



1.1 GOALS

- A. The goal of this section is to provide guidance in the design of Mechanical HVAC systems to LAWA standards. The LAWA Mechanical Design Standards are a compilation of general design and construction practices that are already in place in our facilities, as well as recent discoveries that should be implemented throughout the facilities to maximize the performance of existing systems, minimize maintenance costs and improve the travelling public's experience. These standards are by no means an exhaustive description of all items practiced in our facilities; however, this document does present LAWA's standards for most of the major mechanical systems. If any discrepancy is found between these standards and the LAWA Design & Construction Handbook, the more restrictive standards shall take precedence.

1.2 GENERAL

A. Design Requirements

1. All systems and equipment shall comply with applicable building and mechanical codes, LAWA criteria, and the scope of project work.
2. Provide design, engineering, permits, installation, start-up, testing, adjusting, balancing, and commissioning of complete HVAC, plumbing and fire protection systems. The Contractor shall review all the documents and comply with the requirements.
3. Address the presence of hazardous materials. There is a high probability that portions of the existing HVAC systems, piping, insulation and the like may contain lead based-paint, asbestos containing materials (ACMs) and/or other materials classified as toxic or hazardous by LAWA, State or Federal regulations. The Contractor, and the Contractor's designer, must include the impact and abatement of hazardous materials on this project.
4. Designs shall utilize systems and products that are/have:
 - a. Long-life, industrial quality.
 - b. Readily-available products and components with service support available.
 - c. Maintainable arrangements with multiple units.
 - d. Readily available spare parts and materials that incorporate multiple equipment elements in key systems that can be provided for reduced capacity operation when portions are down for maintenance or failure.
5. The Design Consultant/Contractor shall perform a quality control review of all documents for completeness, constructability and coordination with all building trades.
6. Large Equipment Installation Sequencing:
 - a. In conjunction with other design disciplines, provide the necessary scheduling, sequencing, movement and positioning of large equipment into the building during construction, including provisions for temporary removal/replacement of existing building components.
7. Equipment Protection and System Protection:
 - a. Project specifications shall clearly indicate that all equipment and systems intended for a project shall be properly protected from damage, corrosion and weather during shipment, in-transit storage, job-site storage, field/shop prep, installation and checkout until the work is accepted by LAWA. Ends of piping, valves and fittings shall be protected from abuse and the entry of moisture.



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Electrical equipment controls and insulation shall be protected against moisture and water damage. LAWA may, at Contractor's risk and expense, disallow or reject the installation of previously approved equipment, if it is later determined to have deteriorated considerably during the Contractor's custody, such as during shipment, storage and/or installation.

8. Special and LAWA-Furnished Equipment:
 - a. Special types of equipment, including LAWA-furnished and contractor-installed materials, shall be coordinated for correct rough-in and attachment requirements.
9. Special Support and Anchors:
 - a. All equipment including piping supports, anchors, support guides, and pre-insulated versions thereof, which exerts force on the structure other than those forces produced by gravity, shall be designed to meet Code and detailed on the drawings and coordinated with structural engineer and appropriate fire protection drawings.
10. Maintenance Access and Clearance Requirements:
 - a. Maintenance Access is defined as the unobstructed space required for maintenance personnel to get to the equipment with the necessary tools and perform routine maintenance and repair of equipment. Maintenance Access may be provided from the floor, equipment platform, catwalk, maintenance lift, ladder, etc., depending on the specific location. AC units, valves, fans, piping, pumps and other equipment shall be coordinated with building construction to provide a minimum 30"x30" access door for maintenance and repair, unless an approved Exemption Request Form is obtained from LAWA PDG and FTSD Management. Equipment, piping and ducts shall be coordinated with other engineering disciplines. Accessibility for maintenance and repair shall be demonstrated graphically in the drawings.
 - b. AC units, valves, fans, piping, ducts, pumps and other equipment shall be reviewed for interferences that would prevent proper installation. Coordinate with LAWA Planning & Development Group (PDG) and Facilities & Technical Services Division Management (FTSD Management).
 - c. AC units, valves, fans, piping, pumps and other equipment shall have a minimum of 30" clearance on all sides, including above and below. Deviation from the code-mandated minimum 30" clearance and factory recommendations, whichever is greater, is not acceptable, unless an approved Exemption Request Form is obtained from LAWA PDG and FTSD Management. Clearance shall be demonstrated graphically in the drawings.
 - d. Where feasible, all equipment shall be arranged for maximum maintenance access, while reserving space for future equipment and future uses. Ensure that all components and equipment are easily accessible for maintenance and replacement. Coordinate with PDG and FTSD Management.
11. Access Panels:
 - a. The following applies where the code does not restrict access panel locks. All access panels in public restrooms, nursing rooms and pet relief rooms shall be provided with a lock. In public spaces, wall access panels located at a height of 8'-0" and below shall be provided with a lock. Locks shall be operated with a master key. See Guide Specification section "08 31 13 - Access Panels and Frames" for additional information.



