes spare conduits designated for telecommunications use.

O. Spare conduits shall be plugged with expandable plugs.

P. All service entrance conduits through building shall be sealed or resealed upon cable placement.

Q. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support work. Supports shall meet the approval of Design Consultant.

R. Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.

1. Cables shall be combed and each strand shall run parallel with the other strands.

2. After combing and straightening strands, Contractor shall separate strands into bundles according to routing requirements and termination points.

3. Bundles shall be secured with hook-and-loop cable strap material.

   a. Cable ties manufactured from a hard polymer material, such as plastic or nylon, shall not be used.

   b. Hook-and-loop material shall be low life cycle, back-to-back type, black in color, and ½ inch wide.

4. Contractor shall begin to bundle and strap cables within 6 inches of exit from conduit, and bundles shall have cable straps applied at intervals not greater than 10 feet for entire length of vertical and horizontal run.

3.2 PHASES OF IMPLEMENTATION

A. Provide a consolidated and integrated schedule.

3.3 INSPECTIONS

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit installation drawings for LAWA review and approval.

3.4 SYSTEM STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.

2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.

4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.

5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.5 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

D. All outdoor cables shall be labeled with ACP FT-LAWAATAG-2.5X4 plastic tags and pre-printed with permanent ink, outdoor cables shall be labeled (and secured with heavy duty straps) in every manhole and handhole within 12 inches of where the cable enters and exits the manhole or handhole and on the slack coil.

E. Backbone cables shall be marked at each endpoint and at all intermediate pull/ access points or junction boxes. Label shall indicate origination and destination TR ID’s, sheath ID and strand or pair range.

3.6 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. LAWA is in the process of procuring and implementing a CMMS. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.7 FINAL INSPECTION AND ACCEPTANCE

A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA management system and successful performance of the cabling system for a two-week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

END OF SECTION 27 13 33

SECTION 27 21 33 – WIRELESS COMMUNICATION SYSTEM (WiFi)

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the minimum requirements for wireless communication systems contractor proposes to install as part of Terminal renovations.

B. Contractor shall include in the Bid all labor, materials, tools, plant, transportation, storage costs, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational system shown and described in the Specifications.

C. The Contractor is responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.

D. The Contractor shall coordinate with electrical contractor for provision of horizontal conduit and field boxes required to accommodate cabling of all wireless access points and other system equipment.

E. The Contractor shall coordinate specialty electronic, Information Technology (IT) data networks and any other IT infrastructure systems that depend on or are transported by wireless communications.

F. Related documents:

1. Section 27 05 00 – Basic Telecommunication Requirements

1.2 GLOSSARY

A.	ANSI	American National Standards Institute
B.	AP	Access Point (wireless receive and transmit antenna)
C.	ASTM	American Society for Testing Materials
D.	BFU	Board of Fire Underwriters
E.	BICSI	Building Industry Consulting Services International
F.	CSA	Canadian Standards Association
G.	DEC	Department of Environmental Conservation
H.	EIA	Electronics Industry Association
I.	ER	Equipment Room
J.	FCC	Federal Communications Commission
K.	FM	Factory Mutual
L.	IEEE	Institute of Electrical and Electronics Engineers
M.	ISO	International Standards Organization
N.	NEC	National Electrical Code

O. NEMA National Electrical Manufacturers' Association
P. NESC National Electrical Safety Code
Q. NFPA National Fire Protection Association
R. OSHA Occupational Safety and Health Administration
S. TIA Telecommunications Industry Association
T. TR Telecommunications Room
U. TWC Tenant Wiring Closet
V. UFBC Uniform Fire Prevention and Building Code
W. UL Underwriter's Laboratories, Inc.

1.3 SUBMITTALS

A. Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

B. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.

C. Submit all proposed labeling materials and nomenclature for approval.

D. Coordination Drawings:

1. Indicate locations where space is limited for installation and access.

2. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.

E. Submit details of proposed wireless system, access point locations (refer to paragraph 3.4), bandwidth(s) and other details to LAWA for approval and coordination with other existing wireless systems and LAWA wireless usage agreements and procedures.

F. Submit floor plans with heat maps overlaid that show the results of contractor's wireless vendor's predicative analysis modeling to indicate areas of coverage and extrapolated signal strength.

G. Submit all testing plans (acceptance, and endurance) for review and approval prior to the performance of any testing.

H. Project Record Documents required include:

1. Marked-up copies of Contract Drawings

2. Marked-up copies of Shop Drawings

3. Newly prepared Drawings

4. Marked-up copies of Specifications, Addenda and Change Orders

5. Marked-up Project Data submittals

6. Record Samples

7. Field records for variable and concealed conditions

8. Record information on Work that is recorded only schematically

9. As-built drawings

10. Record drawings

11. Electronic as-built and LAWA LUSAD requirements

I. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. Design Consultant will periodically review Project Record Documents to assure compliance with this requirement.

J. At every quarter, submit Project Record Documents to Design Consultant for LAWA's records.

1. Upon completion of the as built drawings, the Design Consultant will review the as built work with the Contractor.

2. If the as built work is not complete, the Contractor will be so advised and shall complete the work as required.

K. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

1.4 CODES, STANDARDS AND REFERENCES

A. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the following:

1. IEEE 802.11 (a, b/g, n) - Information Technology - Telecommunications And Information Exchange Between Systems - Local And Metropolitan Area Networks - Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) And Physical Layer (PHY) Specifications

2. ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 02/02/09

3. ANSI/TIA/EIA –569-B Commercial Building Standard for Telecommunications Pathways and Spaces, May 2009

4. ANSI/TIA/EIA -606-A Administration Standard for Commercial Telecommunications Infrastructure, 11/24/08

5. ANSI/TIA/EIA -607 Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994

6. ANSI/TIA/EIA – 862 Building Automation Systems Cabling Standard for Commercial Buildings, 2002

7. FCC 47 Part 68 Code of Federal Regulations, Title 47, Telecommunications

8. IEEE National Electrical Safety Code (NESC); 2007

9. ISO/IEC 11801 Information Technology - Generic Cabling For Customer Premises

10. LADBS Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code

11. NEMA 250 Enclosures for Electrical Equipment (1000 V Maximum)

12. NFPA-70 National Electric Code; 2008

13. UL 1863 Underwriters Laboratories Standard for Safety – Communications Circuit Accessories

B. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

1.5 QUALITY ASSURANCE

A. The Contractor's Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with the LAWA's and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the Design Consultant. The Design Consultant shall be notified by the Contractor of any inspection(s) and the Design Consultant may elect to participate in any inspection(s). All QC information shall be provided to LAWA for input into the CMMS (refer to paragraph 3.8).

1.6 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids Specification requirements.

B. Under no circumstances shall the LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to Engineer all evidence to support the contention that the item proposed for substitution is equal to the specified item. The Owner's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor.

1.7 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

2. Equipment shall meet all applicable FCC Regulations.

3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.

4. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.

5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.

1. All components of an assembled unit need not be products of the same manufacturer.

2. Constituent parts, which are alike, shall be from a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for intended service.

4. The Contractor shall guarantee for a minimum of fifteen (15) years, the performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

C. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model.

E. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

F. Maximum standardization of components shall be provided to reduce spare part requirements.

1.8 WARRANTY

A. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of fifteen (15) years from Final Acceptance.

1. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.

2. The Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

B. Submit a copy of all manufacturer warranty information.

1.9 ON-SITE PERSONNEL REQUIREMENTS

A. The Contractor shall be responsible for the proper placement of all cabling, racks, cabinets, patch panels, cover plates, outlet boxes, and related hardware, as well as all distribution, and termination equipment.

B. The Contractor shall obtain the approval of Engineer or Design Consultant for the final layout of any equipment to be installed in new or existing telecommunications rooms and tenant wiring closets prior to the installation of any materials or equipment. Shop drawings showing proposed installation details shall be submitted for approval before beginning installation.

C. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of the LAWA.

D. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

E. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

F. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

G. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

H. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of the Engineer so the area can be appropriately noted.

I. Following each day's work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

PART 2 - PRODUCTS

2.1 WIRELESS EQUIPMENT GENERAL SPECIFICATIONS

A. RF Management:

1. RF management shall be set to restrict performance-impacting operations such as channel changes when voice over IP traffic is present.

B. User Bandwidth Control:

1. The bandwidth contract shall be implemented to ensure that one single user cannot monopolize bandwidth and can limit users to a maximum amount of bandwidth. Bandwidth contracts can be specified by user role for simple administration, and can be applied per-user (one user cannot exceed 2Mbps, for example) or per-group (all guest users together cannot exceed 2Mbps.)

C. Privacy Protection:

1. AP's shall contain no configuration, passwords, encryption keys, or security information. The AP shall have no exposed serial port, no recoverable passwords, no vendor-installed certificates, and no way for an intruder to tap into the wired side of the AP to eavesdrop on wireless communication.

2. AP's shall be FIPS-140 Level 2 compliant.

D. Simplified Management:

1. The system shall be manageable through a single interface and a single web-based URL. Each of these devices shall have a software image, configuration file, and run-time statistics, as well as different configuration and operation commands.

2. The system shall not require a separate management appliance or software package for basic functionality such as RF visualization, location tracking, or multi-controller management.

E. Security:

1. All security functionality shall be centralized and housed in the mobility controller (including encryption) and not the AP, guaranteeing that AP does not have to be replaced as security standards evolve to protect the investment, and ensure the continuous security of the network.

F. Application Bandwidth Control:

1. The system shall support a stateful protocol inspection for voice protocols with automatic mapping to bandwidth control and quality of service schemes. These schemes shall limit the maximum bandwidth and/or guarantee a minimum bandwidth, latency, and jitter for an application. This way, a mixed-use wireless network can support both voice and data with both getting sufficient resources.

G. User/device Controls:

1. The system shall support the ability to restrict the types of protocols on a wireless LAN, as well as to restrict the types of resources a wireless device can access (for example, the system permits administrators to block or restrict client-to-client communication, dramatically reducing malicious attacks, viruses, and worms).

2. The system shall possess the ability to allow modification of network access permissions at any time during the life of a session, based on both internal controls and integration with external systems through SNMP, syslog, XML, and RADIUS.

H. Secure Guest Access:

1. The system shall differentiate between internal users and guest users through integrated authentication, encryption, and authorization. All three functions shall be managed by the mobility controller. The external firewall, knowing users only through IP addresses, will pass the traffic into the network.

2. The system shall not be vulnerable to such an attack, making it safe to deploy internal and guest users on the same infrastructure.

I. Integrated Intrusion Protection:

1. The system shall support a wireless intrusion detection system that is integrated with the wireless infrastructure. By placing these two functions in the same device, the system becomes a protection system rather than simply a detection system.

2. The system shall detect then lock out rogue APs, ad-hoc networks, bridges, DoS attacks, man in the middle attacks, impersonation attacks, and many others.

J. Users shall be capable of using wired access, wireless access, remote access, or a combination of these accessed.

K. Extended policy criteria shall be capable make access control decisions based on parameters, such as identity, physical location, time of day, authentication method, device type, device integrity state, protocol, and application. Put in more general terms, a per-packet access control decision can be made based on:

1. Who the user is
2. How the user is accessing the network
3. Where the user is
4. When the access is made
5. What resource the user is trying to access

2.2 WIRELESS EQUIPMENT FUNCTIONAL SPECIFICATIONS

A. Provide the required number of Access Point antenna devices needed to provide 100% coverage to all areas of the terminal and provide an additional 25% spare amount of APs.

B. Provide a minimum of -50 dBm RSSI at the following locations:

1. Curbside areas
2. Ticketing check-in and ATO office spaces
3. Tenant and concessions areas
4. Concourses and holdrooms
5. Ramp areas
6. Inbound and outbound baggage makeup areas.

C. Access Points shall be capable of the following minimum functional specifications:

1. FIPS 140-2 802.11i, Military Grade L2 Security
2. Domain/Realm AAA Server Control
3. LAN Speed VPN Authentication/Termination
4. AP VPN/IPSec Tunnels
5. Remote Traffic Bridging with Central/Mgmt
6. Security Extension via 3rd Party (A/V, IPS, etc.)

7. Web-Based/Clientless Scanning/Remediation
8. Virtual Desktop/Clean Erase
9. Identity/Role/Policy-Based Traffic Separation
10. Stateful Access Rights
11. Time, Location Access Policies
12. WiFi Anomaly Thresholds and Blacklisting
13. Advanced Captive Portal / Web-Authentication
14. Complete Intrusion Prevention (All Threats)
15. Integrated Blacklisting & Location Tracking
16. Integral Wired Access Control
17. Advanced Location Tracking & Heatmaps
18. End-to-End QoS/Voice Optimization
19. Remote 802.11 Packet Capture
20. Per User/Device Troubleshooting (RealTime)
21. AP Self Provisioning & Optimization (RealTime)
22. Rogue/Threat Classification
23. Strong/Complete Intrusion Detection
24. Central Authentication, L2/L3 Fast Roaming
25. Rogue Detection/Containment/Location
26. AP Monitoring, Config Mgmt, Reporting (Offline)
27. Multi-SSIDs (Hidden/Broadcast), VLANs, NAT
28. Encryption/Authentication (WPA1.0/2.0)
29. Integral Wired Port Access Control
30. Seamless Small/Branch Site Solution
31. Eliminate Campus LAN Integration

32. End-to-End Data Encryption
33. Auto/Self Provisioning AP's
34. Real-Time AP RF Optimization/Tuning
35. Dynamic/Smart Load Balancing
36. "Any Device" Location Tracking
37. Client-Client Fire-walling
38. AP Failure Detection/Recovery
39. SNMP Monitoring & Basic Reporting
40. AP Configuration / Update Mgmt
41. Offline Analysis & Config Tuning
42. "Assisted" AP Install/Configuration
43. Advanced, Stand-alone Access Point
44. Multiple SSID's
45. VLANs, NAT, DHCP, 1 x Radio Adjustments

2.3 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear "tail" that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Acceptable Manufacturers:

1. W.H. Brady
2. Ideal
3. Panduit
4. Other equal

2.4 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 3 - EXECUTION

3.1 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.

1. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

C. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with Design Consultant the exact location and mounting height of all equipment in finished areas.

D. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, Engineer shall be notified before starting that part of the work. In areas with no ceilings, install only after Design Consultant reviews and comments on arrangement and appearance.

E. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

F. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support work. Supports shall meet the approval of Design Consultant.

G. Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.

1. Cables shall be combed and each strand shall run parallel with the other strands.

2. After combing and straightening strands, Contractor shall separate strands into bundles according to routing requirements and termination points.

3. Bundles shall be secured with hook-and-loop cable strap material.

   a. Cable ties manufactured from a hard polymer material, such as plastic or nylon, shall not be used.

   b. Hook-and-loop material shall be low life cycle, back-to-back type, black in color, and ½ inch wide.

4. Contractor shall begin to bundle and strap cables within 6 inches of exit from conduit, and bundles shall have cable straps applied at intervals not greater than 10 feet for entire length of vertical and horizontal run.

3.2 PHASES OF IMPLEMENTATION

A. Provide a consolidated and integrated schedule.

3.3 INSPECTIONS

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit installation drawings for LAWA review and approval.

3.4 AP SITE SURVEY

A. A full site survey of the Terminal(s) shall be conducted in order to determine and document the exact number, placement, and coverage of access point devices and the type of antenna required by each to provide full wireless network coverage. The contractor shall carry out and document the survey at its cost, working closely with Design Consultant and stakeholders.

B. Upon concurrence and approval of AP design and layout, provide installation, programming and commissioning of all AP and wireless network components.

3.5 TESTING REQUIREMENTS

A. Phases of Testing

1. On-Site Performance Verification Testing

2. On-Site Endurance Testing

B. Test Plan/Procedure: The Contractor shall submit a Test Plan for each testing phase for the review and approval of the Design Consultant. The test plan for each phase shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein. The test plan shall be provided at least forty-five (45) days prior to the scheduled start of each test. Test plans shall contain at a minimum:

1. Functional procedures including use of any test equipment

2. Test equipment is to be identified by manufacturer and model

3. Interconnection of test equipment and steps of operation shall be defined

4. Expected results required to comply with specifications

5. Record of test results with witness initials or signature and date performed

6. Pass or fail evaluation with comments.

7. The test procedures shall provide conformity to all specification requirements. Satisfactory completion of the test procedure is necessary as a condition of system acceptance.

8. Documentation verification, both interconnects and functionality, shall be part of the test. Where documentation is not in accordance with the installed system interconnect and operating procedures, the system shall not be considered accepted until the system and documentation correlate.

9. The Contractor shall cooperate with and provide LAWA representative(s) the opportunity(s) to participate in any or all of the tests.

10. Test Reports: The Contractor shall submit for each test, a test report document that shall certify successful completion of that test. Submit for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:

a. Commentary on test results.

b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.

c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.

d. Signatures of persons who performed and witnessed the test.

e. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to the Owner. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by the Design Consultant, before any subsequent testing phase is performed.

C. Performance Verification Testing

1. Complete operational testing of all components and systems shall be witnessed by designated LAWA Representatives.

2. Schedule test with Design Consultant. Do not begin testing until:

a. All systems have been installed and individually and jointly tested to ensure they are operating properly.

b. Written permission from Design Consultant has been received.

3. Testing: As part of performance verification, test all components of system. The tests shall demonstrate system features.

4. Verification: Verify correct operation of the required system functionality as defined in these specifications.

5. Adjustment, Correction, and Completion:

a. Correct deficiencies and retest affected components.

b. Make necessary adjustments and modification to system after obtaining approval of the Design Consultant.

c. Completion: Performance verification test shall be complete when testing or retesting of each component has produced a positive result and has been approved in writing by the Design Consultant.

6. Recording:

a. Describe actual operational tests performed and equipment used and list personnel performing tests.

b. Record in tabular form all test results, deficiencies, and corrective measures.

7. Termination

    a. Performance verification test shall be terminated by the Design Consultant when:

        1) Individual components, subsystems, or the integrated system fail to perform as specified.

        2) It is determined that system is missing components or installation is not complete.

    b. Upon termination, corrective work shall be performed and performance verification test rescheduled with the Design Consultant.

    c. Retesting shall be performed by Contractor at no additional expense.

    d. Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of the Design Consultant.

D. Endurance Testing

1. Provide personnel to monitor the systems 24 hours per day, including weekends and holidays during endurance testing.

2. Start test after:

    a. Successful completion of performance verification testing.

    b. Training as specified has been completed.

    c. Correction of deficiencies has been completed.

    d. Receipt of written start notification from the Design Consultant.

3. Monitor all systems during endurance testing. Coordinate monitoring with the Design Consultant.

4. Recording: Record data on approved forms so as to provide a continuous log of systems performance. Include:

    a. Date and time for all entries.

    b. Name of individual making entry.

    c. Environmental conditions.

    d. Authority activities in process.

    e. Description of all alarm annunciations, responses, corrective actions, and causes of alarms. Classify as to type of alarm.

    f. Description of all equipment failures, including software errors.

g. Description of all maintenance and adjustment operations performed on system.

h. Daily and weekly tabulations.

i. Daily entries of performance data shall be reviewed by the Design Consultant's representative designated to observe monitoring of system.

5. The Design Consultant may terminate testing at any time when the system fails to perform as specified. Upon termination of testing the Contractor shall commence an assessment period as described in Phase II.

6. Testing

a. Phase I - Initial Testing:

1) Time: 24 hours per day for 15 consecutive calendar days.

2) Make no repairs during this phase unless authorized in writing by the Design Consultant.

3) If system experiences no failures, proceed to Phase III - Final Testing.

b. Phase II - Initial Assessment:

1) After conclusion of Phase I or terminating of testing, identify all failures, determine causes, and repair. Submit report explaining: Nature of each failure, corrective action taken, results of tests performed to verify corrective action as being successful, and recommended point for resumption of testing.

2) After submission of report, schedule review meeting at job site. Schedule date and time with the Design Consultant.

3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

4) Based on report and review meeting, the Design Consultant will direct Contractor to repeat Phase I, restart Phase I, or proceed to Phase III - Final Testing.

c. Phase III - Final Testing:

1) Time: 24 hours per day for 15 consecutive calendar days.

2) Make no repairs during this phase unless authorized in writing by Engineer.
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7. Phase IV - Final Assessment:

1) After conclusion of Phase III or termination of testing, identify all failures, determine causes, and repair. Submit explaining the nature of each failure, corrective action taken, results of tests performed, and recommended point for resumption of testing.

2) After submission of report schedule review meeting at job site. Schedule date and time with the Design Consultant.

3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

4) Based on report and review meeting, the Design Consultant will approve endurance test or direct Contractor to repeat all or part of Phases III and IV.

8. Adjustment, Correction, and Maintenance

a. During endurance testing make adjustments and corrections to system only after obtaining written approval of the Design Consultant.

b. During endurance testing, perform required maintenance on systems including provision of replacement parts.

E. Commissioning Testing

1. The Contractor shall develop a commissioning test plan that includes the following components, as a minimum:

a. LAWA readiness

b. Operational procedures verification

c. Disaster recovery procedures

d. Computerized Maintenance Management System data verification

e. Change management procedures

2. The commissioning test plan/procedures shall be submitted to the Engineer for review and approval.

F. Final Inspection and Acceptance

1. After endurance testing is complete, review tabulated records with the Design Consultant.

2. The Contractor will not be responsible for failures caused by:

a. Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished and automatic shutdowns and restarts of systems performed as specified.

b. Failure of any LAWA furnished power, communications, and control circuits provided failure was not due to Contractor furnished equipment, installation, or software.

c. Failure of existing LAWA equipment provided failure was not due to Contractor furnished equipment, installation, or software.

3. When performance of integrated system does not fall within the above rates, determine cause of deficiencies, correct, and retest.

4. When requested by the Design Consultant, extend monitoring period for a time as designated by the Design Consultant.

5. Period shall not exceed 60 days exclusive of retesting periods caused by termination of Phases I or III and assessment period of Phases II and IV.

6. Submit final report of endurance testing containing all recorded data.

3.6 SYSTEM STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.

2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.

4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.

5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.7 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

3.8 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. LAWA is in the process of procuring and implementing a CMMS. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.9 TRAINING

A. By means of training classes augmented by individual instruction as necessary, the Contractor shall fully instruct LAWA's designated staff and Airline personnel in the operation, adjustment and maintenance of all products, equipment and systems.

B. The Contractor shall be required to provide all training aids, e.g., notebooks, manuals.

C. The Contractor shall provide an appropriate training area equipped with all required equipment. The location of the training area shall be coordinated with the Design Consultant.

D. All training shall be completed a minimum of two weeks prior to system cut over. Training schedule shall be subject to the Design Consultant's approval.

E. Training shall be conducted by experienced personnel and supported by training aids. An adequate number and amount of training material shall be provided by the Contractor. The following is considered a minimum.

1. Functional flow-charts, overall block diagrams, and descriptive material for all software;

2. Schematic drawings for each of the hardware components;

3. All procedure manuals, specification manuals, and operating manuals;

4. As-built drawings.

F. Participants shall receive individual copies of technical manuals and pertinent documentation at the time the course is conducted. The courses shall be scheduled such that LAWA personnel can participate in all courses (no overlap).

3.10 TYPES OF TRAINING

A. User Training: System users shall be instructed in all aspects of operations of the system. Four (4) hours of basic user training shall be provided. Additionally, four (4) hours of advanced user training shall be provided.

B. Technician Training: Eight (8) hours of maintenance training shall be provided. Training for maintenance technicians shall be provided on site, and shall include, but not be limited to, installation, operation, renovation, alteration, inspection, maintenance and service on each system and subsystem provided, so as to enable troubleshooting and repair to the component level.

C. System Administrator Training: System Administrator Training shall be provided. System Administrator Training shall include both classroom work and on the job training and shall be provided on-site at LAX or at a location within 50 miles of LAX.

1. Classroom Training: Eight (8) hours of software training shall be provided for each system. The Contractor shall structure the course to describe all systems, software and applications and support programs. This course shall include a functional overview of the complete software system. The course material must be presented in depth with the instructor covering detailed design, structure, and algorithms.

3.11 FINAL INSPECTION AND ACCEPTANCE

A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA management system and successful performance of the cabling system for a two-week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

END OF SECTION 27 21 33

SECTION 27 42 20 – COMMON USE SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the minimum requirements for common use check-in and passenger processing systems that are to be included in Terminal renovations.

B. The Common Use Systems ("Systems") shall integrate with systems currently installed in the Tom Bradley International Terminal (TBIT). Systems shall be implemented as modules that integrate with the existing TBIT airline support systems (TASS). The key elements of systems integration include:

1. Integration with and/or upgrade as required of the existing airport operations database (DB) including an existing storage area network as the data repository

2. Electronic Visual Information Display System (EVIDS) which includes flight, baggage, dynamic signage, visual paging and way finding signage

3. Integration / Interfaces with the Passenger Messaging (PM) and the IED paging system including both audio and visual messaging

4. Resource Management System (RMS) including gate, ticket counter, shared baggage, and bus resource allocation.

5. Shared Use Systems including common use passenger processing (CUPPS) and common use self service (CUSS).

6. Integration / Interfaces to the Local Departure Control System (LDCS)

7. Interface to the existing LAWA Message Broker System (MB) supporting both international and domestic bag routing messages as required.

8. Voice Over Internet Protocol (VoIP) telephone system

9. Baggage Reconciliation System (BRS) to support all Terminal operations.

C. Systems will support all international airlines that will inhabit the new Terminal, alliance partners and charter airlines and shall be capable of provisioning domestic carriers that will inhabit the new Terminal via the same flexible provisioning systems in use at TBIT.

D. Systems will utilize the common physical telecommunications infrastructure in the new Terminal and this Section will provide whatever active data network components are required to interface and integrate with the TBIT TASS and data network.

E. Contractor of this Section is responsible for providing all data cabling information and closely coordinating with data cabling subcontractor to ensure that all conduit and Category 6 UTP cabling is provided wherever needed for the components of this Section.

F. Contractor of this Section is responsible for providing all power load information and closely coordinating with electrical subcontractor to ensure that all conduit, cabling, power circuits (particularly for special needs such as core network switches or servers that require extra power) is provided for the components of this Section.

G. Contractor of this Section is responsible for providing heat loads in all telecommunications rooms where Systems equipment is to be installed and for closely coordinating with mechanical contractor to ensure that appropriate cooling is provided for the components of this Section.

H. Contractor shall include in the Bid all labor, materials, tools, plant, transportation, storage costs, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational system shown and described in the Specifications.

I. The Contractor is responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.

J. The Contractor shall coordinate with electrical contractor for provision of horizontal conduit and field boxes required to accommodate cabling of all wireless access points and other system equipment.

K. The Contractor shall coordinate specialty electronic, Information Technology (IT) data networks and any other IT infrastructure systems that depend on or are interfaced to Common Use Systems.

L. Related documents:

1. Section 27 05 00 – Basic Telecommunication Requirements

2. Section 27 21 33 – Wireless Communication System (WiFi)

3. Section 27 51 13 – Paging Systems

1.2 GLOSSARY

A.	ANSI	American National Standards Institute
B.	AP	Access Point (wireless receive and transmit antenna)
C.	ASTM	American Society for Testing Materials
D.	BFU	Board of Fire Underwriters
E.	BICSI	Building Industry Consulting Services International
F.	BTP	Bag Tag Printer
G.	CSA	Canadian Standards Association
H.	CUPPS	Common Use Passenger Processing System
I.	CUSS	Common Use Self Service

J.	DEC	Department of Environmental Conservation
K.	DHCP	Dynamic Host Configuration Protocol
L.	DNS	Domain Name System
M.	EIA	Electronics Industry Association
N.	ER	Equipment Room
O.	EVIDS	Electronic Visual Information Display System
P.	FAA	Federal Aviation Adminstration
Q.	FCC	Federal Communications Commission
R.	FM	Factory Mutual
S.	IATA	International Air Transport Association
T.	ICAO	International Civil Aviation Organization
U.	IEEE	Institute of Electrical and Electronics Engineers
V.	ISO	International Standards Organization
W.	LDCS	Local Departure Control System
X.	MB	Message Broker
Y.	NEC	National Electrical Code
Z.	NEMA	National Electrical Manufacturers' Association
AA.	NESC	National Electrical Safety Code
BB.	NFPA	National Fire Protection Association
CC.	OSHA	Occupational Safety and Health Administration
DD.	PM	Passenger Messaging System
EE.	RMS	Resource Management System
FF.	SITA	Société Internationale de Télécommunications Aéronautiques
GG.	SNMP	Simple Network Management Protocol
HH.	TASS	TBIT Airline Support System
II.	TBIT	Tom Bradley International Airport
JJ.	TIA	Telecommunications Industry Association
KK.	TR	Telecommunications Room
LL.	TWC	Tenant Wiring Closet
MM.	UFBC	Uniform Fire Prevention and Building Code
NN.	UL	Underwriter's Laboratories, Inc.
OO.	UPS	Uninterruptible Power Supply
PP.	VoIP	Voice over Internet Protocol
QQ.	VPN	Virtual Private Network

1.3 SUBMITTALS

A. Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

B. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.

C. Submit all proposed labeling materials and nomenclature for approval.

D. Coordination Drawings:

1. Indicate locations where space is limited for installation and access.

2. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.

E. Submit all testing plans (acceptance, and endurance) for review and approval prior to the performance of any testing.

F. Project Record Documents required include:

1. Marked-up copies of Contract Drawings

2. Marked-up copies of Shop Drawings

3. Newly prepared Drawings

4. Marked-up copies of Specifications, Addenda and Change Orders

5. Marked-up Project Data submittals

6. Record Samples

7. Field records for variable and concealed conditions

8. Record information on Work that is recorded only schematically

9. As-built drawings

10. Record drawings

11. Electronic as-built and LAWA LUSAD requirements

G. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. Design Consultant will periodically review Project Record Documents to assure compliance with this requirement.

H. At every quarter, submit Project Record Documents to Design Consultant for LAWA's records.

1. Upon completion of the as built drawings, the Design Consultant will review the as built work with the Contractor.

2. If the as built work is not complete, the Contractor will be so advised and shall complete the work as required.

I. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

1.4 CODES, STANDARDS AND REFERENCES

A. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the following:

1. IATA RP 1797 Common Use Passenger Processing Systems Technical Specification

2. IATA RP 1797 Common Use Passenger Processing Systems Technical Requirements

3. IEEE 802.11 (a, b/g, n) - Information Technology - Telecommunications And Information Exchange Between Systems - Local And Metropolitan Area Networks - Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) And Physical Layer (PHY) Specifications

4. ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 02/02/09

5. ANSI/TIA/EIA –569-B Commercial Building Standard for Telecommunications Pathways and Spaces, May 2009

6. ANSI/TIA/EIA -606-A Administration Standard for Commercial Telecommunications Infrastructure, 11/24/08

7. ANSI/TIA/EIA -607 Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994

8. ANSI/TIA/EIA – 862 Building Automation Systems Cabling Standard for Commercial Buildings, 2002

9. FCC 47 Part 68 Code of Federal Regulations, Title 47, Telecommunications

10. IEEE National Electrical Safety Code (NESC); 2007

11. ISO/IEC 11801 Information Technology - Generic Cabling For Customer Premises

12. LADBS Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code

13. NEMA 250 Enclosures for Electrical Equipment (1000 V Maximum)

14. NFPA-70 National Electric Code; 2008

15. UL 1863 Underwriters Laboratories Standard for Safety – Communications Circuit Accessories

B. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

1.5 QUALITY ASSURANCE

A. The Contractor's Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with the LAWA's and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the Design Consultant. The Design Consultant shall be notified by the Contractor of any inspection(s) and the Design Consultant may elect to participate in any inspection(s). All QC information shall be provided to LAWA for input into the CMMS (refer to paragraph 3.8).

1.6 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids Specification requirements.

B. Under no circumstances shall the LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to Engineer all evidence to support the contention that the item proposed for substitution is equal to the specified item. The Owner's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor.

1.7 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

2. Equipment shall meet all applicable FCC Regulations.

3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.

4. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.

5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.

1. All components of an assembled unit need not be products of the same manufacturer.

2. Constituent parts, which are alike, shall be from a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for intended service.

4. The Contractor shall guarantee for a minimum of fifteen (15) years, the performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

C. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model.

E. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

F. Maximum standardization of components shall be provided to reduce spare part requirements.

1.8 WARRANTY

A. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of fifteen (15) years from Final Acceptance.

1. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.

2. The Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

B. Submit a copy of all manufacturer warranty information.

1.9 ON-SITE PERSONNEL REQUIREMENTS

A. The Contractor shall be responsible for the proper placement of all cabling, racks, cabinets, patch panels, cover plates, outlet boxes, and related hardware, as well as all distribution, and termination equipment.

B. The Contractor shall obtain the approval of Engineer or Design Consultant for the final layout of any equipment to be installed in new or existing telecommunications rooms and tenant wiring closets prior to the installation of any materials or equipment. Shop drawings showing proposed installation details shall be submitted for approval before beginning installation.

C. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of the LAWA.

D. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

E. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

F. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

G. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

H. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of the Engineer so the area can be appropriately noted.

I. Following each day's work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

1.10 GENERAL INTEGRATION REQUIREMENTS

A. Contractor shall be responsible for writing all necessary code, performing all stakeholder interviews and data gathering, and performing all data level systems integration and interfaces for the Systems components identified herein.

B. Contractor shall be responsible for coordinating with existing TBIT TASS vendor and maintainer to perform all necessary programming and integration with existing system. Contractor shall subcontract existing systems vendor as required to obtain manpower and assistance from them as necessary to perform integration and implementation required by this Section.

C. Contractor shall be responsible for the development of Interface Design Documents as follows:

1. An Interface Design Document (IDD) shall be developed for each interface and shall provide the functional and technical descriptions and guidelines for the required data, hardware, transport, protocol, and software configurations for each interface. This document should reflect standards based protocols, interfaces, and a modular approach to each system to be integrated.

2. Each IDD shall include the following sections: General Characteristics, General Architecture, Functional Characteristics, Data Formats (as applicable), application programming interfaces, Translation Tables (as applicable), Transport Definition, Physical Characteristics, and Required Hardware/Software Configuration Items.

3. Each IDD shall be submitted for review and approval in accordance with the overall submittal schedule.

D. All Systems workstations shall have the ability to run all applications and modules that are provided as part of Common Use Systems. This shall include common use applications, database applications, resource management applications, baggage reconciliation applications, and EVIDS applications. As an example, the Systems workstation at a common use ticket counter or gate shall have the ability to perform common use applications as well as EVIDS applications. In the bag makeup location, the Systems workstation shall have the ability to perform common use applications as well as BRS applications. The use of a particular application at a specific workstation shall be secured via user log in access rights. A simple pointing device or keyboard action shall allow the agent to switch between the common use applications and any other available applications.

1.11 RESOURCE MANAGEMENT SYSTEM INTEGRATION REQUIREMENTS

A. The Resource Management System (RMS) shall assist Operations in the assigning of common use resources including gates, ticket counters, baggage claim carousels, baggage makeup conveyors, buses, remote gate operations, and off-gate parking stands. The RMS shall provide planning functions, 'best-fit' recommendations, and real-time conflict warnings to assist Operations in the management of these resources.

B. The RMS application shall utilize the existing DB as its database tier for all of its data storage requirements. The RMS shall be fully integrated with the DB and shall utilize it for the storage and retrieval of all RMS application data; this includes current assignments, status (out of service, available, etc.), planned assignments, and other RMS data fields. The RMS application shall contain and make use of all airport, airline, and other operations organizations related business rules for staff, equipment, and processing parameters.

C. The RMS shall store, access, maintain, and control current (real-time and day of operation) and planned (season schedules) assignment information in the DB for dissemination to other systems such as the EVIDS, MB, and shared use system.

D. The RMS shall access information controlled by other systems (e.g., EVIDS) via the DB such as current flight status and other flight and baggage related information. The RMS shall have an interface to PASSUR data streams, ACARS, SITA Text, Station Manager updates, and LAWA Operations staff updates to assist in making resource assignments. The RMS shall also take FAA related data streams to account for arrival and departure delays due to weather, route

congestion, and global aviation system information not readily available via an automated input stream.

E. The RMS shall provide resource information that includes, but is not limited to, gate assignments, baggage carousel assignments, and ticket counter assignments to the EVIDS for incorporation into the information that is displayed on the flight and baggage displays. The RMS shall receive current flight information from all available sources to use in its real-time management of gates and baggage devices.

F. The RMS shall provide the shared use system with resource assignment information in an automated fashion. This shall be the same information that is provided to the EVIDS to support the accurate display of all resource assignments.

G. The MB shall send the RMS current resource information from the baggage handling system (makeup belts unavailable, etc.) for utilization in its resource planning and assignments. The RMS shall transmit baggage resource assignments to the MB.

H. The RMS shall include the appropriate interfaces and integration with the TBIT LAN as necessary to support the functional requirements of the Systems.

1.12 EVIDS INTEGRATION REQUIREMENTS

A. The EVIDS shall provide flight and baggage information to the traveling public and operational information to other systems and to aviation and airline staff members. This component shall also manage all electronic signage throughout the facility creating a single “administrator” of all dynamic signage. This component shall also allow remote monitoring and management of all the signage connected to the EVIDS platform. The signage to be controlled by the EVIDS shall include but not be limited to, flight, baggage, way finding, visual paging, art features and advertising.

B. The EVIDS shall utilize the DB for all of its database-tier functions. As such, the EVIDS shall receive and transmit data as required via the DB. All data related to flights, baggage, and other information to be displayed on any monitor controlled by the EVIDS shall be stored and accessed via the DB. EVIDS information stored in the DB shall be available for distribution to other systems via the DB.

C. The EVIDS system shall receive two types of flight information from airline host systems. The first type of information is the airline’s seasonal flight schedules which are input into the DB via the EVIDS on a periodic basis. This information shall be used to create daily flight schedules. The second type of information is current flight status. This information shall be used to update the daily flight schedules showing both scheduled time of arrival/departure and actual or estimated time of arrival/departure.

1. Airline flight information shall be obtained via multiple methods including a direct link to airline host systems (via WAN interfaces or local TCP/IP connections) and updates via portable media and manual input. In addition to these methods, flight information updates shall be obtained via a third party (real-time) flight information interface utilizing the existing Passur (Megadata) subscription service that is in place at LAX. In

implementing these interfaces to tenant host or third party sources, appropriate security measures shall be put in place to ensure data integrity is maintained.

2. The Contractor shall develop "rules" in the DB to set priority for the source of the flight information to be used. These priority rules shall be defined for each airline in coordination with the PMT Representative and the airlines.

3. The interface to host systems shall be through WAN interfaces (T1, frame relay, etc.), or local Ethernet or RS-232/485 with the specific connection dependant on the individual host. The Contractor shall coordinate with each airline operating in the Terminal to determine the specific interface requirements. These interfaces may also be incorporated as a part of other modules or Systems applications.

D. The EVIDS shall control the information on all electronic displays throughout the Terminal. All information to be displayed shall be stored in the DB and formatted by the EVIDS for display on the specific display device. The displays supported include; public display banks art features, gate displays (counter, backwall, PBB, and general gate information), ticket counter displays (backwall and ANDS), baggage makeup operational displays, public baggage displays, and visual information displays. A brief description of the functionality of each sign type is provided below. The final functional requirements for each type of signage will be established during the required design workshops.

1. Public display banks – these displays will show information related to flight status including, but not limited to; city of origin/destination, scheduled time of departure/arrival, estimated time of departure/arrival, remarks/comments, baggage carousel assignment, etc. The information displayed on these monitors shall be provided through the DB and information will be updated through automated feeds and manual input.

2. Gate displays – these displays will show gate related flight information. The system shall configure these displays to show the appropriate information related to gate usage (i.e. flight number, airline, destination, etc.) when assigned through the RMS. In addition, the local gate operator (with the appropriate log in credentials) shall have override capabilities to modify the information displayed.

3. Ticket counter displays – these displays will show ticket counter related information including, but not limited to, airline name and logo, flight information, position information (e.g. open/closed, first class, ticketing, etc.). Upon assignment from the RMS, the displays shall automatically be configured to display the appropriate airline and their desired "default" display. In addition, the local ticket counter operator (with the appropriate log in credentials) shall have override capabilities to modify the information displayed.

4. Baggage makeup operational displays – these displays will show flight related information that is pertinent to the baggage handling operators. Information displayed on these devices will be from assignments provided by the RMS and from the data associated with EVIDS (i.e. flight arrival/departure times, gate, bag claim device, etc.).

5. Public baggage displays – these displays will show flight information on the baggage carousel. This will display the arriving flight number and origination city for the public.

Information displayed on these devices will be from the database (from EVIDS and RMS) and may be manipulated by the baggage handlers via input through the baggage input consoles.

6. Visual information displays – these displays will show visual paging information from inputs provided by the passenger messaging system.

E. The EVIDS shall interface with the audio portion of the IED Public Announcement System (via Passenger Messaging – PM) to provide the ability to visually display messages that are audibly broadcast. The PM interface shall provide the ability to synchronize visual and audio messages.

F. The EVIDS shall interface with the video portion of the PM to provide the ability to display any visual announcement on any EVIDS display device.

G. The EVIDS shall support multiple input devices for the updating, configuration, and manipulation of flight and other display information. The inputs that shall be supported include baggage input consoles and TASS workstations. All input devices shall be interfaced through a standard LAN connection.

