MISSION STATEMENT

The goal of this section is to provide guidance to the users of this document in the design of Mechanical (HVAC, Plumbing and Fire Protection) 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.

GENERAL

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, and 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 (ACM's) and/or other materials classified as toxic or hazardous by LAWA or Federal regulations. The Contractor, and the Contractor's designer, must consider the impact 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, coordination with all building trades.
6) Plan Coordination: 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.
7) Sectional Views and Elevations: 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 floors to ceiling sections with the cutting plane through the major axes 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.
8) Equipment Rooms: All equipment rooms shall be designed and located to facilitate the removal, transport and replacement of the largest equipment component housed within the room. Room locations shall be depicted in plan view with expanded details shown by part plan at a scale no less than 1/4" = 1' – 0". All pipes and ducts larger than 6" shall be drawn as double lines. All rooms shall be adequately ventilated and provided with hose bibbs and floor drains.

9) Large Equipment Installation Sequencing: 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.
10) Special and LAWA-Furnished Equipment: Special types of equipment, including LAWA-furnished and contractor-installed materials, shall be coordinated for correct rough-in and attachment requirements.
11) Interferences: AC units, valves, fans, piping, ducts, valves, pumps and other equipment shall be reviewed for interferences that would prevent proper installation of each system.
12) Clearances: AC units, valves, fans, piping, ducts, valves, pumps and other equipment shall have adequate clearance on all sides as well as above and other interferences where space is limited.
13) Accessibility: AC units, valves, fans, piping, ducts, valves, pumps, and other equipment shall be coordinated with building construction, beams, column walls, etc., to provide adequate clearances and accessibility for maintenance. Piping and ducts shall be coordinated with other engineering disciplines. Clearances and locations shall be demonstrated graphically**.**
14) Penetrations: 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 provided. Details for protection of all penetrations of fire resistive construction are required on plans submitted for construction approval permit.
15) Construction of New Buildings over Existing Utilities: 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 shall be relocated as required.
16) Equipment Protection and System Protection: 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. 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.
17) Special Support and Anchors: All equipment including piping supports, anchors, supports-guides, and pre-insulated versions thereof, which exert force on the structure other than those forces produce by gravity, and equipment shall be designed with a component importance factor of 1.5, and detailed on the drawings and coordinated with structural engineer and appropriate fire protection drawings.
18) All equipment shall be arranged for maximum service access, while reserving space for future equipment and future uses. Ensure that all components and equipment are easily accessible for maintenance and replacement.
19) Install valves as needed to isolate each piece of equipment for maintenance and replacement requirements.
20) All piping, conduits and ductwork shall be concealed from public view and protected from the elements, unless approved in writing by the Chief Airports Engineer with the Facilities Management Group.
21) As Built Drawings: All installations shall be provided with minimum of three sets of As-built drawings and CD's (AutoCAD drawings in DWG file electronic format, drawn in the latest AutoCAD version), warranty documents and maintenance manuals during closeout period prior to final acceptance by LAWA. All known and unknown utilities identified during construction shall be shown on the final as-built drawings.

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.
    a) The following data and calculations are the minimum requirements for submission:
        (1) All calculations and designs.
        (2) Catalog cuts showing capacities and selection points for all equipment.
        (3) Heat and mass balances for all systems.
        (4) Pressure drop calculations.
2) Instrumentation design: Include process 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, water treatment and associated plumbing systems.
4) 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.
5) 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 EFMD personnel shall be properly trained in the operation and maintenance of all installed HVAC system for minimum of 8 hours (4 hours classroom training and 4 hours hands-on) prior to final acceptance by LAWA.
    i) All installed HVAC equipment shall be provided with minimum of three sets of As-built drawings and CD's (AutoCAD drawings in DWG file electronic format, drawn in the latest AutoCAD version), warranty documents and maintenance manuals during closeout period prior to final acceptance by LAWA.

B. Design

1) All HVAC packaged rooftop unit larger than 5 tons and pumps shall have motors in Variable Frequency/adjustable Speed Drives, Maximum distance allowed between VFD's and motors served shall be in accordance with CEC and manufacturers application guidelines.

2) Provide manufacturer's recommended space for a service access envelope around each AC unit, AHU, Pump, Boiler, Fan, Cooling Tower, Heat Exchanger, VAV box, Fan coil, Fans and accessories for service in all dimensions.
3) Provide note on the plan that the bottom of the VAV box shall be located maximum of 12 inches above ceiling for inspection and maintenance access of damper, coils, control panel, valves and other accessories.
4) Provide minimum of 24 inches clear space around the VAV box and Fan coil units for inspection and maintenance access.
5) All HVAC equipment hung or mounted shall be provided with vibration isolators and seismic restraints unless otherwise noted per manufacturer recommendation.
6) No Air Handling unit or AC unit shall be relocated outside the designated Mechanical Room.
7) No Air Handling unit or AC unit shall be relocated or built on the roof unless otherwise approved by LAWA EFMD.

C. Calculations

1) Calculations and compliance documentation for California Title 24, Part 6 energy code. Provide detailed engineering calculations for all systems prior to construction to confirm final sizes and equipment and system efficiencies and submit for approval by LAWA. Performance Criteria identify minimum levels of quality, materials and workmanship. Calculations to confirm overall system coefficient of performance meets or exceeds the basis of design presented in this document.
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 design development.
3) Define occupant density per ASHRAE Standard 62.

D. Testing, Adjusting, and Balancing

Project specifications shall clearly indicate the following.

1) All installed HVAC system shall be air and water balanced by a certified third party balancing company approved by LAWA.
2) Testing Agency:
    a) Total System Balance shall be performed by an independent, non-affiliated agency certified by the Associated Air Balance Council (AABC) which specializes in the balancing and testing, ventilating and air conditioning systems, to balance, adjust, and test air moving and distribution systems, water systems and steam systems.
    b) Minimum of 5 years as air balance and testing agency and proof of having successfully completed at least 5 projects of similar size and scope.
    c) All work shall comply with applicable procedures and standard of "National Standards for Field Measurements and Instrumentation, Total System Balance" by the Associated Air Balance Council.
3) Test and Balance Reports
    a) 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:
        (1) AABC Certification credential(s) for the responsible Air Balance Company Engineer of record and all certified technicians involved in the project.
        (2) Project Summary and comments.
        (3) Table of contents and test forms for all systems.
        (4) Calibration certificates for all test equipment.
        (5) Drawings:
            (a) Full scale single line schematic drawings showing actual duct runs and outlet/inlet locations.

(b) Drawings shall be in AutoCAD version 2002 or later format.
(6) Copy of AABC National performance guaranty.
(7) Copy of data for all supply fans.
(8) Copy of data for the Coils.
(9) Copy of data for the pumps.

4) Guarantee
   a) Air Balance Testing agency shall provide an extended warranty of 90 days 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 {23 08 00}

Project Specifications shall clearly indicate the following:

1) An independent certified Building Commissioning agent shall provide commissioning services.
2) Minimum guidelines of commissioning shall be per ASHRAE Guideline: HVAC&R Technical Requirements for The Commissioning Process.
3) All installed HVAC system shall be commissioned prior to final acceptance by LAWA.

F. HVAC Piping {23 21 13, 23 23 00, 23 05 53}

1) Equipment 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. 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 or cold tapping method. Provide connections with standard tee fittings and reducers.
   b) Victaulic fittings shall not be used on the chilled water lines and heating hot water lines.
      (1) If the existing area has welded lines, any modifications shall use welded lines.
   c) Dielectric fittings and unions shall not be used on any piping. Provide a brass ball valve and a 6” brass nipple at each location where the piping transitions from copper to steel.
4) Thermometers and pressure gauges shall be provided on chilled and hot water supply and return lines at every Air Handling Unit

G. Mechanical/ Mechanical Storage/ Pump Room

1) No equipment other than Mechanical shall be allowed in the Mechanical 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.
3) No Air Handling unit or AC unit shall be relocated outside the designated Mechanical Room.

H. Computer Room (Small Room) {23 81 23}

1) Provide new split system AC unit manufactured by Liebert, Stulz-ATS or APC. It includes 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.
2) Condenser unit shall be on the roof, with minimum 4" mounting pad, vibration isolator, and 10.0 mils phenolic baked exterior coating corrosion protection.
3) Interlock split system AC units with Building Automation System (BAS) for remote monitoring and control.

I. UPS/Battery Room {23 81 26}

1) Provide new split system manufactured by Carrier, Data-Aire, or Compu-Aire.
2) Condenser unit shall be on the roof, with minimum 4" mounting pad, vibration isolator, and 10.0 mils phenolic baked exterior coating corrosion protection.
3) Battery Rooms shall be ventilated according to the type of batteries. Rooms with wet cell batteries shall be provided with a minimum six air changes per hour, and dry cell battery rooms shall be provided with a minimum of four air changes per hour and per the requirement of the Fire Marshall.
4) Battery rooms shall be maintained under negative pressurization by the exhaust system. Make-up air shall be through a diffuser from the AHU system.
5) Interlock exhaust fan with the Air Handling Unit (AHU) or AC unit and connect to BAS for remote monitoring and control.

J. Electrical Room {23 81 26}

1) Provide new 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.
2) Condenser unit shall be on the roof, with minimum 4" mounting pad, vibration isolator, and 10.0 mils phenolic baked exterior coating corrosion protection.
3) Interlock split system AC units with BAS for remote monitoring and control.

K. Elevator Machine Room {23 81 26}

1) Provide new 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.
2) Condenser unit shall be on the roof, with minimum 4" mounting pad, vibration isolator, and 10.0 mils phenolic baked exterior coating corrosion protection.
3) Interlock split system AC units with BAS for remote monitoring and control.

L. General Exhaust {23 34 00}

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 12 air changes per hour. Make up air shall be forced air from AC unit. Transfer air from ceiling or adjacent room not acceptable.
3) For all locations, other than restrooms, provide with a minimum six air changes per hour ventilation rate.
4) Interlock the exhaust fan with the AHU and connect to BAS for remote monitoring and control.

M. Boiler {23 52 00}

1) Connect the boiler to BAS for remote monitoring and control.

N. Air Side Design {23 31 00, 23 33 00, 23 36 00}

1) Duct systems shall be designed with maximum velocities as follows:

a) Supply Ductwork: 1900 feet per minute for main ductwork. Pressure drop of 0.10 inch water gage per hundred feet for main ducts and 0.05 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 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 to meet current code requirements. 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 for approval.
6) Within lease space, all VAV boxes, ductwork and registers/ grilles/ diffusers shall be new.
7) Within the lease space, the new VAV box shall have stand-alone DDC controls, BACnet compatible, open protocol, capable of future integrations with the building BAS.
8) Existing ductwork
   a) Within lease space, if modifications are done to the existing ductwork only, any existing duct and register/grille/diffusers shall be cleaned by a third party certified duct cleaner. A video of the before and after cleaning shall be provided.

O. HVAC Packaged Rooftop Unit {23 400, 234200, 234300, 237400, 237500}

1) Select and schedule proper equipment customized for the project requirements.
2) For units greater than 5 tons.
   a) Provide 65% pre-filter, carbon filter, bipolar ionization unit and MERV 13 final filter.
   b) Provide with ultraviolet light for the cooling coil, economizer controls, variable frequency drive for the fan(s).
   c) Exterior panel shall be min. 20 gauge galvanized steel, pre-coated with min. 6.0 mils topcoat phenolic baked coating over 4.0 epoxy primer for a total of 10.0 mils. Coating shall withstand 5,000 hours of salt spray per ASTM B-117. Coating shall be applied at the factory.
   d) Unit shall be mounted in minimum 4" height platform with 2" deflection spring vibration isolators and seismic restraint.
   e) Refrigerant shall be R410a, 407C or R134a.
   f) All HVAC equipment higher than 15 tons shall be factory tested, witnessed and certified by LAWA EFMD personnel and LAWA Inspector prior to shipping to the job site.
3) For units of 5 tons or less.

a) Unit shall be mounted in minimum 4" height concrete platform or equipment roof curve with 2" deflection spring vibration isolators and seismic restraint.
b) Refrigerant shall be R410a or 407C.

4) Coordinate design and placement of new equipment with architect and structural engineer.
5) 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 rooftop design temperature: 101°F.
      (4) Winter design temperature (Fahrenheit): 40° F @ 0.2%.
   b) Indoor Design: Indoor conditions for all spaces in the building shall be defined at 72 degree F for cooling and 70 degree F for heating. UPS and telecommunication rooms shall be designed for 68 degree F.
6) Connect the AC unit to BAS for remote monitoring and control.
7) Thermostat shall be electric 365 days programmable type.

P. Air Handling Unit (AHU) {23 74 13}

1) Provide 65% pre-filter, carbon filter, ionization unit and MERV 13 final filter as well as ultraviolet light for the coil. If possible, make revisions to the existing equipment to add these items. If not, advise LAWA.
2) Connect the AHU to BAS for remote monitoring and control.
3) Replace existing air handling units older than 20 years at LAX terminals with new units unless otherwise noted by LAWA. Units shall be listed by the California Energy Commission and comply with T-24 requirements.
4) All AHU higher than 15 tons shall be factory tested, witnessed and certified by LAWA EFMD personnel and LAWA Inspector prior to shipping to the job site.

Q. Building Automation System (BAS) {25 20 00}

1) Investigate if the building has an existing BAS that can be reused.
2) 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.
3) BAS shall include equipment graphical representation and floor plans showing layout of equipment and control points.
4) 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.
5) The BAS shall consist of networked controllers capable of stand alone control and integrations with the existing building BAS.

R. Terminal HVAC System and Pump {23 74 13}

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. Ensure that all components and equipment are readily accessible for maintenance and replacement.
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 equipment, piping, and miscellaneous appurtenances. Provide labeling and identification of all equipment and piping. LAWA to select colors.
    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. Provide platforms, stairways, fixed ladders, etc. as required.
11) Pipe Sizing: Piping shall be sized for maximum flows in the chilled water pipe not to exceed 12 feet per second in mains and 10 feet per second in branches to coils and pumps. Maximum pipe velocity of 12 feet per second (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) Provide individual sub-meter for the chilled water and heating hot water lines from the CUP to each tenant area with option for future remote data gathering connection
13) CUP Heating Hot Water Design Temperatures
    a) Existing Heating Hot Water Design Temperatures (supply/ return)
        (1) Primary Loop – 280/230 degrees F
        (2) Secondary Loop – 180/140 degrees F
    b) Future Heating Hot Water Design Temperatures (supply/ return)
        (1) Primary Loop – 220/170 degrees F
        (2) Secondary Loop – 180/140 degrees F

PLUMBING SYSTEMS

A. Submittals

1) Design Phase: A complete package of design calculations and information on the plans shall be provided for review by LAWA. Calculations and plans shall be provided with whatever markings or notations that are needed to make them clearly understandable.

B. Design

1) The plumbing system designer shall consider using such techniques as controlling hot water temperatures, water pressures, providing faucets with flow restrictors. The economic use of thermal insulation, automatic shutdown of water heating and circulating systems, use of occupancy sensor for automatic flushing, use of automatic closing faucets, and using minimum energy consuming equipment to provide maximum energy efficiency. The plumbing system designer should understand how the building consumes energy. When this is understood, energy conservation design practices should become integrated into the building allowing it to operate more efficiently and use less energy, while meeting the needs of the user.

2) Provide information on the existing plumbing lines and plumbing system that are affected by new work. Provide separate riser diagrams for the water, waste/ vent, and gas systems. The water riser shall show the entire system from the main water meter to the most remote plumbing fixture outlet. The waste/vent riser shall show the entire system from the street sewer main point of connection to the most remote plumbing fixture outlet. The gas riser shall show the entire system from the main gas meter to the most remote gas outlet.

C. Calculations

1) Existing Plumbing Systems
   a) Provide a table of the fixture unit count with the total of existing fixtures and new fixtures. If the number of new fixtures is more than the number of removed fixtures, Provide hydraulic calculations of the water system.
   b) If pipe sizing for modified system is per Appendix A of the LA Plumbing Code, verify that the pipe sizing criteria corresponds with the existing plumbing system.

D. Piping {22 11 00, 22 13 00, 22 14 00, 22 70 00}

1) Piping should meet the following requirements:
   a) Discharge line from Trash Compactor – ABS (to where it meets the Point of Connection to the existing waste line).
   b) AC unit condensate drains – Copper Type M.
   c) Equipment vents – Black Carbon Steel, ASTM A53, Type S (Seamless) or Type E (Electric-Resistance Welded), Grade B, Schedule 40 or Copper Type L.

   NOTE: 50-50 solder shall not be used for any pipe jointing. No direct buried copper piping shall be permitted inside or outside terminals or other buildings. The use of ferrous metal pipe and fittings under slabs shall be reviewed by LAWA on a case by case basis.
2) 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 or cold tapping method. Provide connections with standard tee fittings and reducers.
   b) Victaulic fittings shall not be used on hot water lines.
   c) Dielectric fittings and unions shall not be used on any piping. Provide a brass ball valve and a 6” brass nipple at each location where the piping transitions from copper to steel.
3) Horizontal drainage pipe shall be provided with a cleanout at its upper terminal, and each run of piping, that is more than 75 feet in total developed length shall be provided with a cleanout for each 75 feet, or fraction thereof, in length of such piping.

E. Valves {220523, 230523}

1) Isolation valves shall be class 150 lug type butterfly valves for piping 2-1/2” and larger and bronze ball valves for piping 2” and under.
2) Butterfly valves 6” and larger shall have worm gears.
3) Valves 8 feet and higher above the floor to have chain wheel operators.
4) Shut off valves shall be provided on every branch line from the main line.
5) Valves shall be accessible.

F. Pumps {220610}

1) Terminal Pump Room
   a) Pumps shall be base mounted horizontal, split-case or end suction centrifugal type. Pumps located on ground or grade level will be mounted to concrete bases with vibration pads. Pumps located on structural floors shall have concreted filled inertia vibration bases. All pumps to have flex connections, isolation valves, strainer, spring loaded check valves, pressure

gauge, and flow measurement device. Pumps manufacturer shall be Armstrong, Bell & Gossett or Taco.

2) In-Line Circulating Pumps {22 34 00}
    a) Pumps shall be all stainless steel for domestic water service. Provide a line size ball valve on suction and discharge side of pump. Provide unions or bolted flange connection on each side of pump. Pressure gage and thermostat are required on in-line circulators.
    b) The designer shall study water usage periods and shall operate pumps just prior to usage periods and limit operation as much as possible. A 7-day 12-hour timer should be installed to control such pump operation especially during peak demand periods as an energy reduction measure.
3) Submersible Pumps {22 13 00, 22 14 00}
    a) Generally, submersible pumps are avoided where possible except electric power manholes where high voltage switches or tap boxes are installed. Diaphragm actuated pumps are preferred rather than float actuated pumps.
4) Sump Pumps {22 14 00}
    a) Commercial type duplex sump pump is required. Explosion proof motor is required in a mechanical/electrical equipment room containing high voltage switchgear or motor control panels.
    b) Mechanical alternator, check valves, automatic float switch with rod, rod guide, copper float, and high water alarm bell shall be provided on duplex pump.
    c) Pumps shall be of the wet-pit type complete with gas tight sump cover, vent, curb ring, grease lubricated, including alemite fittings extended to pump base plate.
    d) Pumps shall be heavy duty, vertical centrifugal, open non-corrosive impeller type with vertical drip-proof type motor with anti-friction grease lubricated bearings.
    e) Pumps shall be provided with separate circuit and circuit breaker.
    f) Where pumps are installed to provide protection for mechanical/electrical equipment and/or critical equipment, in addition to high water alarm bell in the area, alarm contacts should be provided for a central monitoring system.
5) Sewer Ejector Pumps {22 13 00}
    a) Sewer ejector pump design and selection design criteria are the same as those listed for “Sump Pumps” except sewer ejector pumps shall be of the standard three (3) inch, non-clog type specifically designed and installed for purpose intended.