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12. Isolation Valves :
 - a. Install valves to isolate each piece of equipment for maintenance and replacement requirements.
 - b. Temporary Isolation Valves: The Contractor shall remove all temporary isolation valves installed for ease of construction upon project completion.
13. Utilities:
 - a. Buildings or other structures shall not be constructed over existing or new utility lines except where such utility lines serve the buildings or structures. Utilities interfering with new construction shall be relocated as required. Where relocation is impractical, obtain an approved Exemption Request Form from LAWA PDG and FTSD Management.
 - b. All utility lines and equipment proposed to be abandoned shall be demolished and removed. The Engineer/Contractor shall submit demolition drawings identifying the piping and equipment to be demolished and removed.
 - c. All known and unknown utilities identified during construction shall be shown on the final record drawings, including the record digital data files. See the "LAWA Standards for the Construction Contract" section in the DCH for additional information.
14. Penetrations:
 - a. Piping/utility and duct penetrations through floors, walls and roofs shall be coordinated and identified on the architectural and structural construction drawings. Proper cross-referencing between drawings shall be done. Details for protection of all penetrations of fire resistive construction are required on plans submitted for construction approval permit.
15. All piping, conduits and ductwork shall be concealed from public view and protected from the weather, unless an approved Exemption Request Form is obtained from LAWA PDG and FTSD Management.

B. Drawings Requirements

1. Plan Coordination:
 - a. Work shall be coordinated with all disciplines to ensure that size and location of all required chases, soffits, access panel requirements, etc., are indicated on the plans. All pipes larger than 6" shall be drawn as double lines. Duct layout larger than 6" diameter shall be drawn as double lines.
2. Sectional Views and Elevations:
 - a. Sectional views and elevations that clearly define the details and space constraints shall be developed from floor plans included within the construction drawings. All equipment rooms shall have a minimum of two composite floor to ceiling sections with the cutting plane through the major axis that defines equipment sizes, and piping, and their relationship to architectural, structural and electrical installations. Identify the clearances necessary to perform preventive maintenance and space requirements for equipment servicing/disassembly by dimensioning, noting and/or cross-hatching.
3. Pump & Fan Rooms:
 - a. All equipment in Pump, Fan and miscellaneous mechanical rooms shall be designed and located to facilitate the removal, transport and replacement of the



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largest equipment component housed within the room. Room locations shall be depicted in plan view with expanded details shown by partial plans at a scale no less than 1/4" = 1' - 0".

4. Access to new and existing equipment, valves and other appurtenances:
 - a. Drawings to include the following note with a text height not less than 1/4":
“Contractor shall coordinate with PDG and FTSD Management to determine the location and clearance requirements of existing and new equipment, valves and other appurtenances within the limits of Work that will require access, maintenance or repair. Unless otherwise agreed upon in writing, provide minimum 30”x30” access door and a minimum of 30” clearance on all sides, including above and below. Deviation from the code-mandated minimum 30” clearance and factory recommendations, whichever is greater, is not acceptable, unless an approved Exemption Request Form is obtained from LAWA PDG and FTSD Management. The Work shall not restrict the ability to access, maintain or repair the existing or new equipment, valves and other appurtenances. Shop drawing shall accurately reflect access information.”
5. Drawing to include the following note: “Contractor is responsible for providing identification for HVAC equipment, valves and other appurtenances when concealed in the ceiling. See Guide Specification section “22 05 53 – Identification for Plumbing Piping and Equipment”, “23 05 23 – Identification for HVAC Piping and Equipment and 21 05 00 – Common Work Results for Fire Suppression.”
6. Isolation Valves:
 - a. Provide an isolation valve layout plan for the domestic cold water, domestic hot water, chilled water and heating hot water piping systems in the construction drawings to show the location of the valves.
7. Abandoned Utilities:
 - a. Existing abandoned utility lines and equipment found during construction shall be demolished and removed to the limits of Work. Coordinate with PDG and FTSD Management.
8. Maintenance Access Temporary Signage:
 - a. Temporary signage during construction noting maintenance access requirements shall be installed for ceiling mounted equipment such as VAVs, FCUs, etc., requiring maintenance access. Equipment and clearance requirements shall be coordinated with FTSD during the design phase. Temporary signage attached to the equipment in bold letters, minimum 2” in height, shall note clearance requirements around the equipment and shall remain in place until final acceptance.