H. The Contractor shall provide control of the dynamic visual displays and associated equipment in the Terminal including Ticket Counter backwall displays, Gate Counter backwall and Passenger Loading Bridge (PLB) displays, Baggage Information Displays (BIDS) and Baggage Input Consoles (BICs), Airline Name Displays (ANDS), and Airline Assignment Displays (ticket counter locations).

I. The EVIDS shall be interfaced to the Resource Management System to provide and receive flight updates and resource assignments.

J. EVIDS displays associated with allocated resources (i.e., ticket counter displays, gate counter displays, loading bridge displays, etc.) shall display the most recent assignment information as provided by the RMS. The changing of displayed information shall be triggered by RMS assignments and scheduling through the DB.

K. The RMS assignments / schedules shall trigger associated EVIDS displays on and off times. The RMS assignments / schedules shall trigger information display and removal on associated EVIDS displays. Trigger time shall be based on RMS schedules plus/minus a system configurable (on a per display per location basis) amount of time.

1. The day of operation's resource allocation shall determine the associated EVIDS signage display information (based on airline defined preferences). The day of operation resource allocation shall determine display information start and stop times.

2. Any authorized modifications to the day of operation's allocation assignments in the RMS shall adjust dynamic signage display information accordingly.

3. Final configuration and sequence of operation shall be coordinated with each airline and LAWA Operations.

4. EVIDS signs, associated with unassigned resources, shall display a pre-defined screen (e.g., LAX logo). The pre-defined, default, screen shall be assignable on a per location per display basis.

L. EVIDS should provide standard API capabilities for potential future interface requirements.

M. EVIDS shall provide real-time flight information to the MB for baggage related messages allowing for proper sortation of baggage.

N. The EVIDS systems shall provide a provision to interface with Passenger Messaging and Common Use Systems to automatically alert passengers of scheduled changes in operations.

1.13 PASSENGER MESSAGING INTEGRATION REQUIREMENTS

A. The passenger messaging application (PM) shall control the broadcast of public messaging information to the traveling public in both an audio and visual format utilizing the IED Public Address System (refer to Section 27 51 13) and EVIDS display devices respectively. This information shall include public announcements, personal pages, and flight information specific to individual gate areas. The system shall also include mechanisms for generating messages for airport and airline staff and shall provide for the ability to retrieve messages in an audio or visual format.

B. The visual portion of the PM shall be fully integrated to the EVIDS and data pertaining to this function shall be stored in the DB.

C. The audio portion of the PM shall be interfaced to the IED paging system and shall not have a direct link to the DB; however, common information such as messaging statistics (announcement logs, retrieval times, courtesy announcement records, audio messages, etc.) that are controlled by the PM shall be stored within the DB.

D. The PM shall be integrated with the EVIDS and interfaced with the IED paging system to synchronize the broadcast of audio messages with visual messages.

E. The PM shall maintain overall control and administration of both visual and audio announcements. The PM shall provide the ability to monitor and administer the retrieval of messages from the system.

1.14 SHARED USE SYSTEM AND CUSS INTEGRATION REQUIREMENTS

A. The shared use system shall allow multiple airlines to operate in the facility using their host software and a common set of compatible hardware, increasing the flexibility and efficiency of the facility.

B. The shared use system shall provide the use of each airline’s native system from all shared use system locations within the Terminal. The shared use system shall allow the extension of the airline host network onto the telecommunications infrastructure through a secure connection.

C. The shared use system provided shall ensure that any applications which are available on the host system are also accessible through the shared use system. As such, the airline processes shall be no different than their operations at a non-common use airport.

D. The shared use system shall provide connection for the shared use system workstations to each participating airline's host computer (e.g., System One, Sabre, etc.) via a dedicated interface that is specifically configured to meet the individual airline requirements (e.g., gateway, router, etc.).

E. The shared use system shall provide access to the LDCS via the shared use system workstations. The LDCS shall include a self-service interface. The LDCS self-service application shall be accessible on the CUSS kiosks.

F. The RMS shall control and provide all resource allocations for specific users. The shared use systems shall fully support the schedule of resources developed by the RMS. As such, when the RMS has assigned a resource to a specific user, the applications and functionality required by the assigned user shall be available on the assigned resource during time slot allotted by the RMS. Conversely, if the RMS has not assigned a specific user to a resource, the resource and all applications and functions shall not accessible to that user. However, any assigned or unassigned resource shall be able to be manually overridden at the workstation level with the appropriate log in credentials.

G. The RMS and shared use systems shall provide the ability to block any user from the utilization of any resource. The default configuration at each shared use resource shall be to deny access, unless it has been assigned by the RMS.

H. The shared use system shall be interfaced with the VoIP system to dynamically assign the VoIP handsets to match the shared use system requirements. Once resource assignments are made by the RMS and transmitted to the shared use system, the shared use system shall configure the VoIP handset at the assigned resource into the appropriate configuration. The system shall allow the specific telephony requirements associated with each tenant to be dynamically allocated to any shared use system station regardless of physical location.

I. The existing SITA Common Use Terminal Equipment (CUTE) system shall be accessible through any workstation associated with the new shared use system. Any airline selecting to use the SITA CUTE must be able to access the SITA CUTE at any shared use system workstation.

J. The BRS shall be interfaced with the shared use system and LDCS to receive Baggage Service Messages to support all baggage reconciliation functionality.

1.15 MESSAGE BROKER (MB) INTEGRATION REQUIREMENTS

A. The MB will serve as the information broker for passenger related information that is contained within the Airlines Departure Control System. This includes baggage service messages (and other related bag messages) to support the Terminal baggage sortation system, inter-airline transfers, baggage reconciliation, and inter-terminal transfers throughout the LAX campus as well as other information including any data regarding the security status of a given passenger when that capability is made available by the Airlines host systems.

B. The MB will include its own data storage repository (database). The DB shall replicate required database tables and fields to the MB database. The replicated data includes baggage resource assignments, flight information data, and baggage information.

C. In turn, the MB shall replicate a limited number of fields or tables to the DB including equipment status and statistical data. The MB fields shall be replicated to the DB to provide overall integration with other TBIT systems.

D. The MB shall obtain real-time flight from the EVIDS and resource information from the RMS via the DB to pass to the BHS for the proper sortation of baggage.

E. The MB shall provide BHS specific resource information (carousels out of service, etc.) to the DB for use by the RMS for the proper allocation / reallocation of resources.

F. The MB, the shared use system, and the LDCS shall be interfaced to send / receive Baggage Service Messages to the baggage reconciliation system.

G. The MB shall also be integrated with airline host systems or a message.

1.16 BAGGAGE RECONCILIATION SYSTEM INTEGRATION REQUIREMENTS

A. The BRS shall be interfaced with the Shared Use System, the LDCS and the Message Broker System to receive IATA compliant baggage services messages. These messages will include all IATA defined BSMs including; Baggage Transfer Message (BTM), Baggage Source Message (BSM), Baggage Processed Message (BPM), Baggage Unload Message (BUM), Baggage Not Seen Message (BNS), Baggage Control Message (BCM), and Baggage Manifest Message (BMM). These messages will be stored in the BRS database allowing the system to construct and maintain information of the baggage being processed.

1.17 LOCAL DEPARTURE CONTROL SYSTEM INTEGRATION REQUIREMENTS

A. The LDCS will provide automated check-in departure control for non-hosted airlines and will support irregular flight operations for all airlines operating out of the Terminal.

B. The LDCS shall interface with the RMS so that it can be provided with resource assignments.

C. The LDCS shall interface with the MB and BRS to transmit and receive Baggage Service Messages (BSM) for baggage checked. The LDCS shall transmit this information via Systems to the MB and BRS. The LDCS shall also receive baggage processed messages from the MB and BRS.

D. The LDCS shall have a data replication interface with the DB to transmit statistical and accounting data to the DB and to receive required data for LDCS operations.

E. The LDCS shall interface with all peripheral devices including, but not limited to, 2D Bar Code Printer, BTP, document printer, and Bar Code Scanner.

F. Any Systems workstation shall have the ability to run the LDCS. These workstations shall be fully functional workstations. A simple pointing device or keyboard action shall allow the agent to switch between the LDCS and any other available applications.

1.18 VoIP INTEGRATION REQUIREMENTS

A. The VoIP system shall be implemented to support the dynamic nature of a shared use environment and shall allow telephony services to be dynamically and temporarily allocated to specific locations throughout Terminal. With the VoIP system in place, a tenant's telephony functional requirements shall be met regardless of their location throughout the Terminal.

B. Based on RMS assignments, the VoIP handsets shall be dynamically configured to provide the assigned user's full set of telephone functionality, regardless of the location of the handset within the LAX campus. This functionality shall be based on successful user login and validation through the system. The shared use system shall provision the VoIP handset configurations and the specific handset configurations shall be accessible in the DB.

1.19 STORAGE AREA NETWORK (SAN) INTEGRATION REQUIREMENTS

A. As a key hardware component to the DB, a Storage Area Network (SAN) shall be provided. The SAN shall provide the basis for data storage and archival for the Systems. The SAN shall provide a highly resilient and easily expandable data storage platform that shall provide a structured means to grow hard drive storage for data systems.

B. The SAN will not be limited to data storage for the DB only, but shall also support future system's and module's storage requirements.

C. A secondary, offsite SAN, shall be provided for further redundancy. The location of this SAN shall be coordinated with the Engineer.

PART 2 - PRODUCTS

2.1 GENERAL

A. Due to the rapid advancement and antiquation of hardware technology, the supplied hardware shall be the "contemporary technical and operational equivalent" of the specified hardware. The following requirements shall be met:

1. Contemporary technical and operational equivalent shall be based on a comparison of technology at the time of publication of this Section to the technology at the time of ordering the equipment for each phase.

2. Hardware shall be ordered as close to the actual installation date for a given phase as reasonable (i.e., latest responsible date). Final hardware approval and scheduled order date are at the sole discretion of the Engineer.

3. Hardware equivalence shall be based on both technical equivalence and operational equivalence.

4. Contractor is responsible to verify and certify that newer technologies or models chosen will be compatible with the existing systems and technologies being interfaced or integrated with.

2.2 PRIMARY SERVERS

A. The Contractor shall recommend and provide the server configuration that best serves the Contractor's overall design solution. LAWA's existing standard for server technology is based upon Hewlett Packard®. Alternative solutions for high processor capacity servers may be submitted for review and approval.

B. The servers shall be fault tolerant via clustering, mirroring or other vendor technology. The implemented configuration shall allow a server to be powered down and replaced without disruption to the network or applications. Server failover shall occur if the primary server fails for any number of reasons including: power failure, hardware failure, software failure, and network connection failure. Multiple load sharing application servers or other configurations shall be considered viable alternatives to redundant application server pairs if equivalent or improved system redundancy and resiliency can be demonstrated. The system shall be configured as a geographically distributed clustered and/or load balanced server cluster. These systems shall be installed at two separate core rooms in the Terminal. The server solutions shall be available for 99.9999% on an annual basis.

C. Servers shall be standard 19-inch rack mountable.

D. Servers shall be capable of upgrading the number of processor units by simply adding another processor or processor card.

E. Servers shall be "dual-homed" to the LAN core switches via server grade Gigabit Ethernet NICs. Final requirements and configuration shall be coordinated with Design Consultant.

F. Disk Storage: Total useable disk capacity shall be at least 4 times the estimated storage requirements of the application and operating system. RAID shall be implemented as best suits the application. Internal RAID 6 shall be provided unless justification for alternative configuration is provided. RAID shall not be implemented via the operating system, but by a hardware controller. Disk arrays shall have open frames to allow the capacity to be doubled by addition of RAID drives without system shutdown. Disk storage systems shall be configured so that an increase in capacity of 33% can be made without purchasing any other components other than the disk drives.

G. Monitor: Shared rack-mounted monitor per rack (provide rack-mounted input switching device). The monitor provided shall meet the requirements provided under the section titled Workstation Monitors.

H. Servers shall be configured to meet or exceed the minimum hardware requirements detailed below and also meet or exceed the performance, operational, and functional requirements of this Specification.

2.3 FILE SERVERS

A. Two (2) 2.8 GHz processors (latest version) with 1MB cache. Architecture should be Intel or RISC as required by the operating system.

B. 1 GB DDR2 400 MHz RAM. Sufficient memory shall be provided to meet the maximum transaction load and ensure the memory is never a restriction on system performance

C. Minimum 72 GB useable internal hardware RAID 6 disk storage (10,000 rpm)

D. Two (2) NICs (server-class card) for LAN connection (coordinate network requirements with network administrator)

E. Minimum 72 GB internal Tape Backup Unit with SCSI card and back up software

F. 24X IDE CD-RW/DVD ROM drive

G. Remote Access Card

H. Multiple hot-pluggable redundant power supplies

I. Standard windows keyboard and USB 2-button wheel mouse

J. Minimum of two (2) USB 2.0 ports

2.4 APPLICATION SERVERS

A. Two (2) 3.2 GHz processors (latest version) with 1MB cache. Architecture should be Intel or RISC as required by the operating system.

B. 4 GB DDR2 400 MHz RAM. Sufficient memory shall be provided to meet the maximum transaction load and ensure the memory is never a restriction on system performance

C. Minimum 36 GB useable internal hardware RAID 6 disk storage (10,000 rpm)

D. Two (2) NICs (server-class card) for LAN connection (coordinate network requirements with network administrator)

E. Minimum 36 GB internal Tape Backup Unit with SCSI card and back up software

F. 24X IDE CD-RW/DVD ROM drive

G. Remote Access Card

H. Multiple hot-pluggable redundant power supplies

I. Standard windows keyboard and USB 2-button wheel mouse

J. Minimum of two (2) USB 2.0 ports

2.5 DATABASE SERVERS

A. Four (4) 2.7 GHz processors (latest version) with 2 MB cache. Architecture should be Intel or RISC as required by the operating system.

B. 8 GB DDR Mirroring. Sufficient memory shall be provided to meet the maximum transaction load and ensure the memory is never a restriction on system performance

C. Minimum 144 GB useable internal hardware RAID 6 disk storage (10,000 rpm)

D. Two (2) Host Bus Adapters for redundant data storage system interface (refer to data storage system requirements for further details)

E. Two (2) NICs (server-class card) for LAN connection (coordinate network requirements with network administrator)

F. Minimum 144 GB internal Tape Backup Unit with SCSI card and back up software

G. 24X IDE CD-RW/DVD ROM drive

H. Remote Access Card

I. Minimum of two (2) USB ports

J. Multiple hot-pluggable redundant power supplies

K. Standard windows keyboard and USB 2-button wheel mouse

2.6 DATA STORAGE SYSTEM

A. A Storage Area Network (SAN) shall be provided to accommodate data storage and retrieval for the TASS. The SAN shall provide the sharing of data among different servers in a network, disk mirroring, backup and restore, archival and retrieval of archived data, and data migration from one storage device to another.

B. The Contractor shall implement a Tier 1 storage environment to aggregate the Tier 2 systems being deployed for all systems with TBIT. This Tier 1 solution shall include IBM SAN Volume controller, Fiber Channel component architectures for integration, and Tier 1 controllers and backup systems.

C. The Contractor shall provide only the necessary resources to support the integration of the building systems data, back up and recovery, and business continuity and disaster recovery for the TBIT programs. The Contractor shall provide operations and guidance to LAWA ITS staff as needed for operational support and integration to the LAWA ITS campus wide SAN systems.

D. IBM System Storage solution, or approved equivalent

2.7 UNINTERRUPTIBLE POWER SUPPLIES

A. All server and local area network equipment installed in telecommunications rooms shall be UPS backed to prevent unnecessary service interruptions. The Contractor shall be responsible for coordinating with the CMJV and PMT to ensure that existing UPS capacity will support the additional load of the new equipment. In any case where new hardware is installed in a location where the capacity of the existing UPS is exceeded, it shall be the responsibility of the Contractor to supplement or replace the UPS in such a fashion that the UPS is capable of supporting required load for the minimum period of time.

B. The UPS equipment shall have batteries that are capable of being replaced in the field.

C. The UPS interface port shall have a 10 Base-T Ethernet for LAN management.

D. Each UPS shall provide a minimum of 30 minutes standby power at full load.

E. The UPS shall be rack mountable in a standard 19 inch equipment rack/cabinet.

F. The control panel shall have a LED status display for load and battery bar-graphs in addition to replace battery and overload indicators.

G. Each UPS shall include software and interface card to provide Web/SNMP management through 10Base-T Ethernet port. Management software shall include the following attributes:

1. Shall allow complete configuration of the UPS devices from a remote location

2. Shall provide periodic UPS self-tests

3. Shall provide full control over UPS transfer settings

4. Shall provide user name and password security

5. Shall log all power events with a description

H. Standard UPS warranty of two years shall be provided. Contractor shall submit recommended standard and optional warranty and maintenance plan per TASS RFP.

2.8 SYSTEM WORKSTATIONS

A. LAWA standard desktop is manufactured by Hewlett Packard.

B. Performance Workstation

1. 3.6 GHz Pentium 4 processor with hyper threading technology

2. 4 GB DDR2 SDRAM

3. 160 GB ATA Hard Drive (7200 rpm)

4. 10/100/1000 Mbps Ethernet card

5. 128 MB PCI Video card

6. 48x CD-RW drive plus 16x DVD+RW/+R drive

7. 2 serial ports, 1 parallel port, and 4 2.0 USB 2.0 ports

8. Standard windows keyboard and USB 2-button wheel mouse

9. 21-in LCD monitor (refer to monitor requirements)

C. Standard Workstation

1. 3.2 GHz Pentium 4 processor with 1 MB cache

2. 1 GB RDRAM

3. 80 GB ATA Hard Drive (7200 rpm)

4. 10/100 Mbps Ethernet card (auto-negotiating)

5. 64 MB PCI Video card

6. 48x CD-ROM

7. 2 serial ports, 1 parallel port, and 4 USB 2.0 ports

8. Standard windows keyboard and USB 2-button wheel mouse

9. 17-in LCD monitor (refer to monitor requirements)

D. Display Device Controllers (DDC)

1. Device Display Controllers are being provided by the base project. If any new DDCs are required they shall match the DDC configuration provided by the base project.

2.9 INTEGRATED SYSTEM DEVICES

A. CUSS Kiosk

1. The CUSS Kiosks shall be full function kiosk with a modular design for improved scalability. It shall provide ease of use. A lockable panel shall be provided for easy authorized access to internal components for maintenance. The kiosks shall conform to the following, as a minimum:

a. Compliance with IATA/ATA

b. Compliance with ADA

c. Stand alone version

d. 17-in touchscreen, card reader, and ticket printer

e. Powered by a PC meeting the requirements of a performance workstation

f. Baggage tag printer

g. Thermal 1D/2D barcode printer

h. Card reader (credit card, frequent flyer card, and contactless smart cards)

i. Passport reader

j. Optional 1D/2D barcode reader

k. Compatible with IEEE 802.11 wireless communications

l. Payment module

m. Ability to provide customization with CMJV specific signage and markings (to be coordinated with the CMJV)

n. Include a leaflet holder

o. Be supported by CUSS middleware

p. Include CUSS remote monitoring software to manage both the hardware and the CUSS applications of the kiosk

2.10 WORKSTATION MONITORS

1. 17-in flat screen monitor shall meet the following minimum requirements:

2. 1280 x 1024 @ 75 Hz refresh rate

3. Pixel Pitch 0.264mm (H) × 0.264mm (V)

4. 4:3 aspect ratio

5. 17-in viewable area

6. Viewing angle of 140 degrees

7. Contrast ratio of 400:1

8. Brightness of 250 candelas/meter2

B. 20-in LCD monitor shall meet the requirements of 20-in LCD displays under LCD displays.

2.11 LCD DISPLAYS

A. 20-in LCD: 20-in LCD monitors are being provided by the base project. Any new monitors provided by the TASS shall meet the following minimum requirements:

1. 1600 x 1200 native resolution
2. 0.255 mm pixel pitch
3. 16:9 aspect ratio
4. Response time 16 ms
5. Viewing angle minimum 170 degrees
6. Contrast ratio of 400:1
7. Brightness of 250 candelas/meter2

B. 32-in LCD: 32-in LCD monitors are being provided by the base project. Any new monitors provided by the TASS shall meet the following minimum requirements:

1. 1366 x 768
2. 0.511 mm pixel pitch
3. 16:9 aspect ratio
4. Viewing angle of 176 degrees
5. Contrast ratio of 600:1
6. Response time 18 ms
7. Brightness of 500 candelas/meter2

C. 40-in LCD: 40-in LCD monitors are being provided by the base project. Any new monitors provided by the shall meet the following minimum requirements:

1. 1366 x 768
2. 0.641 mm pixel pitch
3. 16:9 aspect ratio
4. Viewing angle of 176 degrees
5. Contrast ratio of 1000:1
6. Brightness of 450 candelas/meter2

D. 46-in LCD: 46-in LCD monitors are being provided by the base project. Any new monitors provided by the TASS shall meet the following minimum requirements:

1. 1366 x 768

2. 0.746 mm dot pitch

3. Viewing angle of 178 degrees

4. Contrast ratio of 1000:1

5. Brightness of 450 candelas/meter2

2.12 PERIPHERAL DEVICES

A. Baggage Input Console

1. Baggage Input Consoles (BIC): There will be Baggage Input Consoles located throughout the baggage breakdown area for use by the baggage handlers. The BICS shall have the following minimum attributes:

a. The BIC shall be a workstation with an integrated touch-screen with the following minimum requirements:
1) Pentium III 500 MHz.

2) 256 MB DRAM.

3) Internal 10 GB hard drive.

4) Integrated, bus-mastering Fast Ethernet (10 / 100 Mbps) controller.

5) 8 MB video adapter.

6) 15” LCD TFT resistive touch-screen capable of 1024x768 resolution.

7) Rugged, spill resistant ABS housing suitable for harsh, high-use environments such as the baggage make-up levels of the Airport.

b. The Contractor shall provide materials to mount and attach the BICs in the required area of intended operation. The Contractor shall coordinate exact BIC mounting locations with the CMJV and PMT.

c. SuperLogics model SL-PPC-150A, or approved equivalent

B. 2D Ticket Printer

1. A receipt style printer shall be provided that is able to print 2D (PDF417) barcodes. The barcodes shall include machine-readable boarding pass data formatted to support single segment, multi-segment, and interline data encoding.

2. Interface: USB

3. The Contractor is required to determine additional 2D printer requirements in coordination with tenant requirements.

C. Bag Tag Printer (BTP)

1. Interface: Ethernet LAN (TCP/IP)

2. The printers shall be set up for direct thermal printing only. The printers shall not include a cutter or burster.

3. The BTP shall conform to the IATA resolutions relating to ATB's and shall be compatible with the AEA specification for PECTAB's. All required firmware shall be provided and installed.

4. The Contractor is required to determine additional bag tag printer requirements in coordination with tenant requirements.

D. Optical Character Recognition (OCR)

1. Desko BMOL 4000 with integrated OCR or PMT approved equivalent substitution. Option pricing shall be provided for the AiT PAX Reader.

2. The OCR shall be capable of reading passports and other standard travel documents.

3. Per unit option pricing shall be provided for a bar code scanner, smart card reader, photo ID scanner, and fingerprint sensor along with the required drivers.

4. The Contractor is required to determine additional OCR requirements in coordination with tenant requirements.

E. Boarding Gate Reader (BGR)

1. The supplied BGR shall read 2D bar code printed boarding documents and shall support the various functional requirements of all airlines supported by TASS.

2. All required firmware shall be provided and installed.

3. The Contractor is required to determine additional boarding gate reader requirements in coordination with tenant requirements.

F. Shared Use System Standard Printer (DOC)

1. LaserJet printer with the following minimum specifications:

a. Print speed up to 25 pages per minute (ppm)

b. Utilize laser print technology

c. 1200 x 1200 dpi resolution

d. Two (2) paper trays

e. Support 8.5 x 11 and 8.5 x 14 inch paper

f. Minimum memory 64 MB

G. IP addressable

1. The Contractor is required to determine additional document printer requirements in coordination with tenant requirements.

H. General Document Printer

1. Provide two (2) general document printers. The location of the printers shall be coordinated with the PMT.

2. The specifications shall be that of the shared use system Standard Printer.

I. BRS Handheld Scanner

1. Ruggedized wireless handheld device for scanning bag tags with the following minimum specifications:

a. WLAN – Compatible with 802.11 a/b/g

b. 53 key keyboard

c. Minimum RAM – 64 MB

d. Data capture – 1D and 2D supported

e. Drop specification – multiple drops to concrete: 6 feet / 1.8 meters

f. Electrostatic discharge: ±15 kVdc air discharge; ±8 kVdc direct discharge; ±8 kVdc indirect discharge

g. Sealing: IP64 (electronic enclosure, display, and keypad)

h. Rechargeable batteries

i. Environmental:

1) Operating Temperature: -4º to 122º F

2) Charging Temperature: 32º to 104º F

3) Storage Temperature: -40º to 158º F

4) Humidity: 5% to 95% non-condensing

5) UL Certified

2.13 SOFTWARE

A. Software provided shall be at least 32-bit based applications. Software shall be built around a compliant operating system as defined in this Specification.

B. The Contractor shall deliver all required system and application software for a fully functioning Integrated IT System. Each shall be identified by the generic, off-the-shelf name. The software provided by the Contractor to operate the Systems shall be delivered in a ready-to-run form, including all necessary utility programs and documentation.

C. The systems shall use industry standard components. The systems shall not contain any proprietary interfaces or components. The system shall use industry standard application development software such as Java, JavaScript, Perl, Visual Basic, C/C++ and XML. CMJV approval shall be required for use of alternative application development software.

D. All new inter-relationships between the applications, databases, and operating system shall be the responsibility of the Contractor.

2.14 USER INTERFACE

A. Systems shall have an interface to manage data and the individual applications. The user interface shall provide a common look and feel for each component and/or application.

B. The user interface shall, to the extent feasible, be web enabled to provide additional flexibility for the users of the system.

C. The client Operating System user interface shall be configured to limit access to each application based on user login. Authorized users shall select an authorized application(s) to execute (e.g., shared use system, EVIDS, DB, BRS, RMS application) from the client desktop.

D. Software modules shall have a Graphical User Interface (GUI) and use a true windowing navigation interface.

E. The system shall support a pointing device, touch screen, and keyboard interface. Standard pointing device actions shall have a "hot key" equivalent. Pointing device functions without a “hot key” equivalent shall be noted.

F. The systems shall provide context sensitive, on-line help capabilities. The online help system shall contain enough information to inform the user of the nature of the current form/window, and provide a reference for the user to gather further information. The Contractor shall populate the on-line help messages prior to Performance Verification Testing and provide a facility for maintenance and update of online help.

2.15 SYSTEMS ARCHITECTURE

A. Operating System

1. Server Operating System: The Contractor shall select a standardized Operating System to use across all servers such as Windows (latest version). The proposal shall specify the server operating system(s) along with any exceptions. The server operating system shall support Symmetric Multi-Processing (SMP). Systems applications provided shall take advantage of the SMP server capabilities.

2. Client Operating System: Client and desktop devices shall use the Windows XP Professional operating system, or approved equivalent.

3. The operating system for the Contractor's products shall meet the minimum criteria below. All exceptions shall be noted in the contractor's bid.

    a. 64-bit, multi-tasking, multi-threading.

    b. Support TCP/IP network protocol.

    c. Latest version and service pack of the operating system at time of initiation of systems testing.

B. System Architecture

1. The systems shall adhere to a Client / Server model. The end devices shall be the clients to the primary/secondary servers. All information shall be communicated between the server(s) and the clients via the assigned Virtual Local Area Network (VLAN).

2. Network connectivity shall be via the assigned VLAN on the data network provided by this Section. Network communications shall utilize TCP/IP network communications protocol. The Contractor shall identify the network bandwidth requirements such as 10 Mb, 100 Mb, or Gigabit Ethernet.

3. End device addressing shall be coordinated with the LAWA.

4. Sufficient resiliency / redundancy and logic shall be provided to assure that the availability objectives (refer to Performance Requirements) can be met without manual intervention. All major system hardware components shall be designed so that there is not any single point of failure that can cause operations to be disrupted.

5. The system shall synchronize the date and time on all devices. The system servers shall receive a time synchronization signal from the local area network using the Network Time Protocol (NTP).

6. Workstations shall support web access without rebooting or changes to the workstation configuration.

7. The systems shall use industry standard components. The systems shall not contain any proprietary interfaces or components.

8. System components shall be independent and capable of co-existing on the system to allow for an increased level of capacity. Modular design and flexibility shall be provided for easy expansion of the system without degradation to the system's performance.

C. Database

1. The Systems will be integrating with and upgrading as necessary the existing TBIT TASS database. The requirements below are given to assure the new Systems database requirements are consistent and compatible with the existing system.

2. The provided database(s) shall be capable of supporting real time data warehousing. The database(s) shall use a common relational database to store all data. The database(s) shall be based on accepted and recognized industry standards. The LAWA preferences for databases are MS SQL or Oracle. The TASS database is Oracle.

3. The database(s) shall be open database connectivity (ODBC) compliant and support the simple object access protocol (SOAP).

4. Database Architecture: The database(s) shall meet the following requirements:

   a. Provide read consistency (data seen by a statement is consistent with respect to a single point-in-time)

   b. Provide creation of a read-consistent set of data when a table is being queried (read) and simultaneously updated (written)

   c. Provide original data values upon query when updated transaction remains uncommitted

   d. Utilize rollback methodology for uncommitted transactions

   e. Utilize record locking mechanisms to prevent simultaneous updates to the same record. Only the record(s) being updated shall be locked.

   f. Provide support for both distributed processing and distributed multiple databases along with standard DML operations, including queries, inserts, updates, and deletes of remote table data

   g. Provide support for automatic recovery from system or network failures (i.e., automatically commits or rolls back any in-doubt distributed transactions consistently on all involved nodes when a failure occurs)

   h. Provide referential integrity for all data such that modifications to current data does not affect historical data

   i. Provide capability of online “live” backup of all database objects

   j. Provide capability of “point of failure” recovery of all database objects within one hour of the failure (i.e., dump transaction logs hourly) with a native utility package.

5. Database Security: Third-party database and reporting tools shall support database security functions. Database security shall include the following items as a minimum:

a. Encryption capability for defined data fields within database objects such as tables or views

b. Prevention of unauthorized database access

c. Prevention of unauthorized access to schema objects

d. Control of system resource usage (such as CPU time)

e. Auditing of user actions and database transactions

f. Assignment of valid username/password combinations

g. Assignment and control of resource limits for a user including hardware, database and application resources

h. Control of user access rights including database, table, record and field level authority

i. Control of which system functions a user can perform.

6. The Contractor shall submit all database schema(s) for review and approval. The Contractor shall coordinate with the LAWA, airlines, and applicable third party vendors to identify unique database requirements. The Contractor shall add needed fields as requested by LAWA. The database(s) shall be designed such that the addition of fields and/or tables is easily accommodated. The database schema shall be provided in a chart format showing all tables, key fields, and hierarchical relationships.

7. SQL: The utilized native structured programming language shall be storable in the database. The database shall employ a native structured programming language that can utilize standard Structured Query Language (SQL) which includes the following:

a. Data Definition Language (DDL) statements

b. Data Manipulation Language (DML) statements

c. Transaction control statements

d. Session control statements

e. System control statements

f. Embedded SQL statements

8. Database Maintenance: The database maintenance system shall be capable of maintaining configuration control (i.e., keep track of changes and compare versions of the database). Database maintenance software shall be provided to allow modification of designated database fields. Database documentation shall be provided to enable the updating or regeneration of the database tables when inputs are changed and added and as programs are modified or added.

9. Archival Viewing: The database shall provide an archive capability that provides “near time” retrieval of archived data. The data held within the “operational” portion of the database shall include a minimum of 7 days of operational data. The Contractor shall propose, and submit for approval, the maximum amount of operational data to be stored for real time access that will not impact the efficiency of the database. In addition to real-time (daily) operational data, the database shall provide the ability to generate real-time reports for operational data for a minimum of thirty-six (36) months.

10. The database shall include the functionality and capability to allow the authorized user to view or report on historical data. If the user wishes to view or report on data which has been archived, an automated mechanism shall be provided to have the requested data put online. The methodology for providing this functionality must be approved by the Engineer prior to implementation.

2.16 SYSTEM CONFIGURATION

A. Security

1. Authorized users shall log into the system using a unique user name and password. Depending on assigned user access privileges, the user shall be either granted or denied access to individual applications. In no case shall any user identified via user name and password as an airline employee or any other user without proper authorization gain access to any other airline's data, other than that pertaining to their own flights and baggage. Data that can be viewed at the user's workstation pertaining to data by airlines other than the user's airline shall be limited to data that can be viewed on public displays.

2. The System Administrator shall be able to add, delete, set, and change user privileges and access authorization via a GUI. System security parameters shall be configurable by the System Administrator.

3. Workstations shall have an "inactivity timeout period" such that if any workstation is determined to be inactive by having no input/output performed at that workstation for the defined timeout period, that workstation shall be automatically logged out of the application.

4. The timeout feature shall be turned on or off by the System Administrator. The timeout period shall be configurable by the System Administrator.

5. The occurrence of an inactivity timeout occurring as described above shall be recorded in the fault log, showing date, time, workstation identifier, and the user name of the user who was logged in at the time when the inactivity timeout occurred.

6. Systems shall prevent a user name from being logged in more than one time concurrently.

7. Systems shall provide an audit trail of all transactions. The audit trail shall track on a per user basis. The audit trail file shall indicate any changes that occurred to applications configuration, data structure, or database fields/records, and shall contain the date and time of the change, the user identification of the user who made the change, and the details of the change.

8. Systems shall provide automated tracking of the audit trail database, and shall alert the System Administrator when this file has exceeded pre-determined size restrictions. The System Administrator shall then have the ability to archive this database, along with the ability to restore it for reporting purposes. The system shall also include the option of a "rolling window". In this case, the audit trail database shall use a rolling window with a System Administrator configurable window (i.e., after defined period of time oldest records are automatically dumped).

9. If remote access is required for system administration, a security feature such as secure VPN encryption shall be used.

B. Availability Requirements

1. System Availability:

   a. At any given time, the overall Systems shall be considered unavailable if two (2) percent or more of the end devices are non-operational, not fully functional, or do not meet response time criteria.

   b. Software and system devices shall execute, without degradation, at the scheduled periods and response times for the systems to be considered available.

   c. The systems shall operate as specified twenty-four (24) hours per day, seven 7 days per week.

   d. Availability of the overall Systems shall be at least 99.9999 percent.

2. Device Availability:

   a. A system server and PC shall be considered available only if all components are operating and fully functional.

   b. A peripheral device shall be considered unavailable if it cannot be placed on-line and perform its intended function(s).

   c. Besides scheduled downtime, as identified below, individual device availability shall exceed 99.80 percent (17 hours 30 minute maximum downtime per year).

3. Scheduled Downtime:

   a. Downtime to update the computer operating system or repair a component shall be acceptable reasons for downtime, but at no time shall more than 5 percent of the system be non-operational.

   b. Scheduled downtime shall be anticipated to be between 12:01am and 3:59am, or during CMJV and PMT approved hours and must be coordinated with the CMJV and PMT a minimum of 48 hours in advance of any work being performed.

   c. If the operating system of the servers requires maintenance or updates, or if the servers require system maintenance, each server shall be brought down

individually to be updated/maintained, such that at no time is more than one server down at the same time.

d. If the operating system of the end device computer requires maintenance or updates, or if the end device computers require system maintenance, the end device that requires the maintenance shall be brought down during non-peak hours of operation.

e. It shall be acceptable to perform maintenance/updates on an end device computer system during other than non-peak hours if the particular end device is non-functional without having the maintenance or updates performed.

C. Performance Requirements

1. The performance requirements in this section are for system design and testing and not service response time.

2. Capacity: Systems shall be designed to support the operational, functional, and performance requirements, specified herein, for a minimum of 400 flight operations per hour and 40 different airlines with a total of 200 users simultaneously conducting 60 user operations per minute with a minimum of 750 end devices being updated.

3. Response time criteria shall be met under maximum capacity conditions as defined above.

4. External System Interface: The total additional delay for a transaction between a Systems workstation to an external system shall not exceed 1.5 seconds for 95 percent of all transactions. The remaining 5 percent of delays shall not exceed 3.0 seconds.

5. Database Transactions: For 95 percent of database transactions, there shall be no more than a 0.5 second delay between the time that a user selects an action and the system responds in some way that the input has been received. The remaining 5 percent of transactions shall not exceed 1.0 second.

6. Peripheral Command: For 95 percent of peripheral commands, there shall be no more than a 3.0 second delay between the time that a user selects an action and the associated peripheral responds to the request. The remaining 5 percent of command responses shall not exceed 5.0 seconds.

7. Peripheral Configuration: For 95 percent of peripheral configuration changes, there shall be no more than a 6.0 second delay between the time that a user selects an action and the associated peripheral responds to the request. The remaining 5 percent of peripheral configuration changes shall not exceed 10.0 seconds.

8. Display: For 95 percent of dynamic display device changes, there shall be no more than a 30.0 second delay between the time that a user inputs a database change and the affected display devices reflect the change. The remaining 5 percent of transactions shall not exceed 45.0 seconds.

D. System Management

1. The devices connected to the network shall be SNMP manageable. A positive relationship (e.g., system heart beat) shall exist between the system devices and the controlling server(s) at all times.

2. Managed system failures shall include, but not be limited to, PC failure, display device failure, application failure (server and local applications), network connectivity failure, and server failure. Server failure shall include hardware, software, network, and power based failure.

3. System failures shall be viewable at a central control point (i.e., the system administrator's workstation). A failure shall initiate an alarm and add a failure record to the failure database table. The system administrator shall receive a warning message on the System Administrator workstation, notifying them of the failure. The system shall provide e-mail, pager, and text messaging notification. The Contractor is responsible for providing all hardware, software, and WAN/PSTN access necessary to support the notification functions.

4. End user devices shall have remote administration and monitoring capabilities. This capability shall allow the specific machine to be remotely configured and to provide a status report to the management system. Data included in the reporting capabilities shall include: data pertaining to the machine's memory, storage devices, network connections, and general health of the machine.

2.17 REPORTING CAPABILITIES

A. The Systems shall support the utilization of a generic report writer module providing the ability to develop customized reports. The reporting tool shall be capable of building reports from any fields in the database and on any subset of records that user authority allows.

B. The Contractor shall detail the capabilities, functionality, and the user interface for both types of reporting.

C. In addition to canned reports all Systems components shall include the ability to develop ad-hoc reports through the use of Crystal Reports.

D. For any and all reports, including both "canned" reports and "ad hoc" reports, only authorized users shall have access to the reporting features.

E. For any and all reports, including both "canned" reports and "ad hoc" reports, only the System Administrator, or users with a sufficient level of security access authorization shall be able to see all airlines' information on the reports. Airline users shall be limited to reporting data from their airline only.

F. To ensure the desired reporting requirements are fully met, the Contractor shall be required to coordinate and administer workshops with the appropriate airport and tenant stakeholders to define the initial "canned" reports to be provided with the system. Up to six (6) workshops shall be held. These workshops shall be split into functional areas of the Systems and should include, as a minimum:

1. EVIDS (ADA requirements, display formats, user interfaces, and reports)

2. Resource Management System Reports

3. Common Use Passenger Processing System Reports

4. Database Reports

5. Baggage Reconciliation System Reports

2.18 BUSINESS INTELLIGENCE TOOL

A. In addition to the reporting requirements specified herein, and further identified during the implementation process, the Contractor shall provide a business intelligence tool to LAWA to allow them to customize reporting, analysis information, and to develop "dashboards" for information management. The business intelligence tool shall include the following, as a minimum:

1. Utilize a multi-tier architecture using modern Web standards, including but not limited to; XML, SOAP, and WSDL.

2. Utilize a single API to allow programmers to customize business intelligence capabilities.

3. Be scalable to support the entire LAX campus requirements.

4. Support multiple exporting formats including, but not limited to; Excel, .pdf, XML, HTML, and CSV.

5. Support flexible data distribution methods including centralized access, e-mail, application integration, and MS Office.

B. To support the Business Intelligence Tool features and functionality, training shall be provided by the Contractor. This training shall be included in, and coordinated with the training requirements specified in Part 3.

2.19 EVIDS REPORTING REQUIREMENTS

A. EVIDS Master Flight Database (MFD) Report.

1. Contractor shall provide a report which lists flights contained in the EVIDS Master Flight Database (MFD). The user shall be able to select records for the report based on various criteria including but not limited to the following fields:

a. Starting date of the flights

b. Ending date of the flights

c. Day(s) of the week that the flights operate

d. Name of origin/destination

e. Assigned gate(s)

f. Assigned baggage carousel(s)

g. Airline(s)

h. Aircraft type(s)

2. For this report, the user shall be able to specify the sort order for the report. The default sort order, if not specified by the user, shall be by ascending airline code and flight number. The user shall be able to specify multiple sorting fields, including but not limited to the following fields:

a. Day of the week the flight operates.

b. Assigned gate.

c. Assigned baggage carousel.

d. Airline.

e. Flight number.

f. Name of origin/destination.