G. Restroom {22 05 00, 22 05 23, 22 11 00, 22 13 00, 22 40 00}

1) Public and Private Restroom Design including Janitorial plumbing fixtures and accessories shall be in compliance with LAWA Public Restroom Design Guidelines and Specification Updated Version July 7, 2008.
2) All exposed metal work at fixtures shall be brass with chromium plate. All faucets, fittings, supply stops for fixtures, and similar devices shall be one (1) manufacturer unless otherwise required. Each fixture shall contain standardized interchangeable operating units made up of separate renewable stem, seat, washer retainer, and nut. All faucets and fittings must close with the water pressure. All fixtures shall be installed with supply stops/valves accessible at the fixtures. Fixtures shall be electronic with manual over-ride.
3) Provide a pipe chase, minimum 30” with door.
4) Provide a separate header for each restroom for the cold water and hot water lines.
5) Each restroom hot and cold water supply shall be provided with accessible shut off valves.
    a) Provide a shut-off valve at each header within the restroom, in the accessible pipe chase.
6) Waste cleanout for maintenance shall be provided for each plumbing fixture.

7) Each restroom shall be provided with floor drain and trap primer.
8) Public restroom shall be provided with hose bib connection for cleaning.
9) Each private or public restroom with flushometer valve water closet and/or urinal shall be provided with water hammer arrester in the domestic cold water line.

H. Standard Water Heaters {22 33 00, 22 34 00}

1) Water Heaters shall adhere to the following:
   a) Water heaters shall be completely copper lined.
   b) Gas water heaters shall have automatic gas shut-off device and be equipped with an American Gas Association certified draft hood. Water heaters shall utilize electric ignition devices.
   c) Electric water heaters shall be U. L. listed.
   d) Electric water heaters shall be provided with submersed type thermostat.
   e) All standard water heaters shall have a three (3) year limited warranty.
   f) Energy saver water heaters shall meet ASHRAE Standards for Energy Efficiencies, latest edition.
   g) Water heater drains shall have valves and shall be plumbed to a floor drain with Copper Type L piping.
   h) All water heaters shall be readily accessible.
   i) Electric water heaters located in ceiling/attic spaces shall be accessible by permanent ladder or stairway, an unobstructed walkway (minimum 24" in width) and a 30"x30" minimum work platform with lights located over the walkway and service area. Locate the switch at the access opening.
   j) All water heaters to be seismically braced per code.

I. Roof and Overflow Drains {22 14 00}

1) Roof and overflow drains shall be compatible with roof system. The designer shall use two (2) inches per hour as a minimum rainfall intensity guideline for sizing roof drains.

J. Backflow Preventers {22 11 00}

1) Where the service line provides potable water for domestic service, a backflow preventer shall be installed on any domestic water line serving other closed or chemically treated systems that could foreseeably contaminate the potable water line.
2) Guidelines for selection of backflow prevention shall be in accordance with LADWP Water Service Rule 16-D, August 2006 or latest revision. Copy can be obtained from the Los Angeles Department of Water and Power. Water quality and Distribution division, 111 North Hope Street, Room 1213, Los Angeles, California 90012.

K. Grease Traps or Interceptors {22 13 00}

1) Waste water from disposers, sinks, dishwashers, floor drains and floor sinks in food facilities shall drain to a grease collection system or through a grease trap or grease interceptor serving one or more facilities. Installation shall comply with the latest edition of the Los Angeles Plumbing Code.
2) Grease interceptors shall not be located in any Mechanical Rooms.
3) See Airport Structural Design Standards for loading criteria.

L. Food Services {22 40 00}

1) Sinks used for food service shall each have a food grinder.
2) Food grinder in commercial kitchen shall require approval from City of LA Bureau of Sanitation Industrial Waste Division (Amended by Ord. No. 174,047, Eff. 8/5/01). When the use of grinder is allowed, the following fineness of grind requirements shall be met at all times:
   a) At least 40% shall pass a No. 8 sieve.

b) At least 65% shall pass a No. 3 sieve.
c) 100% shall pass a ½-inch screen.

M. Sub-meter {22 11 00, 22 07 00}

1) Domestic water and Gas lines serving each concession area, terminal or other buildings shall be provided with individual sub meter with option for future remote data gathering connection.

FIRE PROTECTION SYSTEMS

A. Submittal

1) Design Phase: A complete package of design calculations and information on the plans shall be provided for review by LAWA. Calculations and plans shall be provided with whatever markings or notations that are needed to make them clearly understandable.

B. IT Rooms {21 22 00, 21 13 16}

1) Computer rooms with LAWA IT Equipment shall be protected with FM 200 system and Pre-Action system. The sequence of operation shall have the FM 200 system primary with the secondary Pre-Action system.

NOTE: If any discrepancies are found, the manufacturers name listed in the Airport Mechanical Equipment Standards has precedence over Airport Mechanical Design Standard list of manufacturers.

PURPOSE

The purpose of these Standards is to highlight the most important Electrical system items based on LAWA standards. The Standards are a compilation of general design and construction practices that are already in place in our facilities, as well as recent discoveries that shall 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 a complete description of all items practiced in our facilities. However, this document does represent LAWA's standards for most of the major electrical systems. The majority of these Standards are also found in the LAWA Design and Construction Handbook. If any discrepancy is found between these Standards and the Design and Construction Handbook, these Standards shall take precedence.

MEDIUM VOLTAGE CABLE

A. Conductor insulation level thickness shall be 133 percent.
B. Testing. Engage a qualified inspecting and testing agency to perform each visual and mechanical inspection and electrical testing in accordance to NETA ATS.
C. Provide cable pulling tension calculations.

LOW VOLTAGE POWER CONDUCTORS AND CABLES

A. #12 AWG feeder and branch circuit conductors shall be solid.
B. All other feeder and branch circuit conductors shall be stranded.

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

CONDUIT

A. All conduits, cables and wiring shall be concealed from public view.
B. All conduits shall be Electrical Metallic Tubing (EMT) for building interior and Rigid Galvanized Steel (RGS) for building exterior. RGS conduit shall be installed in all areas subject to physical damage. EMT conduit may be installed in exterior areas exceeding 10 feet from finished grade.
C. Spare conduits shall be provided with pull lines.
D. The minimum conduit size shall be 3/4 inch.
E. Romex, MC cable and aluminum flex conduits are not allowed.

ENCLOSURES

A. Indoor dry enclosures shall be NEMA Type 1.
B. Outdoor enclosures shall be NEMA Type 4 or Type 3R stainless steel gasketed.
C. Enclosures exposed to dust or moisture shall be NEMA Type 12 or Type 3R/12.

IDENTIFICATION FOR ELECTRICAL SYSTEMS

NAMEPLATES ON EQUIPMENT

A. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 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.
    Punched or drilled for mechanical fasteners.
    Text is at 1/2-inch (13 mm) high lettering

B. Nameplates shall adequately describe the function of the particular equipment involved. Where nameplates are detailed on the drawings, 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. The next item shall be either LAWA, Concessions, or Airline panel, depending on loads served. In addition, describe where the panel is fed from.

For example, PANEL 1LA, 120/208V, 3PH, 4W
LAWA PANEL
FED FROM MS

C. Nameplates shall be secured to equipment front using stainless steel screws or rivets.

D. Custom metal master nameplates shall be furnished and installed by the manufacturer on each distribution section, switchboard section and motor control center indicating the manufacturer's name, ampere rating, short-circuit rating (bus bracing) and date. Paper stickers are not acceptable.

For example, ABC SWITCHBOARD CO.
AMPERE RATING: 5000A
SHORT CIRCUIT RATING: 100KAIC
DATE: 01/01/2011

PANELBOARD DIRECTORIES

A. Panelboard directories shall be typewritten, arranged in numerical order, and shall list each circuit load and room number in which each load is located. Directories shall be mounted in a 6 by 8 inch metal frame under transparent plastic inside each panelboard door.

B. Changes to existing panelboard directories shall be made with a P-Touch or other label machine.

PERMANENT MARKING

A. All conduits, busways, cable trays and pullboxes shall be identified with permanent 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 1/4 inch minimum height. For pullboxes and busways, the letter height shall be 1/2 inch minimum height and not larger than 3/4 inch 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 as shown on the drawings) 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.

E. All receptacle and switch faceplates shall be labeled with the source panel and circuit number. The label shall be black Arial font on white or clear tape, produced by a P-Touch or other label machine.

CONDUCTOR IDENTIFICATION

A. All power and branch circuit conductors shall be provided with color-coded insulation or color-coded self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide. Vinyl tape shall be used in vaults, pull and junction boxes, manholes and handholes. Identify the source and circuit number of each set of conductors with write-on tags.

B. Color coding shall be as follows:

Phase	208Y/120V	480Y/277V
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	White with Black Stripe
Ground	Green	Green

UNDERGROUND WARNING TAPE

A. Description: Permanent, detectable, red colored, continuous printed, polyethylene tape with suitable warning legend describing buried electrical lines. Tape shall be minimum 6 inches wide by 4 mils thick. Other color codes include:

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

MANHOLE AND UNDERGROUND PULLBOX COVER LABEL

A. All manhole and underground pullbox covers shall have the following cast-in or bead welded and galvanized identification label permanently affixed to the exterior:
   "ELEC-LV" for electrical power circuits 600 volts or less
   "ELEC-HV" for electrical power circuits over 600 volts
   "COMM" for communications circuits
B. A custom 3-digit number shall be added to the cover. Contact the Engineer for number assignment.
C. The minimum letter height shall be one (1) inch.

LOW VOLTAGE TRANSFORMERS

A. The equipment, major components and anchorage shall be suitable for and certified to meet all applicable seismic requirements defined in Division 26 Section Vibration and Seismic Controls for Electrical Systems.
B. Transformer coils shall be wound of electrical grade copper with continuous wound construction.

SWITCHBOARDS

A. 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.
B. The manufacturer of the switchboard assembly shall be the same as the manufacturer of the circuit breakers installed within the assembly.
C. The equipment, major components and anchorage shall be suitable for and certified to meet all applicable seismic requirements defined in Division 26 Section Vibration and Seismic Controls for Electrical Systems.
D. Distribution bus bars shall be silver-plated or tin-plated copper and shall have bus extensions provided at the ends where future sections can be added. Bus bars shall be fully rated for the entire length of the switchboard.
E. Switchboards shall be positioned so there is open space on either side for future additional sections.

PANELBOARDS

A. Panelboards shall be "fully-rated" for the available short circuit current. "Series-rated" equipment is not acceptable.

B. The manufacturer of the panelboard assembly shall be the same manufacturer of the major components within the assembly, including the circuit breakers.
C. The equipment, major components and anchorage shall be suitable for and certified to meet all applicable seismic requirements defined in Division 26 Section Vibration and Seismic Controls for Electrical Systems.
D. Panelboard main bus bars shall be copper with full capacity neutral and equipment ground bus.
E. Panelboards shall be installed in rooms or areas not within public view.

MOTOR CONTROL CENTERS

A. Motor control center shall be heavy duty industrial grade.
B. All indicator and pilot lights shall be LED with metal housing and easily replaceable parts.
C. All control wiring shall be installed in Panduit wiring ducts. Wiring shall be stranded copper.
D. Provide wire markers or tags for all control wiring at all termination points.
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
J. Provide three (3) position selector switch, Hand-Off-Auto, not Start-Stop button
K. For motors with two (2) speeds, provide a separate selector switch, High-Low.
L. Wire ties shall be attached to the unit with screws or epoxy, not adhesive tape.

ENCLOSED BUS ASSEMBLIES

A. All busway components shall be of the same manufacturer as the busway.
B. Indoor busway feeders shall be sprinkler-proof, IP54 rating.
C. The equipment, major components and anchorage shall be suitable for and certified to meet all applicable seismic requirements defined in Division 26 Section Vibration and Seismic Controls for Electrical Systems.

STATIC UNINTERRUPTABLE POWER SYSTEMS

A. Manufacturers
    1. Liebert
    2. Eaton Corp.
    3. Toshiba

WIRING DEVICES

A. All receptacles shall be flushed and recessed in the wall or floor.

INTERIOR LIGHTING

A. All light fixtures shall be installed in areas accessible by ladder or lift to allow for ease of maintenance.
B. Standard fluorescent lamps shall be T8.

EXTERIOR LIGHTING

A. Provide fuses and fuse holders for outdoor lighting ballasts and light pole fixtures.
B. Outdoor flood lighting lamps shall be metal halide type.
C. Wallpacks shall be induction type.

APRON LIGHTING

D. Illuminance levels are as follows:
   The minimum horizontal illuminance at ground level: 2.0 footcandles at a distance of 200 feet.
   The maximum horizontal illuminance at ground level: 0.50 footcandles at a distance of 300 feet.
   The minimum vertical illuminance at a height of 3 feet above ground level: 5.0 footcandles at a distance of 200 feet.
   The maximum vertical illuminance at a distance of 250 feet: 0.25 footcandles at a height of 50 feet.
E. Floodlight fixture type shall be WideLite Aktra II and shall have an internal reflector to reduce glare and block high angle light.
F. Floodlight fixtures mounted on a lowering device shall have ballasts installed within the fixture. Fixtures mounted on non-lowering device poles shall have remotely located ballasts in a separate ballast enclosure, mounted to the lighting pole, at an accessible height.
G. Pole shafts shall be round tapered steel. Pole gauge for two-piece poles shall be minimum 3 gauge (0.2391") for lower section and minimum 7 gauge (0.1793") for upper section.

ELECTRICAL SUBMETERS

A. Electrical submeters are required to be installed for any tenant other than LAWA, in order to monitor electrical usage.
B. Submeter features shall include a display for cumulative kWh readings, kW demand loads, and built-in wireless transceiver.
C. Submeters shall be consolidated in multimeter enclosures in no more than 2 to 4 electrical rooms within the terminal.
D. The following loads shall be submetered with the most minimal amount of submeters: All Concessions separately, TSA rooms and equipment, In-Line Baggage system, passenger loading bridge power (including pre-conditioned air and 400Hz units), large electrical loads such as major refrigeration units, Airline VIP lounges. The philosophy of submetering is to submeter any load type that is not common for all tenants, therefore not included in the general formula $$ /SQFT charged to tenants in addition of being exclusive to particular tenants.

APPROVED EQUIPMENT

A. All electrical equipment installed shall be listed by a City of Los Angeles recognized electrical testing laboratory.

PURPOSE

The purpose of these Standards is to highlight the most important Electrical system items based on LAWA standards. The Standards are a compilation of general design and construction practices that are already in place in our facilities, as well as recent discoveries that shall 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 a complete description of all items practiced in our facilities. However, this document does represent LAWA's standards for most of the major electrical systems. The majority of these Standards are also found in the LAWA Design and Construction Handbook. If any discrepancy is found between these Standards and the Design and Construction Handbook, these Standards shall take precedence.

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C. Provide cable pulling tension calculations.

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A. #12 AWG feeder and branch circuit conductors shall be solid.
B. All other feeder and branch circuit conductors shall be stranded.

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

CONDUIT

A. All conduits, cables and wiring shall be concealed from public view.
B. Rigid Galvanized Steel (RGS) conduit shall be installed in Wet and Damp locations. Electrical Metallic Tubing (EMT) conduit may be installed in Dry locations. RGS conduit shall be installed in all areas subject to physical damage.
C. Spare conduits shall be provided with pull lines.
D. The minimum conduit size shall be 3/4 inch.
E. Romex, MC cable and aluminum flex conduits are not allowed.

ENCLOSURES

A. Indoor dry enclosures shall be NEMA Type 1.
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   Punched or drilled for mechanical fasteners.
   Text is at 1/2-inch (13 mm) high lettering

B. Nameplates shall adequately describe the function of the particular equipment involved. Where nameplates are detailed on the drawings, 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. The next item shall be either LAWA, Concessions, or Airline panel, depending on loads served. In addition, describe where the panel is fed from.

For example, PANEL 1LA, 120/208V, 3PH, 4W
LAWA PANEL
FED FROM MS

C. Nameplates shall be secured to equipment front using stainless steel screws or rivets.

D. Custom metal master nameplates shall be furnished and installed by the manufacturer on each distribution section, switchboard section and motor control center indicating the manufacturer's name, ampere rating, short-circuit rating (bus bracing) and date. Paper stickers are not acceptable.

For example, ABC SWITCHBOARD CO.
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A. Panelboard directories shall be typewritten, arranged in numerical order, and shall list each circuit load and room number in which each load is located. Directories shall be mounted in a 6 by 8 inch metal frame under transparent plastic inside each panelboard door.

B. Changes to existing panelboard directories shall be made with a P-Touch or other label machine.

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C. Spare conduits, pullboxes, busways, and abandoned raceways (that are to remain as shown on the drawings) 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.

E. All receptacle and switch faceplates shall be labeled with the source panel and circuit number. The label shall be black Arial font on white or clear tape, produced by a P-Touch or other label machine.

F. All boxes and enclosures (including transfer switches, generators, and power panels) for emergency circuits shall be permanently marked in red with the words, "EMERGENCY SYSTEM", so they will be readily identified as a component of an emergency circuit or system.

CONDUCTOR IDENTIFICATION

A. All power and branch circuit conductors shall be provided with color-coded insulation or color-coded self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide. Vinyl tape

shall be used in vaults, pull and junction boxes, manholes and handholes. Identify the source and circuit number of each set of conductors with write-on tags.

B. Color coding shall be as follows:

Phase	208Y/120V	480Y/277V
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	White with Black Stripe
Ground	Green	Green

UNDERGROUND WARNING TAPE

A. Description: Permanent, detectable, red colored, continuous printed, polyethylene tape with suitable warning legend describing buried electrical lines. Tape shall be minimum 6 inches wide by 4 mils thick. Other color codes include:

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

MANHOLE AND UNDERGROUND PULLBOX COVER LABEL

A. All manhole and underground pullbox covers shall have the following cast-in or bead welded and galvanized identification label permanently affixed to the exterior:
   "ELEC-LV" for electrical power circuits 600 volts or less
   "ELEC-HV" for electrical power circuits over 600 volts
   "COMM" for communications circuits
B. A custom 3-digit number shall be added to the cover. Contact the Engineer for number assignment.
C. The minimum letter height shall be one (1) inch.

LOW VOLTAGE TRANSFORMERS

A. The equipment, major components and anchorage shall be suitable for and certified to meet all applicable seismic requirements defined in Division 26 Section Vibration and Seismic Controls for Electrical Systems.
B. Transformer coils shall be wound of electrical grade copper with continuous wound construction.