1.3 HEATING, VENTILATION & AIR CONDITIONING SYSTEMS

A. Submittals

1. Design Phase: A complete package of design calculations and information on the plans shall be provided for review by LAWA. The calculations packages shall be completed in a bound and indexed format and shall be distributed with the final plans and specifications. Calculations shall be provided with whatever markings or notations that are needed to make them clearly understandable.



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- a. The following data and calculations are the minimum requirements for submission:
 - (1) All calculations and designs.
 - (2) Catalog cut sheets showing capacities and selection points for all equipment.
 - (3) Heat and mass balances for all systems.
 - (4) Pressure drop calculations.
 2. Instrumentation design:
 - a. Include flow diagrams, P&I diagrams, wiring diagrams, and catalog information on all equipment. Coordinate design with all vendor control packages to achieve sequences of operation.
 3. Provide system schematics for chilled water, heating hot water, condensing water, water treatment and associated mechanical systems.
 4. Provide an HVAC zoning diagram to indicate the areas being served by its designated AC unit.
 5. Submit type of chemical water treatment system and approach proposed for chilled water and heating hot water systems, with sufficient literature to validate approach and technology, along with references from projects and users where system has been employed for at least one year. Specific emphasis should be given to successful treatment programs in connecting new hydronic systems to existing buildings.
 6. Project specifications shall clearly indicate that the Contractor shall submit, as a minimum, the following to demonstrate compliance with these requirements.
 - a. Shop drawings showing all the duct layout, piping, AC equipment, pumps, valves, and other equipment including piping accessories to complete the work.
 - b. Describe phasing of project implementation and strategy.
 - c. Manufacturer's product catalog.
 - d. HVAC system air balance report.
 - e. Copy of manufacturer equipment warranty documents shall be submitted during project closeout.
 - f. Supplement, as appropriate, with graphic material to convey the design intent.
 - g. Describe approach to commissioning of systems. Identify roles and responsibilities of key players.
 - h. Training Schedule. LAWA to attend the equipment operations training. LAWA maintenance personnel shall be properly trained in the operation and maintenance of all installed HVAC system for minimum of 8 hours per shift (4 hours classroom training and 4 hours hands-on) prior to final acceptance by LAWA.
- B. Design
1. All rooftop mechanical equipment shall be fully screened. See LAWA DCH Roof Utility Management Standards.
 2. All HVAC packaged rooftop units larger than 5 tons shall have motors with Variable Frequency Drives (VFD). Maximum distance allowed between VFDs and motors served shall be in accordance with CEC and manufacturers application guidelines.
 3. Provide minimum 30" or manufacturer's recommended space, whichever is greater, for a service access envelope around each AC unit, Air Handling Unit (AHU), Pump,



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Boiler, Fan, Cooling Tower, Heat Exchanger, VAV box, Fan coil, Fans and accessories for service in all dimensions.