B. EVIDS Active Flight Database (AFD) and Historical Flight Database (HFD) Report. The system shall provide a report which lists flights contained in the EVIDS Active Flight Database (AFD) or the Historical Flight Database (HFD). The user shall be able to select records for this report based on various criteria, including but not limited to:

1. Assigned gate(s).

2. Assigned baggage carousel(s).

3. Name.

4. Airline(s).

5. Aircraft type(s).

6. For the EVIDS AFD and HFD reports, the user shall be able to specify the sort order for the report. The default sort order, if not specified by the user, shall be by ascending airline code and flight number. The user shall be able to specify multiple sorting fields, including but not limited to the following fields:

a. Assigned gate.

b. Assigned baggage carousel.

c. Name.

d. Airline.

e. Flight number.

C. Gate Utilization Report: The system shall provide a Gate Utilization Report which shall list, for each selected gate, the flights utilizing that gate throughout the defined time period. For this report, the user can specify the reporting criteria based on the following:

1. Gate(s), default is all gates if not specified.

2. Starting time period, default is 12:01 a.m.

3. Ending time period, default is 12:00 a.m.

D. Video Advertising Report: The system shall provide a report detailing the tracking information for the display of video advertising files. The report shall include the time, length, the display monitor that was used for all advertisements, and a summary of the number of times each video was played on each monitor as well as the total number of times each video was played in a given time period throughout the airport.

E. The initial reporting requirements for EVIDS shall be fully defined during the stakeholder workshops. The base system shall provide up to fifteen (15) canned reports to be defined during this process.

2.20 RESOURCE MANAGEMENT SYSTEM REPORTS

A. The initial reporting requirements of the RMS shall be defined during the stakeholder workshops. The base system shall provide up to fifteen (15) canned reports to be defined during this process.

2.21 SHARED USE SYSTEM REPORTS

A. The initial reporting requirements of the shared use system shall be defined during the stakeholder workshops. The base system shall provide up to fifteen (15) canned reports to be defined during this process.

2.22 DATABASE REPORTS

A. The initial reporting requirements of the DB shall be defined during the stakeholder workshops. The base system shall provide up to fifteen (15) canned reports to be defined during this process.

2.23 BAGGAGE RECONCILIATION SYSTEM REPORTS

A. The initial reporting requirements of the DB shall be defined during the stakeholder workshops. The base system shall provide up to fifteen (15) canned reports to be defined during this process.

2.24 DATA NETWORK

A. TBD. Latest Cisco information to be obtained from LAWA IT and inserted.

2.25 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Acceptable Manufacturers:

1. W.H. Brady
2. Ideal
3. Panduit
4. Other equal

2.26 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 3 - EXECUTION

3.1 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.

1. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

C. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with Design Consultant the exact location and mounting height of all equipment in finished areas.

D. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, Engineer shall be notified before starting that part of the work. In areas with no ceilings, install only after Design Consultant reviews and comments on arrangement and appearance.

E. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

F. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support work. Supports shall meet the approval of Design Consultant.

G. Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.

1. Cables shall be combed and each strand shall run parallel with the other strands.

2. After combing and straightening strands, Contractor shall separate strands into bundles according to routing requirements and termination points.

3. Bundles shall be secured with hook-and-loop cable strap material.

a. Cable ties manufactured from a hard polymer material, such as plastic or nylon, shall not be used.

b. Hook-and-loop material shall be low life cycle, back-to-back type, black in color, and ½ inch wide.

4. Contractor shall begin to bundle and strap cables within 6 inches of exit from conduit, and bundles shall have cable straps applied at intervals not greater than 10 feet for entire length of vertical and horizontal run.

3.2 PHASES OF IMPLEMENTATION

A. Provide a consolidated and integrated schedule.

3.3 INSPECTIONS

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit installation drawings for LAWA review and approval.

3.4 TESTING REQUIREMENTS

A. Phases of Testing

1. On-Site Performance Verification Testing

2. On-Site Endurance Testing

B. Test Plan/Procedure: The Contractor shall submit a Test Plan for each testing phase for the review and approval of the Design Consultant. The test plan for each phase shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein. The test plan shall be provided at least forty-five (45) days prior to the scheduled start of each test. Test plans shall contain at a minimum:

1. Functional procedures including use of any test equipment

2. Test equipment is to be identified by manufacturer and model

3. Interconnection of test equipment and steps of operation shall be defined

4. Expected results required to comply with specifications

5. Record of test results with witness initials or signature and date performed

6. Pass or fail evaluation with comments.

7. The test procedures shall provide conformity to all specification requirements. Satisfactory completion of the test procedure is necessary as a condition of system acceptance.

8. Documentation verification, both interconnects and functionality, shall be part of the test. Where documentation is not in accordance with the installed system interconnect and operating procedures, the system shall not be considered accepted until the system and documentation correlate.

9. The Contractor shall cooperate with and provide LAWA representative(s) the opportunity(s) to participate in any or all of the tests.

10. Test Reports: The Contractor shall submit for each test, a test report document that shall certify successful completion of that test. Submit for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:

    a. Commentary on test results.

    b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.

    c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.

    d. Signatures of persons who performed and witnessed the test.

    e. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to the Owner. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by the Design Consultant, before any subsequent testing phase is performed.

C. Performance Verification Testing

1. Complete operational testing of all components and systems shall be witnessed by designated LAWA Representatives.

2. Schedule test with Design Consultant. Do not begin testing until:

    a. All systems have been installed and individually and jointly tested to ensure they are operating properly.

    b. Written permission from Design Consultant has been received.

3. Testing: As part of performance verification, test all components of system. The tests shall demonstrate system features.

4. Verification: Verify correct operation of the required system functionality as defined in these specifications.

5. Adjustment, Correction, and Completion:

   a. Correct deficiencies and retest affected components.

   b. Make necessary adjustments and modification to system after obtaining approval of the Design Consultant.

   c. Completion: Performance verification test shall be complete when testing or retesting of each component has produced a positive result and has been approved in writing by the Design Consultant.

6. Recording:

   a. Describe actual operational tests performed and equipment used and list personnel performing tests.

   b. Record in tabular form all test results, deficiencies, and corrective measures.

7. Termination

   a. Performance verification test shall be terminated by the Design Consultant when:

      1) Individual components, subsystems, or the integrated system fail to perform as specified.

      2) It is determined that system is missing components or installation is not complete.

   b. Upon termination, corrective work shall be performed and performance verification test rescheduled with the Design Consultant.

   c. Retesting shall be performed by Contractor at no additional expense.

   d. Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of the Design Consultant.

D. Endurance Testing

1. Provide personnel to monitor the systems 24 hours per day, including weekends and holidays during endurance testing.

2. Start test after:

   a. Successful completion of performance verification testing.

   b. Training as specified has been completed.

   c. Correction of deficiencies has been completed.

d. Receipt of written start notification from the Design Consultant.

3. Monitor all systems during endurance testing. Coordinate monitoring with the Design Consultant.

4. Recording: Record data on approved forms so as to provide a continuous log of systems performance. Include:

   a. Date and time for all entries.

   b. Name of individual making entry.

   c. Environmental conditions.

   d. Authority activities in process.

   e. Description of all alarm annunciations, responses, corrective actions, and causes of alarms. Classify as to type of alarm.

   f. Description of all equipment failures, including software errors.

   g. Description of all maintenance and adjustment operations performed on system.

   h. Daily and weekly tabulations.

   i. Daily entries of performance data shall be reviewed by the Design Consultant's representative designated to observe monitoring of system.

5. The Design Consultant may terminate testing at any time when the system fails to perform as specified. Upon termination of testing the Contractor shall commence an assessment period as described in Phase II.

6. Testing

   a. Phase I - Initial Testing:

      1) Time: 24 hours per day for 15 consecutive calendar days.

      2) Make no repairs during this phase unless authorized in writing by the Design Consultant.

      3) If system experiences no failures, proceed to Phase III - Final Testing.

   b. Phase II - Initial Assessment:

      1) After conclusion of Phase I or terminating of testing, identify all failures, determine causes, and repair. Submit report explaining: Nature of each failure, corrective action taken, results of tests performed to verify corrective action as being successful, and recommended point for resumption of testing.

2) After submission of report, schedule review meeting at job site. Schedule date and time with the Design Consultant.

3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

4) Based on report and review meeting, the Design Consultant will direct Contractor to repeat Phase I, restart Phase I, or proceed to Phase III - Final Testing.

c. Phase III - Final Testing:

1) Time: 24 hours per day for 15 consecutive calendar days.

2) Make no repairs during this phase unless authorized in writing by Engineer. .

7. Phase IV - Final Assessment:

1) After conclusion of Phase III or termination of testing, identify all failures, determine causes, and repair. Submit explaining the nature of each failure, corrective action taken, results of tests performed, and recommended point for resumption of testing.

2) After submission of report schedule review meeting at job site. Schedule date and time with the Design Consultant.

3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

4) Based on report and review meeting, the Design Consultant will approve endurance test or direct Contractor to repeat all or part of Phases III and IV.

8. Adjustment, Correction, and Maintenance

a. During endurance testing make adjustments and corrections to system only after obtaining written approval of the Design Consultant.

b. During endurance testing, perform required maintenance on systems including provision of replacement parts.

E. Commissioning Testing

1. The Contractor shall develop a commissioning test plan that includes the following components, as a minimum:

a. LAWA readiness

b. Operational procedures verification

c. Disaster recovery procedures

d. Computerized Maintenance Management System data verification

e. Change management procedures

2. The commissioning test plan/procedures shall be submitted to the Engineer for review and approval.

F. Final Inspection and Acceptance

1. After endurance testing is complete, review tabulated records with the Design Consultant.

2. The Contractor will not be responsible for failures caused by:

a. Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished and automatic shutdowns and restarts of systems performed as specified.

b. Failure of any LAWA furnished power, communications, and control circuits provided failure was not due to Contractor furnished equipment, installation, or software.

c. Failure of existing LAWA equipment provided failure was not due to Contractor furnished equipment, installation, or software.

3. When performance of integrated system does not fall within the above rates, determine cause of deficiencies, correct, and retest.

4. When requested by the Design Consultant, extend monitoring period for a time as designated by the Design Consultant.

5. Period shall not exceed 60 days exclusive of retesting periods caused by termination of Phases I or III and assessment period of Phases II and IV.

6. Submit final report of endurance testing containing all recorded data.

3.5 SYSTEM STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.

2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.

4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.

5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.6 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

3.7 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. LAWA is in the process of procuring and implementing a CMMS. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.8 TRAINING

A. By means of training classes augmented by individual instruction as necessary, the Contractor shall fully instruct LAWA's designated staff and Airline personnel in the operation, adjustment and maintenance of all products, equipment and Systems.

B. The Contractor shall be required to provide all training aids, e.g., notebooks, manuals.

C. The Contractor shall provide an appropriate training area equipped with all required equipment. The location of the training area shall be coordinated with the Design Consultant.

D. All training shall be completed a minimum of two weeks prior to system cut over. Training schedule shall be subject to the Design Consultant's approval.

E. Training shall be provided for each individual component of the Systems. This includes; DB, EVIDS, RMS, Common Use, CUSS, BRS, and VoIP.

F. Training shall be conducted by experienced personnel and supported by training aids. An adequate number and amount of training material shall be provided by the Contractor. The following is considered a minimum.

1. Functional flow-charts, overall block diagrams, and descriptive material for all software;

2. Schematic drawings for each of the hardware components;

3. All procedure manuals, specification manuals, and operating manuals;

4. As-built drawings.

G. Participants shall receive individual copies of technical manuals and pertinent documentation at the time the course is conducted. The courses shall be scheduled such that LAWA personnel can participate in all courses (no overlap).

H. A final course schedule and syllabus shall be prepared by the contractor for each course to be conducted for Airport personnel, and submitted for review at least four (4) weeks prior to the scheduled date of the course commencement.

I. Each course outline shall include, in addition to the subject matter, a short review of the prerequisite subjects (where appropriate); how this course fits into the overall training program; the objective; the standards of evaluation; and any other topics that will enhance the training environment.

J. A DVD of each course shall be provided to LAWA.

3.9 TYPES OF TRAINING

A. User Training: System users shall be instructed in all aspects of operations of the system, including the business intelligence tool and all reporting functions. Twelve (12) hours of basic user training shall be provided (2 hour class repeated 6 times with 10 system users per class). Additionally, twelve (12) hours of advanced user training shall be provided (4 hour class repeated 3 times with six advanced users per class). User training shall be conducted at a location that is coordinated with the Design Consultant.

B. Technician Training: Twenty-four (24) hours of maintenance training (24 hours of training repeated 1 time for 4 maintenance technicians per class) shall be provided. Training for maintenance technicians shall be provided on site, and shall include, but not be limited to, installation, operation, renovation, alteration, inspection, maintenance and service on each system and subsystem provided, so as to enable troubleshooting and repair to the component level. Maintenance training shall be conducted at a location that is coordinated with the Design Consultant.

C. System Administrator Training: System Administrator Training shall be provided. System Administrator Training shall include both classroom work and on the job training and shall be provided on-site at LAX or at a location within 50 miles of LAX.

1. Classroom Training: Forty-eight (48) hours of software training (48 hours of training repeated 1 time for 2 system administrators) shall be provided. The contractor shall structure the course to describe all systems, software and applications and support programs. This course shall include a functional overview of the complete software system. The course material must be presented in depth with the instructor covering detailed design, structure, and algorithms. Location of this training shall be coordinated with the Design Consultant.

2. On the Job Training: An additional six (6) weeks of on the job training shall be provided. On the job training of the designated LAWA personnel shall commence no later than two months prior to expiration of the equipment warranty period. This training shall be conducted on site at the Airport. The contractor shall provide LAWA specified trainees with daily job supervision and direction by a contractor engineer. The contractor shall answer any and all questions regarding the operation, repair, and maintenance of the system, software, and equipment.

3.10 FINAL INSPECTION AND ACCEPTANCE

A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA management system and successful performance of the cabling system for a two-week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

END OF SECTION 27 42 20

SECTION 27 51 13 – PAGING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the minimum requirements for public address announcement and paging systems to be installed and interfaced to existing systems as part of Terminal renovations. Contractor shall interface with the existing public address system in the Terminal which is manufactured by Innovative Electronic Designs, Inc. (IED) and shall provide all equipment and cabling necessary for a complete and upgraded system. Contractor shall upgrade existing IED system as required to meet the requirements given in this Specification Section.

B. Contractor shall include in the Bid all labor, materials, tools, plant, transportation, storage costs, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational system shown and described in the Specifications.

C. The Contractor is responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.

D. The Contractor shall coordinate with electrical contractor for provision of horizontal conduit and field boxes required to accommodate cabling of all loudspeakers, microphones and other system equipment.

E. The Contractor shall coordinate specialty electronic, Information Technology (IT) data networks and any other IT infrastructure systems necessary for transport of paging systems audio or data information.

F. Refer to Construction Drawings for device locations and details.

G. Related documents:

1. Section 27 05 00 – Basic Telecommunication Requirements

2. Section 27 05 05 – Selective Demolition Telecommunication Systems

1.2 GLOSSARY

A. ACS Announcement Control System
B. ANSI American National Standards Institute
C. ASTM American Society for Testing Materials
D. BFU Board of Fire Underwriters
E. BICSI Building Industry Consulting Services International

F.	CSA	Canadian Standards Association
G.	DEC	Department of Environmental Conservation
H.	EIA	Electronics Industry Association
I.	ER	Equipment Room
J.	FCC	Federal Communications Commission
K.	FM	Factory Mutual
L.	IED	Innovative Electronic Designs, Inc.
M.	IEEE	Institute of Electrical and Electronics Engineers
N.	ISO	International Standards Organization
O.	NEC	National Electrical Code
P.	NEMA	National Electrical Manufacturers' Association
Q.	NESC	National Electrical Safety Code
R.	NFPA	National Fire Protection Association
S.	OSHA	Occupational Safety and Health Administration
T.	TIA	Telecommunications Industry Association
U.	TR	Telecommunications Room
V.	TWC	Tenant Wiring Closet
W.	UFBC	Uniform Fire Prevention and Building Code
X.	UL	Underwriter's Laboratories, Inc.

1.3 SUBMITTALS

A. Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

B. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.

C. Submit all proposed labeling materials and nomenclature for approval.

D. Coordination Drawings:

1. Indicate locations where space is limited for installation and access.

2. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.

E. Submit all testing plans (acceptance, and endurance) for review and approval prior to the performance of any testing.

F. Paging Zone Code Documents.

1. Submit floor plans which use color coding and shading to indicate all of the individual loudspeaker zones and the codes that access each loudspeaker zone individually and each zone group. Laminated color copies and PDF format software copies shall be provided.

2. Submit a list of all paging stations, their locations, and which buttons or codes access which zone groups. If the paging stations are of the 12-button type and require a user-

access code, the document is to contain a list of the user types, a description of their level of access, and what the access code is. The user types (for instance: emergency, administrator, airline employee, etc.) and levels of access shall be determined by the Owner and submitted to the Contractor in a timely manner.

3. The documents above are to be submitted to the Design Consultant for approval prior to the System Acceptance testing. The final version of this document shall be created after one month of regular system use and written approval from the Owner that paging station zone group assignment are satisfactory.

G. Project Record Documents required include:

1. Marked-up copies of Contract Drawings

2. Marked-up copies of Shop Drawings

3. Newly prepared Drawings

4. Marked-up copies of Specifications, Addenda and Change Orders

5. Marked-up Project Data submittals

6. Record Samples

7. Field records for variable and concealed conditions

8. Record information on Work that is recorded only schematically

9. As-built drawings

10. Record drawings

H. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. Design Consultant will periodically review Project Record Documents to assure compliance with this requirement.

I. At every quarter, submit Project Record Documents to Design Consultant for LAWA's records.

1. Upon completion of the as built drawings, the Design Consultant will review the as built work with the Contractor.

2. If the as built work is not complete, the Contractor will be so advised and shall complete the work as required.

J. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

1.4 CODES, STANDARDS AND REFERENCES

A. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the following:

1. CFR 47 Part 15 Radio Frequency Devices
2. EIA-160 Sound Systems
3. EIA-219 Audio Facilities for Radio Broadcasting Systems
4. ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 02/02/09
5. ANSI/TIA/EIA –569-B Commercial Building Standard for Telecommunications Pathways and Spaces, May 2009
6. ANSI/TIA/EIA -606-A Administration Standard for Commercial Telecommunications Infrastructure, 11/24/08
7. ANSI/TIA/EIA -607 Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994
8. ANSI/TIA/EIA – 862 Building Automation Systems Cabling Standard for Commercial Buildings, 2002
9. FCC 47 Part 68 Code of Federal Regulations, Title 47, Telecommunications
10. IEC 60849 Sound Systems for Emergency Purposes
11. IEEE National Electrical Safety Code (NESC); 2007
12. ISO/IEC 11801 Information Technology - Generic Cabling For Customer Premises
13. LADBS Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code
14. NEMA 250 Enclosures for Electrical Equipment (1000 V Maximum)
15. NFPA-70 National Electric Code; 2008
16. NFPA 72 National Fire Alarm And Signaling Code
17. UL 1863 Underwriters Laboratories Standard for Safety – Communications Circuit Accessories

B. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

C. System installation and construction practices shall conform to standard industry practices as defined by the National Association of Broadcasters Engineering Handbook (latest edition), and Sound System Engineering (Don and Carolyn Davis, Howard W. Sams, publisher).

1.5 PAGING SYSTEM GENERAL DESCRIPTION

A. System shall be a professional quality, multi-function system to be used primarily for transmission and broadcast of emergency and audible paging messages and background music sources throughout the Terminal. New equipment shall consist of:

1. New loudspeakers, connectors, transformers, crossovers, signal delays, cabling, conduit, boxes, wiring, and appurtenances for a fully functional and operational systems as described herein and shown on the contract drawings. Installation shall include all branch conduit, required for a complete installation including all fittings, pull strings, seismic supports/bracing, etc.

2. Amplifiers, mixers, signal conditioning equipment, digital message repeaters and storage, compressor/limiters, switchers/routers, equalizers, operating software, test equipment, and head end equipment as described herein and shown on the contract drawings.

3. All system operations and controls shall be controlled by a microprocessor and appropriate digital processing. The microprocessor shall manage and control all system functions and hardware such as microphone stations and associated queuing, telephone interfaces, distribution of emergency announcements, local announcements, terminal announcements, background music, recorded announcements, and pre-recorded messages.

B. Public address system shall consist of the following:

1. Announcement control system (ACS).

2. System control computer.

3. Ambient analysis system (AAS)

4. Monitor/test system.

5. Gate, podium, and supervisory microphone stations.

6. Equalizers

7. Amplifiers

8. Loudspeakers.

C. Announcement control system (ACS) shall consist of:

1. The ACS microprocessor controlled multiple microphone station inputs and multiple output zones.

2. All microphone input stations shall be assignable to any combination of the output zones.

3. Assignments must be readily changeable by qualified authorized personnel through the use of the system control computer.

4. Message types shall have the following priority:

	Description:	Priority:
b.	Fire Marshalls Microphone Dispatch Center Emergency All Call (Airport-wide)	1
c.	Emergency Pre-Recorded Message -Fire Emergency Pre-Recorded Message Evacuation (Bomb Threat/Earthquake)	2
d.	Gate – Direct Podium/Supervisor – Direct Local Multi-Zoned Group (Flight Calls) Local Multi-Zoned Pre-Recorded (Area Specific Advisories) Local Multi-Zoned Group Pre-Recorded (Tenant/Airport Specific Advisories)	3
e.	Remote Zoned (Communications Center Operators) Terminal Zone Group - Prerecorded	4

D. Use of the Fire Marshall's microphone or Dispatch Center Emergency 'All Call' (Airport-wide) shall override all other messaging, including supervisory microphones.

1. Only one emergency announcement may be made at a time, regardless of zone assignments, and an emergency announcement or message shall interrupt and prevent any other use of the system.

E. A multi-local or local announcement shall not prevent a terminal announcement from playing, but it shall interrupt and override the terminal announcement in the zones that have been assigned to multi-local or local zone's use.

F. System shall be capable of making at least 8 local announcements simultaneously, as long as there is no zone overlap.

G. ACS shall be capable of recording at least 8 terminal announcements simultaneously, but shall only play 1 terminal announcement in each zone at a time.

H. All audio switching circuits shall be designed and constructed so that no switching transients, clicks, pops or microphone keying tones will be audible.

I. All external connections to the ACS shall be made with compression type screw terminal strips.

J. Redundant power supplies shall be furnished so that the system can continue to operate if a power supply fails.

K. Control system components shall be mounted on printed circuit cards installed in plug-in card files.

L. All control system equipment shall be rack mounted in standard 19-inch rack assemblies, as defined in EIA-310D.

M. ACS shall incorporate audio and control inputs from the following:

1. Main Terminal Dispatch Center: up to 6 inputs.

2. Podium microphones

3. Gate microphones

4. Fire Marshall's microphone

5. Supervisory microphones located throughout the Terminal

6. Emergency relay contact from the facility life safety system

N. Public address system control computer system.

1. Contractor shall furnish a permanent PC-compatible computer for configuration and control of the ACS, control and operation of the AAS specified functions, manipulation and operation of the DRP and PDRP, and operation of the PA system's monitor/test system.

2. Minimum hardware/software requirements: control system computer configuration shall be sufficient to ensure proper operation of the public address system and shall incorporate, at a minimum:

a. Processor based PC-compatible computer with fastest available processor speed at time of product submittal. ACS host computer shall come equipped with multiple serial and parallel data ports.

b. 19-inch or larger color flat panel monitor.

O. Program storage:

1. Permanent program storage shall be accomplished in non-volatile memory and EPROMS.

2. Following interruption of service, power restoration shall be automatically sequenced in a minimum of two stages - processing equipment followed by amplification equipment.

3. There shall be no loss of operating configuration information and operator intervention shall not be required in order to restore system operation.

P. Digital record/playback system (DRP):

1. The DRP shall be designed so it can be installed in the ACS as an integral part of the whole system.

2. The DRP shall have at least 8 separate channels and each channel shall be able to record at least 600 seconds of audio. When a microphone station zone group selection button is momentarily pressed the following functions shall be performed:

a. The microprocessor shall detect the action.

b. The system shall find an open DRP channel.

c. The 'READY' LED indicator shall illuminate on the microphone station.

d. The DRP channel shall be assigned, and the announcement from the microphone station shall be stored. The announcement time duration shall be preset to 50 seconds.

e. The green LED associated with that button shall start to flash 8 seconds before the preset announcement limit.

f. The announcement shall be retained for playback when the microphone or announce button is released. The microphone or announce button must be released prior to the preset announcement limit or prior to any 5 second silent period.

3. The announcement will play back automatically, to the selected zones, in its assigned queue position.

4. An announcement shall be canceled when a microphone or announce button is pressed and held for a 5 second silent period. Cancellation shall be indicated by the green light going off.

5. The red 'BUSY' LED's beside the zone group select buttons on the microphone station shall light when all DRPS channels are busy.

6. The microphone station shall be able to select a desired zone group when all DRPS channels are busy. The 'BUSY' LED will flash acknowledging acceptance of the station into the queue (first-in, first-out). When the station reaches the top of the queue, the station beeper will sound and the green 'READY' LED will turn on and the microphone station can proceed with its announcement recording.

Q. Permanent digital record/ playback system (PDRP):

1. The PDRP system shall be designed as an integral part of the announcement control system.

2. The PDRP system shall have a non-volatile Memory capable of storing not less than 800 seconds of audio messages.

3. Playback of the PDRP system messages shall be assignable to any zone or zones by the microcomputer.

4. Scheduling of PDRP system messages shall be set by the microcomputer.

    a. The PDRP system shall have the ability to record and play back a limited or unlimited repeat sequence, or to play any message at a specified interval on a real time clock schedule.

    b. Initiation or interruption of a playback sequence, on site recording, or monitoring of all PDRP messages shall be possible from any assigned microphone station.

    c. It shall be possible to play a message to the zone map for multi-local group 1 of that microphone station, or to a terminal zone group instead of to the zone map assigned to the message.

5. The PDRP system shall hold in permanent storage recorded messages such as:

    a. Emergency evacuation instructions.

    b. Fire warning/life safety instructions

    c. Public service messages (clean air act announcements, white zone, vehicle parking messages, and freedom of speech area identification.)

    d. Airline regulatory announcements such as the number of bags allowed on a flight, or non-smoking flights.

    e. Institutional messages such as baggage matching/unattended baggage announcements.

R. Ambient analysis system (AAS):

1. The AAS shall control specified audio levels in response to ambient or background noise levels.

2. All parameters governing the manner in which the system responds to noise and adjusts the program signal shall be set individually for each channel.

3. Manufacturer’s software package shall be provided to set up the system, observe and tailor its operation, permanently save the setup parameters, and produce a printed record of them.

4. The AAS shall have the capability to differentiate between ambient noise and the actual program material.

5. The system shall be a microprocessor based system with software which removes the contribution of the program signal from the sensed signal to determine the true level of the ambient noise.

6. The microprocessor shall direct the associated digital attenuator(s) corresponding to the appropriate program channel(s) to increase or decrease level accordingly.

7. The period of time over which levels can be adjusted shall be established in the software in the range of 1 second to 5.25 hours.

8. Each AAS shall be configured in the field from the portable control computer system. The public address system control computer shall be the permanent host for the setup software package following initial set-up.

9. A 'CALIBRATE CHANNEL' screen shall display real-time levels of 4 key parameters, allowing the Owner to accurately fine-tune the system and verify its proper operation.

10. A computer shall only be required for setup and monitoring. Once the initial set-up procedure is completed, setup parameters shall be saved in non-volatile memory in the AAS. Following set-up, the AAS shall then operate without the use of a computer.

11. The AAS shall have the ability to control one channel or a group of channels in real-time response to the ambient noise.

12. The AAS microprocessor shall be capable of controlling at least 44 channels simultaneously.

13. The system shall provide precise control of the program level in response to inputs from remote sensors.

14. AAS ambient noise sensor units shall have mounting options for deep double gang electrical boxes, or 4-inch speaker back boxes and grills.

15. One sensor shall be capable of controlling from one to forty-four attenuators simultaneously. A group of sensors shall be capable of being averaged to control one attenuator.

16. Each AAS microphone shall consist of an omnidirectional condenser microphone, a preamplifier, and an analog signal converter.

17. Each AAS microphone shall be capable of being located up to 5,000 feet from the mainframe.

18. Connections between the sensors and the mainframe shall be made using standard audio shielded twisted pair cable of 18 AWG or larger.

S. Monitor/test system:

1. The monitor/test system shall have the capability to audibly monitor the signal at any point in the system. As a part of the monitor system, manual or programmed audible frequency self-testing shall be available, as well as an inaudible (20 kHz) test designed to exceed the requirements of NFPA 72F. The monitor test system shall be a full function monitoring system with self-diagnostics systems testing capability.

2. The monitor/test system shall be designed to allow the user to check status and condition of the audio and non-audio signals both audibly and visually.

    a. Via the System control computer, the monitor/test system shall be capable of selecting and feeding any one of remotely located monitor/test points to an audio interface module which measures and attenuates the signal for use by the computer and monitor amplifier which shall be connected to a dedicated monitor/amplifier.

    b. This feature shall allow the operator of the computer to select any remote signal, measure its level and listen to this level at some fixed predetermined level independent of the original, so that a quality and magnitude comparison can be made both electronically and audibly.

    c. At the same time, the output level shall be displayed numerically on the screen. System shall also be capable of monitoring power supply voltages throughout the system. The monitor test system shall also be capable of monitoring low impedance power amplifiers (8 ohms or less), line level audio, DC voltages, and AC voltages.

    d. System shall have a useful input signal range of minus 55dB to plus 40dB.

    e. System shall consist of high quality line level amplifiers that can be switched to a single line level output.

3. The monitor/test system shall consist of two main parts: the first part shall be a rack mount unit, and the second shall be the monitor interface module. These two products shall be designed to be used together or to be used independently.

    a. The monitor/test system shall consist of the monitor test card, physical housing, power supply and motherboard. The monitor test card shall contain 64 balanced, differential, high impedance, gain adjustable, high quality audio amplifiers. These amplifiers shall normally be set to accept a standard 70 Volt line input at clipping level but shall also be capable of accepting input level from DC to 1000 Volts AC. The outputs of these 64 amplifiers shall be computer switched to an active output module. The monitor test card shall also contain necessary card edge connections and circuitry to interface a standard EIA-422 digital link to the 64 switches that select one of the inputs.

    b. A support panel that serves as a card guide and mount for the plus 15 V and plus 5 V power supply shall be physically mounted to the monitor test card.

c. The monitor test system board shall be the motherboard that is the rear panel of the housing, shall provide a mounting for all internal and external connectors and shall provide the interconnecting wiring. The external connectors shall be:
   1) Wire-in compression screw terminal that provides access to all 64 audio inputs with 192 individual screw terminals and three additional terminals for access to the audio line output.
   2) The AC line connector which shall be a standard 3 pin male European style socket;
   3) Two each 37 pin sub D connectors that shall provide access to the controlling computer and to other components in the EIA- 422 circuit.
      a) Up to 255 monitor/test systems shall be able to be linked together per intercommunications port on the monitor-test system.

T. Microphone Stations

1. Each microphone station shall originate announcements into zone groups as detailed in the floor plans and public address system drawings.

2. Any microphone station shall be capable of being programmed into any zone group.

3. Microphone stations shall be capable, if so programmed, of making emergency zone group announcements, terminal zone group announcements, local zone group announcements, and multi-local group announcements.

4. If programmed, microphone stations shall also be capable of performing any or all of the control functions of prerecorded messages. These control functions shall include initiating a playback sequence, interrupting a playback sequence, recording a message, monitoring a message, or playing back a message to its own multi local zone group, or to a terminal zone group instead of to the zone map assigned to that message.

5. Microphone stations shall include a hand-held, push-to-talk microphone. Each microphone station shall have buttons for zone group selection to activate that microphone station for announcements into pre-programmed zones. Each station shall contain its own microphone preamplifier, limiter/compressor, and line amplifier with balanced output. Each microphone station will be provided complete with cut-outs and mounting hardware for microphone stations mounted in furniture, fixtures, equipment, or structure.

   a. A green ‘READY’ LED shall illuminate when the desired portion of the system is ready for the announcement.

   b. After the green LED is illuminated, any 5 second pause in the announcement whether before, during or at the end of the announcement, will terminate the announcement.

   c. A red ‘BUSY’ LED on the microphone station shall indicate when the portion of the system requested is busy.

d. If the portion is busy, selecting the desired zone group will automatically enter that microphone station into the queue (first-in/first-out).

e. The red 'BUSY' LED shall begin to flash, acknowledging acceptance of the microphone station into the queue.

f. When the microphone station gets to the top of the queue, the beeper shall beep and the green LED shall illuminate, indicating that the microphone station is available for the announcement.

g. The normal procedure for making an announcement on the microphone station type being used shall be resumed before the cessation of the beeps.

U. Podium and supervisory microphone stations

1. Supervisory microphone stations shall have a twelve (12) button keypad for data entry plus an LCD digital display.

a. Keypad entry shall enable them to select any zone group or prerecorded message function in the system to which it has been given access by programming from the computer keyboard.

b. Supervisory microphone stations shall have three non-announcement functions available from the keypad by entry of a number sequence:

2. Keypad disable/enable.

3. Self test.

4. Internal oscillator 'ON/OFF' for system test purposes.

V. Gate microphone stations

1. Gate microphone stations shall consist of a push-to-talk microphone, microphone clip and connector.

2. When a gate microphone is activated, it will activate the zone to which the associated podium microphone is normally programmed to activate.

3. Connection to the public address system shall be via a connection to the podium station with which the gate microphone is associated.

4. No access to preprogrammed announcements shall be available from the gate microphone stations.

W. Telephone interface:

1. Telephone interface stations, when addressed from a tone type telephone, shall have capabilities similar to those of the supervisory microphone stations.

2. Provide three dual input telephone interface stations.

X. Loudspeakers shall be the type and number depicted in the contract drawings and as required by the Contract Documents.

Y. Amplification shall:

1. Be provided as shown in the Contract Drawings.

2. Provide full bandwidth signals to those loudspeakers that have a single, full range audio input.

3. Provide crossovers and a high and low frequency signal to those loudspeakers which are bi-amplified.

4. Be capable of supplying 4 Ohm, 8 Ohm, 16 Ohm and 70 Volt output without the use of a transformer.

5. Be provided with adequate cooling for the amplifiers, as recommended by the amplifier's manufacturer.

Z. Connection to the emergency announcement system:

1. Emergency messaging shall be automatically initiated whenever the system is notified of a general alarm condition in the new Terminal.

a. Whenever a local alarm condition is detected by the fire alarm system, the fire alarm system will initiate immediate notification of the alarm condition to the Dispatch Center.

b. If a General Alarm Condition is annunciated the fire alarm system will immediately provide contact closure to the system.

c. The system shall automatically broadcast emergency instructions whenever a General Alarm notification is transmitted. The System emergency message shall repeat for a minimum of 20 minutes or until the fire alarm system is manually reset.

2. The system shall be provided with a sensing input which will accept a relay or contact closure from the fire alarm system which will completely and fully mute the system.

3. When the relay or contact closure is removed, the system shall return to normal operational status with the settings that were active and in place just prior to the system's receipt of the contact closure.

1.6 QUALITY ASSURANCE

A. The Contractor's Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with the LAWA's and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the Design Consultant. The Design Consultant shall be notified by the Contractor of any inspection(s) and the Design Consultant may elect to participate in any inspection(s). All QC information shall be provided to LAWA for input into the CMMS (refer to paragraph 3.7).

1.7 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids Specification requirements.

B. Under no circumstances shall the LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to Engineer all evidence to support the contention that the item proposed for substitution is equal to the specified item. The Owner's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor.

1.8 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

2. Equipment shall meet all applicable FCC Regulations.

3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.

4. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.

5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.

1. All components of an assembled unit need not be products of the same manufacturer.

2. Constituent parts, which are alike, shall be from a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for intended service.

4. The Contractor shall guarantee for a minimum of fifteen (15) years, the performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

C. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model.

E. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

F. Maximum standardization of components shall be provided to reduce spare part requirements.

1.9 WARRANTY

A. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of two (2) years from Final Acceptance.

1. The Contractor shall use qualified service personnel to conduct all maintenance work. Service personnel must be local to the project jurisdiction to allow required response times to be met.

2. The Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

B. Submit a copy of all manufacturer warranty information.

C. The Contractor shall, within the warranty period, schedule two visits to inspect and perform preventive maintenance on the system. The first visit shall be six months after the commencement of the warranty period. The last visit shall be just prior to the end of the

warranty period. All work done must be submitted to LAWA in a written report describing the work, the amount of time taken, and all the individual's names who performed the work.

D. The Contractor shall return 90 to 120 days after the system has been turned over to the Owner for additional programming, maintenance and system fine-tuning. Conduct interviews with the user group via telephone to acquire information needed to complete this task. Allow for one full day of programming in your initial bid to complete. Provide a per hour programming fee that will be charged if additional programming is needed.

E. The following items shall be furnished to the Owner by the Contractor for future maintenance and repair:

1. Provide (6) spare 12 button paging stations.

2. Provide (3) spare 200 watt amplifier cards

3. Provide (2) spare 400 watt amplifier card.

4. Provide (1) spare 500R card

5. Provide (2) ambient noise sensors

1.10 ON-SITE PERSONNEL REQUIREMENTS

A. Contractor shall be (or shall subcontract with an installer who is) certified by the paging system manufacturer (IED) to install their equipment.

B. The Contractor shall be responsible for the proper placement of all cabling, racks, cabinets, patch panels, cover plates, outlet boxes, and related hardware, as well as all distribution, and termination equipment.

C. The Contractor shall obtain the approval of Engineer or Design Consultant for the final layout of any equipment to be installed in new or existing telecommunications rooms and tenant wiring closets prior to the installation of any materials or equipment. Shop drawings showing proposed installation details shall be submitted for approval before beginning installation.

D. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of the LAWA.

E. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

F. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

G. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

H. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

I. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of the Engineer so the area can be appropriately noted.

J. Following each day's work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

PART 2 - PRODUCTS

2.1 GENERAL PERFORMANCE REQUIREMENTS

A. System Performance:

1. Electrical Performance; Source Input to Power Amplifier Output:

   a. Frequency Response (Equalizer flat): +/- 0.2 dB 20 Hz to 20 kHz.

   b. Total Harmonic Distortion (THD): Less than 0.05%, 20 Hz to 20 kHz, 4 ohms.

   c. Noise: At least -105 dB, 20 Hz to 20 kHz, referenced to input of +4 dBm.

   d. Crosstalk: At least 60 dB, 20 Hz to 20 kHz.

   e. Damping Factor: Greater than 20 (below 1 kHz).

2. Nominal gain from microphone station output to input of Ambient Noise Analysis system shall be 0dB.

3. Nominal voltage at input of Ambient Noise Analysis Systems shall be 1.00 volt RMS.

4. Electro/Acoustic Performance; Distributed Systems: 90 dB maximum RMS single word level, 80 dB average RMS measure at ear level in each zone with test speech source having equivalent RMS voltage equal to that measured at the microphone station output with 65dBA speech at normal microphone distance from the mouth.

5. Intelligibility Performance; objective measurements of intelligibility, as referenced in IEC standard 60268-16, shall be performed in all representative acoustical environments. Representative acoustical environments are defined as major functional areas such as Baggage Claim areas, Departures Ticketing Lobby, Departures Hold Rooms, etc. Measurements are to meet or exceed standards established by IEC 60849 which calls for a 'Common Intelligibility Scale' greater than or equal to 0.7 (STI equivalent of 0.5). Measurements shall be carried out according to all provisions and limitations as provided by IEC 60849.

B. Ambient Noise Analysis System:

1. Shall be adjusted in each zone to provide variable attenuation in the range of 0 to -10dB. To be calibrated to correspond with minimum and maximum expected ambient noise levels, but not to exceed 10dB, + or – 3dB, above maximum ambient noise level, as measured when area is full of people. Ambient Noise Analysis System must be calibrated by a manufacturer-approved consultant, and calibration process must include at least 2 follow-up visits which measure all representative acoustical environments. Observations and measurements must be submitted in written form.

2. Contractor shall confirm that ambient microphone positions are not located in close proximity to noise emitting equipment which turns on and off intermittently, providing false ambient noise information to the system.

C. Monitor/Test System: Shall perform routine, automatic diagnostic tests utilizing a self-generated test tone. Refer to manufacturer's instructions and recommendations for settings.

D. Each output zone shall be adjusted at the corresponding power amplifier and using the system software so that volume levels (using an appropriate pink noise source) from zone to adjacent zone are within 3dB of each other, before any Ambient Noise System auto-attenuation takes place.

E. General Network Requirements:

1. A 100Mbps switched Ethernet network is required for general audio, switched at a layer 2 (MAC) protocol level throughout.

2. Microphone Station to ACS - One dedicated VLAN at 100Mbps.

3. Digital Amplifier to ACS - One dedicated VLAN at 100Mbps.

4. ACS to ACS - One dedicated VLAN at 100Mbps.

5. Quality of Service - QoS shall be used to give the time sensitive CobraNet data precedence over less sensitive computer traffic, insuring that other transactions occurring over the network do not affect audio delivery.