SWITCHBOARDS

A. 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.
B. The manufacturer of the switchboard assembly shall be the same as the manufacturer of the circuit breakers installed within the assembly.
C. The equipment, major components and anchorage shall be suitable for and certified to meet all applicable seismic requirements defined in Division 26 Section Vibration and Seismic Controls for Electrical Systems.
D. Distribution bus bars shall be silver-plated or tin-plated copper and shall have bus extensions provided at the ends where future sections can be added. Bus bars shall be fully rated for the entire length of the switchboard.
E. Switchboards shall be positioned so there is open space on either side for future additional sections.

F. The AIC rating of the equipment shall exceed 130% of the available short circuit current at the equipment.

PANELBOARDS

A. Panelboards shall be "fully-rated" for the available short circuit current. "Series-rated" equipment is not acceptable.
B. The manufacturer of the panelboard assembly shall be the same manufacturer of the major components within the assembly, including the circuit breakers.
C. The equipment, major components and anchorage shall be suitable for and certified to meet all applicable seismic requirements defined in Division 26 Section Vibration and Seismic Controls for Electrical Systems.
D. Panelboard main bus bars shall be copper with full capacity neutral and equipment ground bus.
E. Panelboards shall be installed in rooms or areas not within public view.
F. The AIC rating of the equipment shall exceed 130% of the available short circuit current at the equipment.

MOTOR CONTROL CENTERS

A. Motor control center shall be heavy duty industrial grade.
B. All indicator and pilot lights shall be LED with metal housing and easily replaceable parts.
C. All control wiring shall be installed in Panduit wiring ducts. Wiring shall be stranded copper.
D. Provide wire markers or tags for all control wiring at all termination points.
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
J. Provide three (3) position selector switch, Hand-Off-Auto, not Start-Stop button
K. For motors with two (2) speeds, provide a separate selector switch, High-Low.
L. Wire ties shall be attached to the unit with screws or epoxy, not adhesive tape.

ENCLOSED BUS ASSEMBLIES

A. All busway components shall be of the same manufacturer as the busway.
B. Indoor busway feeders shall be sprinkler-proof, IP54 rating.
C. The equipment, major components and anchorage shall be suitable for and certified to meet all applicable seismic requirements defined in Division 26 Section Vibration and Seismic Controls for Electrical Systems.

WIRING DEVICES

A. All receptacles shall be flushed and recessed in the wall or floor.

INTERIOR LIGHTING

A. All light fixtures shall be installed in areas accessible by ladder or lift to allow for ease of maintenance.
B. Standard fluorescent lamps shall be T8.

EXTERIOR LIGHTING

A. Provide fuses and fuse holders for outdoor lighting ballasts and light pole fixtures.
B. Wallpacks shall be induction type.

APRON LIGHTING

C. Illuminance levels are as follows:
   The minimum horizontal illuminance at ground level: 2.0 footcandles at a distance of 200 feet.
   The maximum horizontal illuminance at ground level: 0.50 footcandles at a distance of 300 feet.
   The minimum vertical illuminance at a height of 3 feet above ground level: 5.0 footcandles at a distance of 200 feet.
   The maximum vertical illuminance at a distance of 250 feet: 0.25 footcandles at a height of 50 feet.
D. Floodlight fixture type shall be WideLite Aktra II and shall have an internal reflector to reduce glare and block high angle light.
E. Floodlight fixtures mounted on a lowering device shall have ballasts installed within the fixture. Fixtures mounted on non-lowering device poles shall have remotely located ballasts in a separate ballast enclosure, mounted to the lighting pole, at an accessible height.
F. Pole shafts shall be round tapered steel. Pole gauge for two-piece poles shall be minimum 3 gauge (0.2391") for lower section and minimum 7 gauge (0.1793") for upper section.

ELECTRICAL SUBMETERS

A. Electrical submeters are required to be installed for any tenant other than LAWA, in order to monitor electrical usage.
B. Submeter features shall include a display for cumulative kWh readings, kW demand loads, and external wireless module.
C. Submeters shall be consolidated in multimeter enclosures in no more than 2 to 4 electrical rooms within the terminal.
D. The following loads shall be submetered with the most minimal amount of submeters: All Concessions separately, TSA rooms and equipment, In-Line Baggage system, passenger loading bridge power (including pre-conditioned air and 400Hz units), large electrical loads such as major refrigeration units, Airline VIP lounges. The philosophy of submetering is to submeter any load type that is not common for all tenants, therefore not included in the general formula $$ /SQFT charged to tenants in addition of being exclusive to particular tenants.

MISSION STATEMENT: The goal of this section is to provide guidance to the users in designing structures that meet required performance objectives, provide structures that will limit the business interruptions of LAWA and their tenants after a moderate earthquake and produce an economical design. The guidelines provided below are general requirements necessary to meet LAWA's objectives. It is incumbent upon the professional engineers and architects to utilize this section, along with their engineering judgment, to meet the stated objectives and comply with all local, state and federal rules and regulations.

This section is targeted at the construction of new structures and the major renovation of existing structures. It is not intended to mandate retrofit of any structure, however, if the structure is being retrofitted, these provisions should be used as guidance towards achieving LAWA's objectives.

Cost is always a factor in the construction and renovation of facilities. Use of the provisions in this section is meant to decrease the total cost of facilities over their lifetime, however, the initial first cost may be greater. Decisions as to the use of some of these provisions are left to the discretion of LAWA, where cost becomes a major factor in the ability to complete the project within the defined budget. However, an increase in the total cost of the facility should be expected if they are not used.

A. Performance Objective

1) The required performance level of all LAWA facilities is divided into two categories: LAWA Mission Critical Structures and Other Structures. The LAWA Mission Critical Structures are structures deemed critical to the operation of the Airport such that after a natural or manmade disaster will be functional in a relatively short time and will be able to maintain a minimum level of air traffic.
    a) LAWA Mission Critical Structures include, but are not limited to:
        (i) Code required structures with a seismic importance factor equal to 1.5.
            1. Air Traffic Control Tower (ATCT).
            2. Fire Stations.
            3. Airport Police Administration and Vehicle Parking Structures.
        (ii) LAWA required structures with a seismic importance factor equal to 1.5.
            1. Terminal Buildings & Passenger Boarding Bridges.
            2. Remote Gates.
            3. Elevated Level Roadways and Railways.
            4. Structures and Bridges over Central Terminal Area (CTA) Roadways.
            5. FAA/Airport Police/Construction & Maintenance Critical Communications Equipment and Supports.
            6. Central Utilities Plant (CUP).
            7. Network Stations and Major Electrical Distribution Structures.
            8. Airport Operation Centers.
            9. Telecommunications and Data Centers.
            10. Fuel Farm.
            11. Emergency Generators.
    b) Other Structures:
        (i) Code required structures with a seismic importance factor less than 1.5.
            1. Administration Buildings.
            2. Maintenance Buildings.
            3. Parking Structures.

4. Cargo Facilities and Fixed Base Operations (FBOs).
5. Etc.

2) All structures shall be designed to meet current building code requirements.
   a) Mission Critical Structures:
      (i) LAWA Mission Critical Structures must be designed to meet drift limitations and importance factors corresponding to Essential Facilities (i.e. Occupancy Category IV per ASCE 7). As an alternate to the prescriptive requirements in the building code, new structures may be designed using a Performance Based Engineering methodology with a performance level of Immediate Occupancy. ASCE 41 shall be the design standard for Performance Based Engineering. An independent peer review team, selected by, paid for, and accountable to LAWA, shall be required during the entire design process. The Engineering and Facilities Management Division shall be responsible for monitoring the technical aspect of the peer review process and shall also be included in the review process.
      (ii) Existing structures to be seismically retrofitted may be designed using a Performance Based Engineering methodology with a performance level of Immediate Occupancy.
      (iii) Existing structures not seismic retrofitted, with an anticipated non-structural improvement construction cost of greater than 25% of the value of the building, or as determined by LAWA, shall comply with the following:
         1. Structures utilizing moment frame connections constructed prior to 1994, and all other structures constructed prior to 1972, shall be analyzed by a structural engineer using a Performance Based Engineering methodology to determine if the structure can meet the performance level of Life Safety.
         2. A report shall be generated and submitted to Facilities Planning and Engineering and Facilities Management Divisions for review and archival. The report shall indicate whether or not the structure is capable of achieving the performance level noted. If the level is not achievable, the report shall indicate the anticipated performance level that can be reached, along with a brief description of the expected damage. If the level is achievable, the report shall provide a conceptual plan describing what work would be necessary to improve the performance level from Life Safety to Immediate Occupancy.
         3. The report noted in subsection 2 above need not be performed if an existing or similar report is already on file for the structure.
      (iv) The Structural Engineer of Record shall describe in the contract documents that all Mechanical/Electrical/Plumbing (MEP) systems have been assigned a Component Importance Factor, I_p, of 1.5, and therefore, shall be assigned as part of the designated seismic system and must be tested in accordance with the Code. Furthermore, the certificate of compliance submitted by each manufacturer of designated seismic system components shall also be submitted to LAWA's Engineering and Facilities Management Division for review and acceptance.
   b) Other Structures:
      (i) As an alternate to the prescriptive requirements in the building code, new structures may be designed using a Performance Based Engineering methodology with a performance level of Life Safety. ASCE 41 shall be the design standard for Performance Based Engineering. An independent peer review team, selected by, paid for, and accountable to LAWA, shall be

required during the entire design process. The Engineering and Facilities Management Division shall be responsible for monitoring the technical aspect of the peer review process and shall also be included in the review process.

(ii) Existing structures to be seismically retrofitted may be designed using a Performance Based Engineering methodology with a performance level of Life Safety.

(iii) Existing structures not seismic retrofitted, with an anticipated non-structural improvement construction cost of greater than 25% of the value of the building, or as determined by LAWA, shall comply with the following:

1. All Other Structures shall be analyzed by a structural engineer using a Performance Based Engineering methodology to determine if the structure can meet the performance level of Collapse Prevention.
2. A report shall be generated and submitted to Facilities Planning and Engineering and Facilities Management Divisions for review and archival. The report shall indicate whether or not the structure is capable of achieving the performance level noted. If the level is not achievable, the report shall indicate the anticipated performance level that can be reached, along with a brief description of the expected damage. If the level is achievable, the report shall provide a conceptual plan describing what work would be necessary to improve the performance level from Collapse Prevention to Life Safety.
3. The report noted in subsection 2 need not be performed if an existing or similar report is already on file for the structure.

B. Lateral Force Resisting System

1) All members and connections of the lateral force resisting system shall be designed and detailed to be capable of sustaining, within the strength and deflection limitations specified in the Code, all gravity, wind, seismic and earth loads applied to them. All members shall transfer the applied loads from the point of application through the structure to the final point of resistance.
2) The lateral force resisting system for Mission Critical Structures shall be composed of one of the following systems or a combination of these systems:
    a) Special Steel Moment Frames with or without Viscous Fluid Dampers.
    b) Buckling-Restrained Braced Frames with Moment-Resisting Beam-Column Connections.
    c) Special Reinforced Concrete Moment Frames.
    d) Base Isolation or Seismically Isolations Systems.
3) The lateral force resisting system for Other Structures shall be composed of one of the following systems or a combination of these systems:
    a) Special Steel Moment Frames with or without Viscous Fluid Dampers.
    b) Buckling-Restrained Braced Frames with Moment-Resisting Beam-Column Connections.
    c) Special Steel Plate Shear Walls.
    d) Special Steel Truss Moment Frames.
    e) Special Reinforced Concrete Moment Frames.
    f) Special Reinforced Concrete Shear Walls.
    g) Special Reinforced Masonry Shear Walls.
    h) Base Isolation or Seismically Isolations Systems.

C. Gravity Load-Supporting Systems

1) All members of the structural framing system shall be designed and detailed to be capable of sustaining, within the strength and deflection limitations specified in the Code, all loads applied to them. All members shall transfer the applied loads from the point of application through the structure to the final point of resistance.
2) In addition to the self-weight of the structural framing members, dead loads shall include, but is not limited to:
    a) Mechanical ducts, VAV boxes, piping, conduits, cables, ceilings, shelving, cabinets, partitions, glazing, signs, antennas plumbing and fire protection pipes, electrical lighting, insulation, etc.
    b) Floor finishes, access flooring and roofing.
    c) Fixed equipment (mechanical, electrical, elevator, etc.).
    d) A minimum 6 inch thick concrete housekeeping pad under fixed equipment (mechanical, electrical, plumbing, etc.).
3) Deflection Control and Level Tolerances
    a) All structural-framing members shall be designed to limit deflections within the Code and specific component criteria minimums.
4) Floor Flatness and Levelness
    a) For all structural concrete slabs and concrete slabs-on-grade, the Structural Engineer of Record shall designate in the Construction Documents a level and flat surface plane that meets the requirements of ACI 302, “Guide for Concrete Floor and Slab Construction”. A minimum FF/FL number of 25-17/20-15 shall be met.
5) Minimum roof slope shall be as required by the code. In no case shall the slope be less than 3/8” per foot.
6) Design operating weights of all mechanical, electrical and plumbing equipment shall be indicated on the structural plans.

D. Foundation Systems

1) The foundation systems design shall be developed as a result of the final subsurface investigation and the foundation recommendation prepared by a qualified Geotechnical Engineer.
2) The foundation design shall include, but not be limited to, the following:
    a) Design foundation system to accommodate all dead, live, wind, seismic and earth loads applied to the structure and all other loads as required by governing codes, and the final Geotechnical Report.
    b) Design foundation system to accommodate load effects from adjacent buildings.
    c) Design for shoring and underpinning of existing structures including existing buildings, public utilities and street retainage structures, as necessary on property lines or design for temporary and permanent systems to support surcharge as loading of adjacent buildings on new structure.
    d) Where there is below grade construction, the structural design shall account for withstanding or relieving of the hydrostatic pressures.
3) For LAWA Mission Critical Structures only, the foundations shall additionally comply with the latest OSHPD requirements for overstrength force transfer as described in the 2010 CBC Section 1615A.1.10, or more current edition of the code.

E. Design Earthquake Provisions

1) The Code-mandated provisions for earthquake design of new buildings are minimum requirements to achieve Life Safety performance objectives. The seismic design shall comply with the following:
    a) All governing building codes.
    b) The final geotechnical and geohazard report and site specific response spectra data.

2) The following minimum design factors and parameters shall be used for seismic design, unless site specific information is available:
    a) Occupancy Category: II (Occupancy Category IV for LAWA Mission Critical Structures, for strength and stiffness criteria).
    b) Site Classification: D
    c) Site Modification Factors: F_a = 1.0; F_v =1.5
    d) Design Spectral Response Accelerators: S_{D1} = 0.640g; S_{DS} = 1.137g
    e) Importance Factor for Non-Structural Components: I_P = 1.5 for all structures. See Section I for additional information.
    f) Allowable (Inelastic) story drift per Code.
3) A continuous load path with adequate strength and stiffness shall be designed and detailed to transfer all seismic forces from the point of application through the structure to the final point of resistance.

F. Wind Loads

1) The minimum wind design loads shall be determined in accordance with the Code using a minimum basic wind speed equal to 85 MPH and Exposure Category C.
2) Design wind pressure on components and cladding shall be determined by the Code except as noted below:
    a) Wind load for Terminal buildings at the airside face only shall be 50 psf applied to any 15 square foot area for components and cladding per FAA AC 150/5300-13, Chapter 8, “The Effects and Treatment of Jet Blast”. This load need not apply at inset penthouse structures forty (40) feet above the apron level. This load is a result of aircraft jet blast plus meteorological conditions.

G. Design Live Loads

1) The minimum design live loads shall be determined in accordance with the Code, but no less than the following:
    a) 100 psf at pedestrian bridges.
    b) 100 psf plus a maintenance lift, similar to a Falcon Reachmaster FS-105, weighing 10,000 pounds, in public areas within Terminals. Additionally, an ingress and egress path of travel shall be identified on the drawings to get the lift from the street to each level of the Terminal.
    c) HL-93 where vehicular traffic is anticipated per Caltrans and AASHTO, including under the Terminals where vehicular traffic is possible. Where Ground Service Equipment (GSE) traffic is expected, use a tug weight of 140,000 lbs or the weight of the heaviest piece of GSE.
2) Apron slabs shall be designed to support the largest aircraft and associated GSE, as defined by LAWA, for the area in question. Contact LAWA for apron slab removal requirements. Apron slabs shall be unreinforced unless approved by LAWA, or as noted below.
    a) Grease Interceptors (GI), or other buried tanks, located within 20’ of the exterior face of the buildings shall comply with the following:
        (i) GI may be constructed of precast concrete, fiberglass, or other material approved by LAWA.
        (ii) Apron slab shall be designed to support the GSE noted in G.1.c and the anticipated nose wheels of the largest aircraft anticipated for the area.
        (iii) GI shall be parallel with the building, where possible.
        (iv) GI installation shall disturb as few of the apron slabs as possible. Drawings shall reflect the actual layout of existing and panel revisions.
        (v) Apron slabs may be reinforced within 20’ of the exterior face of the building, however, all reinforced slabs shall have metallic embeds cast into the four

corners of the panel indicating that the panel is reinforced. Rebar shall be galvanized or epoxy coated.

b) Grease Interceptors, or other buried tanks, located more than 20' from the exterior face of the buildings shall comply with the following:
   (i) GI shall be constructed of precast concrete.
   (ii) Apron slab and GI shall be designed to support the GSE noted in G.1.c and the anticipated nose wheels, or the main wheels of the largest aircraft anticipated for the area.
   (iii) GI installation shall disturb as few of the apron slabs as possible. Drawings shall reflect the actual layout of existing and panel revisions.
   (iv) Apron slabs shall not be reinforced, except for the dowels across the construction joints.

3) Design live loads at all levels shall be graphically noted through load maps on structural drawings.

H. Material Selection

1) The selection of structural system and materials shall be based on, but not limited to, the following structural parameters:
   a) All structural framing components shall be designed to be non-combustible.
   b) Structural steel, reinforced concrete and reinforced masonry shall be the basic materials for the structural framing systems.
2) Wherever structural steel is the main material for the building framing, the following standards shall be met:

Material Type	Specification
• W, WT Shapes	ASTM A992
• Pipe Shapes	ASTM A53 Grade B
• HSS Shapes	ASTM A500 Grade B
• Channels, Angles, Bars, Plates	ASTM A36
• Miscellaneous, UNO	ASTM A36

3) Wherever reinforced concrete is used, the following standards shall be met:

Location in structure:	f'c (psi)	weight (pcf)
• Hardrock Concrete Fill On Metal Deck	4,000	150
• Ltwt Concrete Fill On Metal Deck	4,000	115
• Slab-On-Grade	3,000	150
• Columns and Beams	4,000	150
• Walls And Footings	4,000	150
• Miscellaneous, UNO	3,000	150

4) Wherever reinforced masonry is used, the following standards shall be met:

Location in structure:	f'm (psi)	weight (pcf)
• Typical Masonry, UNO	1,500	varies

5) Reinforcing bars shall conform to the requirements of ASTM A615, Grade 60, unless noted otherwise.
6) Reinforcing bars to be welded shall conform to the requirements of ASTM A706.
7) Reinforcing bars in locations where water is expected shall be epoxy-coated and shall conform to the requirements of ASTM A775.