4. Provide note on the plan that the bottom of the VAV box shall be located a maximum of 12 inches above ceiling for inspection and maintenance access to damper, coils, control panel, valves and other accessories.
5. Provide minimum of 30 inches clear space in front of VAV box and fan coil unit instrument and control panels for inspection and maintenance access.
6. All HVAC equipment, except VAV boxes, shall be provided with vibration isolators and seismic restraints unless otherwise noted per manufacturer recommendation.
7. No AHU shall be located outside of the designated Mechanical Room.
8. No AHU shall be located on the roof, unless approved by LAWA PDG.
9. Mechanical equipment (VAV boxes, FCUs, controls, etc.) requiring maintenance serving the men's and women's public restrooms shall be located outside of the footprint of the restrooms.
 - a. Public restrooms with supply air from a VAV with DDC connection shall be provided with a flush-mounted room temperature sensor with a blank stainless steel cover plate. Otherwise, provide a lockable thermostat.
 - b. Sensor or thermostat shall be located on the men's side of the restroom.
10. Public spaces with supply air from a VAV with DDC connection shall be provided with a flush-mounted room temperature sensor with a blank stainless steel cover plate.
 - a. Thermostats shall be installed at a height of 48 inches above floor finish, as allowed per code.

C. Calculations

1. Calculations and compliance documentation shall comply with California Title 24, Part 6 Energy Code. Provide detailed engineering calculations for all systems to confirm final sizes and equipment and system efficiencies and submit for approval by LAWA. Include the performance criteria, identifying minimum levels of the materials and workmanship quality.
2. Cooling and heating load calculations shall be per the ASHRAE method. Load calculations will also conform to the California Energy Commission T-24 calculations, including safety factors. Cooling and heating load calculations shall be provided in formal submittal format for review at the completion of the Design Development (DD).
3. Define occupant density per ASHRAE Standard 62 and the new Occupant Load Requirements per LAWA DCH Planning – Notes to Design Team.

D. Testing, Adjusting, and Balancing

1. Project specifications shall clearly indicate the following:
 - a. All installed HVAC systems shall be air and water balanced by a certified third party balancing company approved by LAWA.
 - b. Testing Agency:
 - (1) Total System Balance shall be performed by the independent, non-affiliated Contractor, certified by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB). Contractor shall specialize in the balancing and testing of the ventilating



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and air conditioning systems. Contractor shall be capable of balancing, adjustment, and testing of the air moving distribution systems, water and steam systems.

- (2) Minimum of 5 years of Air Balancing and testing experience and proof of having successfully completed at least 5 projects of similar size and scope is required.
- (3) All work shall comply with applicable procedures and standards published by the AABC or NEBB.

c. Test and Balance Reports

- (1) The Test and Balance agency shall prepare and submit minimum of three (3) copies of the Test and Balance Analysis to LAWA within five (5) working days of completion. This report shall contain, at a minimum:

- i. AABC or NEBB Certification credentials for the responsible Air Balance Company and all certified technicians, involved in the project.
- ii. Project Summary and comments.
- iii. Table of contents and test forms for all systems.
- iv. Calibration certificates for all test equipment.
- v. Drawings:
 - (a) Full scale single line schematic drawings showing the actual duct runs and outlet/inlet locations.
 - (b) Drawings shall be in the latest AutoCAD format.
- vi. Copy of AABC or NEBB performance guaranty.
- vii. Copy of data for all supply fans.
- viii. Copy of data for the coils.
- ix. Copy of data for the pumps.
- x. Chilled Water Piping Balance Report
- xi. Heating Water Piping Balance Report.

d. Guarantee

- (1) Air Balance Testing agency shall provide an extended 1 Year warranty after completion of test and balance work for recheck or resetting of any outlet, supply air fan, VAV box, return/exhaust fan or pump as listed in test report.

E. Building Commissioning

1. Project Specifications shall clearly indicate the following:
 - a. That an independent certified Building Commissioning agent shall provide commissioning services.
 - b. Minimum guidelines of commissioning shall be per the latest ASHRAE “Guideline 0 The Commissioning Process” and ASHRAE “Guideline 1.1: HVAC&R Technical Requirements for The Commissioning Process”.
 - c. All installed HVAC systems shall be commissioned prior to final acceptance by LAWA.

F. HVAC Piping

1. Equipment air vents: Schedule 40 black steel or Type L hard drawn copper pipe.
2. Piping Identification Markings and Color Codes: Piping and Duct Identification Markings and Color Codes shall be in accordance with ANSI A13.1 standards. Markings shall include arrows indicating direction of flow. Markings shall be installed at a minimum of every 20' on straight runs where there are no visibility obstructions.