2.2 MAJOR EQUIPMENT

A. Schedule of major equipment (or equivalent):

Description	**Mfr.**	**Model**
Speakers:		
Ceiling Loudspeaker – 6.5”	Atlas	FAP 62T with and without custom hanger
Ceiling Loudspeaker – 8”	Atlas	FAP 82T w. hanger
Ceiling-mount speaker system	EAW	CP621
Wall speaker	Atlas Sound	SM42T-W
Amplifier and DSP Section:		
Titan Mainframe System 120VAC	IED	TITANSYS-L
Titan DSP Software	IED	T-DSP
Titan Monitor/Test Software	IED	T-MON
Titan Backup power amp switching software	IED	T-BACK
Power Amp Card Dual 70-Volt 200W 120VAC	IED	IED6272L
Power Amp Card 70-Volt 400W 120VAC	IED	IED6470L
Ambient Analysis Sensor Collector	IED	IED6540TSYS-L
Ambient Sensor Collector Software	IED	T-AMB
Ambient Sensor - 2 Gang Plate	IED	IED0540S
Headend Section:		
ACS "System" (includes cardframe, CPU, power supplies, and "R" card)	IED	IEDA500ACS-L
Backup CPU/Hard Drive Card	IED	510CPU
Digital Frame link Card- Multimode with Back ST	IED	510N and NT
Microphone station input card and strip	IED	500C and FT
ACS Configuration Computer	IED	591R-S1
UPS for ACS	APC	SU3000RMXL3U with one SUA48R3XLBP
Relay input card (for Fire Alarm Interface)	IED	508BI0
Telephone Interface	IED	508T
ACS Software	IED	IED0631
FAS Software	IED	Model 632
Network Switch with (2) single-mode fiber mini-GBICs and 10/100 ports	HP Procurve	4104gl

Custom software for Duran Audio network "fault" feed	IED	IED0760
Audio Ducker	Rolls	DU-30
Network Switch	HP Procurve	2626
Keyboard, Video, Mouse Switcher	IED	MKM-RS1
Rackmount LED Display	IED	Video Display
Telephone Auto Dialer	Antx	DS8-N
Microphone Stations:		
Paging mic station - 12 button, IP digital, horizontal (flush or surface mounted depending on backbox)	IED	518HFM-H
Rackmount paging station w. spkr, IP digital	IED	508SRM

2.3 CUSTOM FABRICATION

A. Equipment cabinets: Telecommunications Rooms and equipment cabinets are supplied by Section 27 05 00. Contractor may arrange with cabinet supply contractor to ship cabinets to their factory for pre-rack and wiring of paging equipment. Paging system contractor is responsible for providing all cooling equipment, shelves, drawers, special power wiring, ground connections, cables, connectors, appurtenances, and adapters of any kind necessary to accommodate the PA system installation, operation, testing, or maintenance.

1. Contractor shall provide the appropriate factory or custom rack mount adapters for all equipment installed in the equipment rack, whether specifically itemized or not.

2. Contractor shall provide security covers for all equalizers, crossovers, signal delays, and other adjustable signal processors.

3. Unused slots shall be covered using blank panels provided by the system manufacturer.

4. Contractor shall provide at least one security screw for each piece of equipment and four security screw tools for the system.

B. Interface tie points: Contractor shall furnish custom-fabricated interface tie points to accommodate distribution of system program material, and to transition wiring types between the paging system equipment racks and loudspeaker zones. Contractor shall furnish operable methods for labeling, dressing, and distributing wires, shields, and grounding conductors so as not to adversely impact the quality of system voice and data transmission. Contractor shall provide test points at each audio and data circuit appearance for that tie point for maintenance and testing purposes. All circuits and cables shall be clearly labeled. All interface tie-points will be mounted within NEMA 12 enclosures, to be sized by Contractor in accordance with the requirements of the NFPA 70. Enclosures are to include integral door locks. All interface tie points are to be keyed alike. Keys shall be turned over to the Owner at Final Acceptance.

C. Transformers: Where required by the function of the system, provide appropriate impedance ratio and power handling capacity for audio transformers required in the system.

D. Loudspeaker hardware: Contractor is solely responsible for ensuring that all grilles, transformers, enclosures, baffles, and ancillary hardware to be supplied are compatible with the loudspeakers specified.

E. Pads: Contractor shall provide balanced pads, comprised of 0.5 watt, 5 percent composition resistors soldered to fixed connection points at each end, as required to achieve proper impedance matching and levels.

F. Remote control panels and receptacle plates: Contractor shall fabricate with 1/8-inch thick 6061-T6 aluminum with a brushed, anodized finish (color to match surrounding surfaces).

G. System functional diagrams: Contractor shall provide 1/2-size as-built functional diagram, framed with acrylic cover and mounted adjacent to equipment rack, for each control or audio system (including patch field designations). Mounting inside interface tie point enclosures will be acceptable.

2.4 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Acceptable Manufacturers:

1. W.H. Brady
2. Ideal
3. Panduit
4. Other equal

F. Contractor shall provide permanently mounted 1/32-inch thick by 1/4-inch high black lamicoid or anodized, brushed aluminum labels with 1/8-inch engraved lettering for each piece of equipment and every user-adjustable control and input on the audiovisual equipment.

2.5 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration

Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 3 - EXECUTION

3.1 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.

1. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

C. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with Design Consultant the exact location and mounting height of all equipment in finished areas.

D. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, Engineer shall be notified before starting that part of the work. In areas with no ceilings, install only after Design Consultant reviews and comments on arrangement and appearance.

E. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

F. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support work. Supports shall meet the approval of Design Consultant.

G. Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend

radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.

1. Cables shall be combed and each strand shall run parallel with the other strands.

2. After combing and straightening strands, Contractor shall separate strands into bundles according to routing requirements and termination points.

3. Bundles shall be secured with hook-and-loop cable strap material.

    a. Cable ties manufactured from a hard polymer material, such as plastic or nylon, shall not be used.

    b. Hook-and-loop material shall be low life cycle, back-to-back type, black in color, and ½ inch wide.

4. Contractor shall begin to bundle and strap cables within 6 inches of exit from conduit, and bundles shall have cable straps applied at intervals not greater than 10 feet for entire length of vertical and horizontal run.

3.2 PHASES OF IMPLEMENTATION

A. Provide a consolidated and integrated schedule.

B. Functionality of the existing paging system shall be maintained at all times. The work shall be done in such a fashion that no existing paging zone is out of service during the hours of 5:00am to Midnight, and no zone is out of service at all for more than 1 hour in areas which are still in use. Temporary paging must be provided as required at no additional cost to the Owner.

3.3 INSPECTIONS

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit installation drawings for LAWA review and approval.

3.4 TESTING REQUIREMENTS

A. Phases of Testing

1. On-Site Performance Verification Testing

2. On-Site Endurance Testing

B. Test Plan/Procedure: The Contractor shall submit a Test Plan for each testing phase for the review and approval of the Design Consultant. The test plan for each phase shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein. The test plan shall be provided at least forty-five (45) days prior to the scheduled start of each test. Test plans shall contain at a minimum:

1. Functional procedures including use of any test equipment

2. Test equipment is to be identified by manufacturer and model

3. Interconnection of test equipment and steps of operation shall be defined

4. Expected results required to comply with specifications

5. Record of test results with witness initials or signature and date performed

6. Pass or fail evaluation with comments.

7. The test procedures shall provide conformity to all specification requirements. Satisfactory completion of the test procedure is necessary as a condition of system acceptance.

8. Documentation verification, both interconnects and functionality, shall be part of the test. Where documentation is not in accordance with the installed system interconnect and operating procedures, the system shall not be considered accepted until the system and documentation correlate.

9. The Contractor shall cooperate with and provide LAWA representative(s) the opportunity(s) to participate in any or all of the tests.

10. Test Reports: The Contractor shall submit for each test, a test report document that shall certify successful completion of that test. Submit for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:

a. Commentary on test results.

b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.

c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.

d. Signatures of persons who performed and witnessed the test.

e. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to the Owner. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by the Design Consultant, before any subsequent testing phase is performed.

C. Performance Verification Testing

1. Complete operational testing of all components and systems shall be witnessed by designated LAWA Representatives.

2. Schedule test with Design Consultant. Do not begin testing until:

a. All systems have been installed and individually and jointly tested to ensure they are operating properly.

b. Written permission from Design Consultant has been received.

3. Testing: As part of performance verification, test all components of system. The tests shall demonstrate system features.

4. Verification: Verify correct operation of the required system functionality as defined in these specifications.

5. Adjustment, Correction, and Completion:

a. Correct deficiencies and retest affected components.

b. Make necessary adjustments and modification to system after obtaining approval of the Design Consultant.

c. Completion: Performance verification test shall be complete when testing or retesting of each component has produced a positive result and has been approved in writing by the Design Consultant.

6. Recording:

a. Describe actual operational tests performed and equipment used and list personnel performing tests.

b. Record in tabular form all test results, deficiencies, and corrective measures.

7. Termination

a. Performance verification test shall be terminated by the Design Consultant when:

1) Individual components, subsystems, or the integrated system fail to perform as specified.

2) It is determined that system is missing components or installation is not complete.

b. Upon termination, corrective work shall be performed and performance verification test rescheduled with the Design Consultant.

c. Retesting shall be performed by Contractor at no additional expense.

d. Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of the Design Consultant.

D. Endurance Testing

1. Provide personnel to monitor the systems 24 hours per day, including weekends and holidays during endurance testing.

2. Start test after:

a. Successful completion of performance verification testing.

b. Training as specified has been completed.

c. Correction of deficiencies has been completed.

d. Receipt of written start notification from the Design Consultant.

3. Monitor all systems during endurance testing. Coordinate monitoring with the Design Consultant.

4. Recording: Record data on approved forms so as to provide a continuous log of systems performance. Include:

a. Date and time for all entries.

b. Name of individual making entry.

c. Environmental conditions.

d. Authority activities in process.

e. Description of all alarm annunciations, responses, corrective actions, and causes of alarms. Classify as to type of alarm.

f. Description of all equipment failures, including software errors.

g. Description of all maintenance and adjustment operations performed on system.

h. Daily and weekly tabulations.

i. Daily entries of performance data shall be reviewed by the Design Consultant's representative designated to observe monitoring of system.

5. The Design Consultant may terminate testing at any time when the system fails to perform as specified. Upon termination of testing the Contractor shall commence an assessment period as described in Phase II.

6. Testing

a. Phase I - Initial Testing:

1) Time: 24 hours per day for 15 consecutive calendar days.

2) Make no repairs during this phase unless authorized in writing by the Design Consultant.

3) If system experiences no failures, proceed to Phase III - Final Testing.

b. Phase II - Initial Assessment:

1) After conclusion of Phase I or terminating of testing, identify all failures, determine causes, and repair. Submit report explaining: Nature of each failure, corrective action taken, results of tests performed to verify corrective action as being successful, and recommended point for resumption of testing.

2) After submission of report, schedule review meeting at job site. Schedule date and time with the Design Consultant.

3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

4) Based on report and review meeting, the Design Consultant will direct Contractor to repeat Phase I, restart Phase I, or proceed to Phase III - Final Testing.

c. Phase III - Final Testing:

1) Time: 24 hours per day for 15 consecutive calendar days.

2) Make no repairs during this phase unless authorized in writing by Engineer.
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7. Phase IV - Final Assessment:

1) After conclusion of Phase III or termination of testing, identify all failures, determine causes, and repair. Submit explaining the nature of each failure, corrective action taken, results of tests performed, and recommended point for resumption of testing.

2) After submission of report schedule review meeting at job site. Schedule date and time with the Design Consultant.

3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

4) Based on report and review meeting, the Design Consultant will approve endurance test or direct Contractor to repeat all or part of Phases III and IV.

8. Adjustment, Correction, and Maintenance

a. During endurance testing make adjustments and corrections to system only after obtaining written approval of the Design Consultant.

b. During endurance testing, perform required maintenance on systems including provision of replacement parts.

E. Commissioning Testing

1. The Contractor shall develop a commissioning test plan that includes the following components, as a minimum:

a. LAWA readiness

b. Operational procedures verification

c. Disaster recovery procedures

d. Computerized Maintenance Management System data verification

e. Change management procedures

2. The commissioning test plan/procedures shall be submitted to the Engineer for review and approval.

F. Final Inspection and Acceptance

1. After endurance testing is complete, review tabulated records with the Design Consultant.

2. The Contractor will not be responsible for failures caused by:

a. Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished and automatic shutdowns and restarts of systems performed as specified.

b. Failure of any LAWA furnished power, communications, and control circuits provided failure was not due to Contractor furnished equipment, installation, or software.

c. Failure of existing LAWA equipment provided failure was not due to Contractor furnished equipment, installation, or software.

3. When performance of integrated system does not fall within the above rates, determine cause of deficiencies, correct, and retest.

4. When requested by the Design Consultant, extend monitoring period for a time as designated by the Design Consultant.

5. Period shall not exceed 60 days exclusive of retesting periods caused by termination of Phases I or III and assessment period of Phases II and IV.

6. Submit final report of endurance testing containing all recorded data.

3.5 SYSTEM STARTUP

A. Upon completion of the installation of all equipment in an area, perform the following tests and record results. Verify safe and proper operation of all components, devices, or equipment, establish nominal signal levels within the systems and verify the absence of extraneous or degrading signals. Make all preliminary adjustments and document the setting of all controls, parameters of all corrective networks, voltages at key system interconnection points, gains and losses, as applicable. Submit test report. Correct all non-conforming conditions prior to requesting Acceptance Testing. Perform at least the following procedures:

B. Mechanical. Verify:

1. Integrity of all support provisions.

2. Absence of debris of any kind, tools, etc.

C. Power and Isolated Ground. Verify:

1. Isolation of Isolated Ground system from raceway and related ground.

2. Grounding of devices and equipment. Integrity of signal and technical power system ground connections.

3. Proper provision of power to devices and equipment.

D. Signal Wiring. Verify:

1. Integrity of all insulation, shield terminations and connections.

2. Integrity of soldered connections. Absence of solder splatter, solder bridges.

3. Routing and dressing of wire and cable.

4. Continuity, including conformance with wire designations on running sheets, field and shop drawings.

5. Absence of ground faults.

6. Polarity.

E. Use the proper sequence of energizing systems to minimize the risk of damage.

F. Sound Systems:

1. Electronic Tests; confirm:

a. Gain at 1 kHz.

b. Maximum output.

c. Input clipping level.

d. Frequency response.

e. Total harmonic distortion.

f. Signal-to-Noise ratio.

g. Signal-to-Crosstalk ratio.

2. Gain control settings: Establish tentative normal settings for all gain controls. Set all equalizers flat. Set all automatic gain control devices to bypass. Terminate power amplifier outputs with power load resistors with resistance value within 10% the nominal output impedance of the respective amplifier. Adjust all gain controls on equipment for optimum signal to noise ratio and signal balance and, unless they are sub panel mounted, cap them to prevent tampering. Unless specified or directed otherwise, adjust gains such that in a given system the "front end" operates at unity gain and maintains 10 dB of clip margin referenced to the first onset of clipping of the associated power amplifier(s). Measure and document system gains at 1 kHz. Settings may require further adjustment by the Contractor, a result of testing by the representative of the Owner.

3. Freedom from parasitic oscillation and radio frequency pickup: Maintain previous setup. Set up for each mode of operation specified in the functional requirements; verify that all systems are free from spurious oscillation and radio frequency pickup using broadband oscilloscope. Correct any such defects.

4. Hum and noise level/signal to noise level/signal to crosstalk level: Maintain previous setup. Terminate microphone and line level inputs with shielded resistors of 150 and 600 ohms, respectively. Set available variable gain controls such that full power amplifier output would be achieved with 40 dBm input level at a microphone input and +12 dBm at a line level input. Measure and document the specified parameters of the system overall for each microphone input channel and line level input channel. Compare with nominal signal level.

5. Total Harmonic Distortion: Maintain previous setup. Measure at reference operating level at 63 Hz, 125 Hz, 1 kHz, 10 kHz.

G. Electro/Acoustic Tests:

1. Uniformity of coverage.

2. Electronic and acoustic frequency response/one third octave equalization. Measure at ear level. Comply with applicable portions of ANSI (SMPTE) PH22.202M-1984, "B chain electro-acoustic response - control rooms and indoor theaters." Adjust to "curve X of B chain characteristic". Representative of the Owner will direct final adjustment.

3. Maximum continuous sound pressure level (in the reverberant field). Drive systems with broadband pink noise. Sustain for at least five minutes with no system damage. Measure for "A" and "C" weightings at ear level on loudspeaker axis. Turn off noise.

4. Acoustic signal to noise ratio referenced to the specified maximum continuous sound pressure level in the reverberant field. Measure for "A" and "C" weightings at ear level on loudspeaker axis with mechanical systems operating. Present comparison with previous measurement.

5. Acoustic gain before feedback. Locate acoustic source (4 inch loudspeaker/pink noise generator) two feet from system microphone. Measure at system microphone position and at most distant listener position at ear level. Present comparison.

H. System Overall:

1. Verify levels.

2. Provide permanent "wedge" type labels on all controls, as applies, to indicate correct settings after systems performance testing and adjustment procedures have been successfully completed.

I. At least 10% of the total number of zones must be tested at two different times and at two different locations within the zone during peak hours and during quiet hours. These tests must indicate that pages are at least 6dB, but no greater than 10dB above, ambient noise levels. Measured ambient noise levels must be time averaged over a period of at least one minute and are not to include announcements from the paging system.

J. Upon completion of the installation of all loudspeakers in an area, perform the following tests and record results. Correct non-conforming conditions, unless the cause is clearly outside the Work of this Section, in which case submit the apparent cause to the Owner.

1. Loudspeaker Line Impedance: At terminal cabinets at equipment rooms, measure the impedance of each loudspeaker line. Sweep from at least 20 Hz to at least 16 kHz.

2. Loudspeaker Polarity: Test the acoustic polarity of all loudspeakers using an Acoustic Polarity Tester.

3. Freedom From Buzzes, Rattles and Objectionable Distortion: Individually apply to each loudspeaker line a slow sine wave sweep from 50 Hz to 5 kHz at a level of 6 dB below rated power amplifier output voltage. Listen carefully for buzzes, rattles and objectionable distortion.

4. Uniformity of Coverage: Apply broadband Pink Noise. Adjust level to approximately 70-80 dBA at measurement locations. Measure in 4 kHz octave band at ear level. Adjust loudspeaker aiming and 70 Volt loudspeaker taps for uniformity of coverage.

K. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.6 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

3.7 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. LAWA is in the process of procuring and implementing a CMMS. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.8 TRAINING

A. By means of training classes augmented by individual instruction as necessary, the Contractor shall fully instruct LAWA's designated staff and Airline personnel in the operation, adjustment and maintenance of all products, equipment and systems.

B. The Contractor shall be required to provide all training aids, e.g., notebooks, manuals.

C. The Contractor shall provide an appropriate training area equipped with all required equipment. The location of the training area shall be coordinated with the Design Consultant.

D. All training shall be completed a minimum of two weeks prior to system cut over. Training schedule shall be subject to the Design Consultant's approval.

E. Training shall be conducted by experienced personnel and supported by training aids. An adequate number and amount of training material shall be provided by the Contractor. The following is considered a minimum.

1. Functional flow-charts, overall block diagrams, and descriptive material for all software;

2. Schematic drawings for each of the hardware components;

3. All procedure manuals, specification manuals, and operating manuals;

4. As-built drawings.

F. Participants shall receive individual copies of technical manuals and pertinent documentation at the time the course is conducted. The courses shall be scheduled such that LAWA personnel can participate in all courses (no overlap).

3.9 TYPES OF TRAINING

A. User Training: System users shall be instructed in all aspects of operations of the system. Four (4) hours of basic user training shall be provided. Additionally, four (4) hours of advanced user training shall be provided.

B. Technician Training: Eight (8) hours of maintenance training shall be provided. Training for maintenance technicians shall be provided on site, and shall include, but not be limited to, installation, operation, renovation, alteration, inspection, maintenance and service on each system and subsystem provided, so as to enable troubleshooting and repair to the component level.

C. System Administrator Training: System Administrator Training shall be provided. System Administrator Training shall include both classroom work and on the job training and shall be provided on-site at LAX or at a location within 50 miles of LAX.

1. Classroom Training: Eight (8) hours of software training shall be provided for each system. The Contractor shall structure the course to describe all systems, software and applications and support programs. This course shall include a functional overview of the complete software system. The course material must be presented in depth with the instructor covering detailed design, structure, and algorithms.

3.10 FINAL INSPECTION AND ACCEPTANCE

A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA management system and successful performance of the cabling system for a two-week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent

inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

END OF SECTION 27 51 13

SECTION 28 13 00 – ACCESS CONTROL AND ALARM MONITORING SYSTEM (ACAMS)

PART 1 - GENERAL

1.1 SUMMARY

A. The access control and alarm monitoring system (ACAMS) specified in this section shall be an extension to the existing ACAMS currently deployed throughout the Los Angeles International Airport (Airport).

B. Contractor shall include in the Bid all labor, materials, tools, plant, transportation, storage costs, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational systems shown and described in the Specifications.

C. The Contractor is responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to operations and provide complete and operational systems.

D. The Contractor shall coordinate interfaces to existing systems that are being extended in the Project in order to minimize disruption to the existing systems operations. Any systems outages shall be approved in advance and scheduled with LAWA.

E. This section specifies the minimum requirements for access control, door alarms, intrusion detection, and monitoring and control provision.

F. The standard access control panel deployed throughout the Airport is the General Electric (GE, now a United Technologies Corporation) *Micro/5*. The Micro/5 panels communicate to the host GE Picture Perfect® server via Internet Protocol (IP) Ethernet communication over the Airport communication network. It is anticipated that the LAWA ACAMS system will be upgraded to the GE Picture Perfect Version 4.0 in 2010

G. When the LAWA wide system is updated to V4.0 linkage between alarms and videos will be implemented by LAWA. If this functionality is selected for a location then the contractor shall coordinate and cooperate with the VSS contractor (Section 28 23 00) to set up the linkage between the two systems.

H. Access control panels and electrified locking hardware power supplies shall be located in telecommunication rooms (TR) as indicated in the drawings.

I. The electronic access card format standard shall be the HID i-Class/PIV format. Access control card readers provided must be fully compatible with this format. Note that in addition to any cabling required to make these readers operational, two (2) spare Category 6A UTP cables from each security junction box (SJB) to the telecommunication rooms shall be provided. The

security contractor shall provide space for and install an RJ-45 terminal block in the SJB, and install and test the cables as specified in 27 05 00.

J. Related documents

1. Section 08 71 00 - Door Hardware

2. Section 27 05 00 - Basic Telecommunications Requirements

3. Section 27 05 05 – Selective Demolition Telecommunication Systems

4. Section 28 23 00 – Video Surveillance System (VSS)

1.2 GLOSSARY

1. ACAMS Access Control and Alarm Monitoring System
2. AFF Above Finish Floor
3. ANSI American National Standard Institute
4. ASCII American Standard Code for Information Interchange
5. AOA Aircraft Operations Area
6. ATP Acceptance Test Plan
7. AWG American Wire Gauge
8. BMS Balanced Magnetic Switch
9. CBP U.S. Customs and Border Protection
10. CPU Central Processing Unit
11. CCTV Closed Circuit Television
12. EMI Electromagnetic Interference
13. FAA Federal Aviation Administration
14. FAR Federal Aviation Regulation
15. IATA International Air Transport Association
16. ICAO International Civil Aviation Organization
17. ICEA Insulated Cable Engineering Association
18. IDS Intrusion Detection System
19. ISA Instrument Society of America
20. LAX IATA Symbol for the Los Angeles International Airport
21. LCC Life Cycle Costs
22. LED Light Emitting Diode
23. MHz Megahertz
24. MRT Mean Restoral Time – The mean interval between failure and restoral to operational status; includes MTTR travel time and response time.
25. MTBF Mean Time Between Failures – The mean interval that is the sum of MTTF and MRT.
26. MTTF Mean Time To Failure – The mean interval between placing a specific piece of equipment or system in service and its operational failure.
27. MTTR Mean Time To Repair – The mean interval during which the repair process is successfully performed.
28. O&M Operation and Maintenance

29.	PoE	Power Over Ethernet
30.	PTZ	Pan, Tilt, Zoom
31.	QC	Quality Control
32.	REX	Request to Exit
33.	RFI	Radio Frequency Interference
34.	SCC	Security Control Center
35.	SCP	Security Control Panel
36.	SJB	Security Junction Box
37.	TBIT	Tom Bradley International Terminal
38.	TSA	Transportation Security Administration
39.	UBC	Uniform Building Code
40.	UPS	Uninterrupted Power Supply
41.	VDT	Video Display Terminal
42.	VSS	Video Surveillance System

1.3 SUBMITTALS

A. Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

B. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.

C. Submit Manufacturers' Data:

1. Security Control Panels.

2. Card Reader devices.

3. REX devices and related interfaces.

4. Door alarm contacts and related interfaces.

5. Alarm horns and related interfaces.

6. Power supplies.

7. Any other equipment installed as part of the system.

D. Product submittals shall be provided and approved prior to the commencement of installation activities of the ACAMS.

E. Submit all proposed labeling materials and nomenclature for approval.

F. Shop Drawings:

1. Provide shop drawings that are applicable and pertain to access control and alarm system provisions.

G. Installation drawings:

1. Floor Plans
2. Riser Diagrams
3. Block diagrams
4. Door Details
5. Point Schedules
6. Connection of all new access control and alarm equipment with new Security Control Panels (SCPs), including block diagrams and wiring diagrams
7. Connection of new SCPs with the existing access control CPU, including block diagrams and wiring diagrams
8. Details of connections to power sources, including primary and secondary power supplies, uninterrupted power supplies, and grounding
9. Details of surge protection device installation
10. Equipment mounting details
11. Details of interconnection to data transmission media and data communication network including all hardwire and fiber optic systems

H. Coordination Drawings:

1. Indicate locations where space is limited for installation and access.
2. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.
3. Telecommunication Rooms: At least 30 days before beginning installation in each room, the Contractor shall furnish a telecommunications room drawing showing the initial layout design and plans for the proposed mounting locations of ACAMS equipment, cable routings, and termination locations for all cable and equipment.

I. Theory of Operations

1. Description, analyses, and calculations used in sizing equipment. Describe and show how equipment will operate as a system.

J. Test and Acceptance Plans

1. Submit the following for review and approval prior to the performance of any testing:

    a. Performance Verification Test Plan

    b. Endurance Test Plan

    c. Quality Assurance Plan

K. Maintenance Manuals: Manuals including maintenance instructions and other descriptive material as received from the manufacturers shall be provided that will enable LAWA personnel to maintain equipment and test equipment. This documentation shall include descriptions, specifications, theory of operation (where applicable), layout drawings (showing component types and positions), and back-panel and assembly wiring diagrams. In addition to hardcopies, electronic copies, in a Design Consultant approved format, shall be provided.

L. Preventative Maintenance: Instructions shall be provided for preventive maintenance procedures that include examinations, tests, adjustments, and periodic cleaning. The manuals shall provide guidelines for isolating the causes of hardware malfunctions and for localizing faults. The manuals shall provide thorough instructions on the use of any specialized test equipment needed for hardware maintenance. In addition to hardcopies, electronic copies, in a Design Consultant approved format, shall be provided.

M. Maintenance Schedule: A recommended schedule for preventative, routine, and emergency maintenance indicating frequency and response time. Preventative maintenance services during peak activity periods shall be avoided. The Contractor shall coordinate with LAWA to define peak activity periods. The Contractor shall submit a finalized preventative maintenance schedule for Design Consultant approval.

N. Project Record Documents required include:

1. Marked-up copies of Contract Drawings

2. Marked-up copies of Shop Drawings

3. Newly prepared Drawings

4. Marked-up copies of Specifications, Addenda and Change Orders

5. Marked-up Project Data submittals

6. Record Samples

7. Field records for variable and concealed conditions

8. Record information on Work that is recorded only schematically

9. As-built drawings

10. Record drawings

11. Electronic as-built and LAWA LUSAD requirements

O. As-built drawings:

1. In addition to the Project Record Drawing requirements set forth in Division 01 – General Requirements, As-built drawings shall fully document and be fully developed and provided, and shall include, but not be limited to:

a. Floor Plans.

b. Riser Diagrams.

c. Block diagrams.

d. Point-to point wiring diagrams.

e. Door Details.

f. Point Schedules.

g. Detail of connections to cameras, monitors, and workstations.

h. Details of connections to power sources, including primary and secondary power supplies, uninterrupted power supplies, and grounding.

i. Details of surge protection device installation.

j. Equipment mounting details.

k. Rack/Cabinet layout elevations and details, including heat and load calculations.

l. Details of interconnection to data transmission media and data communication network including all hardwire and fiber optic systems.

P. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. Design Consultant will periodically review Project Record Documents to assure compliance with this requirement.

Q. At every quarter, submit Project Record Documents to Design Consultant for LAWA's records.

1. Upon completion of the as built drawings, the Design Consultant will review the as built work with the Contractor.

2. If the as built work is not complete, the Contractor will be so advised and shall complete the work as required.

R. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

1.4 CODES, STANDARDS, REGULATIONS AND REFERENCES

A. Comply with all applicable codes standards, regulations, and the most current issue of the following publications, including all amendments thereto of the issue that is current on the date of contract award. Applicable requirements of the following publications shall apply to the work under this specification as if fully written herein. Where conflicts exist between the Technical Specification and the referenced publications, local codes shall govern.

1. American Standards Association (ASA)
2. Institute of Electrical and Electronic Engineers (IEEE)
3. National Fire Protection Association (NFPA)
4. National Electrical Manufacturers Association (NEMA)
5. Underwriters Laboratories, Inc. (UL)
6. Federal, State and Municipal Building Codes and all other Authorities having jurisdiction
7. National Electrical Code (NEC)
8. Insulated Power Cable Engineers Association Specification (IPCEA)
9. American Society for Testing Materials Specification (ASTM)
10. Occupational Safety and Health Administration (OSHA)
11. National Electrical Safety Code (NESC)

B. Special attention shall be made to the following specific codes, standards, and publications where applicable:

1. ANSI B20.1 Conveyor Safety
2. ASTM F.1468-93 Standard Practice For Evaluation
3. Customs and Border Protection Airport Technical Design Standards for Passenger Processing Facilities, August 2006
4. EIA 232-D Interface between Data Terminal Equipment and Data Circuit-Termination Equipment Serial Binary Data
5. EIA RS-310-C Racks, Panel, and Associated Equipment

6. 49 CFR 1520 Protection of Sensitive Security Information

7. 49 CFR 1540 Civil Aviation Security General Requirements

8. 49 CFR 1542 Airport Security

9. 49 CFR 1544 Aircraft Operator Security

10. 49 CFR 1546 Foreign Air Carrier Security

11. 49 CFR 1548 Indirect Air Carrier Security. NFPA 72-D - Installations, Maintenance and Use of Proprietary Protective Signaling Systems

12. NFPA 75 Protection of Electronic Computer Data Processing Equipment

13. NFPA 77 Static Electricity

14. NFPA 78 Lightning Protection Code

15. Transportation Security Administration Recommended Security Guidelines for Airport Planning, Design and Construction, June 15, 2006

16. UL 294 Access Control System Units

17. UL 611 Central Station Burglar Alarm Units and Systems

18. UL 634 Intrusion Detection Units

19. UL 681 Installation and Classification of Mercantile and Bank Burglar Alarm Units

20. UL 796 Electrical Printed-Wiring Boards

21. UL 1076 Proprietary Burglar Alarm Units and Systems

22. UL 1950 Information Technology Equipment, including Electrical Business Equipment References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

C. In addition the contractor shall comply with all applicable Security Directives as issued by the TSA.

1.5 QUALITY ASSURANCE

A. Contractor Certification: The Contractor or approved subcontractor shall be a GE/UTC certified security systems installer for the specific type of ACAMS equipment being installed. The Contractor shall offer proof of certification by submitting a copy of certification with the Bid.

B. The Contractor's Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with the LAWA's and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the Design Consultant.

C. The Design Consultant shall be notified by the Contractor of any inspection(s) and the Design Consultant may elect to participate in any inspection(s). Relevant QC information shall be input into the LAWA CMMS (refer to paragraph 3.8).

1.6 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids specification requirements.

B. Under no circumstances shall the LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to Engineer all evidence to support the contention that the item proposed for substitution is equal to the specified item. The Owner's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor.

1.7 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

2. Equipment shall meet all applicable FCC Regulations.

3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.

4. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.

5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.

1. All components of an assembled unit need not be products of the same manufacturer.

2. Constituent parts, which are alike, shall be from a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for intended service.

C. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model.

E. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

F. Maximum standardization of components shall be provided to reduce spare part requirements.

1.8 WARRANTY AND MAINTENANCE

A. Warranty and Maintenance Requirements shall be in accordance with the Division 01 - General Requirements.

B. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of two (2) years from Final Acceptance.

1. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.

2. The Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

C. Submit a copy of all manufacturer warranty information.

D. Spare Parts:

1. The Contractor shall provide to LAWA an inventory of security equipment spare parts, materials, consumables, and any other system item in order to meet the specified

warranty maintenance requirements and keep the security equipment in a continuous operational mode during the warranty period. The quantity of spare parts shall equal no less that 10% of the items provided and installed under this contract.

1.9 ON-SITE PERSONNEL REQUIREMENTS

A. The Contractor shall employ the maintenance contractor with whom LAWA has a maintenance contract to perform the disconnection, connection, re-connection or configuration of ACAMS or other existing systems that might be affected by this Work.

B. Note that all programming and configuration of the GE Picture Perfect Software shall be done only by the LAWA designated maintenance contractor, or by LAWA at its discretion. This scope of work shall include ACAMS programming and configuration required for the components and systems installed under this specification. The Contractor shall secure the services of this specific LAWA designated maintenance contractor for this work at no cost to the Owner.

C. The Contractor shall provide all new UTP cable, optical fiber cable, innerduct, racks, cabinets, patch panels, cover plates, outlet boxes, related hardware, distribution, termination equipment, and any other appurtenances and equipment associated specifically with ACAMS. Coordinate with Section 27 05 00 contractor.

D. The Contractor shall obtain the approval of Engineer or Design Consultant for the final layout of ACAMS equipment to be installed in telecommunications rooms prior to the installation of any materials or equipment. Shop drawings showing proposed room layouts shall be submitted for approval before beginning installation

E. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of the LAWA.

F. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

G. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

H. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

I. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the

Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment to and throughout the site.

J. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of the Engineer so the area can be appropriately noted.

K. Following each day's work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

L. Deliver products to site under provisions of Division 01 - General Requirements.

M. Store and protect products under provisions of Division 01 - General Requirements.

N. Coordinate with the Owner, locations and requirements for equipment and product storage.

1.10 SITE CONDITIONS

A. Environmental Requirements:

1. Comply with all manufacturers' instructions and recommendations concerning environmental factors.

B. Protection:

1. Fragile Items:

a. Handle any fragile items with care using protective coverings to avoid damage to sensitive instrument relays, and other devices, and to avoid contamination by dirt and debris.

2. Weather and Construction Protection:

a. During installation, provide adequate temporary dust and weather protection for all equipment. Reinstall covers each time any adjustments are made on the equipment.

C. Existing Conditions:

1. Contractor shall inspect the site and identify all existing security provisions and conditions. This includes identifying any communications and/or ancillary equipment currently existing and/or in use. It shall be the Contractor's responsibility to identify all existing provisions to be terminated to new, existing, or relocated systems.

2. All provisions shall be identified by the Contractor and documented in the quality control inventory. Individual provision data such as provision type make and model, and serial number shall be obtained by the Contractor at the time of demolition and documented in the quality control inventory.

PART 2 - PRODUCTS

2.1 GENERAL

A. Unless otherwise specified, products for the ACAMS shall be consistent with and compatible with the established standards for LAX ACAMS.

B. Latest technology available: Products shall be provided as specified. In the event the manufacturer(s) of specified products and materials have upgraded or replaced the specified products and materials with newer or improved technologies at the time of purchase, the newer or improved products or materials shall be provided unless they are incompatible with the rest of the ACAMS systems or so directed by LAWA (submit Request For Information is in doubt). Latest technology products and materials shall be operationally and functionally equivalent or superior to the specified products and materials. Products and materials shall be purchased by the Contractor in a timely manner to meet construction schedules, but shall not be purchased so far advanced of the date(s) of installation that they become technologically obsolete or replaced with newer technologies.

2.2 ACAMS EQUIPMENT

A. Access Control Panel (and associated components as required):

1. GE M3000, with internal 12 VDC, 6 amp power supply (no substitutions)

2. Include GE PXN plus CPU board

3. Must be fully compatible with the LAWA Picture Perfect Server Software at time of installation

4. Provide and install one (1) 12 Volt, 12 Amp Hour sealed gel type battery for each GE M3000

B. Card Reader Interface Module

1. GE 8RP model 110100501 (no substitutions)

C. Output interface module

1. Provide and install a minimum of one (1) per M3000, and as required to support outputs as indicated in the specifications and drawings

2. GE DOR model 110078001, no substitutions

D. Input interface module

1. Provide and install a minimum of one (1) per M3000, and as required to support inputs as indicated in the specifications and drawings

2. GE DI model 110072003 (no substitutions)

E. Wiegand Interface Unit

1. Provided and install as required to support card readers as indicated in the specifications and drawings

2. Install in SJBs located above (or near as approved by LAWA) ACAMS doors

3. GE model WIU-4 (no substitutions)

F. Power Supplies

1. Wall Mount

a. 24VDC Power

1) A minimum of one (1) 24VDC, 10 Amp Power Supply shall be provided for each GE M3000 Access control Panel, with no more than eight (8) doors (including one (1) electric lock and one (1) alarm horn per door) powered from a single wall mount 24VDC Power Supply

2) Each door shall be powered from a dedicated current protected output.

3) Provide and install two (2) 12 Volt, 12 Amp Hour sealed gel type batteries for each 24VDC Power Supply.

4) Altronix AL1024ULACM, or approved equal.

2. 12VDC Power

a. Provide as required for 12 volt devices not powered by other sources

b. Provide and install two (2) 12 Volt, 12 Amp Hour sealed gel type batteries for each 12VDC Device Power Supply

c. Altronix, AL1012ULACM, or approved equal

G. Card Reader Compatibility

1. Card Readers and Card Readers with Keypads shall be compatible with Federal Information Processing Standards Publication 201 (FIPS 201)

2. Card Readers and Card Readers with Keypads shall be compatible with LAX HID issued identification and access control cards, and shall be compatible HID 13.56 MHz Contactless Smart Card technologies.

H. Card Reader

1. HID model R40 (no substitutions)

2. The firmware shall support both HID I class and PIV card formats

I. Card Reader with Keypad

1. HID model RK40 (no substitutions)

2. The firmware shall support both HID I class and PIV card formats

J. Door Position Switches (Alarm Contacts)

1. Door Position Switches shall be compatible with the door style and door materials

2. Door Position Switches shall be magnetic activated and shall be flush mounted wherever possible

3. Flush Mount

a. GE 1078/1076 Series, or approved equal

4. Surface Mount

a. Surface mounted Door Position Switches shall be high security triple-biased devices.

b. GE 2700 Series, or approved equal

K. Alarm Horns

1. Alarm Horns shall be installed as indicated in the drawings

2. Alarm Horns shall be installed at a height and in a manner consistent with existing alarms horns installed in the TBIT

a. Alarm Horns shall be connected to the output interface module provided in the door's associated GE M3000 access control panel

3. Interior Alarm Horns

a. System Sensor MHW, or approved equal

4. Exterior Alarm Horns

a. Cooper Notification model MID-DC, or approved equal

L. Audio/Visual Alarm Signals

1. Audio/Visual Alarm Signals shall be installed as indicated in the drawings. Audio/Visual Alarm Signals shall be installed at a height and in a manner consistent with existing alarms horns installed in the TBIT

2. Prior to the installation of the Audio/Visual Alarm Signals the Security Systems Contractor shall coordinate with the Owner and the CBP with respect to the selection of the color of the strobe lens and the tone and level of the audible alarm signal

3. The Security Systems Contractor shall demonstrate to the Owner and the CBP a functional Audio/Visual Alarm Signal device, including all available colored strobe lens options

a. Safety Technology, Inc. (STI) model SA5000 with back-box kit SUB-SA504, or approved equal

M. Duress alarm buttons

1. Mushroom Style

a. Mushroom Style Duress Alarm Buttons shall be installed as indicated in the drawings

b. Unless indicated otherwise, Mushroom Style Duress Alarm Buttons shall be wall mounted 42” AFF

c. Mushroom Style Duress Alarm Buttons shall be latching when activated and require key reset

d. Mounting plate shall be stainless steel

1) Alarm Controls model KR-1-1, or approved equal

N. SJB cabinet

1. Each secure door shall have at least one SJB located on the secure side above each door through which all wiring for that door shall be routed. It shall be used for the mounting of the WIUs and also the Category 6A UTP terminations, and any other equipment as appropriate. If the door is a double door or there are multiple doors in one location, this box may be shared. Any such sharing requires prior approval by the Engineer before installation. The boxes shall conform to:

a. 16.00” x 16.00” x 6.62”, NEMA Type 1, hinged door. Provide with back panel and keyed cylinder lock

b. Hoffman A16N16ALP, or approved equal

O. Wire and Cable

1. Low voltage wire and cable shall be provided and installed as required

2. Wire and cable shall be selected, sized and used as appropriate for the device application in accordance with the device manufacturer's specifications, voltage and load, and distance of the wire/cable run

3. Wire and cable runs shall be "home run"

4. Mid run splices are not permitted

5. Wire and cable shall be Belden, West Penn, Contractors Wire and Cable, or approved equal

2.3 MATERIALS

A. Color and Finish Selection:

1. In all public areas and in all other areas visible from public areas or from the exterior of the building, colors and finishes shall match the custom color and finish samples on file with the Owner. In all other areas, applicable colors and finishes shall be selected by the Owner from the manufacturer's standard color and finish schedule. For such areas, submit manufacturer's standard color and finish schedule(s).