I. Support of Non-structural Elements

1) All permanent non-structural components, including but not limited to, MEP equipment, mechanical ducts, VAV boxes, piping, conduits, cables, ceilings, shelving, cabinets, access floor systems, partitions, glazing, signs, antennas plumbing and fire protection pipes, electrical lighting, etc, shall be anchored to resist the seismic forces prescribed in the Code

with an assigned Component Importance Factor I_p = 1.5. Only LAWA Mission Critical Structures need to meet the additional requirements of being part of the Designated Seismic System as described in Section A.2.a.iv.

2) For interior non-bearing partition walls, full height framing (floor to floor) shall be used where practical.

Los Angeles
World Airports

LOS ANGELES WORLD AIRPORTS

INFORMATION MANAGEMENT & TECHNOLOGY GROUP

IT Infrastructure Standards of Practice

Information Management & Technology Group
Infrastructure Technology Group
6053 W. Century Blvd.
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I. Introduction

A. Scope

This Standards Document provides design guidelines and requirements for designing infrastructure for Information Technology and Security Systems within the City of Los Angeles at Los Angeles World Airports (LAWA).

Architects, engineers, planners, consultants, Installers, tenants, and staff are among the intended audience. The result of adhering to this specification is to provide infrastructure that:

- Is secure
- Provides for growth
- Conforms to industry standards
- Implements best practices
- Improves reliability
- Increases serviceability

B. Construction Approvals

Before the construction or installation of any IT facilities, construction approvals shall be obtained through the Tenanat Approval Process. For more information on tenant projects, refer to the Tenant Project Approval Process Manual or call LAWA's Facilities Planning Division at (424) 646-7690.

Direct all correspondence to:

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

- LAWA Information Management & Technology Group
- Attention: Infrastructure Technology Group Manager
- 6053 W. Century Blvd., Suite 200
- Los Angeles, California 90045
- Phone: (310) 646-2067 Fax: (310) 646-1888

Subsurface utilities shall be located by calling the California Underground Service Alert South at (800) 227-2600, or One Call Referral Systems International at (888) 258-0808. Orange is the uniform color code for utility flagging, painting, and identifying communications, alarms, signals, and CATV.

II. Codes, Standards, & References

A. General

All installations shall comply with the latest National Electric Code, the Los Angeles City Building and Safety Electric Code, and the codes, standards, and methodologies listed below. Except as specified, Standards and practices that prevail and are generally accepted within the industry shall be used to assure the highest quality materials, equipment and workmanship.

All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction only. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

If there is an apparent conflict between this specification, and any code or standard, then the NEC and City of Los Angeles Building and Safety Codes shall prevail.

B. References

List of Codes and Standards governing infrastructure installations:

ANSI C80-1	*Rigid Steel Conduit, Zinc-Coated.*
ANSI C80-3	*Electrical Metallic Tubing, Zinc-Coated.*
ANSI/ICEA S-83-596	*Fiber Optic Premises Distribution Cable Technical Requirements.*
ANSI/NEMA FS 1	*Fittings and Supports for Conduit and Cable Assemblies.*
ANSI/TIA/EIA 107	*Return Loss for Fiber Optic Components.*
ANSI/TIA/EIA-455-A	*Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components (FOTPs) Standard Test Procedures for Optical Fibers & Cables.*
ANSI/TIA/EIA 455-13	*Visual and Mechanical Inspection of Fiber Optic Components, Devices, and Assemblies (R2002).*
ANSI/TIA/EIA 455-57A	*Optical Fiber End Preparation and Examination.*
ANSI/TIA/EIA 455-59	*Measurement of Fiber Point Defects Using An OTDR.*
ANSI/TIA/EIA 455-60	*Measurement of Fiber or Cable Length Using An OTDR.*
ANSI/TIA/EIA 455-61	*Measurement of Fiber or Cable Attenuation Using An OTDR.*
ANSI/TIA/EIA 455-95	*Absolute Optical Power Test for Optical Fibers and Cables.*
ANSI/TIA/EIA -526-7	*Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.*

ANSI/TIA/EIA 455-171	*Attenuation by Substitution Measurement - for Short-Length Multimode Graded-Index and Single-mode Optical Fiber Cable Assemblies.*
ANSI/TIA/EIA 526-14	*Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.*
ANSI/TIA/EIA-568-B.1	*Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, April, 2001.*
ANSI/TIA/EIA-568-B.2	*Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components, April, 2001.*
ANSI/TIA/EIA-568-B.3	*Commercial Building Telecommunications Cabling Standard Part 3: Optical Fiber Cabling Components, April, 2000.*
ANSI/TIA/EIA –569-B	*Commercial Building Standard for Telecommunications Pathways and Spaces, February 2003.*
ANSI/TIA/EIA 598-B	*Optical Fiber Cable Color Coding, 2001.*
ANSI/TIA/EIA -604.2	*Fiber Optic Connector Intermateability Standard, 1997.*
ANSI/TIA/EIA -606-A	*Administration Standard for Commercial Telecommunications Infrastructure, 2002.*
ANSI/TIA/EIA -607	*Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994.*
ANSI/TIA/EIA –758	*Customer-Owned Outside Plant Telecommunications Cabling Standard, April 1999.*
ANSI/TIA/EIA – 854	*A Full Duplex Ethernet Specification for 1000Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling, 2001.*
ANSI/TIA/EIA – 862	*Building Automation Systems Cabling Standard for Commercial Buildings, 2002.*
ANSI/TIA/EIA-4750000B	*Generic Specifications for Fiber Optic Connectors.*
BICSI	*Telecommunications Distribution Methods Manual (Tenth Edition).*
FCC 47 Part 68	*Code of Federal Regulations, Title 47, Telecommunications.*
IEEE	*National Electrical Safety Code (NESC); 2002.*
LADBS	*Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code.*
NEMA 250	*Enclosures for Electrical Equipment (1000 V Maximum).*
NFPA-70	*National Electric Code; 2002.*
TIA/EIA TSB 67	*Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems*.

TIA/EIA TSB 72	*Centralized Optical Fiber Cabling Guidelines.*
TIA/EIA TSB 75	*Additional Horizontal Cabling Practices for Open Offices.*
UL 1459	*Underwriters Laboratories Standard for Safety – Telephone Equipment.*
UL 1863	*Underwriters Laboratories Standard for Safety – Communications Circuit Accessories.*

III. Abbreviations

ACAMS	Access Control and Monitoring System
ACR	Attenuation to Crosstalk Ratio
AWG	American Wire Gage
ANSI	American National Standards Institute
BTU	British Thermal Units
BICSI	Building Industry Consultants Service International
BOAC	Board of Airport Commissioners
CAT	Category e.g. CAT6
CATV	Cable Television
CCTV	Closed Circuit Television
CTA	Central Terminal Area of the airport
EFMD	Engineering & Facilities Management Division
EIA	Electronic Industries Association
ELFEXT	Equal Level Far End Crosstalk
EMT	Electrical Metal Tubing
FIS	Federal Inspection Services
FR-S	Fire Retardant Stamp
INS	Immigration and Naturalization Service
IT	Information Technology
IMTG	Information Management & Technology Group
LABC	Los Angeles Building Code
LADBS	Los Angeles Department of Building & Safety
MM	Multimode fiber optic cable
MPOE	Minimum Point Of Entry
MTR	Main Telephone room
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NEXT	Near End Crosstalk
O.D.	Outer Diameter
OSP	Outside Plant
OTDR	Optical Time Domain Reflectometry
PVC	Polyvinyl Chloride
SM	Singlemode fiber optic cable
TC	Telephone Closet
TDR	Time Domain Reflectometry
TR	Telephone room
UTP	Unshielded Twisted Pair
WAO	Work Area Outlets

IV. IT Rooms and Locations

A. Design Requirements

1. Environment (Surrounding/Exterior Elements)

   a. Critical requirement. The environment surrounding the location of the IT room must be free from sources of electromagnetic interference.

   b. Critical requirement. The immediate environment surrounding an IT room cannot contain equipment such as steam boilers, compressors, chilled/hot water pipes, elevator equipment, electrical co-generation equipment, or waste processing.

   c. Critical requirement. IT rooms need be located away from flying dirt and debris (i.e. airline equipment ramps). If that is not feasible, then the IT rooms shall have positive ventilation and magnetic gasketing.

   d. The location must be above any potential flood zones, including being located below rest rooms and restaurants.

   e. IT rooms need to be accessible from a corridor, stairwell, and/or a service elevator large enough for cabinet and equipment loading and servicing.

2. Location

   a. Critical requirement. The location and quantity of telecommunications rooms shall be designed so that the maximum distance from the IT room to any field device that the room supports shall not exceed 250 feet via the longest possible route (i.e. right angles) traveled by the cable from the room to the field device. This includes all work area outlets, ACAMS card readers, cameras, access points, displays, antennas, etc.

   b. Critical requirement. If the distance from the IT room to the furthest field device exceeds 250' via the longest possible route, then another IT room shall be installed to accommodate the distant field devices

   c. Critical requirement. Within a building, if there are two or more IT rooms per floor, then the distance from one IT room to an adjacent IT room shall not exceed 500 feet via the longest possible pathway route (i.e. right angles).

   d. All field devices shall be fed from an IT room on the same floor where that field device is installed. That is, where feasible, field devices should not be fed from IT rooms on levels above or below.

   e. Where feasible, to maximize coverage of an IT room, IT rooms should be located near the center of the floors that they serve, and there shall be a minimum of at least one IT room per floor.

f. If more than one IT room is installed within a building, then a Main IT room shall be identified that shall be larger that the other IT rooms.

g. In a multi-level building, IT rooms on different floors should stack on top of each other. Straight vertical cable risers should be established for the purpose of cable routing.

h. LAWA IT rooms, closets, or equipment rooms shall not be used by tenants for their equipment. Tenants shall install all communications equipment within their leasehold.

i. Buildings with special shapes and sizes shall be considered on an individual basis.

3. IT Room Size

a. Design standards shall address two room types/sizes:

- IT Rooms that contain six to seven equipment cabinets plus one or two UPS cabinets – 11' x 24' or approximately 264 sq. ft. It is preferable to have the UPS in one cabinet footprint – leaving seven equipment cabinets.
- Minimum Point of Entry (MPOE) Rooms that contain eight to nine equipment cabinets plus one to two UPS cabinets 12' x 30' or approximately 360 sq. ft. It is preferable to have the UPS in one cabinet footprint – leaving nine equipment cabinets.

b. Sizing IT rooms for office locations is different than sizing for rooms to support active equipment in a passenger terminal. IT rooms sizes for offices shall be based upon the number of work stations supported. Final room sizing, location, orientation, and layout shall be reviewed with LAWA for approval during the Tenant Approval Process.

c. All room sizes, orientation, and layout shall be reviewed with LAWA for approval at the 30 percent design review phase.

4. Construction

a. General IT rooms within buildings may be constructed with materials similar to the surround architecture. Refer to the Los Angeles Building Code for requirements.

b. IT equipment rooms shall be constructed with concrete block walls and lined with an electromagnetic interference prevention material.

5. Ceiling

a. Drop or false ceilings are not permitted.

b. Minimum ceiling height is eight feet, six inches, (8’ 6”).

c. Minimum ceiling height is nine feet.

6. Flooring

a. Raised access floors shall not be permitted

b. Shall be covered with an anti-static vinyl.

c. Floor loading for general IT rooms shall be a minimum of 100 lbf/ft^2

d. Floor loading for large IT equipment rooms shall be a minimum of 200 lbf/ft^2

7. Seismic Bracing

a. Contractors shall provide seismic restraint of all infrastructure and equipment installed in TR and MPOE rooms. All infrastructure supports and anchoring shall meet current LADBS code requirements with importance factor 1.5 for essential facility rating.

8. Walls

a. Walls without plywood shall be painted white in a semi-gloss finish.

b. Walls with plywood shall be covered with 3/4 inch x 4 ft x 8 ft, AC-grade, fire-retardant treated plywood, with the FR-S stamp on it.

c. The “C” side shall face the studs so that the “fire retardant” stamp is visible on the “A” side.

d. Cutouts for electrical switches and outlets shall be provided.

e. Important. Plywood shall be painted with two coats of white, fire-retardant, low gloss, paint leaving the FR-S stamp(s) exposed for inspectors.

f. Plywood shall be fastened with #12 flat-head sheet metal screws to metal studs, every 16 inches to 24 inches on center depending upon stud spacing.

g. Plywood shall not be fastened with a nail gun or explosive-charge device.

9. Doors

a. Minimum door size is 36 inches x 80 inches.

b. Door should swing outward if local building codes allow. Refer to Chapter 10 of the LABC for allowable projection. Show swing of doors on plans.

c. All doors shall have entry and exit ACAMS card reader access. Provide symbols on plans.

d. All IT room doors shall be keyed to [TBD] locks to allow opening from the outside, and shall have a mechanism to manually enable and disable the key lock.

10. Windows

a. Windows are not permitted without IMTG's approval. Specify method of shading at the 30% review.

11. Power

a. Design standards for IT rooms shall use a maximum 20kVA/16kW for conditioned user equipment loads as the basis for design. See appendices for UPS equipment specifications and requirements. Refer to the NEC for Load Calculation Requirements.

b. Design standards for MPOE rooms shall use a maximum 30kVA/24kW for conditioned user equipment loads as the basis for design. See appendices for UPS equipment specifications and requirements.

c. Contractor shall design for the major electrical components including but not limited to:

- Electrical Distribution in Room (non-conditioned)
- Uninterruptible Power Supply w/ power distribution
- Electrical Panel (conditioned from UPS output)
- Electrical Distribution to cabinets (conditioned from UPS)
- Maintenance Bypass Circuit (if reqd. due to input voltage)
- Batteries (VRLA type)

b. Electrical panels serving the UPS shall be separate from those serving lighting and mechanical equipment.

d. A dedicated 200 amp electrical panel shall be installed within IT rooms up to 360 square feet.

e. Power requirements for larger rooms shall be calculated on an individual basis.

f. Excepting for special circuits, all panels shall be fully populated with 20 amp circuit breakers.

g. Excepting special power requirements, each individual equipment cabinet or equipment rack shall have two separate 120 VAC, 20 amp circuits feeding them.

h. Walls with backboards shall have 120 VAC, 20 amp, non-switched, quad-plex wall outlets installed every six (6) feet.

12. Lighting

a. Lighting shall provide a minimum of 50 foot candles measured at three foot three inches (3' 3") above the floor.

b. Fluorescent fixtures shall use "cool white" lamps.

c. Dimmer switches shall not be used.

d. Light fixtures shall be centered in the aisles between the low-voltage cable tray segments mounted at a minimum of 8' 6" above the finished floor. Lights shall not be mounted directly above cable tray.

e. A minimum of fifty percent of all fixtures shall be on emergency power.

13. Grounding/Bonding

a. Within the main telecommunications room there shall be installed a telecommunications main grounding busbar (TMGB).

b. The TMGB shall be grounded to both the electrical grounding entrance facility and the building's steel exterior wall, or according to the local authority having jurisdiction. The TMGB shall also connect to a telecommunications grounding busbar (TGB) within each IT room via a telecommunications bonding backbone (TBB). Grounding conductors shall be installed to building steel with clamps designs for the purpose.

c. The TMGB shall be a copper busbar of a minimum 4 inches x 10 inches x ¼ inch with a minimum of eight (8) wire connection lugs attached to it. Busbar shall be insulated from its support.

d. The TGB shall be provided for each IT room, and shall be connected to both the closest grounding point in the building's electrical service panel or according to the local authority [LAEC & NEC] having jurisdiction, and the building's steel exterior wall. Show and note on plans.

e. The TBB shall be installed to connect the TMGB to each TGB. Separate conductors shall run from the TMGB to every level within a building. TBB's can be extended from the TGB's in IT rooms on the same level.

f. TBB's shall be sized according to the distance that they need to run, as follows:

- # 6 AWG for distances less than 13 feet
- # 4 AWG for distances between 13 and 20 feet
- # 3 AWG for distances between 20 and 26 feet
- # 2 AWG for distances between 26 and 33 feet

- # 1 AWG for distances between 33 and 44 feet
- # 1/0 AWG for distances between 44 and 52 feet
- # 2/0 AWG for distances between 52 and 66 feet
- # 3/0 AWG for distances greater than 66 feet

g. For TGB's, a minimum, #6 AWG, stranded, copper, green, insulated, conductor shall be provided to connect equipment racks and cabinets and cable tray intersystem bonding. All equipment racks and cabinets shall be bonded to each other and to the telecommunications grounding busbar.

h. All grounding conductors shall be protected by installing within 1/2" conduit.

i. Isolated grounds to reduce electrical noise shall be provided, only if specified. Isolated grounding receptacles shall be colored orange or marked with an orange triangle.

Codes/Standards Reference

NEC article 250

NEC article 800

ANSI J-STD-607-A

Acceptable Products:

B-Line #SB-477-K Busbar

14. Mechanical

a. Provide and install a dedicated ceiling-mounted air conditioning unit w/ reheat and humidification function. Unit shall be installed immediately outside of the IT space to provide for 24 hour service. See appendices for mechanical equipment specifications and requirements for both TR and MPOE rooms.

b. Air conditioning unit shall be chilled water type. If a suitable chilled water source does not exist, contractor shall submit to EFMD to specify a DX system based on existing conditions and using the same capacities as outlined. See current edition of LAWA's Design and Construction Handbook for mechanical engineering requirements and approved equipment suppliers.

c. Air units shall be sized according to max user equipment loads in the space as calculated by the UPS size in kW for both TR an MPOE rooms.

d. Inside temperature shall be maintained between 64°F to 75°F, at between 30% and 55% relative humidity.

e. A thermostat shall be provided within the room. Call out location on plans.

f. All IT room doors shall be sealed for dust-proofing, have positive ventilation, and all ventilation ducts into the room shall be filtered for dust abatement purposes.

g. Supply ducting and supply diffuser from air unit shall be located above cold aisle in TR and MPOE rooms. Return ducting to air unit shall be located above hot aisle in TR and MPOE rooms.

15. Fire Systems for IT Rooms

a. Provide self-contained double-interlocked pre-action riser system to support TR and MPOE spaces as required by owner. Location of pre-action cabinet shall be outside of TR and MPOE space and shall be coordinated with owner for approval. Refer to the Mechanical Code for Pre-Action System

- Double interlocked pre-action system shall have an electric/pneumatic valve requiring both low-air signal and detection signal to open the valve
- Double interlocked pre-action system shall have pressure gauges to indicate water supply pressure, priming water pressure, and air pressure, and shall contain an automatic air compressor to fill the system in prescribed time.
- Double interlocked pre-action system shall be provided with integral FM approved UL listed butterfly valve installed on the system riser outside of cabinet with test and drain assembly for full-flow testing.
- Pre-action valve shall have sight glass to visually confirm water flow upon system activation.
- Pre-action system shall be type Reliable Prepak or Viking TotalPac

b. Sprinklers heads shall have wire cages installed to prevent damage and accidental activation.

c. Specialty spaces may require a clean agent fire suppression system. Any clean agent system requirements shall be coordinated with the owner.

16. Monitoring Systems

a. Provide monitoring equipment to support both the UPS and mechanical unit. Monitoring equipment shall be compatible with the existing Sitelink system and Sitescan software used to monitor other IT spaces and critical infrastructure. Monitoring equipment shall have interface for future connectivity to BMS.

b. Provide and install SSW-2E Sitelink interface module (or equiv.) allowing for communication with UPS and Mechanical system for integration with Sitescan Web software via BACnet. Module shall be mounted in NEMA-1 wall-mount enclosure within room. Include one external power supply 120VAC/24VAC and startup services. One pair of EIA-422 cable required to both UPS and Air critical

17. Plumbing

    Excepting fire sprinklers required by code, no pipes intended to carry water or any other fluid shall be installed in or above the IT room ceiling. See Fire Section for plumbing requirements related to any pre-action sprinkler systems.