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In areas where visibility of pipe or duct is obstructed or numerous other pipes and ducts exist, markings shall be installed as approved to enable pipes and ducts to be easily traced along its entire path. Pipes shall be marked and color-coded.

3. Installation methods shall be in accordance to the latest edition of the Los Angeles Plumbing Code.
 - a. No piping connections shall be made through hot tapping method unless an approved Exemption Request Form is obtained from LADBS, LAWA PDG and FTSD Management. Provide connections with standard tee fittings and reducers where hot tapping method is not used.
 - (1) Prior to performing the work, piping connections made through hot tapping method or pipe freezing process to chilled water and heating hot water lines connected to the CUP shall be approved by the LAWA CUP Chief Building Operating Engineer.
 - b. Victaulic fittings shall not be used in the heating hot water systems.
 - c. Provide a brass ball valve and a 6" brass nipple at each location where the piping transitions from copper to steel. Dielectric fittings, flanges and unions shall NOT be used on any piping, except dielectric flanges may be used inside the mechanical and pump rooms. Additionally, dielectric unions MAY be used in natural gas piping at the meter and at the equipment connections.
4. Thermometers and pressure gages shall be provided on chilled and hot water supply and return lines at every Air Handling Unit.
5. Isolation valves
 - a. Valves shall be provided on the supply and return lines at the point of entry to all buildings for all Heating Hot Water and Chilled Water distribution systems.
 - b. Valves shall be provided on the main chilled water and heating hot water lines at every riser on each floor level.
 - c. Valves shall be provided on the main horizontal chilled water and heating hot water lines at every 100 feet of main horizontal pipe, or fraction thereof, or at locations that divides the building into thirds, and as mutually agreed upon by the Contractor, PDG and FTSD Management. Provisions shall be made to drain the line with a hose connection, in between isolation valves.
 - d. Valves shall be provided at the equipment's connection to the chilled water and heating hot water piping.
 - e. Where feasible, valves shall be accessible, within 12" of ceiling, for ease of maintenance, otherwise, access for maintenance shall be provided via a ladder, lift or other FTSD Management approved method and demonstrated graphically on the drawings.
6. Drain valves shall be provided at the low point of the chilled water and heating hot water systems. Drain piping shall be terminated at Code approved receptacle.
7. Air vents shall be provided at the high points of the chilled and heating hot water systems. Access for maintenance shall be provided via a ladder, lift or other FTSD Management approved method and demonstrated graphically on the drawings.
8. Pressure independent flow balancing valves shall be provided on the chilled and heating hot water main lines.
9. Condensate from HVAC equipment shall be gravity drained and discharged to a code approved receptacle. The Contractor shall obtain permission from PDG and FTSD



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Management for installation of a condensate pump in the event that a gravity drain is either impractical or impossible. When permitted by PDG and FTSD Management to use condensate pump, it shall be interlocked with the HVAC equipment control system such that it will operate when the HVAC equipment is in operation.

- a. Secondary condensate drain pans shall not exceed more than 2 inches of the footprint of the unit it serves, as to not obstruct the access clearance of the unit.

10. LAWA chilled water and heating hot water system shall be used for space cooling and heating purposes only, unless an approved Exemption Request Form is obtained from LAWA PDG, CUP and FTSD Management.

G. Mechanical Fan Room / Mechanical Storage Room / Pump Room

1. Only mechanical equipment shall be allowed in the Mechanical Fan Room, Mechanical Storage Room and Pump Room.
2. Mechanical rooms, mechanical storage rooms and pump rooms shall not be converted for lease space or similar unless an approved Exemption Request Form is obtained from LAWA PDG.
3. All Mechanical equipment rooms shall be adequately ventilated and provided with hose bibbs and floor drains and/or floor sinks.
4. All Mechanical equipment rooms shall have access to a freight elevator going to the level where the Mechanical room is located. There shall be a service path of four (4) feet minimum in width from the Mechanical equipment room to the freight elevator.
5. All Mechanical rooms are to have a pair of double doors consisting of a minimum of two (2) 36" wide doors. Larger doors may be required due to type of equipment in the room and shall be evaluated on a case by case basis.
6. All Mechanical rooms shall be provided with Access Control & Alarm Monitoring Systems (ACAMS) in addition to manual key access. ACAMS design and installation shall be per LAWA DCH Section 28 13 00 "Access Control and Alarm Monitoring Systems (ACAMS)" for the minimum requirements; additionally coordinate with LAWA IMTG.
7. Mechanical rooms shall have a clear path of travel without any obstruction, including condensate piping and any other piping/ conduit.