2.4 EQUIPMENT

A. All equipment shall be installed in accordance with this specification. Provide and install any and all equipment necessary to provide a complete and operating system, and meet the full intent of this design and other specifications within these construction documents. Any equipment such as consumables, terminators, or any other materials or equipment needed to install this system shall be considered ancillary and be provided as a part of this project. Contractor shall provide cable for all security systems and integration of sub-systems. Cable shall be provided in accordance with manufacturer specifications for the equipment it is terminating to.

2.5 UPS

A. All equipment will be powered by a UPS with a capability to support operations for at least four hours after supply power loss. All power will be obtained from emergency power sources.

2.6 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide and install and make fully operational all components required for a fully functional system.

B. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

C. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

D. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable tray, conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with Design Consultant the exact location and mounting height of all equipment in finished areas.

E. The Contractor shall use existing conduit and surface raceway where possible and practicable. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, Engineer shall be notified before starting that part of the work. In areas with no ceilings, install only after Design Consultant reviews and comments on arrangement and appearance.

F. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. There will be no priority schedule for trades. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and/or furnish other equipment as required for ample maintenance space. Any changes in the size or location of the material or equipment

supplied or proposed that may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of Engineer and approval received before such alterations are made.

G. Provide easy, safe, and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation. All TR cabinets and racks shall be mounted a minimum of 36-inches from the wall or other cabinets, equipment or power panels (or per NEC for voltages exceeding 120VAC).

H. Where required, the Contractor shall be responsible for cutting, patching, coring and associated work for the system at no additional cost to the Owner. Cut and drill from both sides of walls to eliminate splaying. Patch adjacent existing work disturbed by installation of new work. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

I. All conduit and sleeve openings used by the Contractor shall be waterproofed or fireproofed in compliance with State and Local Building and Fire Codes. Strict adherence to National, State, and Local Fire Codes, particularly fire stopping will be required.

J. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations devices to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

K. All building conduits and sleeves installed and/or used under these Specifications shall be fire stopped, or re-fire stopped, upon cable placement through such passageways.

L. Fire stopping for Openings through Fire and Smoke Rated Wall and Floor Assemblies:

1. Provide materials and products listed. The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814. To be used inside all conduits and sleeves. Caulk on exterior of conduit penetration.

2. Provide fire stop system seals at all locations where conduit, fiber, cable trays, cables/wires, and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire stop seal between sleeve and wall for drywall construction.

3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire stop system. The installation shall provide an air and watertight seal.

4. The methods used shall incorporate qualities that permit the easy removal or addition of conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating. Typical rating:

a. Floors – three (3) hours

b. Corridor walls – two (2) hours

c. Offices – three-quarters (0.75) hour

d. Smoke partitions – three-quarters (0.75) – one (1) hour

5. Provide fire stop pillows for existing cable tray penetrations through firewalls.

M. Manufacturer's recommended installation standards must be closely followed (i.e. minimum depth of material, use of ceramic fiber and installation procedures).

3.2 EXAMINATION

A. Inspect the jobsite and survey the conditions to be encountered during performance of the work. This shall be accomplished prior to starting the work. Failure of Contractor to become familiar with the site conditions shall not relieve Contractor of responsibility for full completion of the work in accordance with the contract provisions.

B. Verify that all conduit, wires, cables, security equipment are installed and ready for connection and integration with the rest of the system.

C. Examine area to be protected and verify that environmental characteristics will not affect effective communication and interfacing. Report observed problems in writing.

D. Determine that power supplies, conduit, wires, cables, connections, and equipment are ready for installation and interfacing before attempting installation.

E. Check all power and communications cabling for continuity before making connections.

F. Visually inspect each piece of equipment, determine defects, and correct.

G. Make arrangements through Owner and inspect locations where installation work will be performed. Verify that conditions found are in accordance with drawings and are acceptable for Contractor's installation work. Report any discrepancies in writing to Owner, stating suggested means of correction. As may be required, inspect existing inside and outside cable plant to determine system runs and interface conditions. Coordinate with Owner to establish interfaces.

3.3 INSTALLATION

A. Compliance:

1. Install the equipment in accordance with the contract documents, all applicable codes and standards and the Manufacturer's written instructions. The installed system shall meet all applicable equipment and performance requirements.

B. Standardization:

1. Standardize the installation practices and material to provide uniform materials and procedures to the maximum extent possible.

C. Locations:

1. Locate pull boxes, wire-ways or other items requiring inspection, removal, or replacement conveniently and accessibly with reference to the finished facilities.

D. Electrical Service:

1. Installation of electrical service to equipment shall conform to specific UBC Codes and Standards, NFPA 70, and other applicable requirements.

E. Electrical Equipment Inspection:

1. Provide electrical equipment inspection in accordance with NEMA PB 2.1 Part VII.

F. Installation Requirements:

1. Install all system components, including furnished equipment, and appurtenances in accordance with the manufacturer's instructions, and as shown, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified and shown. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

2. Install the security system equipment in accordance with the standards for safety, NFPA 70, UL 681, UL 1037 and UL 1076, and the appropriate installation manual for each equipment type.

3. All wiring, including low voltage wiring outside the control console, cabinets, boxes, and similar enclosures, shall be installed in rigid galvanized steel conduit conforming to UL 6 (when outdoors), or electric metallic tubing (EMT) when indoors. Minimum conduit size shall be 3/4-inch. All other electrical work shall be as specified with electrical specifications and drawings that are part of the contract document and as shown. Grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

4. Detailed shop drawings shall be provided as part of the submittal process. The shop drawings shall include, but not be limited to exposed conduit and devices, including hangars, brackets, back boxes and related equipment.

5. All equipment connected to alternating current circuits shall be protected from power line surges. Equipment protection shall meet the requirements of ANSI C62.41. Fuses shall not be used for surge protection.

6. All inputs shall be protected against surges induced on device wiring. Outputs shall be protected against surges induced on control and device wiring installed outdoors and as shown. All communications equipment shall be protected against surges induced on any communications circuit.

7. All cables and conductors, except fiber-optics, which serve as communications circuits from the existing access control CPU to field equipment, and between field equipment, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two wave-forms:

    a. A 10 microsecond rise time by 1000 microsecond pulse width wave-form with a peak voltage of 1500 volts and a peak current of 60 amperes.

    b. An 8 microsecond rise time by 20 microsecond pulse width wave-form with a peak voltage of 1000 volts and a peak current of 500 amperes.

8. Calibrate all equipment.

9. Inspect each component, determine obvious defects, and correct.

10. All electrical work shall be in accordance Division 26.

11. Perform tests as recommended by manufacturer or as required to ensure the ACAMS equipment is operating properly and meets specified requirements.

12. Correct all deficiencies detected and retest affected components.

13. Record test data, tabulate, and write narrative describing tests, results, deficiencies found, corrective measures, and results of retesting. Certify that the security equipment has been tested and is ready for performance verification testing.

14. Service Loops

    a. Service loops shall be provided for all ACAMS cabling within the Telecommunication Rooms. Service loops shall be of sufficient length to facilitate relocating wall mounted ACAMS control panels and power supplies to the Security racks without splices. Service loops shall be coiled and contained in appropriately sized pull boxes.

3.4 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

D. Marking:

1. Equipment Name Plates: The following requirements shall apply:

   a. General: Attach a permanent, corrosion-resistant name plate to each equipment component showing the manufacturer's name, address, serial number and equipment rating. Each name plate shall be clearly visible on the exterior of equipment. Components located within equipment enclosures shall also be provided with name plates.

   b. Location and Fastening: Provide nameplates to identify all equipment components. Provide each panel assembly with a name plate on the interior of equipment enclosures, indicating number of equipment and unit of assembly. Fasten name plates securely with slotted stainless steel screws. The use of adhesive for fastening name plates will not be permitted.

2. Control and Display Labels:

   a. Use: Each control, display and any other item of equipment that must be located, identified, read or manipulated shall be appropriately and clearly labeled to permit rapid and accurate identification of its operating state of position.
   b. Orientation: Orient labels and information thereon horizontally so that they may be read quickly and easily. Vertical orientation shall be used only where space is limited.

3. Locations: Locate labels so that there is no confusion as to which item they identify. Labels shall not obscure any other information required by the operator. Controls shall not obscure labels. The location of labels shall be consistent.

E. Use Permanent Room Numbers as indicated on the Room Finish Schedules for construction period identification of rooms and building spaces. All required shop drawings and submittals, including manuals and Project Record Drawings shall identify rooms and spaces using the Permanent Room Numbers. Permanent identification devices including signage, equipment nameplates, and panels shall use the Permanent Room Numbers.

3.5 INSPECTIONS

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

3.6 SYSTEM STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.

2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.

4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.

5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

6. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.7 SYSTEM TESTING AND COMMISSIONING

A. General: System performance and acceptance tests shall be conducted in the normal operational environment to the maximum extent possible. The tests shall represent operation in the normal mode in which each system will operate. If interfaces are incomplete, provide simulation of those interfaces so that the system may be tested as a complete and stand-alone entity. Perform all equipment repair and/or adjustment that may be required during acceptance testing.

B. In addition to any acceptance testing requirements specified elsewhere, the ACAMS shall be fully tested and accepted, with test results recorded individual test reports for review and

acceptance. All ACAMS devices and equipment shall be tested. Test and acceptance reports shall include, but not be limited to:

1. Card reader controlled doors
    a. Valid card read
    b. Invalid card read
    c. Valid request-to-exit
    d. Door forced open
    e. Door held open
    f. Door shunt
    g. Local alarm
2. Alarm and monitor points
3. ACAMS input and output interfaces
4. ACAMS integration with VSS and cameras

C. Phases of Testing
    1. On-Site Performance Verification Testing
    2. On-Site Endurance Testing

D. Test Plan/Procedure: The Contractor shall submit a Test Plan for each testing phase for the review and approval of the Design Consultant. The test plan for each phase shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein. The test plan shall be provided at least forty-five (45) days prior to the scheduled start of each test. Test plans shall contain at a minimum:
    1. Functional procedures including use of any test equipment
    2. Test equipment is to be identified by manufacturer and model
    3. Interconnection of test equipment and steps of operation shall be defined
    4. Expected results required to comply with specifications
    5. Record of test results with witness initials or signature and date performed
    6. Pass or fail evaluation with comments.

7. The test procedures shall provide conformity to all specification requirements. Satisfactory completion of the test procedure is necessary as a condition of system acceptance.

8. Documentation verification, both interconnects and functionality, shall be part of the test. Where documentation is not in accordance with the installed system interconnect and operating procedures, the system shall not be considered accepted until the system and documentation correlate.

9. The Contractor shall cooperate with and provide LAWA representative(s) the opportunity(s) to participate in any or all of the tests.

10. Test Reports: The Contractor shall submit for each test, a test report document that shall certify successful completion of that test. Submit for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:

    a. Commentary on test results.

    b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.

    c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.

    d. Signatures of persons who performed and witnessed the test.

    e. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to the Owner. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by the Design Consultant, before any subsequent testing phase is performed.

E. Performance Verification Testing

1. Complete operational testing of all components and systems shall be witnessed by designated LAWA Representatives.

2. Schedule test with Design Consultant. Do not begin testing until:

    a. All systems have been installed and individually and jointly tested to ensure they are operating properly.

    b. Written permission from Design Consultant has been received.

3. Testing: As part of performance verification, test all components of system. The tests shall demonstrate system features.

4. Verification: Verify correct operation of the required system functionality as defined in these specifications.

5. Adjustment, Correction, and Completion:

   a. Correct deficiencies and retest affected components.

   b. Make necessary adjustments and modification to system after obtaining approval of the Design Consultant.

   c. Completion: Performance verification test shall be complete when testing or retesting of each component has produced a positive result and has been approved in writing by the Design Consultant.

6. Recording:

   a. Describe actual operational tests performed and equipment used and list personnel performing tests.

   b. Record in tabular form all test results, deficiencies, and corrective measures.

7. Termination

   a. Performance verification test shall be terminated by the Design Consultant when:

      1) Individual components, subsystems, or the integrated system fail to perform as specified.

      2) It is determined that system is missing components or installation is not complete.

   b. Upon termination, corrective work shall be performed and performance verification test rescheduled with the Design Consultant.

   c. Retesting shall be performed by Contractor at no additional expense.

   d. Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of the Design Consultant.

F. Endurance Testing

1. Provide personnel to monitor the systems 24 hours per day, including weekends and holidays during endurance testing.

2. Start test after:

   a. Successful completion of performance verification testing.

   b. Correction of deficiencies has been completed.

c. Receipt of written start notification from the Design Consultant.

3. Monitor all systems during endurance testing. Coordinate monitoring with the Design Consultant.

4. Recording: Record data on approved forms so as to provide a continuous log of systems performance. Include:

   a. Date and time for all entries.

   b. Name of individual making entry.

   c. Environmental conditions.

   d. Authority activities in process.

   e. Description of all alarm annunciations, responses, corrective actions, and causes of alarms. Classify as to type of alarm.

   f. Description of all equipment failures, including software errors.

   g. Description of all maintenance and adjustment operations performed on system.

   h. Daily and weekly tabulations.

   i. Daily entries of performance data shall be reviewed by the Design Consultant's representative designated to observe monitoring of system.

5. The Design Consultant may terminate testing at any time when the system fails to perform as specified. Upon termination of testing the Contractor shall commence an assessment period as described in Phase II.

6. Testing

   a. Phase I - Initial Testing:

      1) Time: 24 hours per day for 15 consecutive calendar days.

      2) Make no repairs during this phase unless authorized in writing by the Design Consultant.

      3) If system experiences no failures, proceed to Phase III - Final Testing.

   b. Phase II - Initial Assessment:

      1) After conclusion of Phase I or terminating of testing, identify all failures, determine causes, and repair. Submit report explaining: Nature of each failure, corrective action taken, results of tests performed to verify

corrective action as being successful, and recommended point for resumption of testing.

2) After submission of report, schedule review meeting at job site. Schedule date and time with the Design Consultant.

3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

4) Based on report and review meeting, the Design Consultant will direct Contractor to repeat Phase I, restart Phase I, or proceed to Phase III - Final Testing.

c. Phase III - Final Testing:

1) Time: 24 hours per day for 15 consecutive calendar days.

2) Make no repairs during this phase unless authorized in writing by Engineer. .

7. Phase IV - Final Assessment:

1) After conclusion of Phase III or termination of testing, identify all failures, determine causes, and repair. Submit explaining the nature of each failure, corrective action taken, results of tests performed, and recommended point for resumption of testing.

2) After submission of report schedule review meeting at job site. Schedule date and time with the Design Consultant.

3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

4) Based on report and review meeting, the Design Consultant will approve endurance test or direct Contractor to repeat all or part of Phases III and IV.

8. Adjustment, Correction, and Maintenance

a. During endurance testing make adjustments and corrections to system only after obtaining written approval of the Design Consultant.

b. During endurance testing, perform required maintenance on systems including provision of replacement parts.

G. Final Inspection and Acceptance

1. After endurance testing is complete, review tabulated records with the Design Consultant.

2. The Contractor will not be responsible for failures caused by:

    a. Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished and automatic shutdowns and restarts of systems performed as specified.

    b. Failure of any LAWA furnished power, communications, and control circuits provided failure was not due to Contractor furnished equipment, installation, or software.

    c. Failure of existing LAWA equipment provided failure was not due to Contractor furnished equipment, installation, or software.

3. When performance of integrated system does not fall within the above rates, determine cause of deficiencies, correct, and retest.

4. When requested by the Design Consultant, extend monitoring period for a time as designated by the Design Consultant.

5. Period shall not exceed 60 days exclusive of retesting periods caused by termination of Phases I or III and assessment period of Phases II and IV.

6. Submit final report of endurance testing containing all recorded data.

H. System Commissioning:

1. General: Contractor shall be responsible for ensuring that the installation and related interfaces is completed and operational at least thirty (30) days prior to scheduled beneficial occupancy. In the event the installation and related interfaces is not completed and operational by the scheduled beneficial occupancy date, Contractor shall establish and submit a security plan to Owner that complies with 49 CFR 1542 Airport Security and 49 CFR 1544. Aircraft Operator Security as appropriates, and related Owner security requirements. The security plan shall be submitted to Owner and TSA for approval. The security plan, revisions, and security measures to be deployed until such time the new security equipment is completed and operational shall be at Contractor's expense.

2. After all installation and acceptance test requirements specified have been complied with, the equipment shall be commissioned.

3. Prerequisites To System Commissioning

    a. Outstanding work items that may exist, such as facility interfaces, project record drawings, and/or in-process change orders, shall be documented and submitted to Owner for review prior to start of equipment commissioning. Documentation of outstanding work items shall take the form of punch lists of critical action items lists that describe the work, the expected completion schedule, and the impact upon operation. Depending upon the nature of the outstanding work item, Owner may

grant a waiver to accomplish partial commissioning of any of the equipment. Completion of waived outstanding work items shall then be assigned to the post-commissioning operations and maintenance.

b. Preliminary testing of ACAMS new control panels and alarm monitor devices, shall be conducted and witnessed by the Owner on a separate Picture Perfect server/workstation platform prior to activation and commissioning of the ACAMS devices on the existing LAWA production Picture Perfect server. A Picture Perfect server shall be provided by LAWA for use as a test platform: it shall remain the property of LAWA. The Contractor shall provide a compatible workstation. LAWA shall provide for network connectivity for the workstation. LAWA shall provide the Contractor with anti-virus protection software, and the Contractor shall be required to install and maintain operational the anti-virus software on the Contractor provided workstation.

4. Commissioning Procedure

ACAMS commissioning shall be conducted in accordance with LAWA ACAMS Commissioning Procedures and Flow Chart. Refer to Appendices A and B for the mandatory commissioning procedures for LAWA ACAMS

a. Each commissioning procedure shall be witnessed by Owner. The commissioning procedure shall be conducted by Contractor and shall consist of a detailed inspection, and physical accounting of each equipment item as required.

b. An operational demonstration shall be conducted in which the equipment shall function in the normal operational mode, and shall operate completely error-free in terms of hardware and software performance. Occurrence of any equipment failure shall terminate the demonstration. The demonstration shall restart and run for a period of time designated by Owner after the failure has been corrected.

3.8 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. LAWA is implementing a CMMS. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.9 FINAL INSPECTION AND ACCEPTANCE

A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA cable management system and successful performance of the cabling system for a two-week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent

inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

END OF SECTION 28 13 00

SECTION 28 23 00 – VIDEO SURVELLANCE SYSTEM (VSS)

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies the minimum requirements for video surveillance camera equipment. The video surveillance systems and equipment specified in this section shall be an extension to the video surveillance system (VSS) currently deployed throughout the Los Angeles International Airport (Airport).

B. Contractor shall include in the bid all labor, materials, tools, plant, transportation, storage costs, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational systems shown in the drawings and described in the Specifications.

C. The Contractor is responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to operations and provide complete and operational systems.

D. The Contractor shall coordinate interfaces to existing systems that are being extended in the Project in order to minimize disruption to the existing systems operations. Any systems outages shall be approved in advance and scheduled with LAWA.

E. The standard CCTV cameras to be installed throughout the airport are by Axis® Communications Inc. with a few exceptions. These cameras communicate with the central video management system via Internet protocol (IP) Ethernet communication over the Airport multiprotocol label switching (MPLS) data network. The provision of this central system, network, and storage is not in the scope of this Section.

F. The installation of video surveillance cameras and related equipment shall include the use of both fixed and Pan/Tilt/Zoom (PTZ) color cameras.

G. All cameras shall be IP camera technology and connect to LAWA provided communication IP switches as indicated in the specifications and drawings. The Contractor shall be required to coordinate with LAWA. This includes, but is not limited to, MPLS assignments.

H. Where possible, CCTV cameras shall be capable of being powered by power over Ethernet (PoE) technology. PoE power for cameras shall originate from the network switches.

I. All cameras shall use unshielded twisted pair (UTP) cable for signal transport. Camera video signals and power shall be via the same cable where possible. Cameras that require greater power than can be provided by the standard 802.3af PoE provided by the LAWA network switches, shall be powered by centralized rack mounted high power PoE power injectors or centralized rack mounted CCTV power supplies where possible. In the event that a specific

camera cannot be powered by PoE then a separate design proposal shall be submitted to the Engineer for approval prior to installation.

J. If a CCTV camera is at a location which cannot conveniently be supported by an IP connection over Category 6A UTP cable, then fiber is an acceptable alternative communication mechanism. However, each such installation requires proper approval of approach and products by the Engineer, before installation.

K. When the LAWA wide system access control and monitoring system (ACAMS) is updated to the new software release (V4.4), linkage between alarms and video will be implemented by LAWA. If this functionality is selected for a location on the drawings then the contractor shall cooperate with the ACAMS contractor (Section 28 13 00), and the LAWA video maintenance contractor, to set up the linkage between the two systems.

L. Related documents

1. Section 27 05 00 – Basic Telecommunication Requirements

2. Section 28 13 00 – Access Control and Monitoring System (ACAMS)

1.2 GLOSSARY

1. ACAMS Access Control and Alarm Monitoring System
2. AFF Above Floor Finish
3. ANSI American National Standard Institute
4. ASCII American Standard Code for Information Interchange
5. AOA Aircraft Operations Area
6. ATP Acceptance Test Plan
7. AWG American Wire Gauge
8. BMS Balanced Magnetic Switch
9. CBP U.S. Customs and Border Protection
10. CPU Central Processing Unit
11. CCTV Closed Circuit Television
12. EMI Electromagnetic Interference
13. FAA Federal Aviation Administration
14. FAR Federal Aviation Regulation
15. IATA International Air Transport Association
16. ICAO International Civil Aviation Organization
17. ICEA Insulated Cable Engineering Association
18. IDS Intrusion Detection System
19. ISA Instrument Society of America
20. LAX IATA Symbol for the Los Angeles International Airport
21. LCC Life Cycle Costs
22. LED Light Emitting Diode
23. MHz Megahertz
24. MRT Mean Restoral Time – The mean interval between failure and restoral to operational status; includes MTTR travel time and response time

25. MTBF Mean Time Between Failures – The mean interval that is the sum of MTTF and MRT
26. MTTF Mean Time To Failure – The mean interval between placing a specific piece of equipment or system in service and its operational failure
27. MTTR Mean Time To Repair – The mean interval during which the repair process is successfully performed
28. O&M Operations and Maintenance
29. PoE Power Over Ethernet
30. PTZ Pan, Tilt, Zoom
31. QC Quality Control
32. REX Request to Exit
33. RFI Radio Frequency Interference
34. SCC Security Control Center
35. SCP Security Control Panel
36. SJB Security Junction Box
37. TBIT Tom Bradley International Terminal
38. TSA Transportation Security Administration
39. UBC Uniform Building Code
40. UPS Uninterrupted Power Supply
41. VDT Video Display Terminal
42. VSS Video Surveillance System

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1.3 SUBMITTALS

A. Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

B. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.

C. Submit Manufacturers' Data:

1. Cameras

2. Power supplies

3. Patch panels

D. Product submittals shall be provided and approved prior to the commencement of installation activities of the VSS.

E. Submit all proposed labeling materials and nomenclature for approval.

F. Shop Drawings:

1. Provide shop drawings that are applicable and pertain to CCTV system provisions

G. Installation drawings:

1. Floor Plans
2. Riser Diagrams
3. Block diagrams
4. Camera Details
5. Point Schedules
6. Connection of all new CCTV cameras with their associated junction boxes including block diagrams and wiring diagrams
7. Details of connections to power sources, including primary and secondary power supplies, uninterrupted power supplies, and grounding
8. Details of surge protection device installation
9. Equipment mounting details
10. Details of interconnection to data transmission media and data communication network including all hardwire and fiber optic systems

H. Coordination Drawings:

1. Indicate locations where space is limited for installation and access.
2. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.
3. Telecommunication Rooms: At least 30 days before beginning installation in each room, the Contractor shall furnish a telecommunications room drawing showing the initial layout design and plans for the proposed mounting locations of VSS equipment, cable routings, and termination locations for all cable and equipment.

I. Theory of Operations

1. Description, analyses, and calculations used in selecting equipment. Describe and show how equipment will operate as a system.

J. Test and Acceptance Plans

1. Submit the following for review and approval prior to the performance of any testing:
   a. Performance Verification Test Plan
   b. Endurance Test Plan

c. Quality Assurance Plan.

K. Maintenance Manuals: Manuals including maintenance instructions and other descriptive material as received from the manufacturers shall be provided that will enable LAWA personnel to maintain equipment and test equipment. This documentation shall include descriptions, specifications, theory of operation (where applicable), layout drawings (showing component types and positions), and back-panel and assembly wiring diagrams. In addition to hardcopies, electronic copies, in a Design Consultant approved format, shall be provided.

L. Preventative Maintenance: Instructions shall be provided for preventive maintenance procedures that include examinations, tests, adjustments, and periodic cleaning. The manuals shall provide guidelines for isolating the causes of hardware malfunctions and for localizing faults. The manuals shall provide thorough instructions on the use of any specialized test equipment needed for hardware maintenance. In addition to hardcopies, electronic copies, in a Design Consultant approved format, shall be provided.

M. Maintenance Schedule: A recommended schedule for preventative, routine, and emergency maintenance indicating frequency and required response time. Preventative maintenance services during peak activity periods shall be avoided. The Contractor shall coordinate with LAWA to define peak activity periods. The Contractor shall submit a finalized preventative maintenance schedule for Design Consultant approval.

N. Project Record Documents required include:

1. Marked-up copies of Contract Drawings
2. Marked-up copies of Shop Drawings
3. Newly prepared Drawings
4. Marked-up copies of Specifications, Addenda and Change Orders
5. Marked-up Project Data submittals
6. Record Samples
7. Field records for variable and concealed conditions
8. Record information on Work that is recorded only schematically
9. As-built drawings
10. Record drawings
11. Electronic as-built and LAWA LUSAD requirements

O. As-built drawings:

1. In addition to the Record Drawing requirements set forth in Division 01 – General Requirements, As-built drawings shall fully document and be fully developed and provided, and shall include, but not be limited to:

    a. Floor Plans

    b. Riser Diagrams

    c. Block diagrams

    d. Point-to point wiring diagrams

    e. Door Details

    f. Point Schedules

    g. Detail of connections to cameras, monitors, and workstations

    h. Details of connections to power sources, including primary and secondary power supplies, uninterrupted power supplies, and grounding

    i. Details of surge protection device installation

    j. Equipment mounting details

    k. Rack/Cabinet layout elevations and details, including heat and load calculations

    l. Details of interconnection to data transmission media and data communication network including all hardwire and fiber optic systems.

P. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. Design Consultant will periodically review Project Record Documents to assure compliance with this requirement.

Q. At every quarter, submit Project Record Documents to Design Consultant for LAWA's records.

1. Upon completion of the as built drawings, the Design Consultant will review the as built work with the Contractor.

2. If the as built work is not complete, the Contractor will be so advised and shall complete the work as required.

R. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

1.4 CODES, STANDARDS, REGULATIONS AND REFERENCES

A. Comply with all applicable codes standards, regulations, and the most current issue of the following publications, including all amendments thereto of the issue that is current on the date of contract award. Applicable requirements of the following publications shall apply to the work under this specification as if fully written herein. Where conflicts exist between the Technical Specification and the referenced publications, local codes shall govern.

1. American Standards Association (ASA)
2. Institute of Electrical and Electronic Engineers (IEEE)
3. National Fire Protection Association (NFPA)
4. National Electrical Manufacturers Association (NEMA)
5. Underwriters Laboratories, Inc. (UL)
6. Federal, State and Municipal Building Codes and all other Authorities having jurisdiction
7. National Electrical Code (NEC)
8. Insulated Power Cable Engineers Association Specification (IPCEA)
9. American Society for Testing Materials Specification (ASTM)
10. Occupational Safety and Health Administration (OSHA)
11. National Electrical Safety Code (NESC)

B. Special attention shall be made to the following specific codes, standards, and publications where applicable:

1. ANSI B20.1 Conveyor Safety
2. ASTM F.1468-93 Standard Practice For Evaluation
3. Customs and Border Protection Airport Technical Design Standards for Passenger Processing Facilities, August 2006
4. EIA 232-D Interface between Data Terminal Equipment and Data Circuit-Termination Equipment Serial Binary Data
5. EIA RS-310-C Racks, Panel, and Associated Equipment
6. 49 CFR 1520 Protection of Sensitive Security Information
7. 49 CFR 1540 Civil Aviation Security General Requirements
8. 49 CFR 1542 Airport Security

9. 49 CFR 1544 Aircraft Operator Security

10. 49 CFR 1546 Foreign Air Carrier Security

11. 49 CFR 1548 Indirect Air Carrier Security. NFPA 72-D - Installations, Maintenance and Use of Proprietary Protective Signaling Systems

12. NFPA 75 Protection of Electronic Computer Data Processing Equipment

13. NFPA 77 Static Electricity

14. NFPA 78 Lightning Protection Code

15. Transportation Security Administration Recommended Security Guidelines for Airport Planning, Design and Construction, June 15, 2006

16. UL 294 Access Control System Units

17. UL 611 Central Station Burglar Alarm Units and Systems

18. UL 634 Intrusion Detection Units

19. UL 681 Installation and Classification of Mercantile and Bank Burglar Alarm Units

20. UL 796 Electrical Printed-Wiring Boards

21. UL 1076 Proprietary Burglar Alarm Units and Systems

22. UL 1950 Information Technology Equipment, including Electrical Business Equipment References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

C. In addition the contractor shall comply with all applicable Security Directives as issued by the TSA.

1.5 QUALITY ASSURANCE

A. Contractor Certification: The Contractor or approved subcontractor shall be an Axis and Pelco (as appropriate) certified security system installer for the specific type of VSS field equipment being installed. The Contractor shall offer proof of certification by submitting a copy of certification with the Bid.

B. The Contractor’s Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with the LAWA’s and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the Design Consultant.

C. The Design Consultant shall be notified by the Contractor of any inspection(s) and the Design Consultant may elect to participate in any inspection(s). Relevant QA information shall be input into the LAWA CMMS (refer to Paragraph 3.8).

1.6 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids specification requirements.

B. Under no circumstances shall the LAWA, or the Engineer or the Design Consultant be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to Engineer all evidence to support the contention that the item proposed for substitution is equal to the specified item. The Owner's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor.

1.7 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

2. Equipment shall meet all applicable FCC Regulations.

3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.

4. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.

5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.

1. All components of an assembled unit need not be products of the same manufacturer.

2. Constituent parts, which are alike, shall be from a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for intended service.

C. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model.

E. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

F. Maximum standardization of components shall be provided to reduce spare part requirements.

1.8 WARRANTY AND MAINTENANCE

A. Warranty and Maintenance Requirements shall be in accordance with the Division 01 - General Requirements.

B. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of two (2) years from Final Acceptance.

1. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.

2. The Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

C. Submit a copy of all manufacturer warranty information.

D. Spare Parts:

1. The Contractor shall provide to LAWA an inventory of security equipment spare parts, materials, consumables, and any other system item in order to meet the specified warranty maintenance requirements and keep the security equipment in a continuous operational mode during the warranty period. The quantity of spare parts shall equal no less that 10% of the items provided and installed under this contract.

1.9 ON-SITE PERSONNEL REQUIREMENTS

A. The Contractor shall employ the maintenance contractor with whom LAWA has a maintenance contract to perform the disconnection, connection, re-connection or configuration of VSS or other existing systems that might be affected by this Work.

B. Programming and configuration of the central VSS system shall be by the LAWA designated CCTV maintenance contractor. This scope of work shall include CCTV programming and configuration. The installing security Contractor shall secure the services of the LAWA designated CCTV maintenance contractor for CCTV programming and configuration for this work at no additional cost to the Owner.

C. The Contractor shall provide all new UTP cable, optical fiber cable, innerduct, racks, cabinets, patch panels, cover plates, outlet boxes, related hardware, distribution, termination equipment, and any other appurtenances and equipment associated specifically with the VSS. Coordinate with Section 27 05 00 contractor.

D. The Contractor shall obtain the approval of Engineer or Design Consultant for the final layout of VSS equipment to be installed in telecommunications rooms prior to the installation of any materials or equipment. Shop drawings showing proposed room layouts shall be submitted for approval before beginning installation

E. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of the LAWA.

F. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

G. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

H. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

I. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment to and throughout the site.

J. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of the Engineer so the area can be appropriately noted.

K. Following each day's work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

L. Deliver products to site under provisions of Division 01 - General Requirements.

M. Store and protect products under provisions of Division 01 - General Requirements.

N. Coordinate with the Owner, locations and requirements for equipment and product storage.

1.10 SITE CONDITIONS

A. Environmental Requirements:

1. Comply with all manufacturers' instructions and recommendations concerning environmental factors.

B. Protection:

1. Fragile Items:

a. Handle any fragile items with care using protective coverings to avoid damage to sensitive instrument relays, and other devices, and to avoid contamination by dirt and debris.

2. Weather and Construction Protection:

a. During installation, provide adequate temporary dust and weather protection for all equipment. Reinstall covers each time any adjustments are made on the equipment.

C. Existing Conditions:

1. Contractor shall inspect the site and identify all existing security provisions and conditions. This includes identifying any communications and/or ancillary equipment currently existing and/or in use. It shall be the Contractor's responsibility to identify all existing provisions to be terminated to new, existing, or relocated systems.

2. All provisions shall be identified by the Contractor and documented. Individual provision data such as provision type make and model, and serial number shall be obtained by the Contractor at the time of demolition and documented in the quality control inventory.

PART 2 - PRODUCTS

2.1 GENERAL

A. Unless otherwise specified, products for the VSS shall be consistent with and compatible with the established standards for LAX VSS.

B. Latest technology available: Products shall be provided as specified. In the event the manufacturer(s) of specified products and materials have upgraded or replaced the specified products and materials with newer or improved technologies at the time of purchase, the newer or improved products or materials shall be provided unless they are incompatible with the rest of the VSS systems, or so directed by LAWA (submit Request For Information if in doubt). Latest technology products and materials shall be operationally and functionally equivalent or superior to the specified products and materials. Products and materials shall be purchased by the Contractor in a timely manner to meet construction schedules, but shall not be purchased so far advanced of the date(s) of installation that they become technologically obsolete or replaced with newer technologies.

2.2 VSS EQUIPMENT

A. Camera Compatibility:

1. Cameras shall be compatible with VSS system being deployed throughout LAWA

B. PTZ Dome Cameras, Interior:

1. Mounting options shall include:

a. Ceiling Surface Mount

b. Ceiling Flush Mount

c. Pendant Mount

d. Wall / Column Mount

2. Digital Video Compression methods supported shall include:

a. H.264

b. Motion JPEG

3. Video Resolutions shall include:

a. 4CIF

b. 2CIF

c. CIF

d. QCIF

4. Frame Rate shall be capable of no less than thirty (30) images per second for all required Digital Video Compression methods and all required Video Resolutions

5. Video Streams: A minimum of three (3) simultaneous video streams shall be supported

6. Preset Positions: A minimum of one-hundred (100) PTZ presets shall be supported

7. Pan Movement:

   a. 360° continuous pan rotation.

   b. 0.03° to 300° per second, minimum

8. Tilt Movement:

   a. 180°, minimum

   b. 0.03° to 300° per second, minimum

   c. Image shall auto-flip 180° at the bottom of the tilt travel

9. Zoom Capability: 4.7 ~ 84.6mm 18x optical zoom, minimum with 12x digital zoom minimum

10. Iris Control: Automatic with manual override

11. Auto Focus shall be supported

12. Dome: Dome color shall be “smoked” and shall induce a maximum light attenuation of 0.5 f-stop light loss

13. Axis model P5534, or approved equal

C. PTZ Dome Cameras, Exterior:

1. Mounting options shall include:

   a. Wall / Column Mount

   b. Parapet Mount

2. Day / Night Functionality: Automatic Day / Night functionality shall be supported.

   a. Minimum Illumination

      1) Color: 0.5 lux at 30 IRE

2) Black and White: 0.008 lux at 30 IRE

3. Digital Video Compression methods supported shall include:

   a. H.264

   b. Motion JPEG

4. Video Resolutions shall include:

   a. 4CIF

   b. 2CIF

   c. CIF

   d. QCIF

5. Frame Rate shall be capable of no less than thirty (30) images per second for all required Digital Video Compression methods and all required Video Resolutions

6. Video Streams: A minimum of three (3) simultaneous video streams shall be supported

7. Preset Positions: A minimum of one-hundred (100) PTZ presets shall be supported, with a minimum accuracy of 0.5°

8. Pan Movement:

   a. 360° continuous pan rotation.

   b. 0.05° to 450° per second, minimum

9. Tilt Movement:

   a. 220°, minimum

   b. 0.05° to 450° per second, minimum

   c. Image shall auto-flip 180° at the bottom of the tilt travel

10. Zoom Capability: 3.4 ~ 119mm 35x optical zoom, minimum with 12x digital zoom minimum

11. Iris Control: Automatic with manual override

12. Auto Focus shall be supported

13. Electronic Image Stabilization shall be supported

14. Dome: Dome color shall be “smoked” and shall induce a maximum light attenuation of 0.5 f-stop light loss

15. Environmental Housing: Environmental Housing shall be suited for outdoor weather exposed conditions and shall include sunshield, fan and heater

16. Axis model Q6032-E, or approved equal

D. Fixed CCTV Cameras, Interior:

1. Mounting options shall include:

    a. Ceiling Surface Mount

    b. Ceiling Flush Mount

    c. Wall Surface

    d. Wall / Column Mount

2. Digital Video Compression methods supported shall include:

    a. H.264

    b. Motion JPEG

3. Video Resolutions shall include:

    a. 4CIF

    b. 2CIF

    c. CIF

    d. QCIF

4. Frame Rate shall be capable of no less than thirty (30) images per second for all required Digital Video Compression methods and all required Video Resolutions

5. Video Streams: A minimum of three (3) simultaneous video streams shall be supported

6. Lens:

    a. Iris Control: Automatic with manual override

    b. Focus: Manual

    c. Focal Length: 2.8 ~ 10.0 mm, minimum

7. Dome: Dome color shall be “smoked” and shall induce a maximum light attenuation of 0.5 f-stop light loss

8. Axis model P3301, or approved equal

E. Fixed CCTV Cameras, Exterior:

1. Mounting options shall include:

   a. Ceiling Surface Mount

   b. Ceiling Flush Mount

   c. Wall Surface

   d. Wall / Column Mount

2. Day / Night Functionality: Automatic Day / Night functionality shall be supported.

   a. Minimum Illumination

      1) 6mm:

         a) Color: 0.2 lux

         b) Black and White: 0.04 lux

      2) 12mm:

         a) Color: 0.3 lux

         b) Black and White: 0.05 lux

3. Digital Video Compression methods supported shall include:

   a. H.264

   b. Motion JPEG

4. Video Resolutions shall include:

   a. 4CIF

   b. 2CIF

   c. CIF

   d. QCIF

5. Frame Rate shall be capable of no less than thirty (30) images per second for all required Digital Video Compression methods and all required Video Resolutions

6. Video Streams: A minimum of three (3) simultaneous video streams shall be supported

7. Lens:

    a. Iris Control: Automatic with manual override

    b. Focus: Manual

    c. Focal Length: Coordinate focal length selection with the Owner or Owner's representative prior to installation

        1) Close View: 2.5 ~ 6.0 mm, minimum

        2) Long View: 3.3 ~ 12.0 mm, minimum

8. Dome: Dome color shall be "smoked" and shall induce a maximum light attenuation of 0.5 f-stop light loss

9. Environmental Housing: Environmental Housing shall be suited for outdoor weather exposed conditions

10. Axis model P3343-VE, or approved equal

F. Elevator Cameras:

1. Mounting: Elevator cameras shall be mounted in corner housings, security rated and suitable for elevator applications.

    a. Pelco EH2400, or approved equal

2. Day / Night Functionality: Automatic Day / Night functionality shall be supported.

    a. Minimum Illumination

        1) Color: 0.4 lux at 50 IRE

        2) Black and White: 0.04 lux at 50 IRE

3. Digital Video Compression methods supported shall include:

    a. H.264

    b. JPEG

    c. MPEG

4. Video Resolutions shall include:

a. 4CIF

b. 2CIF

c. CIF

d. QCIF

5. Frame Rate shall be capable of no less than thirty (30) images per second for JPEG and MPEG, and no less than ten (10) images per second for H.264

6. Video Streams: A minimum of three (3) simultaneous video streams shall be supported

7. Lens:

a. Iris Control: Automatic with manual override

b. Focus: Manual

c. Focal Length: Vari-focal, 2.9 to 8.0 mm, with horizontal viewing angles 94° to 34°

8. General purpose input and output ports

a. Inputs: Two (2) alarm input shall be provided, minimum

b. Outputs: Two (2) auxiliary relay output shall be provided, minimum

9. Sony model SNC-CS50N, or approved equal

G. Camera Power Supplies:

1. Exterior Environmental PTZ Dome Camera Power Supply:

a. Exterior Environmental PTZ Dome Camera Power Supply shall be fully compatible with, and fully support the power requirements of the Exterior PTZ Dome Cameras with environmental heater and blower

b. Power supplies for Exterior Environmental PTZ Dome Cameras may be installed adjacent to, or in close proximity to the camera(s) and may be exempt from the requirement of centralized rack mounted power supplies, but only after specific case by case approval by the Engineer

c. The security systems Contractor shall coordinate with the electrical Contractor for the provisions of electrical power for Exterior Environmental PTZ Dome Cameras installed adjacent to, or in close proximity to the camera(s)

2. 802.3at PoE Power Injector: For cameras requiring 802.3at PoE power, provide and install rack mounted power injectors in the Security Rack(s) as required

a. Provide with port configurations to support required cameras plus 25% spare capacity, with a minimum of 12 (twelve) ports per unit

b. Shall provide 36 watts per port over two pairs

c. PoE 802.3af backwards compatible

d. Microsemi PowerDsine model PD-9000G, or approved equal

H. Wire and Cable

1. Low voltage wire and cable shall be provided and installed as required

2. Wire and cable shall be selected, sized and used as appropriate for the device application in accordance with the device manufacturer's specifications, voltage and load, and distance of the wire/cable run

3. Wire and cable runs shall be "home run"

4. Mid run splices shall not be permitted

5. Wire and cable shall be Belden, West Penn, Contractors Wire and Cable, or approved equal.

2.3 MOUNTING HARDWARE

A. Wherever possible use mounting hardware from the camera manufacturer. Mount Cameras at locations shown on drawings. Review each mounting arrangement with the Engineer before procurement.