18. Security

    a. Entry and exit ACAMS card readers shall be provided for all IT room doors.

    b. All IT room doors shall also be keyed to LAWA A-2 locks to allow opening from the outside, and shall have a mechanism to manually enable and disable the key lock.

    c. All IT rooms shall have cameras within the room that connect to the VNET system.

    d. Some rooms shall have cameras mounted on the outside of the room watching the entry door.

    e. Some rooms may have intercoms that connect back to the network operations center.

19. Conduit Sleeves

    a. Conduit sleeves for backbone cabling are not permitted in new construction.

    b. All backbone conduits shall terminate either within equipment cabinets or lockable junction boxes with hinged covers, sized as follows:

    - One 36” x 36” x 12” deep junction box for 2 to 4 four inch conduits
    - Two 36” x 36” x 12” deep junction boxes for 5 to 8 four inch conduits

20. Clearances

    a. Clearances around all electrical and mechanical equipment shall satisfy all local, NEC, and manufacturer’s required clearances.

    b. IT equipment cabinets require a 36” aisle space in front of and behind each cabinet.

Codes/Standards Reference

NEC article 110.26

NEC article 800

ANSI J-STD-607-A

21. Cross-connect Facilities

a. All VOICE backbone and horizontal cables shall be terminated on CAT6 rated, 110 style, punch-blocks. All data backbone and horizontal cables shall be terminated in jack-fields that are rack-mounted.

b. Cables of similar type shall be terminated next to each other.

c. Metal D-rings or some other IMTG approved patch cord management system shall provide patch cord management.

22. Cross-connect Color Coding

a. **LAWA IMTG does not follow Industry standards for color-coding backboards and cross-connects.**

b. Backboards shall be painted white until further notice. Note on plans.

B. Work Area Outlets

1. Work area outlets shall be connected by horizontal cabling, point-to-point, to the IT room/closet.

2. Work area outlets in office areas shall be located so that one outlet serves each 80 square feet of usable office space.

3. Work area outlets shall contain between 6 and 8, eight-position, RJ45 type modular jacks installed for each cubicle.

4. The top three/four jacks shall be for voice, and the bottom three/four jacks shall be for data. (Consult LAWA IMTG as this requirement may vary).

5. Work area outlet boxes shall be a minimum of 4S deep (4 inch square) boxes and shall be flush-mounted and located adjacent to a power recepticle.

6. Work area outlet boxes shall be fed with one 1 - 1.5 inch conduit depending upon the number of cable required to the outlet.

7. Work area outlets shall be mounted at the same height as the existing convenience outlets, unless required to meet ADA requirements.

8. All work area outlets shall be canted at a 45 to 55 degree exit.

9. Work area outlets shall be neatly and professionally labeled at the outlet, on the front of the wall plate and in the IT room/closet.

10. Work area outlets shall meet or exceed the performance criteria for the cable type used, i.e. CAT 6/6e/6A.

Acceptable Products:

- Panduit CAT6E CJ688TG or CAT6A CJ6X88TG or approved equal. Submit info by the 60% review.

V. Pathways

A. Safety

1. Protection Of Material And Work

   a. The Installer shall protect all finished and unfinished work against loss or damage until the final acceptance of the completion of the entire project.

   b. In the event of a loss or damage, the Installer shall promptly notify the LAWA ADG & IMTG Project Manager.

2. Protection Of Person(s) And Property

   a. The Installer shall not interfere with the airlines and/or passenger circulation or tenants in front of or within the terminals, in the parking structures, or on the airfield during the course of the installation without obtaining prior permission from both LAWA ADG & IMTG and the airline or tenant.

   b. The Installer shall protect all persons and all private and public property from hazardous conditions, damage, injury, and death during the course of the installation. These precautions shall include, but shall not be limited to cordoning off the Installer's construction area with lights, barricades, enclosures and sufficient guards at and about the construction site.

   c. The Installer shall promptly notify the LAWA ADG & IMTG Project Manager after the occurrence of such damage, loss or injury and shall prepare a full and complete written report to the LAWA IMTG Project Manager within 24-hours.

3. Traffic Control (reference Transportation section)

   The Installer shall comply with Department of Transportation standards and the requirements of the Airport Police in the control of traffic during installation.

B. Conduits

1. General

   a. Critical requirement. All IT rooms shall connect to the main telecommunications room (MPOE) with a minimum of two 4-inch conduits.

   b. Critical requirement. Adjacent IT rooms shall connect to each other with a minimum of two 4-inch conduits.

c. Critical requirement. Within passenger terminals, there shall be a minimum of two sets of two 4-inch, individual, physically separate, redundant, conduit riser pathways feeding each level of the building from the MPOE.

d. Every IT room on the level immediately below the rooftop shall provide for connectivity to the rooftop.

e. Power lines shall not run in communications conduits.

f. EMT and Rigid metallic conduit shall be reamed and have bushings installed.

g. Conduit shall be sized for forty percent of perfect fill.

h. The maximum number of cables that can be installed with two 90-degree bends is 40 percent of perfect fill.

i. Conduit fill shall be reduced by 15 percent for each additional 90-degree bend, not to exceed 360 degrees of bend.

j. Conduits shall not run more than 150 feet or have more than two 90 degree bends without pull-boxes.

k. Each conduit shall have a pull-string inserted and tied off at each end.

l. One 4 inch conduit entering the IT room and one 4 inch conduit leaving the IT room shall have three, 1-1/4", orange-colored, innerducts or four 1-inch orange-colored innerducts installed with pull-strings in each.

m. All conduit bends shall be long sweeping bends.

n. The inside bend radius for conduits sized 2 inches or less shall be a minimum of 6x the internal diameter of the conduit.

o. The inside bend radius of conduits sized greater than 2 inches shall be a minimum of 10x the internal diameter of the conduit.

p. All conduits shall be labeled on both origin and destination ends.

2. Underground minimum clearances

a. Minimum of 3 inches when near power, light, and other conduits.

b. Minimum of 6 inches when crossing oil, gas, water, and other pipes.

c. Minimum of 12 inches when running parallel to oil, gas, water, and other pipes.

d. Minimum of 12 inches when below the top of railroad rails.

e. Orange colored, detectable, plastic warning tapes shall be installed to prevent accidental dig-ups.

Codes/Standards Reference

NEC article 300.5

C. Pull Boxes

1. Sized according to the NEC, unless specific sizes are specified. Show size of pull boxes on plans.

2. The minimum size pull box for 3/4 inch conduit is 12 inches long x 4 inches wide x 3 inches deep. (12" x4" x 3").

3. The minimum size pull box for 4 inch conduit is 60 inches long x 15 inches wide x 8 inches deep. (60" x 15" x 8").

4. Conduits shall not run more than 150 feet or have more than two 90 degree bends without pull boxes.

5. Conduit entry points shall be placed at opposite ends of the pull box if possible.

D. Innerduct

1. Innerduct shall be installed in all conduit systems where fiber optic cable is placed. (See LAWA IMTG for details).

E. Ductbanks

1. If rigid nonmetallic PVC is used, all conduits and bends shall be 4-inch schedule 80 PVC and shall be encased.

2. Ductbank installation shall meet state general order #128 codes.

3. Conduits shall be encased in concrete and shall have an orange electronic marker strip for future location purposes.

4. A minimum of one 4-inch conduit shall be filled with three 1-1/4 inch innerducts along the installed pathway.

5. All conduits and innerducts shall have 1/2" poly pull rope installed and secured at each end.

F. Maintenance Holes

1. Shall have an H-20 or higher rating for deliberate heavy vehicular traffic for non-airfield installations.

2. Airfield installations shall have an aircraft rating. See LAWA Engineering & Facilities Management Division for specifications.

3. Maintenance holes shall be sized a minimum 4 feet long x 2 feet wide x 4 feet deep (4' x 2' x 4') to allow the coiling of 50' of extra fiber optic cable.

4. Maintenance holes shall be tested for explosive and oxygen-displacing gases, prior to entry.

5. Maintenance holes shall be exhausted and ventilated as required.

6. Maintenance holes having abnormal gas levels shall be reported to the IMTG Supervisor, Risk Mangement and Airfield Ops for record-keeping.

7. New maintenance hole dimensions shall not be less than 12 feet long x 6 feet wide x 10 feet high. (12' x 6' x 10")

8. Distances between maintenance holes shall not exceed 400 feet, (Consult LAWA IMTG, Airfield Ops).

9. Bend radii of conduit entering maintenance holes shall be 9 feet minimum.

10. New maintenance holes shall have cable rack supports, cable hangars, and a metal ladder secured to the structure.

11. Maintenance hole covers shall be numbered by welding the numbers on top of the maintenance hole cover. See LAWA IMTG for a numbering sequence.

12. Maintenance hole numbers shall also be painted on the inside collar of the maintenance hole.

G. Direct Burial

Direct burial shall not be used as a cable installation method on the LAWA campus.

H. Aerial Pathways

1. Poles shall not be set except for temporary projects and only then with approval from the LAWA Engineering & Facilities Management Division. Show proposed locations and height on the plan at the 30% design review.

2. Communications cable shall be mounted 40 inches below any power lines and 15.5 feet above streets and driveways.

3. Aerial cable spans shall not exceed 98 feet to the building.

4. Aerial cable entrances shall be limited to 100 pairs.

Codes/Standards Reference

NEC article 230

NEC article 830.10, 830.11

I. Cable Tray & Vertical Ladder Runway

1. Overhead Cable tray shall be a standard twelve inches wide and five inches deep and mounted at approximately 8' above finished floor. Ideally, cabletrays should be mounted at 12" above the cabinets being served.

2. In office areas, cable trays should be installed above the common corridor. In areas with diverse architecture, pre-approval for cabletray type and routing must be obtained.

3. Overhead cabletray installed within TR and MPOE rooms shall be installed around the perimeter of the room and over the center-line of the cabinets from wall to wall and tee off at intervals not to exceed six feet.

4. Cable tray shall be aluminum ladder-type flange-in cable tray type PW/Legrand Industries model 4E02 w/ 6 inch rung spacing and NEMA Class B rating.

5. Provide and install with the required radius bends and pre-fabricated corner and Tee fittings of the same type as linear sections to match layout as outlined in shop plans to be approved by owner.

6. Coordinate extact cable tray placement over cabinets to facilitate low-voltage cable plant installation via knockouts located on top of cabinets.

7. Cable tray installation shall shall be supported by a threaded rod trapeze sized and unistrut. All overhead cable tray installation and anchoring shall meet essential facility rating of current LADBS code with seismic importance factor 1.5.

8. Cabletrays parts shall be bonded to a number 6 AWG copper conductor and connected to the grounding busbar.

9. Vertical ladder runway shall be installed on the wall to facilitate cable routing from floor or O/H conduit sleeves to cable tray. In IT rooms, install 24 inch black CPI cable runway mounted to wall for all vertical pathways from floor/ceiling conduits to overhead runway. CPI part number 10250-724 or equal.

10. Cabletrays parts shall be bonded to a number 6 AWG copper conductor and connected to the grounding busbar.

J. Raised Access Floors

Telecom and MPOE rooms shall not have raised floors unless specifically noted by LAWA

K. Power Poles

1. Dual channel, vertical, power poles may be used to feed modular furniture that is not adjacent to a wall outlet.

2. EMT Conduits feeding power poles shall be sized according to the number of workstations supported by the power poles.

3. Power and communications shall be routed in separate channels.

L. Surface Mount

Surface-mount raceways shall be used only if there is no other alternative pathway for cables (Consult LAWA IMTG).

M. Fire Stopping

1. All penetrations made through fire-rated structures by conduits, cables, innerducts, cable trays, and duct banks shall be sealed with approved firestopping materials.

2. Firestopping materials shall be sufficient to restore the fire-rating of the penetrated structure.

3. Putty-type firestopping material is preferred for ease of firestop reentry.

4. STI Firestop E-Z Path or equal.

N. Core Drilling

1. Core drilling concrete floors may be permitted with approval from LAWA Engineering & Facilities Management Division provided that structural integrity is not compromised.

2. Ground Penetrating Radar Systems shall not be used.

3. The concrete shall be X-rayed prior to drilling, and that X-ray given to the Engineering & Facilities Management Division along with a request for core drilling.

4. The concrete slurry from the drilling operation shall not be allowed to stain anything either above or below it. Provisions shall be made to protect the environment and contain the slurry.

5. All spillage shall be cleaned up.

6. The core-drilled opening shall be properly firestopped.

O. Cabinets

1. Frame

   a. Cabinet Size (36” deep version) - 84.00" H x 28.00" W x 36.00"D (Overall height reflects distance from bottom of cabinet frame to top surface of roof and overall depth reflects distance from exterior front door surface to rear door exterior surface). Part Number: DAMAC CSN1284Z23077-3

b. Cabinet Size (42” deep version) - 84.00" H x 28.00" W x 42.00"D (Overall height reflects distance from bottom of cabinet frame to top surface of roof and overall depth reflects distance from exterior front door surface to rear door exterior surface). Part Number: DAMAC CSN1284Z23079-3

c. Frame Construction Profile - Tubular steel construction, fully welded chassis w/ gussets and custom mounting channels front/rear of rails.

d. Equipment Mounting Rails - 45U, EIA Standard, with RMU markings, fully adjustable.

e. Cabinet Configuration - High Air-flow cabinet design for hot and cold aisle installation. Special FloTrac hi-flow split mesh doors for future installation of FloTrac cooling system.

2. Roof

a. Roof - Solid, CRS sheet metal, weld in and sealed, flush mounted into the cabinet frame.

3. Side Walls

a. Side Panels - Solid, CRS sheet metal, recessed into cabinet frame. Installation/removal via (2) zinc plated philips truss machine screws at 38.75" from side panel top and 2.125" from side panel edge. (1) CH751 lock is included per side panel, keyed alike, located 1.25" from side panel top, centered.

4. Front & Rear Doors

a. Front/Rear door - Perforated, CRS sheet metal, beveled edge high airflow mesh design for unrestricted air movement. Doors are split in the middle with door lock.

b. Front/Rear Door Ventilation - 82% Perforation, split high air-flow mesh doors.

5. Door Locking Handles

a. Door Locking Handles - Door lock is recessed/mounted flush with the door surface and includes a spring-loaded handle and compression locking pawl. Lock protrudes no more than .125" off of door surface.

Includes #751 key cylinder, keyed alike.

6. Equipment Mounting

a. Equipment Mounting - (4) Vertical 19" rackable, 45u, rails per EIA Standard. Rails are designed with 10-32 tapped equipment mounting holes. Rails are attached to (5) N700 unistrut horizontal sub-frame system for depth adjustability. Maximum rail adjustable depth is 32.50". Front rails are

positioned approx. 6.00" from the front edge of the frame; rear rails will be set approx. 21.00" from front rail set location.

b. Rail Hardware - (30) 10-32 equipment mounting screws included.

7. Grounding

a. Grounding - (1) Grounding stud, threaded, located on rear-right floor mounting gusset. (1) rack-mount busbar, 3/16" -thick X 3/4" -high hard-drawn electrolytic tough pitch 110 alloy copper bar, installed on the bottom rear pair of mounting rails. Includes (18) 12-24 tapped lug mounting holes.

8. Floor Mounting

a. Floor Mounting - (4) corner floor mounting gussets, 8.00" W with 3.50" L X 1.00" W floor anchoring slots at 45 degree angles centered. Additional floor anchoring is located in the front and rear bottom, horizontal frame base with (2) 0.75" X 1.00" slots set at 20.00" X 34.00" on center.

9. PDU Cable Manager

a. PDU Cable Manager - (2) Vertical PDU/cable management plates, 71.75" H X 4.36" W, installed on rear left and right horizontal frame unistrut system. Includes (6) sets of PDU key-hole provisions for tool-less mounting of (1) vertical PDU and (16) sets of square mounting points for 1/4 turn, 3.00"W d-rings. Cabinet light mounting provision is also included.

10. Power Strip

a. Powerstrip - (2) 16-NEMA 5-20R outlets, 110V/20Amp, 66.00" in length with LED light and 10ft power cord w/ NEMA 5-20P plug. UL Listed.

b. Power strip shall be capable of being mounted within three inches of the rear of the cabinet.

11. Enclosure Light

a. (1) Luminaire 21.50" L enclosure light, 110V with on/off rocker switch. Installs on vertical PDU/cable management plate and can be used remotely. Includes power cord with a 15amp blade plug.

12. Enclosure Frame Baying

a. Cabinet Coupling Kit - (1) top mounted cabinet to cabinet coupling kit with hardware included.

13. Paint

a. Color - Kote 30 immersion cleaned and exterior epoxy powder coated in semi-gloss hammer black.

14. Approvals

a. Cabinet shall have a NEMA 12 rating.

b. Cabinets shall be UL listed.

Cabinets shall be constructed in accordance with LADBS code requirements.

Seismic Certification - Tested and Certified to Bellcore Seismic Testing in accordance with GR-63-CORE, Paragraph 4.4.1/5.4.1. at 900 lbs of essential equipment.

Weight Capacity - 2000 lbs dynamic, 3000 lbs static

Acceptable Products:

DAMAC CSN1284Z23077-3 (36”D) and CSN 1284Z23079-3 (42”), Seismic Series

P. Racks

Any use of two-post open frame 19” racks shall be reviewed and approved by LAWA at 30% reveiw. Approved part numbers shall be determined at that time.

Q. Wall Mounting

In special circumstances, if cabinets and racks are not provided, wall mounting is acceptable provided that the equipment is small and the installation can be done securely to the plywood backboard. Any wall-mount equipment plans shall be reviewed and approved by LAWA beforehand.

R. Hardware

All fastening hardware used outdoors shall be stainless steel grade 18-8 or better.

VI. Fiber Optic Cabling

A. Design Requirements

1. Outdoor Backbone Cable

a. Multimode optical fiber shall not be used.

b. 72 singlemode fibers is the minimum count permitted for backbone fibers fibers between major equipment rooms.

c. 24 singlemode fibers is the minimum count permitted for backbone fibers between other outdoor locations.

d. Fibers Optic cables that are run underground shall have fifty feet of cable coiled up in every other maintenance hole along the run. These cables shall be dressed neatly and secured to the inside walls of the maintenance hole.

Acceptable Products:

Outdoor to indoor within fifty feet of the building entrance, CorningAltos™ Cable or approved equal.

Outdoor to indoor beyond fifty feet of the building entrance, Corning Freedm™ Cable or approved equal.

2. Indoor Backbone Cable

a. Multimode optical fiber shall not be used except on an individual basis as approved by LAWA.

b. 72 singlemode fibers is the minimum count permitted for backbone fibers between major IT rooms with the passenger terminals.

c. 48 singlemode fibers is the minimum count permitted for backbone fibers between other IT rooms within the passenger terminals.

d. 24 singlemode fibers is the minimum count permitted for backbone fibers between all other IT rooms.

e. Fibers Optic cables that are run indoors shall have twenty-five feet of cable coiled up at each end of the run. These cables shall be dressed neatly and secured to the inside walls of junction boxes.