H. Computer Room (Small Room)

1. See "Information Management and Technology Group (IMTG) IT Design Guidelines Summary Document" for the MPOE and Computer Rooms Cooling and Fire Protection Requirements.

I. UPS/Battery Room

1. See "Information Management and Technology Group (IMTG) IT Design Guidelines Summary Document" for the UPS/Battery Room Cooling and Fire Protection Requirements.

J. Electrical Room

1. Provide a chilled water fan coil unit.
 - a. Provide chilled water FCU manufactured by Carrier, Data-Aire or Compu-Aire. It includes a wall mounted microprocessor, dirty filter alarm, humidifier,



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disconnect switch, oversized evaporator fan motor, condensate pump and tank, as well as phenolic coating on the condenser coil.

2. Split system may be used with approved Exemption Request Form from LAWA PDG and FTSD Management during the design phase.
 - a. Provide split system AC unit manufactured by Carrier, Data-Aire or Compu-Aire. It includes a wall mounted microprocessor, dirty filter alarm, humidifier, disconnect switch, oversized evaporator fan motor, condensate pump and tank, as well as phenolic coating on the condenser coil.
 - b. Condenser unit shall be installed outdoors on minimum 4" high mounting pad, vibration isolator, and 10 mils phenolic baked exterior coating corrosion protection.
3. Interface the Electrical Room Air Conditioning equipment with the BAS for the remote status and alarm monitoring.

K. Elevator Machine Room

1. Provide a chilled water fan coil unit.
 - a. Provide chilled water FCU manufactured by Carrier, Data-Aire or Compu-Aire. It includes a wall mounted microprocessor, dirty filter alarm, humidifier, disconnect switch, oversized evaporator fan motor, condensate pump and tank, as well as phenolic coating on the condenser coil.
2. Split systems may be used with approved Exemption Request Form from LAWA PDG and FTSD Management during the design phase.
 - a. Provide split system AC unit manufactured by Carrier, Data-Aire or Compu-Aire. It includes a wall mounted microprocessor, dirty filter alarm, humidifier, electric reheat, disconnect switch, oversized evaporator fan motor, condensate pump and tank, as well as phenolic coating on the condenser coil.
 - b. Condenser unit shall be on the roof, with minimum 4" mounting pad, vibration isolator, and 10 mils phenolic baked exterior coating corrosion protection.
3. Interface Elevator Machine Room Air Conditioning equipment with the BAS for the remote status and alarms monitoring.
4. See LAWA DCH Section 14 20 00 "Vertical Transportation, General" for additional requirements.

L. General Exhaust

1. The toilet rooms and janitor closets shall be under negative pressure and interconnected where possible to common exhaust fans.
2. Each restroom and janitor room shall be provided with adequate exhaust ventilation at minimum of 15 air changes per hour. Make up air shall be provided by the HVAC system. Transfer air from above ceiling space or adjacent room not acceptable.
3. For all locations, other than restrooms, provide with a minimum six air changes per hour ventilation rate.
4. Interface Exhaust Fans with the BAS for remote status and alarm monitoring.