2.4 MATERIALS

A. Color and Finish Selection:

In all public areas and in all other areas visible from public areas or from the exterior of the building, colors and finishes shall match the custom color and finish samples on file with the Owner. In all other areas, applicable colors and finishes shall be selected by the Owner from the manufacturer's standard color and finish schedule. For such areas, submit manufacturer's standard color and finish schedule(s).

2.5 EQUIPMENT

A. All equipment shall be installed in accordance with this specification. Provide and install any and all equipment necessary to provide a complete and operating system, and meet the full intent of this design and other specifications within these construction documents. Any equipment such as consumables, terminators, or any other materials or equipment needed to install this system shall be considered ancillary and be provided as a part of this project.

Contractor shall provide cable for all security systems and integration of sub-systems. Cable shall be provided in accordance with manufacturer specifications for the equipment it is terminating to.

2.6 UPS

A. All equipment will be powered by a UPS with a capability to support operations for at least four hours after supply power loss. All power will be obtained from emergency power sources.

2.7 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide and install and make fully operational all components required for a fully functional system.

B. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

C. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

D. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable tray, conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with Design Consultant the exact location and mounting height of all equipment in finished areas, such as equipment racks and telecommunications devices.

E. The Contractor shall use existing conduit and surface raceway where possible and practicable. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, Engineer shall be notified before starting that part of the work. In areas with no ceilings, install only after Design Consultant reviews and comments on arrangement and appearance.

F. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. There will be no priority schedule for trades. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and/or furnish other equipment as required for ample maintenance space. Any changes in the size or location of the material or equipment supplied or proposed that may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of Engineer and approval received before such alterations are made.

G. Provide easy, safe, and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation. All TR cabinets and racks shall be mounted a minimum of 36-inches from the wall or other cabinets, equipment or power panels.

H. Where required, the Contractor shall be responsible for cutting, patching, coring and associated work for the system at no additional cost to the Owner. Cut and drill from both sides of walls to eliminate splaying. Patch adjacent existing work disturbed by installation of new work. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

I. All conduit and sleeve openings used by the Contractor shall be waterproofed or fireproofed in compliance with State and Local Building and Fire Codes. Strict adherence to National, State, and Local Fire Codes, particularly fire stopping will be required.

J. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations devices to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

K. All building conduits and sleeves installed and/or used under these Specifications shall be fire stopped, or re-fire stopped, upon cable placement through such passageways.

L. Fire stopping for Openings through Fire and Smoke Rated Wall and Floor Assemblies:

1. Provide materials and products listed. The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814. To be used inside all conduits and sleeves. Caulk on exterior of conduit penetration.

2. Provide fire stop system seals at all locations where conduit, fiber, cable trays, cables/wires, and similar utilities pass through or penetrate fire rated wall or floor

assembly. Provide fire stop seal between sleeve and wall for drywall construction.

3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire stop system. The installation shall provide an air and watertight seal.

4. The methods used shall incorporate qualities that permit the easy removal or addition of conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating. Typical rating:

   a. Floors – three (3) hours

   b. Corridor walls – two (2) hours

   c. Offices – three-quarters (0.75) hour

   d. Smoke partitions – three-quarters (0.75) – one (1) hour

5. Provide fire stop pillows for existing cable tray penetrations through firewalls.

M. Manufacturer's recommended installation standards must be closely followed (i.e. minimum depth of material, use of ceramic fiber and installation procedures).

3.2 EXAMINATION

A. Inspect the jobsite and survey the conditions to be encountered during performance of the work. This shall be accomplished prior to starting the work. Failure of Contractor to become familiar with the site conditions shall not relieve Contractor of responsibility for full completion of the work in accordance with the contract provisions.

B. Verify that all conduit, wires, cables, security equipment are installed and ready for connection and integration with the rest of the system.

C. Examine area to be protected and verify that environmental characteristics will not affect effective communication and interfacing. Report observed problems in writing.

D. Determine that power supplies, conduit, wires, cables, connections, and equipment are ready for installation and interfacing before attempting installation.

E. Check all power and communications cabling for continuity before making connections.

F. Visually inspect each piece of equipment, determine defects, and correct.

G. Make arrangements through Owner and inspect locations where installation work will be performed. Verify that conditions found are in accordance with drawings and are acceptable for Contractor's installation work. Report any discrepancies in writing to Owner, stating

suggested means of correction. As may be required, inspect existing inside and outside cable plant to determine system runs and interface conditions. Coordinate with Owner to establish interfaces.

3.3 INSTALLATION

A. Compliance:

1. Install the equipment in accordance with the contract documents, all applicable codes and standards and the Manufacturer's written instructions. The installed system shall meet all applicable equipment and performance requirements.

B. Standardization:

1. Standardize the installation practices and material to provide uniform materials and procedures to the maximum extent possible.

C. Locations:

1. Locate pull boxes, wire-ways or other items requiring inspection, removal, or replacement conveniently and accessibly with reference to the finished facilities.

D. Electrical Service:

1. Installation of electrical service to equipment shall conform to specific UBC Codes and Standards, NFPA 70, and other applicable requirements.

E. Where possible for ceiling mounted and wall mounted CCTV install a suitable sized junction box and feed the CCTV camera via a three foot metallic flexible conduit to the mounting location. This is to ease subsequent camera repositioning. Review each mounting arrangement with the Engineer before installation.

F. Electrical Equipment Inspection:

1. Provide electrical equipment inspection in accordance with NEMA PB 2.1 Part VII.

G. Installation Requirements:

1. Install all system components, including furnished equipment, and appurtenances in accordance with the manufacturer's instructions, and as shown, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified and shown. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

2. Install the security system equipment in accordance with the standards for safety, NFPA 70, UL 681, UL 1037 and UL 1076, and the appropriate installation manual for each equipment type.

3. All wiring, including low voltage wiring outside the control console, cabinets, boxes, and similar enclosures, shall be installed in rigid galvanized steel conduit conforming to UL 6 (when outdoors), or electric metallic tubing (EMT) when indoors. Minimum conduit size shall be 3/4-inch. All other electrical work shall be as specified with electrical specifications and drawings that are part of the contract document and as shown. Grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

   Detailed shop drawings shall be provided as part of the submittal process. The shop drawings shall include, but not be limited to exposed conduit and devices, including hangars, brackets, back boxes and related equipment.

4. All equipment connected to alternating current circuits shall be protected from power line surges. Equipment protection shall meet the requirements of ANSI C62.41. Fuses shall not be used for surge protection.

5. All inputs shall be protected against surges induced on device wiring. Outputs shall be protected against surges induced on control and device wiring installed outdoors and as shown. All communications equipment shall be protected against surges induced on any communications circuit.

6. All cables and conductors, except fiber-optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two wave-forms:

   a. A 10 microsecond rise time by 1000 microsecond pulse width wave-form with a peak voltage of 1500 volts and a peak current of 60 amperes.
   b. An 8 microsecond rise time by 20 microsecond pulse width wave-form with a peak voltage of 1000 volts and a peak current of 500 amperes.

7. Calibrate all equipment.

8. Inspect each component, determine obvious defects, and correct.

9. All electrical work shall be in accordance Division 26.

10. Perform tests as recommended by manufacturer or as required to ensure the VSS equipment is operating properly and meets specified requirements.

11. Correct all deficiencies detected and retest affected components.

12. Record test data, tabulate, and write narrative describing tests, results, deficiencies found, corrective measures, and results of retesting. Certify that the security equipment has been tested and is ready for performance verification testing.

13. Service Loops: Service loops shall be provided for all VSS cabling within the Telecommunication Rooms.

3.4 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

D. Marking:

1. Equipment Name Plates: The following requirements shall apply:

a. General: Attach a permanent, corrosion-resistant name plate to each equipment component showing the manufacturer's name, address, serial number and equipment rating. Each name plate shall be clearly visible on the exterior of equipment. Components located within equipment enclosures shall also be provided with name plates.

b. Location and Fastening: Provide nameplates to identify all equipment components. Provide each panel assembly with a name plate on the interior of equipment enclosures, indicating number of equipment and unit of assembly. Fasten name plates securely with slotted stainless steel screws. The use of adhesive for fastening name plates will not be permitted.

2. Control and Display Labels:

a. Use: Each control, display and any other item of equipment that must be located, identified, read or manipulated shall be appropriately and clearly labeled to permit rapid and accurate identification of its operating state of position.

b. Orientation: Orient labels and information thereon horizontally so that they may be read quickly and easily. Vertical orientation shall be used only where space is limited.

c. Locations: Locate labels so that there is no confusion as to which item they identify. Labels shall not obscure any other information required by the operator. Controls shall not obscure labels. The location of labels shall be consistent.

E. Use Permanent Room Numbers as indicated on the Room Finish Schedules for construction period identification of rooms and building spaces. All required shop drawings and submittals, including manuals and Project Record Drawings shall identify rooms and spaces using the Permanent Room Numbers. Permanent identification devices including signage, equipment nameplates, and panels shall use the Permanent Room Numbers.

3.5 INSPECTIONS

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

3.6 SYSTEM STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.

2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.

4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.

5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

6. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.7 SYSTEM TESTING AND COMMISSIONING

A. General: Installation and acceptance tests shall be conducted in the normal operational environment to the maximum extent possible. The tests shall represent operation in the normal mode in which each system will operate. If interfaces are incomplete, provide simulation of those interfaces so that the system may be tested as a complete and stand-alone entity. Perform all equipment repair and/or adjustment that may be required during acceptance testing.

B. In addition to any acceptance testing requirements specified elsewhere, the VSS shall be fully tested and accepted, with test results recorded individual test reports for review and acceptance. All VSS devices and equipment shall be tested.

C. In addition to any acceptance testing requirements specified elsewhere, cameras shall be fully adjusted and tested to provide optimal video pictures and signals. All camera adjustments and settings available shall be utilized and adjusted. All camera adjustments and settings shall be recorded in individual camera test reports for review and acceptance.

D. Phases of Testing

1. On-Site Performance Verification Testing

2. On-Site Endurance Testing

E. Test Plan/Procedure: The Contractor shall submit a Test Plan for each testing phase for the review and approval of the Design Consultant. The test plan for each phase shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein. The test plan shall be provided at least forty-five (45) days prior to the scheduled start of each test. Test plans shall contain at a minimum:

1. Functional procedures including use of any test equipment

2. Test equipment is to be identified by manufacturer and model

3. Interconnection of test equipment and steps of operation shall be defined

4. Expected results required to comply with specifications

5. Record of test results with witness initials or signature and date performed

6. Pass or fail evaluation with comments.

7. The test procedures shall provide conformity to all specification requirements. Satisfactory completion of the test procedure is necessary as a condition of system acceptance.

8. Documentation verification, both interconnects and functionality, shall be part of the test. Where documentation is not in accordance with the installed system interconnect and operating procedures, the system shall not be considered accepted until the system and documentation correlate.

9. The Contractor shall cooperate with and provide LAWA representative(s) the opportunity(s) to participate in any or all of the tests.

10. Test Reports: The Contractor shall submit for each test, a test report document that shall certify successful completion of that test. Submit for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:

a. Commentary on test results.

b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.

c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.

d. Signatures of persons who performed and witnessed the test.

e. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to the Owner. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by the Design Consultant, before any subsequent testing phase is performed.

F. Performance Verification Testing

1. Complete operational testing of all components and systems shall be witnessed by designated LAWA Representatives.

2. Schedule test with Design Consultant. Do not begin testing until:

a. All systems have been installed and individually and jointly tested to ensure they are operating properly.

b. Written permission from Design Consultant has been received.

3. Testing: As part of performance verification, test all components of system. The tests shall demonstrate system features.

4. Verification: Verify correct operation of the required system functionality as defined in these specifications.

5. Adjustment, Correction, and Completion:

a. Correct deficiencies and retest affected components.

b. Make necessary adjustments and modification to system after obtaining approval of the Design Consultant.

c. Completion: Performance verification test shall be complete when testing or retesting of each component has produced a positive result and has been approved in writing by the Design Consultant.

6. Recording:

a. Describe actual operational tests performed and equipment used and list personnel performing tests.

b. Record in tabular form all test results, deficiencies, and corrective measures.

7. Termination

    a. Performance verification test shall be terminated by the Design Consultant when:

        1) Individual components, subsystems, or the integrated system fail to perform as specified.

        2) It is determined that system is missing components or installation is not complete.

    b. Upon termination, corrective work shall be performed and performance verification test rescheduled with the Design Consultant.

    c. Retesting shall be performed by Contractor at no additional expense.

    d. Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of the Design Consultant.

G. Endurance Testing

1. Provide personnel to monitor the systems 24 hours per day, including weekends and holidays during endurance testing.

2. Start test after:

    a. Successful completion of performance verification testing.

    b. Correction of deficiencies has been completed.

    c. Receipt of written start notification from the Design Consultant.

3. Monitor all systems during endurance testing. Coordinate monitoring with the Design Consultant.

4. Recording: Record data on approved forms so as to provide a continuous log of systems performance. Include:

    a. Date and time for all entries.

    b. Name of individual making entry.

    c. Environmental conditions.

    d. Authority activities in process.

    e. Description of all alarm annunciations, responses, corrective actions, and causes of alarms. Classify as to type of alarm.

    f. Description of all equipment failures, including software errors.

g. Description of all maintenance and adjustment operations performed on system.

h. Daily and weekly tabulations.

i. Daily entries of performance data shall be reviewed by the Design Consultant's representative designated to observe monitoring of system.

5. The Design Consultant may terminate testing at any time when the system fails to perform as specified. Upon termination of testing the Contractor shall commence an assessment period as described in Phase II.

6. Testing

a. Phase I - Initial Testing:

1) Time: 24 hours per day for 15 consecutive calendar days.

2) Make no repairs during this phase unless authorized in writing by the Design Consultant.

3) If system experiences no failures, proceed to Phase III - Final Testing.

b. Phase II - Initial Assessment:

1) After conclusion of Phase I or terminating of testing, identify all failures, determine causes, and repair. Submit report explaining: Nature of each failure, corrective action taken, results of tests performed to verify corrective action as being successful, and recommended point for resumption of testing.

2) After submission of report, schedule review meeting at job site. Schedule date and time with the Design Consultant.

3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

4) Based on report and review meeting, the Design Consultant will direct Contractor to repeat Phase I, restart Phase I, or proceed to Phase III - Final Testing.

c. Phase III - Final Testing:

1) Time: 24 hours per day for 15 consecutive calendar days.

2) Make no repairs during this phase unless authorized in writing by Engineer.
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7. Phase IV - Final Assessment:

1) After conclusion of Phase III or termination of testing, identify all failures, determine causes, and repair. Submit explaining the nature of each failure, corrective action taken, results of tests performed, and recommended point for resumption of testing.

2) After submission of report schedule review meeting at job site. Schedule date and time with the Design Consultant.

3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

4) Based on report and review meeting, the Design Consultant will approve endurance test or direct Contractor to repeat all or part of Phases III and IV.

8. Adjustment, Correction, and Maintenance

a. During endurance testing make adjustments and corrections to system only after obtaining written approval of the Design Consultant.

b. During endurance testing, perform required maintenance on systems including provision of replacement parts.

H. Final Inspection and Acceptance

1. After endurance testing is complete, review tabulated records with the Design Consultant.

2. The Contractor will not be responsible for failures caused by:

a. Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished and automatic shutdowns and restarts of systems performed as specified.

b. Failure of any LAWA furnished power, communications, and control circuits provided failure was not due to Contractor furnished equipment, installation, or software.

c. Failure of existing LAWA equipment provided failure was not due to Contractor furnished equipment, installation, or software.

3. When performance of integrated system does not fall within the above rates, determine cause of deficiencies, correct, and retest.

4. When requested by the Design Consultant, extend monitoring period for a time as designated by the Design Consultant.

5. Period shall not exceed 60 days exclusive of retesting periods caused by termination of Phases I or III and assessment period of Phases II and IV.

I. Submit final report of endurance testing containing all recorded data.

J. System Commissioning:

1. Video commissioning shall be conducted in accordance with LAWA standard video commissioning policies and procedures. This will include verification of lens selection, verification of field of view, verification of image quality, verification of focus point and where required final adjustment of position of CCTV camera.

2. General: Contractor shall be responsible for ensuring that the installation and related interfaces is completed and operational at least thirty (30) days prior to scheduled beneficial occupancy. In the event the installation and related interfaces is not completed and operational by the scheduled beneficial occupancy date, Contractor shall establish and submit a security plan to Owner that complies with 49 CFR 1542 Airport Security and 49 CFR 1544. Aircraft Operator Security as appropriates, and related Owner security requirements. The security plan shall be submitted to Owner and TSA for approval. The security plan, revisions, and security measures to be deployed until such time the new security equipment is completed and operational shall be at Contractor's expense.

3. After all installation and acceptance test requirements specified have been complied with, the equipment shall be commissioned.

4. Prerequisites To System Commissioning

   a. Outstanding work items that may exist, such as facility interfaces, project record drawings, and/or in-process change orders, shall be documented and submitted to Owner for review prior to start of equipment commissioning. Documentation of outstanding work items shall take the form of punch lists of critical action items lists that describe the work, the expected completion schedule, and the impact upon operation. Depending upon the nature of the outstanding work item, Owner may grant a waiver to accomplish partial commissioning of any of the equipment. Completion of waived outstanding work items shall then be assigned to the post-commissioning operations and maintenance.

   b. Completion coordination of all lens selection, camera field of view, point of focus determination and obtain video quality approval from the Engineer and Client.

5. Commissioning Procedure

   a. The commissioning procedure shall be witnessed by Owner. The commissioning procedure shall be conducted by Contractor and shall consist of a detailed inspection, and physical accounting of each equipment item. An operational demonstration shall then be conducted in which the equipment shall function in the normal operational mode, and shall operate completely error-free in terms of hardware and software performance. Occurrence of any equipment failure shall terminate the demonstration. The demonstration shall restart and run for a period of time designated by Owner after the failure has been corrected.

b. An operational demonstration shall be conducted in which the equipment shall function in the normal operational mode, and shall operate completely error-free in terms of hardware and software performance. Occurrence of any equipment failure shall terminate the demonstration. The demonstration shall restart and run for a period of time designated by Owner after the failure has been corrected.

3.8 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. LAWA is implementing a CMMS. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.9 FINAL INSPECTION AND ACCEPTANCE

A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA cable management system and successful performance of the cabling system for a two-week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

END OF SECTION 28 23 00

SECTION 28 31 00-FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

A. This performance specification provides the minimum requirements for the Life Safety System. The work provided shall include, but not limited to furnishing all permits, equipment, materials, delivery, labor, documentation, testing and services necessary to design and furnish and install a complete, operational system Fire Alarm System.

B. At the time of bid, all exceptions taken to these Specifications, all variances from these Specification and all substitutions of operating capabilities or equipment called for in these Specification shall be listed in writing and forwarded to the Designer. Any such exception, variances or substitutions that were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment.

C. The contractor must prepare the appropriate fire alarm system design and shall submit all the required drawings, equipment specifications, riser diagrams, worst case voltage drop calculations, battery calculations, mounting details and equipment to the city of Los Angeles Fire Department for review and obtain the permit under a deferred approval.

D. Contractor is responsible for verifying existing fire alarm devices located within the terminal and providing connection to main fire alarm system for a complete working system.

1.2 REFERENCES

A. All work and materials shall conform to all applicable Federal, State and local codes and regulations governing the installation.

B. Fire alarm system, equipment, installation, and wiring materials and methods used shall comply with the following codes and standards:

1. System components proposed in this specification shall be UL listed for its intended use.
2. California State Fire Marshal Listed Components
3. Los Angeles Building Code
4. California Fire Code
5. Los Angeles Fire Code
6. California Mechanical Code
7. California Electrical Code
8. NFPA 72 - National Fire Alarm Code®, As amended by CA code
9. NFPA 13 – Standards for the installation of fire sprinkler systems
10. NFPA 14 - Standards for the installation of fire standpipes and hose systems
11. NFPA 415 Standards for airport terminal building fueling, ramp drainage and loading walkways, 2008 edition.
12. Los Angeles Zoning Code - Chapter 1 LA Municipal Code
13. State of California title 24 energy code

14. State of California elevator code
15. Americans with Disabilities Act (ADA)

1.3 CONTRACTOR QUALIFICATIONS

A. All work in this Section shall be performed (furnished, installed and connected) by a qualified fire alarm contractor. The fire alarm contractor shall provide the following documentation to show compliance with the contractor qualifications within 14 days after notice of award of contractor.

1. Contractor's License: A copy of the contractor's valid State of California License. The contractor must be licensed in the state of project location and have been incorporated in the business in that state for a minimum of 5 years.
2. Proof of Experience: Proof that the fire alarm contractor has successfully installed similar system fire detection, evacuation voice and visual signaling control components on a previous project of comparable size and complexity. Provide a statement summarizing any pending litigation involving an officer or principal of /or the company, the nature of the litigation and what effect the litigation may carry as it relates to this work in the worst case scenario. Non-disclosure of this item, if later discovered, may result, at the LAWA's discretion, in the contractor bearing all costs and any cost related to associated delays in the progress of the work.
3. Insurance Certificates: Copy of fire alarm contractor's current liability insurance and state industrial insurance certificates in conformance with the contract document.
4. Service Capability: The fire alarm contractor shall have in-house Engineering, installation and service personnel with a maintenance office within 50 miles of the project location
5. Authorization Letters: Letters from the fire alarm equipment manufacturer stating that the fire alarm contractor is a Factory Authorized Distributor, and is trained and certified for the equipment proposed on this project and is licensed to purchase and install the software required to provide the specified functions.
6. Certifications:

    a. Provide a copy of the National Institute for Certification in Technologies (NICET) Technician Level 3 Certificate for the employee actively involved in this project.
    b. Documentation that the fire alarm contractor has on staff personnel factory-trained and certified for the equipment proposed for this project.

7. The Contractor shall be an EST Authorized Strategic Partner or contracted with LAWA's fire alarm maintenance contractor to install EST3 equipment. Proof of authorization shall be required.

1.4 SCOPE OF WORK

A. New EST3 fire control panel to add to existing EST3 network and FireWorks Graphical User Interface at CUP shall be installed. All new fire alarm equipment and devices shall be a product of GE, EST Life Safety & Communications.

B. The system supplied under this specification shall be a microprocessor-based direct wired, multi-priority peer-to-peer networked system. The system shall utilize independently addressed, microprocessor-based smoke detectors, heat detectors, and modules as described in this specification. It shall be complete with all necessary hardware, software and memory specifically tailored for this installation. It shall be possible to permanently modify the software on site by using a plug-in programmer.

C. The Contractor shall obtain and pay for all permits and related fees including any fees for after hours testing and expedited plan check.

D. The Contractor will be responsible for providing all required professional Engineering stamps/certification and all required contractors license requirements, which are required by the AHJ.

E. The fire alarm systems shall be operational at all times unless an approved Fire Watch is in place. The system shall not be left out of service during weekends. The contractor shall be responsible for notifying the General Contractor 48 hours in advance of any fire watch in areas that will not be protected by the fire alarm system.

F. Provide and be responsible for fire-watch as required by the AHJ.

G. A factory trained technician shall be on site to supervise the installation.

H. The Contractor shall be responsible to contract with the Existing LAWA Maintenance Contractor to program the Fire Works system at the Central Utilities Plant and to integrate with the existing EST3 system. The Contractor shall ensure current programming efforts are coordinated with other work and contractors.

I. The fire alarm scope of work shall consist of the following minimum requirements.

1. Control Panels and Annunciators

a. Fire Control Panels

1) A new EST3 fire alarm control panel shall be provided. New panels will be connected to main EST3 panel located at new fire control room. Additional related remote data gathering panels shall be provided at these locations as needed.
2) All FACP, remote data gathering panels and annunciators shall complete the “network” between all areas of the building(s) allowing for common monitoring and control.
3) A new matrix graphic annunciator will be provided in the new fire control room as part of the project depicting the final terminal layout. The contractor will be responsible for providing new LED’s at the Matrix annunciator as follows:

a) Horizontal rows of LED’s for each alarm zone (floor) arranged vertically in columns by Pull Station, Area Smoke/Heat Detector, Elevator Lobby Smoke Detector, Duct Smoke Detector, Elevator Shaft Smoke/Heat Detector, Sprinkler Water Flow, Sprinkler Valve Tamper Switch and Special Extinguishing System Zones.

b) Emergency Generator Run & Fail.
c) Fire/Booster Pump Run & Fail.
d) Common Trouble and Power LED's.
e) Lamp Test Push Button.

2. Initiating Devices

a. All initiating devices shall be new addressable devices. Any conventional initiating devices utilized shall have individual addressable monitor modules provided for each conventional device for unique addressing and annunciation.
b. Smoke detectors shall be added as follows:

1) All Mechanical, Electrical, Telephone, Elevator, Transformer, Generator or similar room.
2) At each elevator lobby.
3) Magnetically held open or automatic-closing doors.
4) Roll doors and/or one-hour fire-resistive occupancy separations.
5) Elevator Shafts if required per code.
6) Storage areas.
7) Smoke and combination Smoke/Fire Dampers.

a) Duct smoke detectors not required for dampers where the entire space served by the smoke damper is protected by a system of area smoke detectors.

8) Above each fire alarm control panel or booster power supply.
9) Beam pockets shall be covered as needed in order to meet current code requirements.
10) Provide and install new smoke detectors in rooms designated with pre-action systems. Smoke detectors shall be compatible with pre-action panel designated in the sprinkler specification.

c. Manual pull stations shall be added as follows:

1) At all exits from the building.
2) At every exit from every level
3) At each elevator lobby if required by AHJ.
4) Additional manual pull stations shall be provided so that the travel distance to the nearest manual pull station will not be in excess of (200 ft) measured horizontally on the same floor.
5) A conventional weatherproof Pull Station shall be provided with an individual addressable module per pull station for any exterior locations.

d. Duct Detectors shall be added as follows:

1) Downstream of the air filters and ahead of any branch connections in air supply systems having a capacity greater than 944 L/sec (2000 ft3/min)
2) At each story prior to the connection to a common return and prior to any recirculation or fresh air inlet connection in air return systems having a capacity greater than 7080 L/sec (15,000 ft3/min) and serving more than one story.

a) Return system smoke detectors shall not be required where the entire space served by the air distribution system is protected by a system of area smoke detectors.

3) Smoke detectors shall not be required for fan units whose sole function is to remove air from the inside of the building to the outside of the building.
4) Smoke and combination Smoke/Fire Dampers.

a) Duct smoke detectors not required for dampers where the entire space served by the smoke damper is protected by a system of area smoke detectors.

5) Remote LED's w/ test stations shall be provided for all duct detectors located above ceilings or out of sight.

e. Heat Detectors shall be added as follows:

1) Elevator Machine Rooms
2) Elevator Shafts if required per code.
3) Non-Residential Kitchens with smoke producing equipment.
4) Trash Rooms

f. Sprinkler tamper and waterflow switches shall be individually monitored as follows:

1) Provide one (1) supervisory module circuit for each sprinkler valve supervisory and waterflow switch.
2) Tamper switches in fire pump room only may be grouped together as allowed per coded.

g. Vesda LaserPlus Detector shall be provided per plans as required.

3. Notifications Appliances

a. All notification appliances shall be new.
b. Speakers shall be added as follow:

1) Shall be added throughout public and private spaces to achieve 15db above ambient as needed to maintain intelligibility in all areas during paging and meet current code requirements.
2) Elevator Cabs and Stairwells for Paging Only.
3) Elevator Lobbies
4) Corridors
5) Rooms and tenant spaces exceeding 1,000 square feet.
6) Public Restrooms for intelligibility during paging.

c. Strobes shall be added as follows:

1) Restrooms and Similar Uses: Public, Staff, locker rooms and dressing rooms.
2) Corridor System and Similar Uses: Public, Staff and Service Corridors, Vestibules and Passageways.

3) Occupied Rooms where Ambient Noise Impairs Hearing of the Fire Alarm and Similar Uses: Mechanical equipment rooms, Generator rooms.
4) Lobbies and Similar Uses
5) Rooms used for sleeping and Similar Uses: Sleeping rooms and suites for persons with hearing impairments.

    a) Strobes that are required in sleeping areas shall be located within 16' of pillow and have a minimum intensity of 110cd. For strobes located less than 24" from ceiling the minimum intensity shall be 117cd.

6) Any other area for common use.
7) Additional strobes shall be added in ADA rooms as needed.
8) Sized Per ADA coverage and NFPA72
9) Combination Audible/Visual appliances may be used as needed.
10) Areas having more than 2 strobes in the field of view shall be synchronized

    a) Booster Power Supplies shall be distributed throughout the facility to provide the power necessary for all indicating devices. Power Supplies shall be initiated by Synchronized Signal Modules. Synchronization by means of a common pair of wires chaining power supplies shall not an acceptable means of synchronization between units.
    b) Fan and Damper control as follows.

4. Transmit signal to the building automation system per zone for smoke control operation of all fans and dampers identified in the smoke control sequence of operation. All other dampers and fans shall be non-managed and shutdown or closed by the fire alarm system.
5. Interface and provide fan shutdown control for all non-managed fans not identified in the smoke control sequence of operation. An addressable control relay shall be provided for each unit.
6. Interface and provide non-managed smoke damper shutdown for all dampers not identified in the smoke control sequence of operation. Provide addressable control relays at each electrical panel where smoke dampers are powered.
7. Other device/controls shall be added as follows.

    a. Primary, Alternate elevator recall and shunt trip shall be required for each elevator.
    b. The fire alarm panel shall monitor individual Fire Pump and Emergency Generator "Run" & "Fail" status for each unit. Run & Fail Status shall report as Monitor points.
    c. Interface with any door lock\card accesses release circuits. An addressable control relay shall be provided at each lock location obstructing the emergency exit path. Stairwell door locks may have one common control.
    d. Provide and Interface with magnetic door holder release circuits. Provide addressable control relays as required.
    e. Magnetic door holders shall be provided as part of this section at elevator lobby doors and all cross-corridor doors and as required per code.
    f. Fireman's phone jack shall be provided at all elevators, stairwells and elevator control rooms.

1.5 SEQUENCE OF OPERATIONS

A. General Alarm Operation: Upon alarm activation of any area smoke detector, duct smoke detector, heat detector, manual pull station, sprinkler waterflow, Vesda Detector, the following functions shall automatically occur:

1. The internal audible device shall sound at the control panel, annunciator or command center.
2. The LCD Display shall indicate all applicable information associated with the alarm condition including zone, device type, device location and time/date.
3. All system activity/events shall be documented on the system printer.
4. Any remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.
5. The following notification signals and actions shall occur simultaneously:

    a. An evacuation message shall be sounded on fire floors (zones). The signal shall be a slow whoop tone.
    b. Activate visual strobes on the fire floors (zones). The visual strobe shall stop operating when the "Alarm Silence" is pressed.

6. Provide selective paging to each individual floor (zone). In addition to the message/channels detailed above, a dedicated page channel shall be capable of simultaneously providing live voice instructions without interrupting any of the messages listed above shall be provided.
7. Transmit a signal to the building automation system to activate the automatic smoke control sequences.
8. If a fire originates in any place other than in the communication rooms, all HVAC units will shut down, except the DX units serving the telecom rooms. If a fire originates within the communication rooms, the associated DX units will shut down.
9. All stairwell/exit doors shall unlock throughout the building.
10. All self-closing fire/smoke doors held open shall be released.
11. All automatic events programmed to the alarm point shall be executed and the associated outputs activated.
12. EST Fireworks

    a. Display the address of the alarm or off normal point with type and description and time of the event in a prioritized color-coded event list. Highlighting an event in the event list shall automatically cause the other three quadrants (described below) to display information relating to the highlighted event.
    b. Display color graphical representation of the area in which the alarm or off normal device is located. It shall be possible for the operator to manually zoom down to any portion of a vector-based graphic without aliening, artifacting, or pixilation of the image. Preset zoom levels shall not be considered equal.
    c. Display a set of written operator instructions for each point.
    d. Log operator's comments for each event to history with time and date.
    e. Log all events and operator actions to history for future review.

13. Smoke evacuation louvers shall open.

B. Elevator Lobby / Equipment Room Detectors: Upon alarm activation of any elevator lobby smoke detector or equipment room detector the following functions shall automatically occur:

1. Perform general alarm sequence above.
2. Elevator Lobby smoke detectors shall recall the elevators to primary floor
3. Elevator Lobby smoke detectors located on the primary recall floor shall recall the elevator the alternate floor.
4. Equipment room smoke detectors shall recall the elevator to the primary floor.
5. Activation of the Equipment room heat detector shall initiate the shunt trip in the associated elevator equipment room.

C. Supervisory Operation: Upon supervisory activation of any sprinkler valve supervisory switch, fire pump off-normal, clean agent fire suppression system trouble, Vesda Detector, the following functions shall automatically occur:

1. The internal audible device shall sound at the control panel, annunciator or command center.
2. The LCD display shall indicate all applicable information associated with the supervisory condition including; zone, device type, device location and time/date.
3. All system activity/events shall be documented on the system printer.
4. Any remote or local annunciator LCD/LED's associated with the supervisory zone shall be illuminated.
5. Transmit signal to the central station with point identification.
6. EST Fireworks

    a. Display the address of the supervisory or off normal point with type and description and time of the event in a prioritized color-coded event list. Highlighting an event in the even list shall automatically cause the other three quadrants (described below) to display information relating to the highlighted event.
    b. Display color graphical representation of the area in which the supervisory or off normal device is located. It shall be possible for the operator to manually zoom down to any portion of a vector-based graphic without aliening, artifacting, or pixilation of the image. Preset zoom levels shall not be considered equal.
    c. Display a set of written operator instructions for each point.
    d. Log operator's comments for each event to history with time and date.
    e. Log all events and operator actions to history for future review.

D. Trouble Operation: Upon activation of a trouble condition or signal from any device on the system, the following functions shall automatically occur:

1. The internal audible device shall sound at the control panel, annunciator or command center.
2. The LCD keypad display shall indicate all applicable information associated with the trouble condition including; zone, device type, device location and time/date.
3. All system activity/events shall be documented on the system printer.
4. Any remote or local annunciator LCD/LED's associated with the trouble zone shall be illuminated.
5. Transmit signal to the central station with point identification.
6. EST Fireworks

a. Display the address of the trouble or off normal point with type and description and time of the event in a prioritized color-coded event list. Highlighting an event in the event list shall automatically cause the other three quadrants (described below) to display information relating to the highlighted event.
b. Display color graphical representation of the area in which the trouble or off normal device is located. It shall be possible for the operator to manually zoom down to any portion of a vector-based graphic without aliening, artifacting, or pixilation of the image. Preset zoom levels shall not be considered equal.
c. Display a set of written operator instructions for each point.
d. Log operator's comments for each event to history with time and date.
e. Log all events and operator actions to history for future review.

E. Monitor Activation: Upon activation of any device connected to a monitor circuit (fire pump/emergency generator status, Vesda Detector), the following functions shall automatically occur:

1. The LCD display shall indicate all applicable information associated with the status condition including; zone, device type, device location and time/date.
2. All system activity/events shall be documented on the system printer.
3. Any remote or local annunciator LCD/LED's associated with the status zone shall be illuminated.
4. EST Fireworks

a. Display the address of the monitor or off normal point with type and description and time of the event in a prioritized color-coded event list. Highlighting an event in the event list shall automatically cause the other three quadrants (described below) to display information relating to the highlighted event.
b. Display color graphical representation of the area in which the monitor or off normal device is located. It shall be possible for the operator to manually zoom down to any portion of a vector-based graphic without aliening, artifacting, or pixilation of the image. Preset zoom levels shall not be considered equal.
c. Display a set of written operator instructions for each point.
d. Log operator's comments for each event to history with time and date.
e. Log all events and operator actions to history for future review.

5. Smoke evacuation louvers shall open.

1.6 SYSTEM DESIGN PARAMETERS

A. Standby power

1. The standby power supply shall be an electrical battery with capacity to operate the system under maximum supervisory load for twenty four (24) hours and capable of operating the system for five (5) minutes of evacuation alarm on all devices, operating at maximum load. The system shall include a charging circuit to automatically maintain the electrical charge of the battery. The system shall automatically adjust the charging of the battery to compensate for temperature.

B. Voltage Drop

1. The point-to-point Ohm's Law voltage drop calculations of all alarm system circuits shall no exceed 10%.

C. Spare Capacity

1. The system shall be Engineered to accommodate 20% spare capacity on each individual loop, and 20% spare on system power supplies.

D. Circuiting Guidelines

1. Initiating Device Circuits

a. Where necessary, conventional initiating device circuits (i.e. waterflow switches, valve supervisory switches, fire pump functions, etc.) shall be Class B (Style "A" or "B").

2. Notification Appliance Circuits

a. All notification appliance circuits shall be Class B (Style "Y"). The notification circuits shall be power limited. Non-power limited circuits are not acceptable.

3. Signaling Line Circuits: Addressable Analog Devices

a. The signaling line circuit connecting to addressable/analog devices including, detectors, monitor modules, control modules, isolation modules, intrusion detection modules and notification circuit modules shall be Class B (style 4).
b. Each addressable analog loop shall be circuited so device loading is not to exceed 80% of loop capacity in order to leave for space for future devices.

4. Signaling Line Circuits: Data & Audio for FACP & Annunciator Network

a. The signaling line circuit connecting network panel/nodes, annunciators, command centers, shall be Class A (style 7). The media shall be copper except where fiber optic cable is required.

1.7 SUBMITTALS

A. General

1. It is the responsibility of the contractor to meet the entire intent and functional performance required in these specifications.
2. The proposed equipment shall be subject to the approval of LAWA.
3. Approved submittals shall only allow the contractor to proceed with the installation and shall not be construed to mean that the contractor has satisfied the requirements of these specifications.

B. Equipment Submittal

1. Provide list of all types of equipment and components provided. This shall be incorporated as part of a Table of Contents, which will also indicate the manufacturer's

part number, the description of the part, and the part number of the manufacturer's product datasheet on which the information can be found.

2. Provide manufacturer's ORIGINAL printed data sheets with the printed logo or trademark of the manufacturer for all equipment. Photocopied and/or illegible product data sheets shall not be acceptable.
3. Indicated in the documentation will be the type, size, rating, style, and catalog number for all items proposed to meet the system performance detailed in this specification.
4. CSFM listing sheet for each component
5. Installer's NICET 3 Certification
6. Letter or Certificate from the fire alarm manufacturer stating that the fire alarm contractor is an authorized EST Strategic Partner of the specified product.
7. Submit a copy of the system supplier's training certification for the specified product issued by the manufacturer of the integrated life safety system.
8. Equipment submittals and other documentation shall be incorporated bound with the above information indexed and tabbed for quick reference.