Acceptable Products:

Corning MIC® Cable (OS2) – For 72 minimum use E88-T3131-29 for Plenum and E81-T3131-24 for Riser or approved equal.

Corning MIC® Cable (OS2) – For 48 fiber use E88-61131-29 for Plenum and E81-61131-24 for Riser or approved equal.

Corning MIC® Cable (OS2) – For 24 fiber use E88-33131-29 for Plenum and E81-33131-24 for Riser or approved equal.

Corning SMF28e+ glass with clearCurve bend insensitive properties.

3. Horizontal Cable

a. Multimode optical fiber shall not be used except on an individual basis.

b. 6 singlemode fibers is the minimum count permitted for horizontal fibers between IT rooms and field devices such as work area outlets and surveillance cameras..

Acceptable Products:

Corning MIC® Cable Plenum rated (OS2) E88-31131-29 / Riser rated (OS2) E81-31131-24 or approved equal. (For additional fiber counts use

LAN-89-EN, LAN-92-EN specifications for Riser and LAN-88-EN, LAN-91-EN for Plenum)

4. Patch Panels

a. Wall-mount. All fibers shall be terminated with SC connectors in fiber patch panels. Terminations of all fiber optic cables shall conform to EIA/TIA-568SC standard. APC finish is standard, but UPC may be acceptable in special circumstances based on LAWA approval.

Acceptable Products:

Corning EDC-12P-NH - 144 Port Wall Mount loaded with SC/APC Corning CCH-CP12-6C and splicing for 144 fibers - Corning M67-048 Splice Trays. For SC/UPC use CCH-CP12-59 panels.

Corning EDC-06P-NH - 48 Port Wall Mount loaded with SC/APC Corning CCH-CP12-6C and splicing for 48 fibers - Corning M67-048 Splice Trays. For SC/UPC use CCH-CP12-59 panels.

Corning 72 port patch panels – ICH-06P-IND loaded with SC/APC Corning CCH-CP12-6C. For SC/UPC use CCH-CP12-59 panels.

b. Rack-mount. All fibers shall be terminated with SC connectors in fiber patch panels. Terminations of all fiber optic cables shall conform to EIA/TIA-568SC standard.

Acceptable Products:

In existing IT equipment rooms, until further notice, use:

Corning 72 port patch panels – PCH04U loaded with SC/APC Corning CCH-CP12-6C. For SC/UPC use CCH-CP12-59 panels.

Lockable front covers are required Corning HDWR-LOCK-KIT.

5. Fiber Optic Pigtails

a. Pre-polished connectorized pigtails are fusion spliced to the cable. Connectors shall not be installed and polished in the field.

b. Singlemode – Corning cable (or approved equal), 6 foot (2 meter) length, APC polish for new, Ultra PC polish for existing where specified, Corning “SC” connector, fusion spliced, heat shrink protected on the splice.

c. Multimode - Corning cable (or approved equal), 6 foot (2 meter) length, regular polish, Corning “SC” connector, fusion spliced, heat shrink protected on the splice.

Acceptable Products:

New singlemode installations - Corning cable, 6 foot length, SC-APC polish, Corning connector, pigtails, fusion spliced**,** or approved equal.

Existing singlemode installations - Corning cable, 6 foot length, APC or Ultra PC polish (where specified), Corning “SC” connector or whatever is required to match existing, pigtails, fusion spliced**,** or approved equal.

Multimode installations - Corning cable, 6 foot length, Corning “SC” connector or whatever is required to match existing, pigtails, fusion spliced**,** or approved equal.

6. Fiber Optic Adapters

Fiber optic adapters shall be color coded to differentiate between singlemode and multimode. Adapters shall match termination/polish type of plant. Green-colored adapters shall be used for singlemode angled-polished connections, and beige-colored adapters for existing multimode connections.

Acceptable Products:

Corning “SC” adapter (coupler) plates.

Corning Singlemode part number CCH-CP12-6C for APC or CCH-CP12-3C for UPC or approved equal.

Corning Multimode part number CCH-CP12-91 for 62.5 or approved equal.

7. Fusion-splice Protection Sleeves

The Installer shall protect all fusion splices with rod-reinforced heat-shrink protective sleeves.

Acceptable Products:

Corning heat-shrink sleeves, part # 2806031-01 or approved equal.

8. Splice Trays

a. The Installer shall use metallic splice trays that will accept 60 mm single-fiber heat shrink fusion splice protectors (12 splices per tray).

b. Trays shall be stackable, contain a plastic polycarbonate protective cover, and have a hole in the center for vertical and horizontal mounting.

Acceptable Products:

Corning M67-048 (Clear cover M67-048-C) or approved equal.

9. Fiber Optic Jumpers/Patch Cables

a. The Installer shall not manufacture or assemble fiber optic jumpers. Fiber optic jumpers shall match the fiber optic plant type/performance and shall match the fiber optic connector polish/finish of the fiber optic plant.

b. Singlemode fiber optic jumpers shall be Angled-polished and have SC connectors (SC-APC). Multimode fiber optic jumpers shall be Ultra-PC polished and have SC connectors.

c. For single fiber circuits, use single strand jumpers. For duplex fiber circuits, use zipcord jumpers.

Acceptable Products:

Corning cable or approved equal.

B. Safety Requirements

1. Installation

a. All necessary safety precautions shall be taken to protect personnel from injury while fabricating, inspecting, or testing fiber optic cable assemblies. Protective equipment shall comply with the requirements of Occupational Safety and Health Administration.

b. As a minimum, personnel who may come in contact with bare fibers shall wear wrap-around safety goggles for eye protection.

c. Slivers of bare fiber shall be wrapped in a heavy tape (e.g., duct tape) and placed in a specially marked container for later disposal.

d. Fiber waste is an individual and collective safety concern. The Installer shall not allow slivers of bare fibers to be disposed of on the floors of the telecommunications rooms.

Codes/Standards Reference

OSHA, 29 CFR Part 1910

2. Testing

a. The Installer shall ensure that all employees and their subcontractors testing optical fiber comply with safety standards because some light sources used in testing and operating fiber optic cable assemblies may cause permanent eye damage.

b. Protection from eye exposure to light sources shall be in accordance with the American National Standard for the Safe Use of Lasers; and the Safe Use of Optical Fiber Communication Systems Utilizing Laser Diode and LED Sources.

Codes/Standards Reference

ANSI Z136.1, Z136.2

C. Installation Equipment Requirements

1. General

a. Tooling and equipment used in the termination of fiber optics shall not impart damage to the optical fiber, or to any part of the termination.

b. Equipment shall be appropriately stored and adequately protected when not in use. It shall be verified or recalibrated at established intervals to assure compliance and precision.

c. The Installer shall select tools and equipment used in fiber optic termination and cabling operations appropriate to their intended function, and shall clean and properly maintain equipment and tooling being used on installation.

d. Pulling lubricant shall be used on all fiber optic cable pulls.

e. All test equipment shall be calibrated by a certified laboratory, or the manufacturer, within one year of point of use, and such certification shall be submitted to LAWA prior to testing.

f. Tools requiring calibration shall have records that contain as a minimum:

- Date of calibration.
- Calibration due date.
- The identification of the organization performing the calibration.

g. Calibration shall be traceable to the National Institute of Standards and Technology (NIST). Calibration intervals shall be based on the type of tool and records of the tool calibration. Intervals may be lengthened or shall be shortened on the basis of stability demonstrated over previous calibration periods.

h. If the Installer requests deviation from this equipment list, the burden of proof shall be upon the Installer to demonstrate that any proposed substitute equipment meets or exceeds the specified parameters.

2. Fiber Optic Test Jumpers:

a. Singlemode

- The Installer shall use singlemode test jumpers that meet the requirements of the Telecommunications Industry Association.
- Singlemode test jumpers shall be of the same fiber type as the optical fiber cabling.

b. Multimode

- The Installer shall use multimode test jumpers that meet the requirements of the Telecommunications Industry Association.

- The fiber optic launch cables and adapters must be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.
- Multimode test jumpers shall be of the same fiber type as the optical fiber cabling.

Codes/Standards Reference

TIA/EIA-526-7

TIA/EIA-526-14A, section 3.3

Acceptable Products:

Corning fiber or approved equal.

Corning connectors or approved equal.

SC-APC polish for singlemode.

Connector types as required to adapt to existing equipment.

Lengths as required.

D. Installation Requirements

1. Pre-Testing

   a. The Installer shall procure and install all new and un-refurbished materials.

   b. LAWA has the right to observe and verify all tests. The Installer shall notify LAWA IMTG one week prior to testing so that testing can be observed. Submit results to IMTG within a week of conducting test.

   c. Before installation, while fiber optic cable is still on the reel, the Installer shall test each individual fiber strand with an OTDR for transmission anomalies and length. Singlemode fiber shall be tested at 1310nm, and multimode fiber shall be tested at 850 nm.

   d. Pre-installation test results shall be recorded and given to the LAWA IMTG, in electronic form, with the software to view the test results. These results shall be given to the LAWA prior to installation. There shall be no deviation from these initial test procedures.

   e. Failures detected during the testing shall be recorded. Rectification of all damaged cable(s) shall include replacing damaged cable(s) with new cables. all damaged cables shall be removed from the project site.

2. Installation

   a. During installation, the minimum bending radius shall be 20 times the cable diameter. After installation the minimum bending radius shall be 10 times the cable diameter.

b. If fiber optic cable is damaged during installation, movement or storage, the Installer shall replace the cable at the Installer's expense.

c. There shall be no repairs to damaged cable. Damaged cable shall be replaced.

d. Except for fusion-spliced, factory-connectorized, pre-terminated pigtails, the Installer shall not use fusion splicing or mechanical splicing to repair any damage to any part of the cable prior-to, during, or after installation.

e. Damage includes but is not limited to; breaks in the fiber opens, abrading the cable jacket to expose the fibers or conductors, bending the cable more than the manufacturer's specification for bend radius and exceeding the manufacturer's tensile load installation specification.

f. All installed lengths of fiber shall be brand new and continuous without any splicing. The Installer shall not fusion splice two short pieces of cable to make a longer piece.

g. Fibers Optic cables that are run underground shall have fifty feet of cable coiled up in every other maintenance hole along the run. These cables shall be dressed neatly and secured to the inside walls of the maintenance hole.

h. Fibers Optic cables that are run underground shall have three labels attached. One label shall be attached on the spare coiled-up fiber or in the center between the entrance and exit of the maintenance hole. One label shall be attached within twelve inches of the entrance and one label within twelve inches of the exit of the conduits in the maintenance hole.

3. Terminating

a. The Installer shall only fusion-splice pigtails that have had the connectors installed and polished by the manufacturer or local cable assembly house. The Installer shall not install or polish fiber optic connectors, either in the field or in his shop.

b. For singlemode fiber, only SC-APC, Angled-Polished pre-connectorized, pre-terminated, pigtails shall be fusion spliced to the cable. SC/UPC may be used in special circumstances as approved by LAWA.

c. For multimode fiber, only SC, Ultra-PC polished pre-connectorized, pre-terminated, pigtails shall be fusion spliced to the cable.

d. Fiber optic cable used in the assembly of the pigtails shall have similar optical characteristics as the installed fiber optic backbone cable.

e. Mechanical splices are not permitted.

f. Splices shall be protected with reinforced sleeves and installed in a specified splice tray as specified.

4. Cleaning

a. All connectors installed or accessed for testing shall be cleaned and then examined under a microscope to assure no contamination. Cleaning of optical connector shall be accomplished only with the highest grade optical tools and supplies.

b. All connectors shall have a smooth, polished, scratch free finish. Optical Fiber end face shall not show any signs of cracks or pistoning on optical endface surface at 200X magnification.

5. Connector Replacement

Any connector damaged or improperly installed shall be removed and replaced with a new connector. Damaged conditions will be determined by visual inspection and/or by certified meters for fiber optic power meter testing. LAWA IMTG shall make final decisions on the replacement of questionably damaged connectors.

E. Testing Requirements

1. General

a. LAWA has the right to observe and verify all fiber optic tests. The Installer shall notify LAWA ADG & IMTG one week prior to testing so that testing can be observed. LAWA will require the Installer to retest at the Installer's own expense if the tests are conducted without properly notifying the Project Manager.

b. The testing shall demonstrate that there are no errors, damaged or incorrectly installed components, that the installation is correctly labeled and that all of the installed components meet or exceed the criteria detailed in these specifications.

c. Any test that does not show that a component is satisfactorily installed, as per these specifications, shall be repeated. If a test procedure needs to be modified to satisfactorily test some components, the modifications shall be submitted for approval to the Project Manager, prior to the tests being conducted.

d. The Installer shall supply all test equipment required to carry all of these tests. The Installer shall include the cost of obtaining, calibrating, and maintaining test equipment , and the cost of carrying out and recording the tests detailed in the specification, including labor costs, in the total bid lump sum. No extra or additional costs will be considered.

e. If on submittal of the test results there are any missing test results or incorrectly named files, the test shall be repeated at no additional cost to LAWA.

f. The Installer shall test every fiber optic strand in the installation in accordance with the field test specifications defined by the TIA standard

ANSI/TIA/EIA-568-B, or by the appropriate network application standard(s) whichever is more demanding.

g. The Installer shall offset-null the power meter before starting a testing session to eliminate the detector dark currents. Offset nulling shall be performed before every test session or when environmental conditions change.

h. The Installer shall use “Two Jumper reference” when referenced specification not directed by primary specification to create reference test levels. The reference connections resemble those used during the actual loss test, which means that the same detectors are matched to the same sources for both the reference and the test. See Appendix.

i. Before starting any new testing session or when a test jumper has been disconnected from the source port of either test set, the two jumper reference shall be repeated.

j. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.

k. The link test limits attenuation are based on the use of the Two Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method A and ANSI/TIA/EIA-526-7, Method A.1; or the equivalent method. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.

l. The Installer shall test 100% of the installed cabling links, all cabling links must pass the requirements of the standards mentioned. The Installer shall diagnose and correct all failing links. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.

m. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:

- The manufacturer of the fiber optic cable and/or the fiber optic connectors
- The manufacturer of the test equipment used for the field certification
- Training organizations authorized by BICSI (Building Industry Consulting Services International with headquarters in Tampa, Florida) or by the ACP (Association of Cabling Professionals™) Cabling Business Institute located in Dallas, Texas.

n. Test Jumpers shall have the core diameter and numerical aperture nominally equal to those of the cable plant being measured.

o. The fiber optic launch cables, test reference cables, test jumpers, test aids and adapters must be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters. All test or reference optical patch cords shall be 3 meters in length, no more than 0.25 dB of total insertion loss, and 0.15 dB of repeatability over 10 mating cycles.

p. Any test reference cable, launch cable or test aid used in the acquisition of a performance measurement of a fiber optic link or component shall never be coiled in a diameter less than 12 inches during testing.

q. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.

2. Fiber Optic Test Parameters

a. The maximum allowable splice loss = 0.3 dB

b. The maximum allowable connector loss = 0.50 dB

c. The link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA standard 568-B:

- Cable Attenuation (dB) = Attenuation Coefficient (dB/km) x Length (Km)
- Attenuation Coefficient for Single-mode is:
- 1310 nm = .65 (Depending on fiber)
- 1550 nm = .50 (Depending on fiber)
- Attenuation Coefficient for Multimode is:
- 850 nm = 3.5 (Depending on fiber)
- 1300 nm = 1.0 (Depending on fiber)
- Link Attenuation (dB) = Cable Attenuation + Connector Attenuation + Splice Attenuation
- Splice Attenuation (dB) = number of splices (S) x splice loss (dB)
- Connector Attenuation (dB) = number of connector pairs x connector loss (dB)

3. Singlemode Testing

a. The Installer shall perform the following tests on all singlemode fiber links.

- Bi-Directional Attenuation / Insertion Loss using an Optical Power Meter.

- Bi-Directional Optical Return Loss (ORL).
- Bi-Directional Optical performance Trace using an Optical Time Domain Reflectometer (OTDR).

b. Optical End Face visible inspection.

c. Singlemode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, Two Reference Jumper or the equivalent method. All singlemode links shall be certified with test tools using laser light sources at 1310 nm and 1550nm.

d. Singlemode links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, Two Reference Jumper cable Measurement.

e. All singlemode links shall be certified with test tools using laser light sources at 1310 nm and 1550nm.

f. The Installer shall test attenuation/insertion loss bi-directionally, in accordance with TIA/EIA-526-7, Method A –1.

g. The Installer shall test ORL bi-directionally in accordance with TIA/EIA 107, Return Loss for Fiber Optic Components.

h. The Installer shall perform an optical performance trace using an OTDR, bi-directionally, in accordance with TIA/EIA –455-59, “Measurement of Fiber Point Defects Using An OTDR”, TIA/EIA 455-60, “Measurement of Fiber or Cable Length Using An OTDR”, TIA/EIA 455-61, “Measurement of Fiber or Cable Attenuation Using An OTDR”.

4. Multimode Testing

a. The Installer shall perform the following tests on all multimode fiber links.

b. Bi-Directional Attenuation / Insertion Loss using an Optical Power Meter.

c. Bi-Directional Optical performance Trace using an Optical Time Domain Reflectometer (OTDR).

d. Optical End Face visible inspection.

e. Multimode backbone links shall be tested at 850 nm and 1300 nm. All multimode links shall be certified with test tools using laser light sources at 850 nm and 1300 nm.

f. Multimode links shall be tested at 850 nm and 1300 nm in accordance with ANSI/TIA/EIA-526-14A, Method A..2, Two Reference Jumper cable Measurement.

g. All multimode links shall be certified with test tools using LED light sources at 850 nm and 1300nm.

h. Link segments less than 200 meters need only be tested at 850nm, because attenuation deltas due to wavelength are insignificant.

i. Bi-Directional Attenuation / Insertion Loss.

j. Bi-Directional Optical performance Trace using an Optical Time Domain Reflectometer (OTDR).

k. Optical End Face visible inspection.

5. Optical Fiber Test Results and Documentation

a. The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.

b. The test result records saved by the tester shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test. The popular ‘csv’ format (comma separated value format) does not provide adequate protection and shall not be acceptable.

c. The database for the completed job shall be stored and delivered on CD-ROM; this CD-ROM shall include the software tools required to view, inspect, and print any selection of test reports.

d. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:

- The identification of the link in accordance with the naming convention defined in the overall system documentation.
- The overall Pass/Fail evaluation of the link-under-test including the Attenuation worst case margin (margin is defined as the difference between the measured value and the test limit value).
- The date and time the test results were saved in the memory of the tester.

e. General Information to be provided in the electronic data base containing the test result information for each link:

- The identification of the customer site as specified by the end-user.
- The overall Pass/Fail evaluation of the link-under-test.
- The name of the standard selected to execute the stored test results.

- The cable type and the value of the ‘index of refraction’ used for length calculations.
- The date and time the test results were saved in the memory of the tester.
- The brand name, model and serial number of the tester.
- The revision of the tester software and the revision of the test standards database in the tester.

f. The detailed test results data to be provided in the electronic database for each tested optical fiber must contain the following information:

- The identification of the link/fiber in accordance with the naming convention defined in the overall system documentation.
- The insertion loss (attenuation) measured at each wavelength, the test limit calculated for the corresponding wavelength and the margin (difference between the measured attenuation and the test limit value).
- The link length shall be reported for each optical fiber for which the test limit was calculated.

g. Acceptance of the fiber cable installation is partially contingent on the review and approval of the fiber power meter/source test data submitted.