M. Boilers

1. Interface heating boilers with the BAS for remote status and alarm monitoring.



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N. Air Side Design

1. Duct systems shall be designed with maximum velocities as follows:
 - a. Supply Ductwork: 1900 feet per minute for main ductwork. Pressure drop of maximum 0.3 inch water gage per hundred feet for main ducts and maximum 0.1 inch water gage per hundred feet for ducts downstream of VAV boxes.
 - b. Exhaust/Return Ductwork: 1800 feet per minute for main ductwork. Pressure drop of 0.10 inch water gage per hundred feet.
 - c. Ductwork shall be fabricated for appropriate pressure class.
2. All occupied spaces shall meet room noise criteria (NC) of NC-35, except for conference and meeting rooms that shall be less than NC-30.
3. Within ceiling spaces, flexible duct shall be used to connect the supply air diffuser/register to the rigid duct. Flexible duct shall not exceed seven (7) feet in length.
4. Manual volume dampers shall be provided for every supply air outlet. The damper shall be located on the branch line serving the supply air outlet at the take-off from the main duct. Manual volume dampers shall be accessible. Provide access opening to manual volume dampers located in areas with gypsum board ceiling with the identification streamer/tag in addition to Young regulator for remote operated manual volume dampers.
5. Select and schedule new VAV terminal units per LAWA's approval.
 - a. All VAV terminal units shall be seismically braced without regard to the weight limit in the Code. VAV boxes shall be supported without regard to adjacent ductwork and must be self-supporting. VAV terminal units shall be designed to resist seismic forces in all directions. Tension-only bracing is not allowed; Compression struts are required. See Airport Structural Design Standards for additional information.
 - b. Unit support for VAV terminal units shall be designed by a California licensed Civil or Structural Engineer.
 - c. Unit support for VAV terminal units shall be submitted to LAWA PDG for approval.
6. When the lease space is renovated or remodeled, entire air distribution system shall be replaced, including the VAV boxes, ductwork, registers, grilles and diffusers.
7. When the lease space is renovated, new VAV boxes shall be provided with the new DDC controllers capable of being integrated into the BAS.
8. Existing ductwork
 - a. In the event that the existing air distribution system within the renovated space is deemed to be in working condition, it needs to be cleaned by a third party certified duct cleaner, within the area of work.
 - b. Existing air distribution system shall be balanced according to the new air flow requirements.

O. Air Handling Units

1. Select and schedule proper equipment customized for the project requirements.
2. Coordinate design and placement of new equipment with architect and structural engineer.



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3. Unit shall be mounted on minimum 4" high concrete platform or equipment roof curb with 2" deflection spring vibration isolators and seismic restraints. Where units are installed more than 18" above the roof surface, provide permanent access for operation, maintenance and repair of the AHU without use of portable ladders. Dimensions and loading requirements for platforms, stairways, fixed ladders, etc. shall be in accordance with applicable codes.
4. Exterior panels shall be minimum 20 gauge steel, pre-coated with minimum 6 mils topcoat phenolic baked coating over 4 mils epoxy primer for a total of 10 mils. Coating shall withstand 5,000 hours of salt spray per ASTM B-117. Coating shall be applied at the factory.
5. Refrigerant shall be R410a.
6. Design Conditions
 - a. Outdoor Design:
 - (1) Summer dry bulb design temperature (Fahrenheit): 91° F @ 0.1%.
 - (2) Summer wet bulb design temperature (Fahrenheit): 71° F @ 0.1%.
 - (3) Summer design temperature: 101°F.
 - (4) Winter design temperature (Fahrenheit): 40° F @ 0.2%.
 - b. Indoor Design:
 - (1) Indoor conditions for all spaces in the building shall be defined at 72 degree F for cooling and 70 degree F for heating. UPS, IT MPOE and telecommunication rooms shall be designed for 68 degree F.
7. Interface the AHU controls with the BAS for remote monitoring and control.
8. Units shall be listed by the California Energy Commission and comply with T-24 requirements.
9. HVAC Packaged Rooftop Units (RTU)
 - a. Custom units larger than 5 tons.
 - (1) Provide one of the following two air cleaning options.
 - i. MERV 8 pre-filter, carbon, PCO and MERV 14 final filter as well as ultraviolet light for the coil section.
 - ii. MERV 8 pre-filter, carbon filter, bipolar ionization unit and MERV 14 final filter as well as ultraviolet light for the coil section.
 - (2) Provide with economizer controls, variable frequency drive for the fan(s).
 - (3) Units larger than 15 tons shall be factory tested, witnessed and certified by LAWA PDG and LAWA Inspector prior to shipping to the job site.
 - b. Non-custom units of 5 tons or less.
 - (1) MERV 8 pre-filter and MERV 13 final filter.
 - c. Thermostat shall be electric 365 days programmable type
10. Central Station Air Handling Units (AHU)
 - a. Provide one of the following two air cleaning options.
 - (1) MERV 8 pre-filter, carbon, PCO and MERV 14 final filter as well as ultraviolet light for the coil section.
 - (2) MERV 8 pre-filter, carbon filter, bipolar ionization unit and MERV 14 final filter as well as ultraviolet light for the coil section.
 - b. All custom AHUs larger than 15 tons shall be factory tested, witnessed and certified by LAWA PDG and LAWA Inspector prior to shipping to the job site.