C. Shop Drawings

1. A complete set of shop drawings shall be supplied. The shop drawings shall be reproduced electronically in digital format. This package shall include but not be limited to:

    a. All drawings and diagrams shall include the contractor's title block, complete with drawing title, contractor's name, address, date including revisions, and preparer's and reviewer's initials
    b. Complete system bill of material with peripheral device backbox size information, part numbers, device mounting height information
    c. Detailed system operational description. Any Specification differences and deviations shall be clearly noted and marked.
    d. A riser diagram that individually depicts all control panels, annunciators, addressable devices and notification appliances. Field addressable devices and notification appliances may be grouped together by specific type per loop or circuit if allowed by AHJ.
    e. Complete 1/8" = 1'-0 scale floor plan drawing locating all system devices and elevation of all equipment at the Fire Command Station. Floor plans shall indicate accurate locations for all control and peripheral devices as well as raceway size and routing, junction boxes, and conductor size, and quantity in each raceway. All notification appliances shall be provided with a candela rating and circuit address that corresponds to that depicted on the Riser Diagram. If individual floors need to be segmented to accommodate the 1/8" scale requirements, KEY PLANS and BREAK-LINES shall be provided on the plans in an orderly and professional manner. End-of-line resistors (and values) shall be depicted.
    f. All drawings shall be reviewed and signed off by an individual having a minimum of a NICET 3 certification in fire protection Engineering technology, subfield of fire alarm systems.
    g. Control panel wiring and interconnection schematics. The drawing(s) shall depict internal component placement and all internal and field termination points. Drawing shall provide a detail indicating where conduit penetrations shall be made, so as to avoid conflicts with internally mounted batteries. For each additional data-gathering

panel, a separate control panel drawing shall be provided, which clearly indicated the designation, service and location of the control enclosure.

h. Any additional requirements if required by AHJ for approval.

i. Complete calculations shall clearly indicate the quantity of devices, the device part numbers, the supervisory current draw, the alarm current draw, totals for all categories, and the calculated battery requirements. Battery calculations shall also reflect all control panel component, remote annunciator, and auxiliary relay current draws.

j. System (Load & Battery) calculations shall be provided for each system power supply, each notification appliance circuit and each auxiliary control circuit that draws power from any system power supply.

1.8 OPERATING AND MAINTAINANCE MANUALS

A. The manual shall contain a detailed narrative description of the system Architecture, inputs, notification signaling, auxiliary functions, annunciation, sequence of operations, expansion capability, application considerations and limitations.

B. Manufacturer's data sheets and installation manuals/instructions for all equipment supplied.

C. Minimum two (2) copies of the closeout documents shall be delivered to LAWA's representative at the time of system acceptance.

D. Provide the name, address and telephone of the authorized factory representative.

E. A filled out Record of Completion similar to those provided in NFPA 72.

1.9 AS-BUILT PROJECT DRAWINGS AND DATA

A. Drawings consisting of: a scaled plan of each building showing the placement of each individual item of the Integrated Life Safety System equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.

B. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the Designer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.

C. All drawings shall be provided in standard .DXF or AutoCAD format.

1.10 WARRANTY

A. The contractor shall warranty all materials, installation and workmanship for one (1) year.

B. A copy of the manufacturer's warranty shall be provided with closeout documentation and included with the operation and installation manuals.

C. The System Supplier shall maintain a service organization with adequate spare parts stock within 50 miles of the installation. Any defects that render the system inoperative shall be repaired within 24 hours of the LAWA notifying the contractor.

1.11 EXTRA MATERIALS

A. Provide10% of each type of manual stations (minimum of one for each type).

B. Provide six keys of each type.

C. Provide10% of each type of smoke and heat detector (minimum of one for each type).

D. Provide10% of each type of audible and visual indicating appliances (minimum of one for each type).

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. GE Security: EST Fire & Life Safety – EST3 to match existing system and network.

B. The Contractor shall be an EST Authorized Strategic Partner or contracted with LAWA's fire alarm maintenance contractor to install EST3 equipment. Proof of authorization shall be required.

2.2 GENERAL

A. All equipment and components shall be the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approval agency for use as part of a protected premises (fire alarm) system.

B. The contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer.

C. All System components shall be the cataloged products of a single supplier. All products shall be UL listed by the manufacturer for their intended purpose.

D. All control panel assemblies and connected field appliances shall be both designed and manufactured by the same company, and shall be tested and cross-listed as to ensure that a fully functioning system is designed and installed.

2.3 FIRE ALARM CONTROL PANEL

A. General, EST3.

1. The fire alarm control panel or panels and all system devices (Audible-Visuals, Visuals, pull stations, smoke and heat detectors, etc. shall be GE Security (EST). All under one label "UL/UOJZ listed and approved" for the use of fire alarm systems in this area of the United States of America.
2. The operating controls shall be located behind locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified.
3. The main controller 3-CPU shall be supervised, site programmable, and of modular design supporting up to 64 network nodes. The peer-to-peer network shall contain multiple nodes consisting of the command center, main controller, remote control panels, LCD/LED annunciation nodes, and workstations. Each node is an equal, active functional node of the network, which is capable of making all local decisions and generating network tasks to other nodes in the event of node failure or communications failure between a nodes. When utilizing a network and multiple wiring faults occur, the network shall re-configure into many sub-networks and continue to respond to alarm events from every panel that can transmit and receive network messages.
4. The Main Controller Module shall control and monitor all local or remote peripherals. It shall support a large 168 character LCD, power supply, remote LCD and zone display annunciators, printers, and support communication interface standard protocol (CSI) devices such as color computer annunciators and color graphic displays.
5. Each controller shall contain a RS232 printer/programming port for programming locally via an IBM PC. When operational, each controller shall support a printer through the RS232 port and be capable of message routing.
6. The programmer shall be able to download all network and firmware applications from the configuration computer to all the network panels from a single location on the system.
7. The panels shall have the ability to add an operator interface control/display at each node that shall annunciate, command and control system functions.
8. The system shall store all basic system functionality and job specific data in non-volatile memory. All site specific and operating data shall survive a complete power failure intact. Passwords shall protect any changes to system operations.
9. The control panel shall contain a standby power supply that automatically supplies electrical energy to the system upon primary power supply failure. The system shall include a charging circuit to automatically maintain the electrical charge of the battery.

B. Signaling Line Circuits

1. The main controller 3-CPU shall be supervised, site programmable, and of modular design supporting up to 125 detectors and 125 remote modules per addressable Signaling line Circuit (SLC). The CPU shall support up to 10 SLC's per panel for a total system capacity of 2500 Intelligent Addressable points. The system shall be designed with peer-to-peer networking capability for enhanced survivability, with support for up to 64 nodes, each with up to 2500 points and an overall capacity of 160,000 points.
2. The system shall provide electronic addressing of analog/addressable devices.
3. The system shall have built-in automatic system programming to automatically address and map all system devices attached to the main controller.
4. The system shall use full digital communications to supervise all addressable loop devices for placement, correct location, and operation. It shall allow swapping of "same type" devices without the need of addressing and impose the "location" parameters on replacement device. It shall initiate and maintain a trouble if a device is added to a loop and clear the trouble when the new device is mapped and defined into the system.

5. The system shall have a UL Listed Detector Sensitivity test feature, which will be a function of the smoke detectors and performed automatically every 4 hours.

C. Integrated Digital Audio

1. The system shall be capable of delivering multi-channel audio messages simultaneously over copper and/or fiber media.
2. All audio messages and live pages shall originate at the one-way audio control unit.
3. The one-way audio control unit shall store pre-recorded audio messages digitally. These messages shall be automatically directed to various areas in a facility under program control.
4. The system shall support remote cabinets with zoned amplifiers to receive, amplify and send messages through speakers over supervised circuits.
5. The one-way emergency audio control shall provide control switches to direct paging messages as follows:

    a. "All Call" to direct the page message to all areas in the facility, overriding all other messages and tones.
    b. "Page to Evacuation Area" to direct the message to the evacuation area(s), overriding all other messages and tones.
    c. "Page to Alert Area" to direct page messages to the area(s) receiving the alert message and tones, overriding all other messages and tones.
    d. "Page to Balance Building" to direct page messages to the areas) in the facility NOT receiving either the evacuation area or alert area messages.
    e. "Page by Phone" switch to select the firefighters telephone system as the source for paging.

6. Audio Amplifiers (Multi-Channel)

    a. Provide as minimum one twenty (20) watt audio amplifier per paging zone.
    b. The system software shall be capable of selecting the required audio source signal for amplification.
    c. To enhance system survivability, each audio amplifier shall automatically provide a local 3-3-3 1000 Hz temporal pattern output upon loss of the audio communications with the one-way audio control unit, during an alarm condition.
    d. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring.
    e. Each amplifier shall include a dedicated, selectable 25/70 Vrms output.
    f. Each amplifier shall also include a notification appliance circuit rated at 24Vdc @ 3.5A for connection of visible (strobe) appliances. This circuit shall be fully programmable and it shall be possible to define the circuit for the support of audible, visible, or ancillary devices.

D. DACT

1. The system shall provide off premise communications capability (DACT) for transmitting system events to multiple Central Monitoring Station (CMS) receivers.
2. The system shall capable of providing the CMS(s) with point identification of system events using Contact ID or SIA DCS protocols.

3. In the event of a panel CPU failure during a fire alarm condition, the DACT degrade mode shall transmit a general fire alarm signal to the CMS.

E. User Interfere

1. Main Control & Display

a. The main display shall be a large 168 character LCD with normal, alarm, trouble, supervisory, disabled point and ground fault indicators.
b. The interface shall show the first and most recent highest priority system events without any operator intervention. All system events shall be directed to one of four message queues. Messages of different types shall never intermixed to eliminate operator confusion. A "Details" switch shall provide additional information about any device highlighted by the operator.
c. Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device. The integral audible devices shall produce a sound output upon activation of not less than 85 dBA at 10 feet.
d. The internal audible signal shall have different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
e. The annunciator shall contain the following controls:

1) System Reset Switch with Indicator
2) System Alarm Silence Switch with Indicator
3) System Panel Silence Switch with Indicator
4) Programmable Switch with Indicator
5) Details Switch
6) System Message Queue Scroll Switches.
7) 10-Digit Keypad to Enable/Disable System and Functions.

f. An authorized operator shall have the ability to operate or modify system functions like system time, date, passwords, holiday dates, restart the system and clear control panel event history file.
g. An authorized operator shall be capable of performing test functions within the installed system.

2. Additional Annunciation & Control

a. The system shall be capable to receive, monitor, and annunciate signals from individual devices and circuits installed throughout the building.
b. Each zone, stairwell and elevator bank shall have a control switch to initiate paging. Each paging switch shall have an associated Green LED (zone indicating circuit on) and Yellow LED (zone indicating circuit trouble).
c. Manufacturers' standard control switches shall be acceptable if they provide the required operation, including performance, supervision and position indication. If the manufacturers' standard switches do not comply with these requirements, fabrication of custom manual controls acceptable to the LAWA is required.

F. Internal Modular Power Supply

1. System power supply(s) shall provide multiple power limited 24 VDC output circuits as required by the panel.
2. Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functions.
3. Each system power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition.
4. All standby batteries shall be continuously monitored by the power supply. Low battery and disconnection of battery power supply conditions shall immediately annunciate as battery trouble and identify the specific power supply affected.
5. All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.
6. All AC power connections shall be to the building's designated emergency electrical power circuit and shall meet the requirements of NFPA 72 - The AC power circuit shall be installed in conduit raceway. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside the each control panel the disconnect serves.

G. Reports

1. The system shall provide the operator with system reports that give detailed description of the status of system parameters for corrective action, or for preventative maintenance programs. The system shall provide these reports via the main LCD, and shall be capable of being printed on any system printer.
2. The system shall provide a report that gives a sensitivity listing of all detectors that have less than 75% environmental compensation remaining. The system shall provide a report that provides a sensitivity (% Obscuration per foot) listing of any particular detector.
3. The system shall provide a report that gives a listing of the sensitivity of all of the detectors on any given panel in the system, or any given analog/addressable device loop within any given panel.
4. The system shall provide a report that gives a chronological listing of up to the last 1740 system events.
5. The system shall provide a listing of all of the firmware revision listings for all of the installed network components in the system.

2.4 ANNUNCIATORS

A. General

1. The system shall have the capacity to support 64 network annunciators or EST3 network panel nodes.

B. Remote LCD Annunciator, 3ANN.

1. Remote LCD annunciators shall display each and every point in the system and be sized with the same number of characters as in the main FACP display. Annunciators not capable of displaying each point will not be considered equal. Grouping points to “zones” will not be acceptable.

2. Network alphanumeric annunciators shall be located throughout the facility as indicated on the plans and in the fire safety director's office. This annunciator shall be an Integral part of the Peer to Peer Network for survivability. Systems that require a “host” Network Node to control remote annunciators shall not be considered acceptable.
3. Each annunciator shall contain a supervised, back lit, liquid crystal with a minimum of 8 line with 21 characters per line. Where required, the annunciator shall include additional zonal annunciation and manual control without additional enclosures. The annunciator shall support full ability to serve as the operating interface to the system and shall include the following features;

    a. Matched appearance with other system displays
    b. Each LCD Display on each node (cabinet) in the system shall be configurable to show the status of any or all of the following functions anywhere in the system:

        1) Alarm
        2) Supervisory
        3) Trouble
        4) Monitor

4. Each annunciator must be capable of supporting custom messages as well as system event annunciation. It must be possible to filter unwanted annunciation of trouble, alarm or supervisory functions on a by point or by geographic area. The annunciators shall be mounted in stand-alone enclosures or integrated into the network panels as indicated on the plans.

C. Graphic Annunciator, ENVOY.

1. The annunciator shall depict the graphical diagrams or matrix lamps as required per the contract drawings and AHJ.
2. It shall operate on nominal 24 Vdc and is battery backed up.
3. All annunciator switches shall be system input points and shall be capable of controlling any system output or function.
4. The graphic annunciator shall be UL, ULC and CSFM Listed.
5. The graphic shall be backlit using high intensity LEDs.
6. The unit shall be semi-flush or surface mounted to match existing.
7. The main graphic door shall be tamper resistant and equipped with a key lock.
8. It shall be possible to update the graphic image in the field without replacing the entire graphic.

2.5 EXISTING COMMAND CENTER , FIREWORKS

A. Overview

1. The existing Fireworks command center currently functions as the center point for all operational and administration functions required for the systems provided within the specification. The graphical workstation provides command control and monitoring of the systems provided by this specification. Individual point annunciation shall be provided. Grouping of initiating devices into zones shall not meet the intent of the specification.

2. The existing Fireworks command center shall be modified to show the final TBIT graphic configuration. Custom graphics shall be created or existing graphics modified to show the final site plan of the facility followed by photo building profile and every level of building floor plan map. Additional floor plan sections within a level shall be provided to allow for each initiating device to be clearly shown on a detailed floor plan map

2.6 INTELLIGENT ADDRESSABLE DETECTORS

A. General

1. Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Each device shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller.
2. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and supervision by location. Setting a device's address by physical means shall not be necessary.
3. The System Intelligent Detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable.
4. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and analog loop controller. Detectors not capable of making independent alarm decisions shall not be acceptable. Maximum total analog loop response time for detectors changing state shall be 0.75 seconds. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable.
5. The detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC or the SIGAPRO Signature Program/Service Tool.
6. Each detector shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm communication with the analog loop controller. A red LED shall flash to display alarm status.
7. The detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.
8. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to

program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings.

9. Each detector microprocessor shall contain an environmental compensation algorithm, which identifies and sets ambient "Environmental Thresholds" approximately six times an hour. The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminates as well as detector aging. The process shall employ digital compensation to adapt the detector to both 24 hour long-term and 4 hour short-term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the "learned" base line sensitivity. The base line sensitivity information shall be updated and permanently stored at the detector approximately once every hour.
10. The intelligent analog detectors shall be suitable for mounting on any Signature Series detector mounting base.
11. The Fire alarm system shall have the ability to set individual smoke detectors for alarm verification. Detector in the alarm verification mode shall indicate, by point in a text format at the main control and at the remote LCD annunciators.

B. Photoelectric Smoke Detector, SIGA-PS.

1. Provide intelligent photoelectric smoke detectors SIGA-PS. The analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings.
2. The photo detector shall be rated for ceiling installation at a minimum of 30 ft (9.1m) centers and be suitable for wall mount applications.
3. The photoelectric smoke detector shall be suitable for direct insertion into air ducts up to 3 ft (0.91m) high and 3 ft (0.91m) wide with air velocities up to 5,000 ft/min. (0-25.39 m/sec) without requiring specific duct detector housings or supply tubes.
4. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photo detector shall be suitable for operation in the following environment:

    a. Temperature: 32oF to 120oF (0oC to 49oC)
    b. Humidity: 0-93% RH, non-condensing
    c. Installation Attitude: no limit

C. Fixed Temp/Rate of Rise Heat Detector, SIGA-HRS.

1. Provide intelligent combination fixed temperature/rate-of-rise heat detectors SIGA-HRS. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm.
2. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable.
3. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135 degrees F (57 degrees C) and a rate-of-rise alarm point of 15 degrees F (9 degrees C) per minute.

4. The heat detector shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centers and be suitable for wall mount applications.

D. Standard Detector Bases, SIGA-SB/SIGA-SB4

1. Provide standard detector mounting bases SIGA-SB suitable for mounting on North American 1gang, 3½" or 4" octagon box and 4" square box. The base shall, contain no electronics, support all Signature Series detector types and have the following minimum requirements:

   a. Removal of the respective detector shall not affect communications with other detectors.
   b. Terminal connections shall be made on the room side of the base. Bases, which must be removed to gain access to the terminals, shall not be acceptable.
   c. The base shall be capable of supporting one (1) Signature Series SIGA-LED Remote Alarm LED Indicator. Provide remote LED alarm indicators where shown on the plans.

E. Relay Detector Bases, SIGA-RB / SIGA-RB4

1. Provide standard detector mounting bases SIGA-RB suitable for mounting on North American 1gang, 3½" or 4" octagon box and 4" square box. The base shall support all Signature Series detector types and have the following minimum requirements:

   a. Removal of the respective detector shall not affect communications with other detectors.
   b. Terminal connections shall be made on the room side of the base. Bases, which must be removed to gain access to the terminals, shall not be acceptable.
   c. The relay shall be a bi-stable type and selectable for normally open or normally closed operation.
   d. The position of the contact shall be supervised.
   e. The relay shall automatically de-energize when a detector is removed.
   f. The operation of the relay base shall be controlled by its respective detector processor. Detectors operating standalone mode shall operate the relay upon changing to alarm state. Relay bases not controlled by the detector microprocessor shall not be acceptable.
   g. Form "C" Relay contacts shall have a minimum rating of 1 amp @ 30 Vdc and be listed for pilot duty.

F. Duct Detector, SIGA-SD

1. Provide intelligent addressable photoelectric duct smoke detectors SIGA-SD. The analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop.

2. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 0.79% to 2.46%. The duct detector shall be suitable for operation in the following environment:

    a. Temperature: -20oF to 158oF (-29oC to 70oC)
    b. Humidity: 0-93% RH, non-condensing
    c. Air velocity: 100 to 4000 ft/min

3. Provide an air exhaust tube and an air sampling inlet tube, which extends into the duct air stream up to ten feet. The sampling tube can be installed with or without the cover in place and can be rotated in 45 degree increments to ensure proper alignment with the duct airflow.
4. Status LEDs shall remain visible through a clear assembly cover.
5. The unit shall contain a magnet-activated test switch.
6. One integral form C auxiliary alarm relay shall be provided. The relay contact shall be capable of being individually programmed from the control panel. The contact shall be rated for 2.0A at 30VDC
7. Provide Key-activated Remote Test station w/ integral remote alarm indicator SD-TRK where detectors must be accessed by ladder. (CSFM 7300-1657:226)

G. Vesda LaserPlus Detector shall be provided.

2.7 CONVENTIONAL INITIATING DEVICES

A. General

1. All initiating devices shall be UL Listed for Fire Protective Service.
2. All initiating devices shall be of the same manufacturer as the Fire Alarm Control Panel specified to assure absolute compatibility between the devices and the control panels, and to assure that the application of the initiating devices is done in accordance with the single manufacturer's instructions.

B. Weatherproof Pull Stations, MPSR1-S45W-GE

1. Provide single action, single stage MPSR series fire alarm stations with terminals for wire connections rated for outdoor use.
2. Key reset shall be provided with keys identical to those required for the specified fire alarm panels, booster power supplies and other locked fire alarm cabinets.
3. Finish the station in red plated surface to inhibit corrosion.
4. Compatible factory weatherproof box w/ gasket shall be provided in all locations.
5. Pull Stations shall be individually monitored by addressable monitor module.

C. Projected Beam Smoke Detector, EC-50R/100R

1. The projected beam type smoke detector shall be a 4-wire 12/24 Vdc device used with UL listed separately supplied 4-wire control panels only.
2. The unit shall be listed to UL 268 and shall consist of an integrated transmitter and receiver.
3. The detector shall operate between a range of 15 and 330 ft.

4. The temperature range of the beam shall be -22 °F to 131 °F.
5. The beam detector shall feature automatic gain control, which will compensate for gradual signal deterioration caused by dirt accumulation on the lenses.
6. The unit shall include a wall mounting bracket.
7. Testing shall be carried out using a calibrated test filter.
8. Provide wall mounted, EC-LLT, test station at ground level. Test stations shall include Power and Alarm LEDs with a key activated test switch on a single gang plate. (CSFM 7260-1657:234)
9. The unit shall be individually monitored for alarm trouble by addressable monitor module.

2.8 INTELLIGENT ADDRESSABLE MODULES

A. General

1. Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Each device shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller.
2. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and supervision by location. Setting a device's address by physical means shall not be necessary.
3. It shall be possible to address each Intelligent Signature Series module without the use of DIP or rotary switches. Devices using DIP switches for addressing shall not be acceptable. The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller. Modules requiring EPROM, PROM, ROM changes or DIP switch and/or jumper changes shall not be acceptable. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes, which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:

    a. Temperature: 32oF to 120oF (0oC to 49oC)
    b. Humidity: 0-93% RH, non condensing

B. Single Input Module, SIGA-CT1

1. Provide intelligent single input modules SIGA-CT1 for monitoring of PIV's, Fan Status, Tamper Switches, Flow Switches, Generator & Fire Pump Status, Preaction System Alarm or Trouble or any other dry contact required to be monitored.
2. The Single Input Module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation.

3. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers.
4. The single input module shall support the following circuit types:

    a. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
    b. Normally-Open Alarm Delayed Latching (Waterflow Switches)
    c. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
    d. Normally-Open Active Latching (Supervisory, Tamper Switches)

C. Dual Input Module, SIGA-CT2

1. Provide intelligent dual input modules SIGA-CT2 for monitoring of sets of PIV's, Fan/Damper Status, Tamper Switches, Flow Switches, Generator & Fire Pump Status, Preaction System Alarm or Trouble or any other sets of dry contacts required to be monitored.
2. The Dual Input Module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation.
3. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers.
4. The dual input module shall support the following circuit types:

    a. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
    b. Normally-Open Alarm Delayed Latching (Waterflow Switches)
    c. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
    d. Normally-Open Active Latching (Supervisory, Tamper Switches)

D. Signal Module, SIGA-CC1

1. Provide intelligent single input signal modules SIGA-CC1 for activation of booster power supplies, audible/visual circuits, speaker circuits or for monitoring and communication of phone jacks.
2. The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation.
3. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 2-gang boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes.
4. The single input signal module shall support the following operations:

    a. Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A, 25Vrms @50w or 70 Vrms @ 35 Watts of Audio)
    b. Telephone Power Selector with Ring Tone (Fire Fighter's Telephone)

5. When selected as a telephone power selector, the module shall be capable of generating its own "ring tone".

E. Synchronized Signal Module, SIGA-CC1S

1. Provide intelligent single input signal modules SIGA-CC1S for activation of booster power supplies and/or audible/visual circuits that require synchronization.

2. The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation.
3. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 2-gang boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes.
4. The single input signal module shall support the following operations:

    a. Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A, 25Vrms @50w or 70 Vrms @ 35 Watts of Audio)
    b. Telephone Power Selector with Ring Tone (Fire Fighter's Telephone)

5. Provides UL1971 auto-sync output for synchronizing multiple notification appliance circuits

F. Control Relay Module, SIGA-CR

1. Provide intelligent control relay modules SIGA-CR for activation and/or shutdown of fans, dampers, door holder circuits, door locks, shunt trip, elevator recall or any other fail safe system requiring control or activation.
2. The Control Relay Module shall provide one form "R" dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown.
3. The control relay shall be rated for pilot duty and releasing systems.
4. The position of the relay contact shall be confirmed by the system firmware.
5. The control relay module shall be suitable for mounting on North American 2 ½" (64mm) deep 1gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers.

G. Manual Pull Station, SIGA-270

1. Provide intelligent single action, single stage fire alarm stations SIGA-270. The fire alarm station shall be of metal construction with an internal toggle switch. Provide a locked test feature. Finish the station in red with silver "PULL IN CASE OF FIRE" English lettering.
2. The manual station shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers.
3. Provide compatible surface mount red box, 276B-RSB, at all surface mount locations. Standard electrical boxes are not acceptable.

2.9 NOTIFICATION APPLIANCES

A. General

1. All appliances shall be UL Listed for Fire Protective Service.
2. All strobe appliances or combination appliances with strobes shall be capable of providing the "Equivalent Facilitation" which is allowed under the Americans with Disabilities Act accessibly guidelines (ADA (AG)), and shall be UL 1971.
3. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to insure absolute compatibility between the appliances and the control panels,

and to insure that the application of the appliances are done in accordance with the single manufacturers' instructions.

4. Any appliances, which do not meet the above requirements, and are submitted, for use must show written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers which clearly states that their equipment (as submitted) are 100% compatible with each other for the purposes intended.

B. Wall Strobes, Genesis G1 Series

1. Strobes shall provide synchronized flash outputs. The light output shall be an even "FullLight" pattern with no hot spots. Strobes using specular reflectors are not acceptable.
2. It shall be possible to flash the strobe at a temporal flash rate to match the Chime and meet the intent of UL Private Mode signaling.
3. The strobe shall have selectable 15, 30, 75 or 110 cd settings.
4. It shall be possible to change the strobe setting without removing the device from the wall
5. The strobe shall be a low profile design, finished in neutral white and shall not protrude more than 1" off the wall. In-out screw terminals shall be provided for wiring.
6. The strobe shall be suitable for wall mounting and shall mount in a standard North American 1gang box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.

C. Ceiling Strobes, Genesis GC Series

1. Strobes shall provide synchronized flash outputs. The light output shall be an even "FullLight" pattern with no hot spots. Strobes using specular reflectors are not acceptable.
2. It shall be possible to flash the strobe at a temporal flash rate to match the Chime and meet the intent of UL Private Mode signaling.
3. The standard ceiling strobe shall have selectable 15, 30, 75 or 95 cd settings.
4. The high output ceiling strobe shall have selectable 95, 115, 150 or 177 cd settings.
5. It shall be possible to change the strobe setting without removing the device from the ceiling.
6. The strobe shall be a low profile design, finished in neutral white and shall not protrude more than 1.6" off the ceiling. In-out screw terminals shall be provided for wiring.
7. The strobe shall be suitable for ceiling mounting and shall mount in a standard 4" square 2 1/8" (54 mm) deep electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.

D. Weatherproof Wall or Ceiling Strobes, Integrity CS405 Series

1. In and out screw terminals shall be provided for wiring.
2. Strobes shall provide synchronized flash.
3. Strobe output shall be determined as required by its specific location and application from a family of 15cd, 60cd, or 110cd devices
4. Strobes shall mount in a North American 1-gang box. For weatherproof application provide weatherproof wall boxes for mounting.

E. Wall Speakers, Genesis G4 Series

1. It shall be a low profile design, finished in neutral white and shall not protrude more than 1” off the wall. In-out screw terminals shall be provided for wiring.
2. The low profile speaker shall not extend more than 1" (2.5cm) past the finished wall surface, and provide a switch selectable audible output of 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL-464.
3. Wattage setting shall be visible with the cover installed.
4. It shall be suitable for wall mounting and shall mount in a standard North American 4" x 2 1/8" square electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.

F. Wall Speaker-Strobes, Genesis G4 Series

1. Strobes shall provide synchronized flash outputs. The light output shall be an even “FullLight” pattern with no hot spots. Strobes using specular reflectors are not acceptable.
2. It shall be possible to flash the strobe at a temporal flash rate to match the horn and meet the intent of UL Private Mode signaling.
3. The strobe shall have selectable 15, 30, 75 or 110 cd settings.
4. The high output strobe shall have selectable 95, 115, 150 or 177 cd settings.
5. It shall be possible to change the strobe setting without removing the device from the wall
6. It shall be a low profile design, finished in neutral white and shall not protrude more than 1” off the wall. In-out screw terminals shall be provided for wiring.
7. The low profile speaker shall not extend more than 1" (2.5cm) past the finished wall surface, and provide a switch selectable audible output of 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL-464.
8. Wattage setting shall be visible with the cover installed.
9. It shall be suitable for wall mounting and shall mount in a standard North American 4" x 2 1/8" square electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.

G. Ceiling Speaker-Strobes, Genesis GC Series

1. Strobes shall provide synchronized flash outputs. The light output shall be an even “FullLight” pattern with no hot spots. Strobes using specular reflectors are not acceptable.
2. It shall be possible to flash the strobe at a temporal flash rate to match the horn and meet the intent of UL Private Mode signaling.
3. The standard ceiling strobe shall have selectable 15, 30, 75 or 95 cd settings.
4. The high output strobe shall have selectable 95, 115, 150 or 177 cd settings.
5. It shall be possible to change the strobe setting without removing the device from the ceiling
6. The low profile speaker shall provide a switch selectable audible output of 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL-464.
7. Wattage and Candela setting shall be visible with the cover installed.

8. It shall be a low profile design, finished in neutral white and shall not protrude more than 1.6” off the ceiling. In-out screw terminals shall be provided for wiring.
9. The strobe shall be suitable for ceiling mounting and shall mount in a standard flush mounted 4" square 2 1/8" (54 mm) deep electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.

H. Wall Weatherproof Speakers, Integrity 757 Series

1. Provide 4" surface weatherproof re-entrant speakers at the locations as required.
2. Speakers shall provide 2w, 4w, 8w, and 15w power taps for use with 25V or 70V systems.
3. The re-entrant speakers shall utilize a high efficiency compression drivers. Cone type drivers are not acceptable.
4. At the 15 watt setting, the speaker shall provide a 102 dBA sound output over a frequency range of 400-4000 Hz. when measured in reverberation room per UL-1480.

I. Weatherproof boxes (EST 757A-WB) shall be provided for outdoor mounting.

2.10 ACCESSORY EQUIPMENT

A. Multi-Voltage Control Relays, MR Series

1. General

a. Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc.
b. Relay contact ratings shall be SPDT and rated for 10 amperes at 115 Vac.
c. A single relay may be energized from a voltage source of 24 Vdc, 24 Vac, 115 Vac, or 230 Vac.
d. A red LED shall indicate the relay is energized.
e. A metal enclosure shall be provided.

2. MR-100 Series

a. Relay contact ratings shall be SPDT and rated for 10 amperes at 115 Vac.

3. MR-200 Series

a. Relay contact ratings shall be DPDT and rated for 10 amperes at 115 Vac.

B. Electromagnetic Door Holders, EST 1500 Series, CSFM 3550-1501:137

1. General - Electromagnetic door holders submitted for use must have written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purpose intended.
2. Wall Mounted, 1504/1505/1508/1509 Series

a. Provide flush, semi-flush or surface wall mounted electromagnetic door holder/releases selectable to 24 Vac/dc or 120 Vac as directed by the Consulting Designer. Finish shall be brushed zinc.

C. Remote Booster Power Supplies, BPS6A/BPS10A, CSFM 7300-1657:229

1. Unit shall be a self contained with 24Vdc power supply and batteries housed in its own locked enclosure. Keys provided shall be identical to the keys provided for all other fire alarm equipment provided.
2. Power supply shall be available in both 10 Amp or 6.5 Amp models and 110 Vac or 220Vac.
3. On board LED indicators for each resident NAC, battery supervision, ground fault and AC power.
4. The power supply shall provide four (4) independent 3Amp NACs. Each circuit can be configurable as an auxiliary output.
5. Configurable for any one of three signaling rates: 120SPM; 3-3-3 temporal; or, continuous.
6. Two independent and configurable inputs switch selectable to allow correlation of the two (2) inputs and the four (4) outputs.
7. NACs shall be configurable for either four Class B or two Class A circuits.
8. The unit shall be compatible with SIGA-CC1S for synchronization of multiple power supplies without inter-connect wiring.
9. Brackets shall be provided inside the enclosure to allow mounting the signaling modules. All signaling modules shall be listed to be located inside the booster power supply enclosure.
10. A selectable dip switch shall enable built in synchronization for horns and strobes which may be used to synchronize downstream devices, as well as other boosters and their connected devices.

2.11 CONDUCTORS

A. The requirement of this section apply to all system conductors, including all signaling line, initiating device, notification appliance, auxiliary function, remote signaling, AC and DC power and grounding/shield drain circuits, and any other wiring installed by the Contractor pursuant to the requirements of these Specifications.

B. All circuits shall be rated power limited in accordance with NEC Article 760.

C. Installed in conduit or enclosed raceway.

D. All new system conductors shall be of the type(s) specified herein.

1. All initiating circuit, signaling line circuit, AC power conductors, shield drain conductors and grounding conductors, shall be solid copper, stranded or bunch tinned (bonded) stranded copper.
2. All signaling line circuits, including all addressable initiating device circuits shall be 18 AWG minimum multi-conductor jacketed twisted cable or as per manufacturer's requirements.

3. All non-addressable initiating device circuits, 24 VDC auxiliary function circuits shall be 18 AWG minimum or per manufacturer's requirements.
4. All notification appliance circuit conductors shall be solid copper or bunch tinned (bonded) stranded copper. Where stranded conductors are utilized, a maximum of 7 strands shall be permitted for No. 16 and No. 18 conductors, and a maximum of 19 strands shall be permitted for No. 14 and larger conductors.
5. All audible notification appliance circuits shall be 14 AWG THHN minimum twisted pairs or per manufacturer's requirements.
6. All visual notification appliance circuits shall be 14 AWG minimum THHN twisted pairs or per manufacturer's requirements.
7. All wiring shall be color-coded throughout, to National Electrical Code standards.

2.12 CONDUIT RACEWAY

A. All systems and system components listed to UL864 Control Units for Fire Protective Signaling System maybe installed within a common conduit raceway system, in accordance with the manufacture's recommendations. System(s)or system components not listed to the UL864 standard shall utilize a separate conduit raceway system for each of the sub-systems.

B. The requirements of this section apply to all system conduits, raceways, electrical enclosures, junction boxes, pull boxes and device back boxes.

C. All system conduits shall be of the sizes and types specified.

D. All system conduits shall be EMT, 3/4 -inch minimum, except for flexible metallic conduit used for whips to devices only, maximum length 6 feet, 3/4-inch diameter, minimum.

E. All system conduits, which are installed in areas, which may be subject to physical damage or weather, shall be IMC or rigid steel, 3/4 -inch minimum.

F. Conduits shall be sized according to the conductors contained therein. Cross sectional area percentage fill for system conduits shall not exceed 40%.

G. Existing conduit raceway system may be re-used where possible.

H. All fire alarm conduit systems shall be routed and installed to minimize the potential for physical, mechanical or by fire damage, and so as not to interfere with existing building systems, facilities or equipment, and to facilitate service and minimize maintenance.

I. All conduits, except flexible conduit whips to devices, shall be solidly attached to building structural members, ceiling slabs or permanent walls. Conduits shall not be attached to existing conduit, duct work, cable trays, other ceiling equipment, drop ceiling hangers/grids or partition walls, except where necessary to connect to initiating, notification, or auxiliary function devices.

J. All system conduits, junction boxes, pull boxes, terminal cabinets, electrical enclosures and device back boxes shall be readily accessible for inspection, testing, service and maintenance.

K. All penetration of floor slabs and firewalls shall be sleeved (1" conduit minimum) fire stopped in accordance with all local fire codes.

L. All junction box covers shall be painted red.

PART 3 - INSTALLATION

3.1 INSTALLATION CONDITIONS

A. All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation.

B. The entire system shall be installed in a workmanlike manner, in accordance with approved manufacturer's wiring diagram.

C. The Contractor shall be responsible to contract with the Existing LAWA Maintenance Contractor to program the Fire Works system at the Central Utilities Plant and to integrate with the existing EST3 system. The Contractor shall ensure current programming efforts are coordinated with other work and contractors.

3.2 INSTALLATION REQUIREMENTS

A. Concrete floors shall be X-rayed prior to core drilling.

B. All pull stations shall be mounted 48 inches above the finished floor, as measured on handle.

C. Pull stations currently mounted at the incorrect height shall be lowered accordingly when replaced.

D. All manual pull stations shall be flush mounted. Surface mounted pull stations shall be identified and requested prior to submittal. They shall only be allowed if approved by the Designer prior to installation. All surface mount pull station shall be provided w/ manufacturers listed back box.

E. All new audio/visual devices shall be mounted at a minimum of 80 inches and no more than 96 inches above the finished floor, as measured on strobe center. Devices shall be mounted no less than 6 inches from the ceiling.

F. No area smoke detectors shall be mounted within 36 inches of any HVAC supply, return air register or lighting fixture.

G. No area smoke or heat detector shall be mounted within 12 inches of any wall.

H. All fire alarm devices shall be accessible for periodic maintenance. Should a device location not meet this requirement, it shall be the responsibility of the installing contractor to bring it, in writing, to the attention of the Project Designer. Failure to bring such issues to the attention of the Project Designer shall be the exclusive liability of the installing Electrical Contractor.

I. End of Line Resistors shall be furnished as required for mounting as directed by the manufacturer.

J. Devices containing end-of-line resistors shall be appropriately labeled. Devices should be labeled so removal of the device is not required to identify the EOL device.

K. All addressable modules shall be mounted within 36 inches of the monitored or controlled point of termination. This shall include, but is not necessarily limited to, fan shutdown, elevator recall, shunt trip, sprinkler status points, or door release. Label all addressable modules as to their function.

L. Power-limited/Non-power-limited NEC wiring standards SHALL BE OBSERVED.

M. Auxiliary relays shall be appropriately labeled on the exterior to indicate "FIRE ALARM SYSTEM" and their specific function (i.e. FAN S-1 SHUTDOWN) to match existing.

3.3 TEST & INSPECTION

A. All fire alarm testing shall be in accordance with NFPA 72.

B. The system shall be pre-tested and documented prior to the final inspection by the AHJ. The LAWA shall be notified of the pretest 48 hours in advance and shall witness this test if desired.

C. The pre-test shall include the following:

1. All intelligent analog addressable devices shall be tested for current address, sensitivity, and user defined message.
2. All wiring shall be tested for continuity, shorts, and grounds before the system is activated.
3. Proper operation and execution of all it's sequences

D. Perform a magnahellic test on all new duct smoke detectors to verify proper installation. Provide a copy of all measurements to LAWA.

E. At the final test and inspection, a factory-trained representative of the system manufacturer shall demonstrate to the LAWA, his representative, and the local fire inspector all its sequence of operations and any additional tests required by the AHJ. In the event the system does not operate properly, the test may be terminated. Corrections shall be made and the testing procedure shall be repeated until it is acceptable to LAWA and the fire inspector.

3.4 TRAINING

A. The System Supplier shall schedule and present a minimum of (2) 4 hour segments of documented formalized instruction for the building, detailing the proper operation of the installed System. One training segment shall be available at the completion of the project. The second training segment may be required within the warranty period. Training shall be for a minimum of 10 personnel.

B. The instruction shall be presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.

C. The instruction shall cover the schedule of maintenance required by NFPA 72 and any additional maintenance recommended by the system manufacturer.

D. Instruction shall be made available to the Local Municipal Fire Department if requested by the Local Authority Having Jurisdiction.

END OF SECTION 28 31 00

Los Angeles World Airports

EXHIBIT A

FIVE YEAR EXTENDED PREVENTATIVE AND ROUTINE MAINTENANCE SERVICE AGREEMENT (SERVICE AGREEMENT) SPECIFICATIONS

FOR

ELEVATORS, ESCALATORS, and MOVING WALKS

AT THE

LOS ANGELES INTERNATIONAL AIRPORT

IN

THE CITY OF LOS ANGELES, CALIFORNIA

Los Angeles World Airports

GENERAL CONDITIONS

GC-1. SCOPE OF WORK

1.01 The Contractor agrees to furnish all labor, materials and equipment in strict compliance with the Work requirements, conditions and specifications identified in the Contract Documents.

1.02 It is expressly understood and agreed that the Contractor shall perform all incidental work required to fulfill the requirements of the Contract Documents. All such incidental work shall not be considered Change or Extra Work for which additional compensation can be claimed by the Contractor.

GC-2. NOT USEDAUTHORIZED REPRESENTATIVE OF THE CITY The Engineer and/or Director of Maintenance, represents LAWA, the City, the Board and the Executive Director within the limits of the City Charter and the administrative requirements of both the City on all matters relating to this Service Agreement.

3.01 The Engineer and/or Director of Maintenance or designated representative has the final authority in all matters affecting the Work and the authority to enforce compliance with the Service Agreement. The Contractor shall promptly comply with the instructions of The Engineer and/or Director of Maintenance or its authorized representative.