6. Performance Data

   a. Submit all performance data in feet.

   b. All tracings shall cover between 50% and 75% of the displayed scale on the tracing.

7. Submittals

   a. Submit product data for the following:

- Optical Loss Test Set model and manufacturer.
- OTDR model and manufacturer.
- Submit certification or calibration data for the following:
- Optical Loss Test Set.
- OTDR.

VII. Copper Cabling

A. Design Requirements

1. Voice Backbone

   a. Install sufficient pairs of 22 AWG, 100 ohm, UTP, OSP, CAT3 UTP from the Main IT room to all other IT rooms, to cover current and future needs of telephone wires and data circuits for the area served by that particular IT room.

   b. Sufficient telephone wire-pairs from IT service provider shall also be brought into MPOE of the building to cover current and future needs of telephone wires and data circuits for the building.

   Acceptable Products:

   General Cable or equal

2. Data Backbone

   a. Copper cable is not normally used as backbone cable at LAWA.

3. Horizontal Cables

   a. Sufficient 100 ohm, Category-6, 4-pair UTP shall be installed as a universal structured cable for the structured cable plant at each building.

   b. Cat-6 cables shall be used as a universal cable for all IT needs, including telephone, data, fax, video, audio, etc. Cat-6, 4-pair, UTP cables shall be installed at all conceivable required Locations and for future expansion needs.

   c. Each location shall be installed with a minimum of four, Cat-6, UTP cables.

   d. Termination of the Cat-6 UTP cables shall be on CAT6 RJ45 jacks rated to cable performance on a six or eight position double-gang or six position single-gang faceplate. All terminations of Cat-6 UTP cables shall conform to EIA/TIA-568A (REVISED FROM 568B) standard.

   Acceptable Products:

   General Cable C6E GS6000E CMP or CAT6A GenSPEED 10 MTP or approved equal.

   Commscope (Systimax) C6E 2071 or CAT6A 2091 or approved equal

4. Data Patch Panels

   a. All Cat-6/6e/6A Data UTP cables shall be terminated on CAT6/6e/6A RJ45 (or manufacturer specified) patch panels inside equipment rack.

   b. All data UTP cable termination shall conform to EIA/TIA-568B standards. Wire-minders shall also be installed for cable management.

Acceptable Products:

Panduit CAT6E DP48688TG (48 port) DP24688TG (24 port) CAT6A DP486X88TGY (48 port) DP246X88TGY (24 port) or approved equal

Commscope (Systimax) CAT6E 360 GigaSPEED® XL 1100GS3 CAT6A 360 GigaSPEED® X10D 1100GS5 or approved equal.

5. Patch Cords

   a. Patch cord performance must match installed plant.

Acceptable Products:

PanGen or Commscope

6. Control/Low Voltage Cable

   Follow manufacturer's recommendation.

Acceptable Products:

Belden or approved equal.

West Penn or approved equal

7. Speaker Cable

   14 AWG, unshielded twisted pair

Acceptable Products:

Belden or approved equal.

West Penn or approved equal

8. Coaxial

   a. Cable TV (CATV)

      The cable used is dependent upon the length and type of the segment. Existing analog systems and new digital systems require different cable (coaxial and/or fiber). All CATV plant shall be approved by LAWA before installing either coaxial or optical cables.

Acceptable Products:

If coaxial approved: Belden or Commscope coaxial

If fiber required: Corning single mode fiber (see fiber optic section)

   b. Closed Circuit TV (CCTV)

      The cable used is dependent upon the length and type of the segment. Existing analog systems and new digital systems

require different cable (coaxial and/or fiber). All CCTV plant shall be approved by LAWA before installing either coaxial or optical cables.

Acceptable Products:

If coaxial approved: Belden or Commscope coaxial

If fiber required: Corning single mode fiber (see fiber optic section)

9. Microwave

   a. Consult LAWA IMTG.

Acceptable Products:

To be determined.

10. Antennas

    a. See LAWA IMTG.

    b. Consult BOAC Resolution No. 20466.

Acceptable Products:

To be determined.

B. Installation Requirements

1. Copper UTP Cables

   a. Most LAWA cabling is required to be installed within conduit. However, there are some installations where "J" hooks are allowed if pre-approved by the IMTG Design and Engineering Division Manager at the 30% review.

   b. In ceilings, copper cables shall be suspended either by prefabricated "J" hooks, a trapeze suspended from the ceiling with continuous rod, or some other approved and industry accepted practice. Ties and bridle rings shall not be used to support cable in ceilings.

   c. Approved "J" hooks may be fastened to beams or to the deck above via dedicated hangers or rods.

   d. Supports shall be space every 4 feet to minimize cable sag.

   e. In ceilings, copper cables shall never be pulled directly over suspended ceiling tiles or fluorescent light fixtures.

   f. Cable ties may not be used to permanently secure copper cables. Velcro fasteners shall be used to secure copper cables. Fasteners shall not be over-tighten so that cable performance (internal spacing/structure) is impacted.

g. Adhesive-mounts, one inch square, can be used on metallic surfaces to secure cable ties. e.g, equipment cabinets and racks.

h. Screw-mounts, one inch square, can be used on backboards provided that they are secured with flat-head mounting screws.

2. Coaxial Cables

Similar to copper.

3. Microwave

To be determined, Consult LAWA Engineering & Facilities Management Division and LAWA Information Management & Technology Group for details.

4. Wireless

To be determined, Consult LAWA Engineering & Facilities Management Division and LAWA Information Management & Technology Group for details at the 5% Concept Review Submittal.

5. Rooftops

One junction box for each Vertical Cable Riser with two 4" conduits for each junction box shall be provided on the building rooftop. Each IT junction box shall be connected to the closest IT room via two 4" conduits.

6. Antennas

a. Consult BOAC Resolution No. 20466.

b. Antenna Support: Install structural members on the roof near the rooftop IT junction box for the mounting of satellite antennas for each IT junction box.

c. Antenna transmission lines should follow the manufacturer's specifications on minimum bending radius, connector installation, and support requirements; wrap-lock or other smaller support equipment are not permitted.

C. Testing Requirements

All copper cabling shall meet or exceed all EIA/TIA performance standards and shall be tested in accordance with these standards using the most up-to-date testing criteria. All copper cabling and components testing must satisfy the requirements of the warranty and extended warranty programs of each component manufacturer.

1. CAT3 cabling w/ TDR

   a. DC loop resistance
   b. Continuity
   c. Length
   d. Attenuation
   e. Crosstalk or NEXT
   f. Noise

2. CAT6/6e/6A Cabling

   The contractor will perform a full channel test on the entire Cat6 cable plant with an automated test set according to the most up-to-date criteria from the ANSI/TIA/EIA standard. Parameters include, but are not limited to;

   a. Wire Map.
   b. Length.
   c. Attenuation.
   d. Near-End Crosstalk.
   e. Propagation Delay/Delay Skew.
   f. Power Sum NEXT.
   g. ACR/Power Sum ACR.
   h. ELFEXT.
   i. Return Loss.

   The data from each cable tested will be downloaded directly from the test set and printed showing all tests/parameters performed, the expected test result, and the actual test result achieved. Two hardcopies and two electronic copies of the test results must be provided.

4. Coaxial

   A TDR test will be performed on all coaxial RG6 cable which will be swept to 1GHz. Parameters include, but are not limited to;

   a. DC loop resistance
   b. Length
   c. TDR
   d. Attenuation
   e. Noise

   The data from each coaxial cable segment tested will be downloaded directly from the test set and printed showing all tests/parameters performed, the expected test result, and the actual test result achieved. Two hardcopies and two electronic copies of the test results must be provided.

VIII. Administration

A. Submittals & Records

The contractor shall submit cut-sheets (submittals) for each component to be used before the installation begins. The cut-sheets must be organized in a binder with an index identifying each component. All components must be

compatible with and meet the performance specifications outlined in this document. Index the material cut-sheets by manufacturer and type of component. The contractor will also submit final cut-sheets at the end of the project that include any changes or additional components. Three (3) hardcopies of these submittals must be provided in a binder at the 90% review.

The following project work activities should be documented and recorded:

- Statement of work to be performed
- Project schedules
- Minutes of meetings
- Cell phone numbers of all contractor's project supervisory staff
- Emergency contact lists
- Miscellaneous notes and photos

B. Labeling

1. General

   All labels shall be computer or label maker generated. Labeling scheme shall be consistent with architectural plans and shall be approved by LAWA IMTG.

2. Conduit

   All conduit runs shall be labeled on origin and destination ends

3. Innerduct in Pull Boxes, Maintenance Holes

   Every innerduct installed shall have a brass or plastic tag that contains the origin, destination, and the tenant. These tags shall be placed at both ends and in every pull box, handhole, or maintenance hole along the pathway. These tags shall be securely fastened so that they cannot be accidentally removed. Examples include:

   - LAWA IT
   - COM CTR TO ADMIN BSMT
   - LAWA IT
   - T4, RM 129 TO TBIT, MPOE
   - Terminal 3 MPOE
   - Terminal 4 MPOE
   - XYZ Airlines

4. Cables

   All cables shall be labeled with wrap-around labels on each end with the same labeling schedule provided on as-built prints.

5. Fiber Optic Jumpers

   a. All Fiber patch panels will be labeled by LAWA IMTG.

   b. All fibers in a jumper shall be identified with white heat shrink labels, 5/8" to 3/4" wide by 1 to 1 1/2" long, and shall be placed over the boot of the connector. The heat shrink label **shall not be** shrunk.

   c. Labeling format for jumpers in the IT equipment room and the Records retention center are as follows:

   - Line 1 is the near port of the jumper. The format is: AAA-RXX-Y-ZZ where AAA is the two or three letter building code, RXX is the rack number, Y is the shelf number, and ZZ is the port number.
   - Line 2 is the far port of the jumper. The format is: AAA-RXX-Y-ZZ where AAA is the two or three letter building code, RXX is the rack number, Y is the shelf number, and ZZ is the port number.
   - Line 3 is the circuit number. The format is #XXXX where XXXX is the circuit identification number as assigned by ITs.
   - CC-R59-3-25
   - CC-R53-1-10
   - CKT #3007

   d. Labeling format for all other jumpers is on three lines and is as follows:

   - Line 1 is the near port. The format is: XXX-YY-ZZ where XX is the two or three letter building code, YY is the patch panel number in that building, and ZZ is the port number in that panel.
   - Line 2 is the far port. The format is XXX-YY-ZZ where XX is the two or three letter building code, YY is the patch panel number in that building, and ZZ is the port number in that panel.
   - Line 3 is the circuit number. The format is #XXXX where XXXX is the circuit identification number as assigned by ITs.
   - AD-3-14
   - AD-4-22
   - CKT #2557

6. Work Areas

   a. Work area cabling shall be labeled at each end.

   b. Work area outlets shall be labeled on the front of the wall plate.

7. Tenant Areas with Existing IT Rooms

   If IT rooms are shared with tenants, provide clear separation and identification of the equipment and terminations. Specify dimensions and all notations on plans at the 30% review. See Sec IV-A 2h for proposed IT Rooms.

8. Approved Labeling Scheme

   The final labeling scheme for any/all components must be reviewed and approved by LAWA IMTG beforehand.

C. Documentation

a. Upon completion of installation and after the final acceptance of all systems, the Installer shall supply a complete set of as-built documentation as follows:

- Site plan
- System block diagram
- Interconnection diagram
- As-built prints of the conduit installation with routing
- Final acceptance test data sheet
- Updated Material List with quantities, model numbers and serial numbers
- Manufacturer manuals/data sheets/submittals on all equipment and materials used
- Manufacturer representatives and telephone numbers
- Operation manuals

b. The above documentation shall illustrate in details the interconnection of every component in its correct functional relationship showing the positional and geographical location. The above documentation shall also include the following information:

- All signal levels
- All cable numbers
- All grounding points

c. Two (2) full and half size “D” & “B” hard copies of the System block diagrams and Multi-wire Line diagrams must be submitted, along with one electronic copy in AutoCad (AutoCad 2007 minimum, but must adhere to the current LAWA CAD Standards) .dwg format on CD ROM. In addition, two (2) hard copies of all other documents shall be provided.

d. All information including, but not limited to, the definition of symbols, terms, acronyms shall be included to assist a clear understanding of the documentation.

e. The contractor must submit final certification that the system is complete, meets all functional and performance specifications, and has been accepted into all related warranty and extended warranty programs.

IX. APPENDICES

A. Terminals - UPS Eq. Models for TR & MPOE rooms

B. Terminals - UPS Eq. for TR - Guide Specifications

C. Terminals - UPS Eq. for MPOE - Guide Specifications

D. Terminals - Mechanical Eq. Models for TR & MPOE rooms

E. Terminals - Mechanical Eq. for TR - Guide Specifications

F. Terminals - Mechanical Eq. for MPOE - Guide Specifications

Appendix A

Terminals - UPS Eq. Models for TR & MPOE Rooms

Make/model Specifications (or equiv.)
Three-Phase Uninterruptible Power System

Section 1. Telecom Room UPS Requirements

A. Electrical – UPS, 208V Input (4 wire plus ground)
Provide (1) 20kVA/16kW 120/208V-input, 3-phase UPS, model Liebert NX 38SB020C0CHX. Include internal VRLA battery capacity rated to 18 minutes at full load w/ disconnect facility for maintenance. UPS shall be packaged in a single 24" wide cabinet with automatic continuous static transfer switch and internal manual bypass. Include seismic anchoring and (1) OC-485 Webcard to interface w/ Sitelink system. Connect 120/208V output to single wall-mounted panelboard.

Option 1.
Provide (1) external VRLA battery cabinet providing for a total of (41) minutes at 16kW load, model Liebert 38BP020RHX1BNR. Include DC cables so that 27" battery cabinet can be directly bolted to right side of UPS cabinet. Include seismic anchoring.

Option 2.
Provide (1) external maintenance bypass cabinet, model Liebert 38MB0200CC6AL. Include interconnecting cables for bolting to left side of UPS. Cabinet shall be 27" wide with single rotary switch interlocked for make-before-break manual transfers. Include seismic anchoring.

B. Electrical – UPS, 480V Input (3 wire plus ground)
Provide (1) 20kVA/16kW 480V-input, 120/208v output, 3-phase UPS. Model Liebert NX 38SB020C0CHX. Include internal VRLA battery capacity rated to 18 minutes at full load w/ disconnect facility for maintenance. UPS shall be packaged in a single 24" wide cabinet with automatic continuous static transfer switch and internal manual bypass. Include (1) OC-485 Webcard to interface w/ Sitelink system. Include (1) external maintenance bypass/transformer cabinet, model Liebert 38MB0200AC6DL. Include interconnecting cables for bolting to left side of UPS. Cabinet shall be 27" wide with 480V input isolation transformer and single rotary switch interlocked for make-before-break manual transfers. Include seismic anchoring for both cabinets. Connect 120/208V UPS output to single wall-mounted panelboard.

Option 1.
Provide (1) external VRLA battery cabinet providing for a total of (41) minutes at 16kW load, model Liebert 38BP020RHX1BNR. Include DC cables so that 27" battery cabinet can be directly bolted to right side of UPS cabinet. Include seismic anchoring.

Section 2. MPOE Room UPS Requirements

A. Electrical – UPS, 208V Input (4 wire plus ground)
Provide (1) 30kVA/24kW 120/208V-input, 3-phase UPS, model Liebert NX 38SB030C0CHX. Include internal VRLA battery capacity rated to 10 minutes at full load w/ disconnect facility for maintenance. UPS shall be packaged in a single 24" wide cabinet with automatic continuous static transfer switch and internal manual bypass. Include seismic anchoring and (1) OC-485 Webcard to interface w/ Sitelink system. Connect 120/208V output to single wall-mounted panelboard.

Option 1.
Provide (1) external VRLA battery cabinet providing for a total of (26) minutes at 24kW load, model Liebert 38BP030RHX1BNR. Include DC cables so that 27" battery cabinet can be directly bolted to right side of UPS cabinet. Include seismic anchoring.

Option 2.
Provide (1) external maintenance bypass cabinet, model Liebert 38MB0300CC6AL. Include interconnecting cables for bolting to left side of UPS. Cabinet shall be 27" wide with single rotary switch interlocked for make-before-break manual transfers. Include seismic anchoring.

B. Electrical – UPS, 480V Input (3 wire plus ground)
Provide (1) 30kVA/24kW 480V-input, 120/208v output, 3-phase UPS. Model Liebert NX 38SB030C0CHX. Include internal VRLA battery capacity rated to 10 minutes at full load w/ disconnect facility for maintenance. UPS shall be packaged in a single 24" wide cabinet with automatic continuous static transfer switch and internal manual bypass. Include (1) OC-485 Webcard to interface w/ Sitelink system. Include (1) external maintenance bypass/transformer cabinet, model Liebert 38MB0300AC6DL. Include interconnecting cables for bolting to left side of UPS. Cabinet shall be 27" wide with 480V input isolation transformer and single rotary switch interlocked for make-before-break manual transfers. Include seismic anchoring for both cabinets. Connect 120/208V UPS output to single wall-mounted panelboard.

Option 1.

Provide (1) external VRLA battery cabinet providing for a total of (26) minutes at 24kW load, model Liebert 38BP030RHX1BNR. Include DC cables so that 27" battery cabinet can be directly bolted to right side of UPS cabinet. Include seismic anchoring.

Note: All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

Appendix B

Terminals - UPS Eq. for Telecom Rooms

GUIDE SPECIFICATIONS
20 kVA
Three-Phase Uninterruptible Power System

1.0 GENERAL

1.1 SUMMARY

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.

All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

1.2 STANDARDS

The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

- ASME
- CSA 22.2, No. 107.1
- FCC Part 15, Class A
- IEC 1000-4-5
- ISO 9001
- National Electrical Code (NFPA-70)
- NEMA PE-1
- OSHA
- UL Standard 1778

The UPS shall be UL listed per UL Standard 1778, and shall be CSA certified.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements - UPS Module

A. Voltage. Input/output voltage specifications of the UPS shall be:

Rectifier Input: 120/208 volts, three-phase, 4-wire-plus-ground.

Output: 120/208 volts, three-phase, 4-wire-plus-ground.

B. Output Load Capacity. Specified output load capacity of the UPS shall be 20kVA/16kW at 0.8 lagging power factor.

1.3.2 Design Requirements - Battery

A. Battery Cells: Sealed, lead-acid, valve-regulated.

B. Reserve Time: 18 minutes at 16kW full load, with ambient temperature of 25°C.

C. Recharge Time: to 95% capacity within ten (10) times discharge time.

1.3.3 Modes of Operation

The UPS shall be designed to operate as an on-line, double-conversion, reverse-transfer system in the following modes:

A. Normal - The critical AC load is continuously supplied 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 the reserve battery.

B. Emergency - Upon failure of utility AC power, the critical AC load is supplied by the inverter, which, without any switching, obtains 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 assume the inverter and battery recharge loads.

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 transfer switch shall perform a reverse transfer of the load from the inverter to the bypass source with no interruption in power to the critical AC load.

1.3.4 Performance Requirements

1.3.4.1 AC Input to UPS

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 0.99 lagging at nominal input voltage and full rated UPS output load.