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- c. For existing Central Station AHUs that are to be refurbished, make revisions to the existing equipment to add the air cleaning options where possible. If not, advise LAWA.

P. Building Automation System (BAS)

1. The BAS shall monitor and control all building mechanical systems and equipment. Each mechanical system shall be complete with factory controls, and shall be specified with accessory integration modules, hardware, computer cards, and software required for full and complete integration to the BAS. The BAS shall monitor mechanical equipment for failure alarms, and all operating set point variables shall be capable of being reset.
2. BAS shall include equipment graphical representation and floor plans showing layout of equipment and control points.
3. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BAS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like. BAS shall have web based monitoring and control capabilities.
4. The BAS shall consist of networked controllers capable of stand-alone controls and shall be integrated with the existing BAS and FMCS.

Q. Terminal/Building HVAC System

1. Submit schematic piping flow diagrams and control valves for the Terminal pump rooms and HVAC systems. Schedule all coil and pump sizes and estimated capacities. Include all control valves in piping diagram. Provide test and balance data indicating the existing flow distribution in the Central Terminal Area (CTA). List all control valves. Identify all chilled water pumps, including branch pumps at ends of existing loop to any coils or systems. Verify if there are any existing 3-way valves or other valve-bypasses, which are diverting flow to the return system.
2. Prepare a load calculation to determine design criteria and recommended capacities.
3. Submit summary report to LAWA as part of Basis of Design Submittal to whether the pump can be simply adjusted for flow, left alone, impeller or motor changed or whether a complete pump change-out is required.
4. Work shall be phased to keep building operations uninterrupted.
5. The system design shall provide flexibility in terms of operation and renovation.
6. The operation, reliability and redundancy of the existing CUP systems shall be maintained throughout the construction. All work requiring a temporary shutdown of services shall be coordinated with LAWA to minimize disruptions.
7. Site investigation: The Contractor shall conduct a site investigation and thorough survey and prepare drawings as necessary to complete construction documents and phasing plans.
8. Field Painting: Provide field painting of all piping, and miscellaneous appurtenances. Provide labeling and identification of all equipment and piping. LAWA to select colors.



AIRPORT MECHANICAL DESIGN STANDARDS

Los Angeles World Airports

- a. Piping labeling shall include color coded arrows, with the line number, commodity inside and direction at regular intervals over the pipe jacketing.
9. All systems shall be properly cleaned and flushed and tested prior to energizing.
10. Accessibility: Install all components, valves, control devices, etc. where they are accessible for operation and maintenance without use of portable ladders, where practical. Otherwise, platforms, stairways, catwalks, fixed ladders, etc. shall be required to provide safe access for operation and maintenance.
11. Pipe Sizing: Piping shall be sized for maximum flows in the chilled water pipe not to exceed 12 feet per second (fps) in mains and 10 fps in branches to coils and pumps. Maximum pipe velocity of 12 fps for piping 8" and larger. All piping shall be sized to not exceed a pressure drop of 4-ft head per 100 feet of piping. The dedicated branch coil piping runs out to each coil shall be sized for the individual coil size and chiller flow capacity calculated at new design conditions.
12. Sub-meter: Provide individual sub-meter for the chilled water and heating hot water lines from the CUP to each building, terminal, and tenant area with option for future remote data gathering connection.
 - a. These tenant areas include:
 - (1) Concessions: Provide submeter for each concession space.
 - (2) Any space with major chilled water and heating hot water loads, not covered by lease agreement.
 - b. See LAWA DCH Submetering Policy.
13. CUP Heating Hot Water Design Supply/Return Temperatures:
 - a. Primary Loop – 220/170 degrees F
 - b. Secondary Loop – 180/145 degrees F.
14. CUP Chilled Water Design Supply/Return Temperatures:
 - a. 40/56 degrees F. The CUP operates most efficiently with a 16 degree F delta T.

END OF SECTION