GC-4. INSURANCE

4.01 Contractor shall procure at its expense, and keep in effect at all times during the term of this Service Agreement the following types and amounts of insurance:

COVERAGE TYPE	POLICY LIMITS
A. Worker's Compensation	Statutory
B. Automobile Liability including i. Any Auto ii. ii. Hired Autos iii. iii. Non-owned Autos)	$10 Million Combined Single Limit ("CSL")
C. Aviation/Airport Liability	$10 Million CSL
OR	
Commercial General Liability (including the following coverages: i. Premises and Operations ii. Contractual Liability (Blanket/Schedule) iii. Independent Contractors iv. Personal Injury v. Products/Completed Operations) vi. Explosion, Collapse & Underground vii. Broad Form Property Damage	$10 Million CSL
D. Professional Liability	$1 Million CSL
E. Employer's Liability	$1 Million CSL

4.02 The specified insurance (except for Workers' Compensation, Employers' Liability and Professional Liability) shall also, either by provisions in the policies, by City's own endorsement form or by other endorsement attached to such policies, include and insure City, its Department of Airport, the Board, and

all of its officers, employees and agents, their successors and assigns, as insureds, against the areas of risk described in Section 4.01 hereof as respects Contractor's acts or omissions arising out of the performance of this Agreement, Contractor's acts or omissions in its operations, use and occupancy of the premises hereunder or other related functions performed by or on behalf of Contractor at the Airport.

4.03 Waiver of Subrogation. For commercial general liability insurance, workers' compensation insurance, and employer's liability insurance, the insurer shall agree to waive all rights of subrogation against City for Losses arising from activities and operations of Contractor insured in the performance of Services under this Service Agreement.

4.04 Sub-Contractors. Contractor shall include all of its Sub-Contractors as insureds under its policies or shall furnish separate certificates and endorsements for each Sub-Contractor. All coverages for Sub-Contractors shall be subject to all of the requirements stated herein unless otherwise agreed to in writing by Executive Director and approved as to form by the City Attorney.

4.05 Each specified insurance policy (other than Workers' Compensation and Employers' Liability and Professional Liability) shall contain a Severability of Interest (Cross Liability) clause which states, "It is agreed that the insurance afforded by this policy shall apply separately to each insured against whom claim is made, or suit is brought, except with respect to the limits of the company's liability." Additionally, Contractor's Commercial General Liability policy ("Policy") shall provide Contractual Liability Coverage, and such insurance as is afforded by the Policy shall also apply to the tort liability of the City of Los Angeles assumed by the Contractor under this Service Agreement.

4.06 All such insurance shall be primary and noncontributing with any other insurance held by City's Department of Airports where liability arises out of, or results from, the acts or omissions of Contractor, its agents, employees, officers, invitees, assigns, or any person or entity acting for, or on behalf of, Contractor.

4.07 Such policies may provide for reasonable deductibles and/or retentions acceptable to the Executive Director, based upon the nature of Contractor's operations and the type of insurance involved.

4.08 City shall have no liability for any premiums charged for such coverage(s). The inclusion of City, its Department of Airports, its Board, and all of its officers, employees and agents, and their agents and assigns, as additional insureds, is not intended to, and shall not; make them, or any of them, a partner or joint venturer of Contractor in its operations at the Airport.

4.09 In the event Contractor fails to furnish City evidence of insurance, or to maintain the insurance as required under this Section, City, upon ten (10) days' prior written notice to Contractor of its intention to do so, shall have the right to secure the required insurance at the cost and expense of Contractor, and Contractor agrees to promptly reimburse City for the cost thereof, plus fifteen percent (15%) for administrative overhead.

4.10 At least thirty (30) days prior to the expiration date of any of the above policies, documentation showing that the insurance coverage has been renewed or extended shall be filed with the City. If any such coverage is cancelled or reduced, Contractor shall, within ten (10) days of such cancellation or reduction of coverage, file with City evidence that the required insurance has been reinstated, or is being provided through another insurance company or companies.

4.11 Contractor shall provide proof of all specified insurance and related requirements to City either by production of the actual insurance policy(ies), by use of City's own endorsement form(s), by broker's letter acceptable to Executive Director in both form and content in the case of foreign insurance syndicates, or by other written evidence of insurance acceptable to Executive Director. The documents evidencing all

specified coverages shall be filed with City prior to the Contractor performing the services hereunder. Such documents shall contain the applicable policy number(s), the inclusive dates of policy coverage(s), the insurance carrier's name(s), and they shall bear an original or electronic signature of an authorized representative of said carrier(s). Such insurance shall not be subject to cancellation, reduction in coverage or non-renewal, except after the carrier(s) and the Contractor provide written notice (by Certified Mail) to the City Attorney of the City of Los Angeles at least thirty (30) days prior to the effective date thereof.

4.12 City and Contractor agree that the insurance policy limits specified in this Section shall be reviewed for adequacy annually throughout the term of this Service Agreement by the Executive Director, who may thereafter require Contractor to adjust the amount(s) of insurance coverage(s) to whatever amount(s) Executive Director deems to be adequate. City reserves the right to have submitted to it, upon request, all pertinent information about the agent(s) and carrier(s) providing such insurance.

GC-5. CITY HELD HARMLESS

5.01 To the fullest extent permitted by law, Contractor shall defend, indemnify and hold harmless City and any and all of City's Boards, officers, agents, employees, assigns and successors in interest from and against any and all suits, claims, causes of action, liability, losses, damages, demands or expenses (including, but not limited to, attorney's fees and costs of litigation), claimed by anyone (including Contractor and/or Contractor's agents or employees) by reason of injury to, or death of, any person(s) (including Contractor and/or Contractor's agents or employees), or for damage to, or destruction of, any property (including property of Contractor and/or Contractor's agents or employees) or for any and all other losses alleged to arise out of, pertain to, or relate to the Contractor's and/or Sub-Contractor's performance of the Service Agreement, whether or not contributed to by any act or omission of City, or of any of City's Boards, officers, agents or employees; Provided, however, that where such suits, claims, causes of action, liability, losses, damages, demands or expenses arise from or relate to Contractor's performance of a "Construction Contract" as defined by California Civil Code section 2783, this paragraph shall not be construed to require Contractor to indemnify or hold City harmless to the extent such suits, causes of action, claims, losses, demands and expenses are caused by the City's sole negligence, willful misconduct or active negligence.

5.02 In addition, Contractor agrees to protect, defend, indemnify, keep and hold harmless City, including its Boards, Departments and City's officers, agents, servants and employees, from and against any and all claims, damages, liabilities, losses and expenses arising out of any threatened, alleged or actual claim that the end product provided to LAWA by Contractor violates any patent, copyright, trade secret, proprietary right, intellectual property right, moral right, privacy, or similar right, or any other rights of any third party anywhere in the world. Contractor agrees to, and shall, pay all damages, settlements, expenses and costs, including costs of investigation, court costs and attorney's fees, and all other costs and damages sustained or incurred by City arising out of, or relating to, the matters set forth above in this paragraph of the City's "Hold Harmless" agreement.

5.03 In Contractor's defense of the City under this Section, negotiation, compromise, and settlement of any action, the City shall retain discretion in and control of the litigation, negotiation, compromise, settlement, and appeals there from, as required by the Los Angeles City Charter, particularly Article II, Sections 271, 272 and 273 thereof.

5.04 Survival of Indemnities. The provisions of this GC-5 shall survive the termination of this Agreement.

GC-6. STANDARD OF CARE

6.01 Contractor's professional services rendered in the performance of this Service Agreement shall conform to the highest professional standards for said designated professional fields in the State of California.

GC-7. NOT USED

GC-8. CONTRACT BONDS

8.01 All provisions of Vertical Transportation General Provisions, Section 14 20 00 shall apply.

8.02 The Faithful Performance Bond and the Payment Bond shall each be for one hundred percent (100%) of the Service Agreement price. The Contractor shall submit both the Faithful Performance Bond and Payment Bond no less than thirty days prior to the expiration of the Warranty Period, with receipt and approval by LAWA and the City Attorney a condition of Final Acceptance of the Procurement and Installation Contract. Both bonds shall be maintained by the Contractor in full force and effect until the Service Agreement term is complete, and until all claims for materials and labor are paid, and shall otherwise comply with Section 3248 of the Civil Code.

8.03 Should any bond become insufficient, the Contractor shall renew the bond within 10 days after receiving notice from The Engineer and/or Director of Maintenance.

8.04 The mutually agreed optional second 5-year Extended Preventative and Routine Maintenance (EPRM) Service Agreement period shall maintain all bond requirements set forth herein.

GC-9. NOT USED

GC-10. ASSIGNMENT OR TRANSFER PROHIBITED

10.01 Contractor shall not, in any manner, directly or indirectly, by operation of law or otherwise, hypothecate, assign, transfer or encumber this Service Agreement, or any portion thereof or any interest therein, in whole or in part, without the prior written consent of the Executive Director. The names of Subcontractors or others whom Contractor intends to employ to perform services as part of the Work shall be submitted to Executive Director for prior approval.

10.02 For purposes of this Service Agreement, the terms “transfer” and “assign” shall include, but not be limited to, the following: (i) if Contractor is a partnership or limited liability company, the transfer of fifty percent (50%) or more of the partnership interest or membership or the dissolution of the Contractor; and, (ii) if Contractor is a corporation, any cumulative or aggregate sale, transfer, assignment, or hypothecation of fifty percent (50%) or more of the voting shares of Contractor.

GC-11. NOT USED

GC-12. NOT USED

GC-13. NOT USED

GC-14. NOT USED

GC-15. NOT USED

GC-16. NOT USED

GC-17. NOT USED

GC-18. NOT USED

GC-19. WAIVER

19.01 The waiver by City of any breach of any term, covenant, or condition herein contained shall not be deemed to be a waiver of any other term, covenant, or condition, or of any subsequent breach of the same term, covenant, or condition.

GC-20. NOT USED

GC-21. NOT USED

GC-22. TERMINATION

22.01 If, at any time, City, for any reason, decides to terminate the Service Agreement, or any part thereof, City may: 1) require Contractor to terminate the performance of all, or a portion, of its services; and/or 2) terminate this Service Agreement, or any part thereof, upon giving Contractor a thirty (30) day written notice prior to the effective date of such termination, which date shall be specified in such notice.

22.02 In the event this Service Agreement, or any portion hereof, is terminated by the City, City shall pay Contractor as set forth in Section GC-22.03 the amount due to the Contractor for Basic Services as set forth in the Service Agreement.

22.03 City shall not be liable for the cost of work performed or expenses incurred subsequent to the date specified by City in the thirty (30) day written notice to terminate, and in no event shall any payments to be paid by City to Contractor, exceed the amount(s) specified, without the prior approval of the City, and unless this Service Agreement is first amended in writing. Any such payments shall be made by City within a reasonable time following receipt of Contractor's invoice(s) therefor.

22.04 City may, at any time, upon written order to Contractor, require Contractor to stop all, or any part, of the services called for by this Service Agreement for a period of thirty (30) days. Said thirty (30) day period shall commence on the day the written order is delivered to Contractor, and shall extend for any further period to which the parties may agree. Any such order shall be specifically identified as a "Stop Work Order" issued pursuant to this clause. Upon receipt of such an Order, Contractor shall forthwith comply with its terms. Within a period of thirty (30) days after a Stop Work Order is delivered to Contractor, or within any extension of that period to which the parties have agreed, City shall either:

a. Cancel the Stop Work Order; or

b. Terminate the services as provided in the Service Agreement. If a Stop Work Order issued under this Section is canceled or expires, or the period of any extension thereof is canceled or expires, Contractor shall resume work. An equitable adjustment will thereafter be made in Contractor's time of performance, Contractor’s compensation, or both, consistent with the provisions of this Service Agreement, if:

   1. The Stop Work Order results in an increase in the time required for, or in Contractor's cost properly allocable to, the performance of services pursuant to this Service Agreement; and
   2. Contractor asserts a claim for such adjustment within thirty (30) days after the end of the period of work stoppage; provided, however, that City may investigate any facts relating to such claim.

   If a Stop Work Order is not canceled, and the services covered by such order are terminated for the convenience of City, the reasonable costs resulting from said Stop Work Order shall be allowed.

22.05 It is understood and agreed that should City decide that any portion of Service Agreement, and/or Contractor's services, shall be suspended or terminated, this Service Agreement shall continue to apply to that portion or those portions not suspended or terminated, and that such suspension or termination of a portion of Service Agreement or services shall in no way make void or invalid this Service Agreement.

22.06 At the termination of this Service Agreement, the Contractor shall deliver to LAWA all records and documentation, including, but not limited to manuals, operations manuals, service records, drawings, computer programs (including applicable software source codes), procedures, and records which the Contractor has used to maintain the equipment. All such records and documents shall remain the sole property of LAWA. The system shall be returned to LAWA in the same or better condition as it was delivered to the Contractor with the exception of reasonable wear and tear.

GC-23. PROTECTION AND RESTORATION OF EXISTING IMPROVEMENTS

23.01 The Contractor shall conduct the operations in a manner that avoids injury or damage to adjacent property and improvements. If damaged or removed due to the Contractor's operations, they shall be restored or replaced in as nearly the original condition and location as is reasonably possible. When ordered by LAWA, the Contractor shall provide and install suitable safeguards to protect any object from injury or damage.

GC-24. PUBLIC CONVENIENCE AND SAFETY

24.01 All provisions of the Contract Documents shall apply.

24.02 The Contractor shall be liable for any damage caused to such premises. The Contractor shall restore areas used for operations or for storage, and all areas adjacent to the construction to their original condition.

GC-25. RESPONSIBILITIES OF THE CONTRACTOR

25.01 All provisions of the General Provisions shall apply.

25.02 The Contractor's employees shall be restricted to immediate work areas at the Site, and shall not go beyond work limits or access routes, except as otherwise approved by LAWA.

25.03 All employees must have a LAWA security badge with a Customs Seal and insurance as required for unescorted access to the Airport’s Security Identification Display Area (SIDA).

25.04 The Contractor shall be responsible for providing and maintaining all tools and all necessary vehicles, including, but not limited to scissor lifts, fork-lift trucks, golf carts, etc. that will be used under this Service Agreement. There will be no additional costs to LAWA for these items, and shall be included as part of Contractor’s rates.

25.05 Before starting work, the Contractor shall designate in writing a representative who shall have complete authority to act on the Contractor's behalf.

25.06 LAWA reserves the right to:

a. Disapprove any candidate named as the Contractor's representative or alternate who fails to meet the provisions set forth herein.

b. Remove, without any right to work on the work site, either the Contractor's representative or alternate, who in the sole opinion of LAWA has demonstrated incompetence, lack of ability, or

other unsuitability to perform supervision of the Work; and that individual shall not, without permission of LAWA, be re-employed on this Service Agreement.

25.07 If the Contractor's representative or alternate leaves the employment of the Contractor, the Contractor will be required to replace the individual(s) within fifteen (15) days.

25.08 The Contractor shall be responsible for obtaining, at its own expense, all necessary licenses and permits. The Contractor shall be responsible for all damages to persons or property that occur as a result of the Contractor's negligence and shall take proper safety and health precautions to protect the work, workers, the public and the property of others.

GC-26. RESPONSIBILITIES OF LAWA

26.01 LAWA will designate its representative whom the Contractor shall coordinate all operational requirements and activities, concerning, but not limited to rules and regulations, safety, enforcements, notifications to stakeholders and airlines.

26.02 LAWA shall pay the reasonable cost of utilities (electric, gas, etc.) used in the course of performing the Service Agreement activities. LAWA will be the exclusive judge of the reasonableness of claimed utility charges.

26.03 LAWA shall reimburse the Contractor for approved work performed on the units that is required due to damage caused to the units by others. The Contractor will be reimbursed in accordance with the agreed upon rate for such work.

GC-27. INTERFACE

27.01 The Contractor shall conduct all operations in a manner that will cause no interference with airplane traffic, passenger flow or normal operation of the Airport. In all operations, the Contractor shall be governed by the regulations and rules of LAWA and shall cooperate fully with LAWA.

27.02 Contractor shall also comply with all applicable laws and regulations and shall hold all necessary consultations and conferences with personnel of any and all City, County, State, or Federal agencies, including, but not limited to the City of Los Angeles, FAA, DHS, TSA, USCBP, LAXTEC, which may have jurisdiction.

GC-28. SAFETY

28.01 During the term of this Service Agreement, The Contractor shall provide all materials, resources, training and any and all services required to ensure that the systems can be safely operated and maintained in conformance with LAWA and the approved documents developed by the elevator/escalator OEM in conformance with industry standards.

28.02 Contractor shall at all times conduct all operations under the Service Agreement in a manner to avoid the risk of bodily harm to persons or risk of damage to any property. Contractor shall promptly take all precautions which are necessary and adequate against any conditions which involve a risk of bodily harm to persons or a risk of damage to any property. Contractor shall continuously inspect all Work, materials and equipment to discover and determine any such conditions and shall be solely responsible for discovery, determination and correction of any such conditions.

28.03 Contractor shall submit their written Safety Program, with detail commensurate with the Work to be performed, for LAWA's review within 30 days of expiration of the 1-year warranty period. Such review and approval shall not relieve Contractor of its responsibility for safety, nor shall such review be construed

as limiting in any manner Contractor's obligation to undertake any action which may be necessary or required to establish and maintain safe working conditions at the facility.

28.04 Contactor shall maintain accurate accident and injury reports and shall furnish LAWA a monthly summary of injuries and man hours lost due to injuries as well as a statement of total man hours worked.

28.05 Material usage by the Contractor shall be accomplished with strict adherence to California Division of Industrial Safety requirements and all manufacturer warnings and application instructions listed on the material Safety Data Sheet and on the product container label.

28.06 The Contractor shall notify LAWA if a specified product cannot be used under safe conditions.

28.07 Worker Protection: In all cases involving exposure of personnel to toxic/hazardous materials and/or elements, the City of Los Angeles Personnel, Occupational Safety Office, shall have field review authority over the Contractor's operations.

GC-29. ADVERTISING

29.01 No use of information related to the Work is permitted without the written approval of LAWA.

29.02 All signage, logos, placards, displays, etc. are subject to written approval by LAWA.

GC-30. AUDITS AND RECORDS

30.01 LAWA shall have access to all records and documents of the Contractor directly relating to labor and materials used for the performance of the work in this Service Agreement.

GC-31. PAYMENT

31.01 It is agreed that, regardless of any other provision of this Service Agreement, unless amended, the total amount to be paid to Contractor by City shall not exceed the amount indicated in the Contractor's proposal.

31.02 Each month, during the term of this Service Agreement, Contractor shall submit a Request For Payment for 1/60 of the amount specified in 31.01.

31.03 Each Request For Payment shall contain documentation acceptable to LAWA that include applicable employee and subcontractor time sheets, identification of the scope of work completed, billing by job classifications and the applicable approved billing rates. Each Request For Payment shall also contain a cumulative total of all monthly billings, and balances. Subject to the provisions of this Service Agreement, LAWA shall pay Contractor based on Contractor's monthly payment requests. Payment will be withheld for any Work not completed in the billing period.

GC-32. NOT USED

GC-33. CONTRACTOR STAFFING

33.01 If LAWA at its sole discretion is dissatisfied with the performance of any of Contractor's personnel, including personnel of Contractor's sub-Contractors, assigned to the Work, and so notifies Contractor, in writing, Contractor shall replace the person(s) to whom objection has been made within five (5) working days of the written notice. City, in exercising its rights may also, in its sole discretion direct Contractor to terminate one or more its sub-consulting agreements.

Los Angeles World Airports

SPECIAL CONDITIONS

SC-1. INTRODUCTION

1.01 The general scope of work is to provide complete Extended Preventative and Routine Maintenance (EPRM), services for the elevators, escalators and moving walks (equipment) installed as part of this Procurement and Installation Contract at LAX. Services include repairs, adjusting, cleaning and lubrication of equipment.

1.02 Any other incidental services that the Contractor determines to be required to assume complete responsibility for EPRM of the new equipment that are not described herein shall be included as part of the Service Agreement costs.

1.03 The Contractor shall have contractual agreements with each of its sub-contractors whose services the Contractor may secure to perform work under this Service Agreement and is in compliance with all of the terms of this Service Agreement. In the event that the Contractor subcontracts certain portions of the work, the term "employee" as used herein shall be deemed to include such subcontractors and their employees.

SC-2. SITE SPECIFIC WORK PROCEDURES AND PROGRAMS

2.01 The Contractor is solely responsible for obtaining any procedures from LAWA prior to commencement of Work and hereby releases LAWA from any and all claims based upon its failure to either become familiar with the governing procedures and programs or its failure to comply with them.

2.02 Contractor is responsible for obtaining copies of any and all approved O&M manuals, drawings, updates, and other documents required to perform all services to the referenced systems called for in this Service Agreement.

2.03 Contractor shall have hardcopy prints of all manuals, drawings, etc. at all times, and update as needed to reflect operation of new or modified systems.

2.04 Any document referenced in this Service Agreement shall become part of the Service Agreement documents.

SC-3. SUBMITTALS

3.01 Contractor shall submit the following documentation at the time specified during the term of the Service Agreement and in accordance with the following submittal deadlines. Prepare all documents in the English language.

a. Contractor's Safety Plan and Drug Policy – Prior to start of any work.

b. Problem Reports - On a monthly basis

c. Maintenance Reports - On a monthly basis

d. Invoices – No later than 10 days from the first day of each following calendar month

SC-4. TERM OF SERVICE AGREEMENT

4.01 The term of this Service Agreement shall be for the five year period commencing immediately upon expiration of the 1-year Warranty for each unit.

SC-5. WORKING HOURS

5.01 Unless restricted elsewhere in the Service Agreement Documents, or directed by LAWA in writing, the normal working hours for services performed while the units remain in service are 8 a.m. to 4:30 p.m., 7 days a week for the term of the Service Agreement.

5.02 Normal working hours for services requiring the units to be taken out of service are 10:30 p.m. to 6:30 a.m., 7 days a week for the term of the Service Agreement. All units shall be returned to service and opened to the public by 6:30 a.m. following the maintenance or repair services. It is anticipated that 85% of the mandated PM hours will fall during this time period.

SC-6. SERVICE CALLS

6.01 The Contractor shall have staff to respond to and provide emergency services twenty-four (24) hours a day, seven (7) days a week. The Contractor shall respond within 30 minutes when the emergency call includes equipment failure, personal injury, entrapment, or potential for personal injury.

6.02 The Contractor shall also maintain an Emergency Service Call Log containing the following:

- Name and telephone number of caller.
- Description of problem and location within the Terminal where problem exists.
- Time and date call was received.
- Description of action taken to resolve the problem and time and date action was taken.

SC-7. WORK RESPONSE TIME

7.01 Response time for work requirements is dependent upon work priority and shall be in accordance with the standards noted below. Any non-compliance with the specified standards and requirements may result in the Contractor being issued a written notification by LAWA.

7.02 Emergency Work: The Contractor shall have available personnel to take action at the emergency location within thirty (30) minutes following notification by LAWA or other designated official.

a. Emergency Work is defined as any mechanical, electrical or controls issue that cannot be resolved within ten (10) minutes or any mechanical problem in which the vertical transportation device is not usable by LAWA. It also includes breakdown, stoppage or loss of critical system or equipment which, if not repaired, could endanger life, safety or health of personnel or might result in the damage to LAWA property, or any condition that they may exist which LAWA determines requires immediate response.

SC-8. NOT USED

SC-9. OPERATION OF VEHICLES

9.01 Contractor's ability to park at Terminals is controlled by LAWA. LAWA shall permit the Contractor and its personnel, during the effective period of Service Agreement to purchase parking pass cards to park motor vehicles used by it exclusively in its operations hereunder in the designated parking lots. The Contractor shall comply with such existing rules, regulations and procedures as are now in force and such reasonable future rules, regulations and procedures as may hereafter be adopted by the LAWA for the safety and convenience of persons who park automotive vehicles in any parking area at the airport or for the safety and proper identification of such vehicles, and the Contractor shall also comply with any and all directions pertaining to such parking which may be given from time to time and at any time by the Airport Manager. LAWA shall have no responsibility of any kind whatsoever, including, without limitation thereto, the loss, theft, destruction or damage to said vehicle or any contents therein, in connection with the permission granted to the Contractor to park its motor vehicles. No other rights or privileges in connection with parking of motor vehicles at the Airport are or shall be deemed to be granted to the Contractor under Service Agreement.

9.02 Each vehicle or unit of equipment that travels, operates or delivers materials in any restricted area of the Airport shall comply with the regulation set forth in Appendices B, C and D.

SC-10. UNIFORMS

10.01 The Contractor shall provide its personnel with all necessary distinctive uniforms and identification badges and woven identification insignia of a type and style which shall be subject to the prior and continuing approval of C&M. Contractor's employees shall wear these uniforms and identification badges or insignias at all times while performing the operations hereunder. The Contractors' employee shall be neat, clean, and professional in appearance.

SC-11. WORKMANSHIP AND MATERIALS

11.01 All repair and replacement materials, parts, and equipment furnished by the Contractor in the Work shall be new, high grade, of the same manufacture and type as material and items being replaced and free from defects. Materials and work quality not conforming to the requirements of the Specifications shall be considered defective and will be subject to rejection. Defective work or material, whether in place or not, shall be removed immediately from the site by the Contractor, at its expense, when so directed by LAWA.

11.02 If the Contractor fails to replace any defective or damaged work or material within 10 days after reasonable notice, LAWA may cause such work or materials to be replaced. The replacement expense shall be deducted from the amount to be paid to the Contractor.

SC-12. OWNER-FURNISHED MATERIALS AND EQUIPMENT

12.01 The Contractor shall maintain all required Spare Parts at all times with, at a minimum, quantities of spare parts equal to or greater than that which are present at the start of the Service Agreement, and as specified by the OEM O&M Manual, or as directed by LAWA. The cost of all Non-Warranty Spare Parts replacement shall be invoiced back to LAWA in accordance with General Provisions.

12.02 The Contractor shall be responsible to accurately record spare parts purchases and inventory at all times.

12.03 At time of acceptance of materials from LAWA, Contractor shall sign a receipt. Signing of such receipt without reservation therein shall preclude any subsequent claim by the Contractor that any such items were received from LAWA in a damaged condition and with shortages. If at any time after acceptance of any such item from LAWA any such item is damaged, lost, stolen or destroyed, such item shall be repaired or replaced at the expense of the Contractor.

12.04 Upon completion of the 5-year Service Agreement, Contractor shall, at its expense, return all surplus and unused materials and parts to LAWA.

SC-13. CONTRACTOR SUPPLIES

13.01 The Contractor shall furnish all incidental supplies, materials, tools, and equipment necessary for the performance of the work in the Service Agreement, unless otherwise specified. The costs for these incidentals shall be inclusive of this Service Agreement.

SC-14. FACILITIES USED BY THE CONTRACTOR

14.01 General

a. Limited facilities such as storage and workshop space may be furnished by LAWA. The Contractor shall be fully responsible and liable for the facilities made available to it, to include security, loss or damage thereto. This responsibility includes the observance of safety, security and sanitary directives. Facilities built or installed by Contractor must be removed at termination of the Service Agreement, unless the Contractor and LAWA agree to their presence. The Contractor may not use any LAWA facilities other than those specifically provided. In case of break-ins, the Contractor shall notify Airport Police immediately upon discovery and assist in determining loss. Notwithstanding this paragraph, in no instance is the Contractor made liable for loss or damage of LAWA furnished facilities when the loss or damage was not caused by Contractor's negligence.

b. Access to Premises: The Contractor shall not permit any unauthorized access to individuals to the work area, and shall enforce all applicable LAWA orders, rules, regulations, and instructions. These requirements shall also be applicable to all individuals with regard to access, removal, and/or possession of classified data, materials, supplies, equipment and all LAWA owned property at the locations designated in Service Agreement. Access to FIS areas is controlled by the Federal Agencies and subject to their rules and restrictions. Contractors' employees working in the FIS areas are subject to extensive background checks by these Agencies.

c. Equipment and materials located on the Airport, but not being used, shall be left at locations to be designated by LAWA. All other operations of the Contractor shall be confined to the areas authorized or approved by LAWA. Areas adjacent to the work will be made available for temporary use by the Contractor, without cost, whenever such use will not interfere with other purposes. The Contractor shall be liable for any damage caused to such premises. The Contractor shall restore areas used for operations or for storage, and all areas adjacent to the work, to their original conditions.

14.02 Cleaning of Site: The Contractor shall be responsible for keeping the work site clean and neat. As necessary, debris shall be removed to an approved disposal location. Areas used by the Contractor during its work shall be cleaned daily before leaving the job site. Items saturated with combustible fluids shall be stored in tightly sealed metal containers and removed from the Work location. Paints and thinners shall not be poured into Terminal drains, lines or sewers. Paint, dirt and other stains on surfaces of Terminals, which are caused by the Contractor's work, shall be carefully removed and the surfaces cleaned. All areas used by the Contractor shall be left in a clean and neat condition.

SC-15. NOT USED

SC-16. NOT USED

SC-17. NOT USED

SC-18. BASIC MAINTENANCE REQUIREMENTS

18.01 General

a. The Contractor shall facilitate proactive preventive maintenance, maximize equipment life and maximize beneficial usage of the vertical transportation equipment covered by this Agreement. Contractor expressly acknowledges that City is relying on CONTRACTOR'S professional expertise and knowledge of covered equipment in the performance of Services to achieve desired results.

b. The Contractor shall provide the EPRM of the vertical transportation systems installed in this Service Agreement in conformance with the LAWA approved O&M Manuals. Services shall strictly comply with all services necessary to maintain the equipment in proper working order for use at a major international airport, and in coordination with LAWA.

c. The Contractor shall be responsible to provide (employ) Senior / Supervising Maintenance Technicians that are licensed elevator mechanics. The Contractor must also possess a valid C-11 Contractor's License. The Contractor shall be responsible for all labor, personnel and employee costs.

d. The Contractor shall be capable of operation, maintenance, trouble-shooting, updating and repairing the equipment computer systems and software.

e. The Contractor shall be responsible for the procurement of all tools and equipment required to perform preventative maintenance and repair functions. Any tools that are required to perform specific maintenance tasks on OEM supplied equipment will be supplied by the OEM as part of the equipment supply and installation. The Contractor shall be responsible for all contracted goods and services.

f. The Contractor shall be responsible to coordinate and cooperate in all respects with LAWA, the user airline, and/or their representatives in the performance of the Contractor's work. EPRM and non-scheduled maintenance tasks shall be coordinated with and scheduled in concurrence with LAWA. The Contractor shall be required to submit a preventative maintenance schedule to LAWA for review.

g. The Contractor shall be responsible for ensuring that the Contractor's personnel follow Customs and Border Protection (CBP) rules and requirements when working in Customs areas.

h. The Contractor shall be responsible for all sundries and components, lubricants, supply and inventory costs.

i. The Contractor shall be responsible for all safety equipment costs.

j. The Contractor shall be responsible for all license fees and expenses.

k. The Contractor shall be responsible for all office supplies, equipment and expenses.

l. The Contractor shall be responsible for all computers, printing, photographs, records, documents and report expenses.

m. The Contractor shall be responsible for all telephone, radio and communication expenses.

n. The Contractor shall be responsible for all Contractor facility and utility expenses.

o. The Contractor shall be responsible for all vehicle expenses.

p. The Contractor shall be responsible for all travel time and travel related expenses.

q. The Contractor shall be responsible for all excise taxes and fuel surcharges.

r. The Contractor shall be responsible for any and all other payments, costs and expenses associated with the Contractor's complete fulfillment of the requirements and obligations as set forth in this Agreement.

18.02 Basic Maintenance Requirements

a. Service Agreement tasks include, but are not limited to:

1. Inspection of completed installation and Periodic testing, as defined by ASME A17.1 and at ASME A17.1-1996 intervals, to maintain each Moving Walk/Elevator/Escalator ("Unit(s)") in completely operable, like new condition.
2. Provide preventative maintenance on each elevator at least monthly for a minimum of four (4) hours. (Total On-Site Time). Provide monthly documentation of the same to LAWA.
3. Provide preventative maintenance on each escalator and moving walkway at least a minimum of four (4) hours each two weeks. (Total On-Site Time). Provide monthly documentation of the same to LAWA. An external review of comb plates and skirt/step clearances will be performed weekly.
4. Periodic lubrication of parts and equipment components as per OEM's recommendation. Charts are to be provided for each Unit indicating when services are provided.
5. Perform work without removing Units from service during peak traffic periods determined by LAWA as 7:00 a.m. to 10:30 p.m. daily.
6. Unlimited regular time callbacks are included with a required response time of one (1) hour. Regular time will be Monday through Friday, 8:00am to 4:30pm, exclusive of holidays. Overtime\Premium time call backs originating from an operational error related to the performance requirements of the equipment shall be borne by the Contractor.

7. Annual clean down of the Units, drip pans, pits, hoistways, pallets, hydraulic pumps and components, and all interior parts is required. Make necessary arrangements with LAWA in order to minimize any inconvenience.
8. Annual tests and confirmations that the Controllers and control systems are functioning properly for each Unit.
9. Reporting: Detailed monthly records of tasks performed including names of individuals performing the tasks, date and time performed, and other pertinent data. Contractor is required to conform to the requirements of LAWA's maintenance system.
10. Five-year, full load, full speed tests of buffers ,governors and safeties.
11. Five year pressure tests on hydraulic elevators.
12. Monthly Testing of Phase I and Phase II Firefighter's Service.

b. Routine Maintenance - Activities such as routine inspections and tests designed to identify any unusual or abnormal equipment condition.

c. Preventative Maintenance ("PM") - Activities required to keep the Units operating at the prescribed levels of safety, efficiency and reliability as defined in the O&M Manuals and installation specifications, which are performed on a regular basis at specified intervals. Preventative measures shall also include cleaning the surrounding area as required to keep Units free from any trash, dirt and/or debris.

d. Non-Scheduled Maintenance - Any corrective measure or repair necessitated by an inspection, a failure, or unusual circumstances adversely affecting the normal equipment operation. Non-scheduled maintenance may be required as a result of unsatisfactory conditions discovered during an inspection.

e. Ordinary Wear - Any corrective measure or repair that may be required because of ordinary wear.

f. Other Maintenance - Maintaining updated maintenance manuals, maintenance of testing equipment and tools, maintaining wiring diagrams, cleaning of equipment and equipment areas.

g. Hours Available for Maintenance Functions – shall be as stated in SC-5 and SC-18, or as approved by LAWA.

h. Repair and Replacement of Damaged Parts, Components or Materials

1. Contractor shall promptly repair and/or replace damaged parts, components or materials, regardless of the cause of such damage. Any and all replacement parts must be new and unused. LAWA will reimburse the Contractor for the cost of such repairs and replacements, in accordance with GP, where the need for the repairs did not result from:
   i. The routine operation and maintenance of the system.
   ii. The careless or negligent acts or omissions of the equipment OEM, Contractor's employees, suppliers, agents or subcontractors. There shall be no separate reimbursement for repairs or replacements for items covered by the warranties or guarantees provided by the OEM.
   iii. Normal wear and tear.
   iv. Contractors negligence.
2. LAWA requires the Contractor to provide sufficient resources to promptly repair the systems at all times.

3. Any additional costs not associated with this Service Agreement must be approved in advance by LAWA.

i. Replacement of Materials

1. If it is necessary for the Contractor to replace any materials, parts or components under this Service Agreement and LAWA is responsible for the cost, the Contractor shall first submit to LAWA, for approval, the name of the item, identifying number and quantity required, name of the proposed supplier and the proposed cost, and the amount that the Contractor intends to bill LAWA. LAWA's written approval is required before the purchase of any parts, components or material shall commence unless, if in the Contractor's opinion, it is needed to keep the Units in operation or is required to comply with any LAWA, city, or national safety requirements. Cost submittal shall be provided within 24 hours of equipment shutdown.

j. Testing Required By Applicable Codes and Agreement Documents:

1. The Contractor shall act as the City's agent for conducting or assisting in the conducting of all Authority Having Jurisdiction and Consultant tests and inspections required for vertical transportation equipment as part of this Agreement. Testing hours shall be at the sole cost and expense of Contractor.

i. Periodic tests:

(a) Contractor shall perform periodic tests as required by the ASME A17.1-2007 Safety Code for Elevators and Escalators at intervals dictated by ASME A17.1-1996, including compliance with the ASME A17.2.1 2007 Inspectors' Manual.
(b) Conduct monthly inspection and testing of the firefighters' service. Maintain test log in each machine/control room. Conduct semi-annual testing of emergency and standby power operation.
(c) When testing is required during working (See SC-18) hours, CONTRACTOR shall coordinate with the City and Code authorities as to minimize disruptions of service to the Airport. City retains the right to have testing performed during non-operating hours when possible.
(d) When required by Local Code Authority or LAWA's Representative, assist in Routine and Periodic inspections and audits of equipment at no additional cost to City.
(e) Provide Routine and Periodic inspections of escalators and moving walks per ASME A17.1, Sections 8.6.8 and 8.11.4. Frequencies shall be as described in ASME A17.1-1996.

2. Complete all repairs found to be necessary as a result of the above examinations, inspections and tests.
3. Inspection and Approvals: The Services shall be subject to inspection and approval by City or City's Representative and all applicable governmental authorities; provided, however, in no event shall any such inspection and/or approval by City or Representative of the City constitute an assumption of Contractor's duties and obligations or a waiver or release of liability or a release of any other obligations whatsoever of Contractor with respect to the Services performed by Contractor pursuant to this Agreement.

SC-19. REPORTS

19.01 Unless specified elsewhere in the Service Agreement, the following are minimum reports to be submitted to LAWA monthly:

1. Completed PM tasks
2. Preventative Maintenance Inspection Sheets and Maintenance Logs
3. Emergency Service Call Log
4. All records of maintenance, repair, testing, alteration, callback, etc., required by this Agreement, shall be kept in a computerized maintenance management system that can be accessed by City at any time during the Agreement. Hard copies of documents shall be made available within 48 hours of City's request.
5. Conduct monthly operational examinations and provide a written report thereof with a copy to the City.

SC-20. QUALITY CONTROL

20.01 The Contractor shall establish and maintain a complete QC program that is acceptable to LAWA and assures the requirements of Service Agreement are provided as specified. The QC Program shall be implemented on Service Agreement start date. A copy of the Contractor's QC Program shall be submitted to LAWA prior to start of work.

20.02 The Contractor's QC Program shall include the following:

a. An inspection system covering all the tasks and services to be provided by the Contractor. It shall specify areas to be inspected on a scheduled or unscheduled basis, the manner in which inspections are to be conducted and the individual who will do the inspection.

b. A method of identifying deficiencies in the quality of services performed before the level of service becomes unacceptable.

c. A file of all inspections or tests conducted by the Contractor, to include any corrective actions taken. This file shall be subject to LAWA review at all times during the performance of Service Agreement. The file shall be property of LAWA and shall be turned over to LAWA upon completion or termination of Service Agreement.

d. QC program shall be in compliance with Contractors, LAWA approved, Maintenance Control Program. The Code required Maintenance Control Program shall be posted in each machine/control room.

e. Codes and Ordinances:

1. All the work covered by these specifications is to be done in full accord with the state and local Codes, and ordinances as are in effect at the time of the execution of the contact and the ASME A17.1-2007 elevator safety orders. All of the elevator/escalator/moving walk related requirements of the local Building Department are to be fulfilled by the Contractor except for inspection fees.

2. The Contractor shall also provide maintenance and/or repairs to comply with any violation of the Governing Agencies and recommendations of casualty companies on due notice from the City, provided that such violations or recommendations did not exist prior to the date of the Agreement or after issuance by either party of any 30 or 90 day cancellation notice. Upon award of this Agreement any pre-existing condition falling within the scope of this Agreement will be covered. The requirement of any new attachments or parts on an elevator, escalator or moving walk, in addition to those on the now existing equipment, shall be the responsibility of the City.

f. Certificate of Inspection/Permit To Operate:

1. State or City inspection fees shall be paid by the City. Fees for re-inspection due to failure to eliminate deficiencies covered by this maintenance Agreement will be paid by the Contractor.

g. City's Right To Inspect and Require Work:

1. City reserves the right to make such inspections and tests whenever necessary to ascertain that the requirements of this AGREEMENT are being fulfilled. Deficiencies noted shall be promptly corrected at Contractor's expense. In no instance shall CITY be liable for the frequency or sufficiency of such inspections or tests.
2. If Contractor fails to perform the work required by the terms of this Agreement in a diligent and satisfactory manner, City may, after ten (10) days' written notice to Contractor, perform or cause to be performed all or any part of the work required hereunder. Contractor agrees that it will reimburse City for any expense incurred therefore, and CITY at its election may deduct the amount from any sum owing Contractor. The waiver by City of a breach of any provision of this Agreement by Contractor shall not operate or be construed as a waiver of any subsequent breach by Contractor. If the City so desires, a qualified Elevator Consultant reasonably acceptable to both parties may be retained by City to mediate any disputes.

h. Labor Laws:

1. The Contractor performing work under this Agreement shall comply with applicable provisions of all federal, state and local labor laws, and Union Labor Agreements.
2. Contractor hereby indemnifies and saves City and/or City's Representative from and against any and all costs, liabilities, and actions arising out of the violation or alleged violation of, or the non-compliance with or alleged non-compliance with, any Labor Laws and or Union Labor Agreements.