E. Inrush Current: 800% of full load current maximum.

F. Current Limit: 125% of nominal AC input current maximum.

G. Input Current Walk-In: 20 seconds to full rated input current maximum. Field selectable 5 through 20 seconds.

H. Current Distortion: 4% reflected THD maximum at full load.

I. Surge Protection: Sustains input surges without damage per criteria listed in IEC 1000-4-5.

1.3.4.2 AC Output, UPS Inverter

A. Voltage Configuration: three-phase, 4-wire plus ground

B. Voltage Regulation:

±1% 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.

±2% 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: 1.0 Hertz per second maximum. Field selectable from 0.1 to 1.0 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.

<4% THD for 100% nonlinear loads (3:1 crest factor) without kVA/kW derating.

H. Load Power Factor Range: 0.7 lagging to 0.95 leading 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).

K. Inverter Output Voltage Adjustment: ±5% manual adjustment.

L. Voltage Transient Response:

100% load step	±4.0%.
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%.

1.4 ENVIRONMENTAL CONDITIONS

The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:

A. Operating Ambient Temperature

UPS Module: 32°F to 104°F (0°C to 40°C).

Battery: 77°F ±9°F (25°C ±5°C).

B. 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)

C. Relative Humidity

0 to 95%, non-condensing.

D. Altitude

Operating: to 3300 ft. (1000 meters) above Mean Sea Level. Derated for higher altitude applications.

Storage/Transport: to 40,000 ft. (12,200 meters) above Mean Sea Level.

E. Audible Noise

Noise generated by the UPS under any condition of normal operation shall not exceed 54 dBA measured 1 meter from surface of the UPS.

1.5 SUBMITTALS

1.5.1 Proposal Submittals

Submittals with the proposal shall include:

- System configuration with single-line diagrams.
- Functional relationship of equipment including weights, dimensions, and heat dissipation.
- Descriptions of equipment to be furnished, including deviations from these specifications.
- Size and weight of shipping units to be handled by installing contractor.
- Detailed layouts of customer power and control connections.
- Detailed installation drawings including all terminal locations.

1.5.2 UPS Delivery Submittals

Submittals upon UPS delivery shall include a complete set of submittal drawings and one (1) set of instruction manuals 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.

1.6 WARRANTY

1.6.1 UPS Module

The UPS manufacturer shall warrant the UPS module against defects in materials and workmanship for 12 months after initial start-up or 18 months after ship date, whichever period expires first.

1.6.2 Battery

The battery manufacturer's standard warranty shall be passed through to the end user.

1.7 QUALITY ASSURANCE

1.7.1 Manufacturer Qualifications

A minimum of twenty years' 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.

1.7.2 Factory Testing

Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the specification.

2.0 PRODUCT

2.1 FABRICATION

2.1.1 Materials

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.

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.

2.1.2 Wiring

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.

Provision shall be made for power cables to enter or leave from the top or bottom of the UPS cabinet.

2.1.3 Construction and Mounting

The UPS unit, comprised of an input circuit breaker, rectifier/charger, inverter, static transfer switch 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 and adjustments. The UPS cabinet shall be structurally adequate and have provisions for hoisting, jacking, and forklift handling.

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.

2.1.4 Cooling

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. There shall be redundant fans.

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.

2.1.5 Grounding

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

2.2.1 Rectifier/Charger

2.2.1.1 General

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 solid-state SCR/IGBT type with constant voltage/current limiting control circuitry.

2.2.1.2 AC Input Current Limiting

The rectifier/charger unit shall be provided with AC input current limiting whereby the maximum input current shall be limited to 125% 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 125% of full load input current. In addition, the rectifier/charger shall have a battery current limit, adjustable from 0 to 25% of the full load input current.

2.2.1.3 Input Current Walk-In

The rectifier/charger shall contain a timed walk-in circuit that causes the unit to gradually assume the load over a 20-second time interval after input voltage is applied. Walk-in time shall be field selectable for 5 through 20 seconds.

2.2.1.4 DC Filter

The rectifier/charger shall have a 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 ensure 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.

2.2.1.5 Automatic Rectifier Restart

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 assume the inverter and battery recharge loads.

2.2.1.6 Battery Recharge

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.

2.2.1.7 Overvoltage Protection

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 load transfer to the static bypass line.

2.2.2 Inverter

2.2.2.1 General

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.

2.2.2.2 Overload Capability

The inverter shall be capable of supplying current and voltage for overloads exceeding 100%. The inverter is to provide 150% of full load for 1 minute and 125% of full load for 10 minutes. A status indicator and audible alarm shall indicate overload operation. The UPS shall transfer the load to bypass when overload capacity is exceeded.

2.2.2.3 Fault Clearing and Current Limit

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.

2.2.2.4 Step Load Response

The output voltage shall be maintained to within ±4% 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.

2.2.2.5 Voltage Distortion

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 4%. The output rating is not to be derated in kVA nor kW due to the 100% nonlinear load with 3:1 crest factor.

2.2.2.6 Phase Balance

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 2% and the phase displacement is to be 120 degrees within ±1 degree.

2.2.2.7 Fuse Failure Protection

Power semiconductors in the inverter unit shall be fused with fast-acting fuses, so that loss of any one power semiconductor will not cause cascading failures.

2.2.2.8 Inverter Shutdown

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.

2.2.2.9 Inverter DC Protection

The inverter shall be protected by the following disconnect levels:

- DC Overvoltage Shutdown
- DC Under voltage Warning (Low Battery Reserve), adjustable
- DC Undervoltage Shutdown (End of Discharge)

2.2.2.10 Inverter Output Voltage Adjustment

The inverter shall use a software control to adjust the output voltage from ±5% of the nominal value.

2.2.2.11 Output Frequency

The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall be temperature compensated and hold the inverter output frequency to ±0.1% for steady state and transient conditions. 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.

2.2.3 Display and Controls

2.2.3.1 Monitoring and Control

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:

- Menu-driven display with pushbutton navigation
- Real time clock (time and date)
- Alarm history with time and date stamp
- Battery backed-up memory

2.2.3.2 Metering

The following parameters shall be displayed:

- Input AC voltage line-to-line
- Input AC current for each phase
- Input frequency
- Battery voltage
- Battery charge/discharge current
- Output AC voltage line-to-line and line-to-neutral for each phase
- Output AC current for each phase
- Output frequency
- Apparent power
- Active power
- Battery time left during battery operation

2.2.3.3 Alarm Messages

The following alarm messages shall be displayed:

- Input power out of tolerance
- Battery charger problem
- Battery failed test
- Low battery warning
- Low battery shutdown
- DC bus overvoltage
- Bypass frequency out of range
- Load transferred to bypass
- Excessive retransfers attempted
- Static switch failure
- UPS output not synchronized to bypass power
- Output undervoltage
- Output overvoltage
- Output overcurrent
- System output overloaded
- Load transferred to bypass due to overload
- Overload shutdown
- Control error
- Critical power supply failure
- Load transferred due to internal protection
- External shutdown (remote EPO activated)
- Fan failure
- Overtemperature shutdown impending
- Overtemperature shutdown

An audible alarm shall be provided and activated by any of the above alarm conditions.

2.2.3.4 Status Messages

The following UPS status messages shall be displayed:

- Normal operation
- Load on maintenance bypass
- Load on UPS
- Load on static bypass
- System shutdown
- UPS on battery

2.2.3.5 Controls

UPS start-up, shutdown, and maintenance 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 screen shall be available on the LCD screen to depict a single-line diagram of the UPS, with switch positions and power flow.

2.2.3.6 On-Line Battery Test

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.

2.2.4 Static Transfer Switch

2.2.4.1 General

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 to clear a 20-ampere load branch circuit breaker.

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.

2.2.4.2 Uninterrupted Transfer

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:

- Inverter overload capacity exceeded
- Critical AC load overvoltage or undervoltage
- Battery protection period expired
- UPS fault condition

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:

- Inverter/bypass voltage difference exceeding preset limits
- Bypass frequency out of limits
- Bypass out-of-synchronization range with inverter output

2.2.4.3 Uninterrupted Retransfer

Retransfer of the critical AC load 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:

- Bypass out of synchronization range with inverter output
- Inverter/bypass voltage difference exceeding preset limits
- Overload condition exists in excess of inverter full load rating
- UPS fault condition present

2.2.5 Maintenance Bypass Switch

2.2.5.1 General

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 transfer switch.

2.2.5.2 Isolation

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 switch shall be provided when the UPS is in the maintenance bypass mode of operation.

2.2.5.3 Maintenance Capability

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 transfer switch. When the application calls for the Maintenance Bypass Switch to be bolted to the UPS cabinet, the interconnecting cables are to be provided, precut and prelugged.

2.2.6 Battery Power Pack

The battery power pack 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 shall be included for isolation of the battery pack from the UPS module. The UPS shall automatically be disconnected from the battery when the battery reaches the minimum discharge voltage level. Casters and leveling feet shall also be provided with the battery power pack 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 and prelugged.

2.2.7 Accessories (Optional Equipment)

2.2.7.1 Optional External Maintenance Bypass Cabinet

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: input and output circuit breakers, single rotary switch with auxiliary contacts, inter-cabinet wiring, casters, and leveling feet. Optional voltage matching transformers and isolation transformers are to be offered. 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.

2.2.7.2 Intellislot™ Relay Board (or equiv.)

Five sets of isolated contacts shall be provided to indicate a change of status of the UPS. Contacts are provided for:

- On UPS
- On Battery
- Low Battery
- On Bypass
- Summary

2.2.7.3 Intellislot™ OC-485 (or equiv.): lnteliislot 485 card. The IntelliSlot® 485 card family delivers Modbus and proprietary protocol for monitoring and control of your equipment through a custom interface and monitoring system or your Building Management System.

3.0 EXECUTION

3.1 FIELD QUALITY CONTROL

The following inspections and test procedures shall be performed by factory-trained field service personnel during the UPS startup.

3.1.1 Visual Inspection

- Inspect equipment for signs of damage.
- Verify installation per drawings.
- Inspect cabinets for foreign objects.
- Verify neutral and ground conductors are properly sized and configured.
- Inspect battery cases.
- Inspect battery for proper polarity.
- Verify all printed circuit boards are configured properly.

3.1.2 Mechanical Inspection

- Check all control wiring connections for tightness.
- Check all power wiring connections for tightness.
- Check all terminal screws, nuts, and/or spade lugs for tightness.

3.1.3 Electrical Inspection

- Check all fuses for continuity.
- Confirm input voltage and phase rotation is correct.
- Verify control transformer connections are correct for voltages being used.
- Assure connection and voltage of the battery string(s).

3.2 MANUFACTURER'S FIELD SERVICE

3.2.1 Service Personnel

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.

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.

An automated procedure shall be in place to ensure that the manufacturer is dedicating the appropriate technical support resources to match escalating customer needs.

3.2.2 Replacement Parts Stocking

Parts shall be available through an extensive network to ensure around-the-clock parts availability throughout the country.

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.

3.2.3 UPS Maintenance Training

Maintenance training courses for customer employees shall be available by the UPS manufacturer. The training is in addition to the basic operator training conducted as a part of the system start-up.

The training course shall cover UPS theory, location of subassemblies, safety, battery considerations and UPS operational procedures. The course shall include AC to DC conversion and DC to AC inversion techniques as well as control, metering, and feedback circuits to the Printed Circuit Board (PCB) level. Troubleshooting and fault isolation using alarm information and internal self-diagnostics should be stressed.

3.2.4 Maintenance Contracts

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. Warranty and preventive maintenance service shall be performed by factory-trained service personnel.

NOTE: These Guide Specifications comply with the format outlined by the Construction Specifications Institute per CSI MP-2-1 and CSI MP-2-2.

Appendix C

Terminals - UPS Eq. for MPOE Rooms

GUIDE SPECIFICATIONS
30 kVA
Three-Phase Uninterruptible Power System

1.0 GENERAL

1.1 SUMMARY

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.

All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

1.2 STANDARDS

The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

- ASME
- CSA 22.2, No. 107.1
- FCC Part 15, Class A
- IEC 1000-4-5
- ISO 9001
- National Electrical Code (NFPA-70)
- NEMA PE-1
- OSHA
- UL Standard 1778

The UPS shall be UL listed per UL Standard 1778, and shall be CSA certified.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements - UPS Module

A. Voltage. Input/output voltage specifications of the UPS shall be:

Rectifier Input: 120/208 volts, three-phase, 4-wire-plus-ground.

Output: 120/208 volts, three-phase, 4-wire-plus-ground.

B. Output Load Capacity. Specified output load capacity of the UPS shall be 30kVA/24kW at 0.8 lagging power factor.

1.3.2 Design Requirements - Battery

A. Battery Cells: Sealed, lead-acid, valve-regulated.

B. Reserve Time: 10 minutes at 24kW full load, with ambient temperature of 25°C.

C. Recharge Time: to 95% capacity within ten (10) times discharge time.

1.3.3 Modes of Operation

The UPS shall be designed to operate as an on-line, double-conversion, reverse-transfer system in the following modes:

A. Normal - The critical AC load is continuously supplied 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 the reserve battery.

B. Emergency - Upon failure of utility AC power, the critical AC load is supplied by the inverter, which, without any switching, obtains 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 assume the inverter and battery recharge loads.

E. Bypass - If the UPS must be taken out of service for maintenance or repair, or should the inverter overload capacity be exceeded, the static transfer switch shall perform a reverse transfer of the load from the inverter to the bypass source with no interruption in power to the critical AC load.

1.3.4 Performance Requirements

1.3.4.1 AC Input to UPS

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 0.99 lagging at nominal input voltage and full rated UPS output load.

E. Inrush Current: 800% of full load current maximum.

F. Current Limit: 125% of nominal AC input current maximum.

G. Input Current Walk-In: 20 seconds to full rated input current maximum. Field selectable 5 through 20 seconds.

H. Current Distortion: 4% reflected THD maximum at full load.

I. Surge Protection: Sustains input surges without damage per criteria listed in IEC 1000-4-5.

1.3.4.2 AC Output, UPS Inverter

A. Voltage Configuration: three-phase, 4-wire plus ground

B. Voltage Regulation:

±1% 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.

±2% 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: 1.0 Hertz per second maximum. Field selectable from 0.1 to 1.0 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.

<4% THD for 100% nonlinear loads (3:1 crest factor) without kVA/kW derating.

H. Load Power Factor Range: 0.7 lagging to 0.95 leading 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).

K. Inverter Output Voltage Adjustment: ±5% manual adjustment.

L. Voltage Transient Response:

100% load step	±4.0%.
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%.

1.4 ENVIRONMENTAL CONDITIONS

The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:

A. Operating Ambient Temperature

UPS Module: 32°F to 104°F (0°C to 40°C).

Battery: 77°F ±9°F (25°C ±5°C).

B. 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)

C. Relative Humidity

0 to 95%, non-condensing.

D. Altitude

Operating: to 3300 ft. (1000 meters) above Mean Sea Level. Derated for higher altitude applications.

Storage/Transport: to 40,000 ft. (12,200 meters) above Mean Sea Level.

E. Audible Noise

Noise generated by the UPS under any condition of normal operation shall not exceed 54 dBA measured 1 meter from surface of the UPS.

1.5 SUBMITTALS

1.5.1 Proposal Submittals

Submittals with the proposal shall include:

- System configuration with single-line diagrams.
- Functional relationship of equipment including weights, dimensions, and heat dissipation.
- Descriptions of equipment to be furnished, including deviations from these specifications.
- Size and weight of shipping units to be handled by installing contractor.
- Detailed layouts of customer power and control connections.
- Detailed installation drawings including all terminal locations.

1.5.2 UPS Delivery Submittals

Submittals upon UPS delivery shall include a complete set of submittal drawings and one (1) set of instruction manuals 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.

1.6 WARRANTY

1.6.1 UPS Module

The UPS manufacturer shall warrant the UPS module against defects in materials and workmanship for 12 months after initial start-up or 18 months after ship date, whichever period expires first.

1.6.2 Battery

The battery manufacturer's standard warranty shall be passed through to the end user.

1.7 QUALITY ASSURANCE

1.7.1 Manufacturer Qualifications

A minimum of twenty years' 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.

1.7.2 Factory Testing

Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the specification.

2.0 PRODUCT

2.1 FABRICATION

2.1.1 Materials

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.

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.

2.1.2 Wiring

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.

Provision shall be made for power cables to enter or leave from the top or bottom of the UPS cabinet.

2.1.3 Construction and Mounting

The UPS unit, comprised of an input circuit breaker, rectifier/charger, inverter, static transfer switch 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 and adjustments. The UPS cabinet shall be structurally adequate and have provisions for hoisting, jacking, and forklift handling.

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.

2.1.4 Cooling

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. There shall be redundant fans.

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.

2.1.5 Grounding

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

2.2.1 Rectifier/Charger

2.2.1.1 General

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 solid-state SCR/IGBT type with constant voltage/current limiting control circuitry.

2.2.1.2 AC Input Current Limiting

The rectifier/charger unit shall be provided with AC input current limiting whereby the maximum input current shall be limited to 125% 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 125% of full load input current. In addition, the rectifier/charger shall have a battery current limit, adjustable from 0 to 25% of the full load input current.

2.2.1.3 Input Current Walk-In

The rectifier/charger shall contain a timed walk-in circuit that causes the unit to gradually assume the load over a 20-second time interval after input voltage is applied. Walk-in time shall be field selectable for 5 through 20 seconds.

2.2.1.4 DC Filter

The rectifier/charger shall have a 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 ensure 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.

2.2.1.5 Automatic Rectifier Restart

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 assume the inverter and battery recharge loads.

2.2.1.6 Battery Recharge

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.

2.2.1.7 Overvoltage Protection

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 load transfer to the static bypass line.

2.2.2 Inverter

2.2.2.1 General

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.

2.2.2.2 Overload Capability

The inverter shall be capable of supplying current and voltage for overloads exceeding 100%. The inverter is to provide 150% of full load for 1 minute and 125% of full load for 10 minutes. A status indicator and audible alarm shall indicate overload operation. The UPS shall transfer the load to bypass when overload capacity is exceeded.

2.2.2.3 Fault Clearing and Current Limit

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.

2.2.2.4 Step Load Response

The output voltage shall be maintained to within ±4% 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.

2.2.2.5 Voltage Distortion

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 4%. The output rating is not to be derated in kVA nor kW due to the 100% nonlinear load with 3:1 crest factor.

2.2.2.6 Phase Balance

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 2% and the phase displacement is to be 120 degrees within ±1 degree.

2.2.2.7 Fuse Failure Protection

Power semiconductors in the inverter unit shall be fused with fast-acting fuses, so that loss of any one power semiconductor will not cause cascading failures.

2.2.2.8 Inverter Shutdown

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.

2.2.2.9 Inverter DC Protection

The inverter shall be protected by the following disconnect levels:

- DC Overvoltage Shutdown
- DC Undervoltage Warning (Low Battery Reserve), adjustable
- DC Undervoltage Shutdown (End of Discharge)

2.2.2.10 Inverter Output Voltage Adjustment

The inverter shall use a software control to adjust the output voltage from ±5% of the nominal value.

2.2.2.11 Output Frequency

The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall be temperature compensated and hold the inverter output frequency to ±0.1% for steady state and transient conditions. 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.

2.2.3 Display and Controls

2.2.3.1 Monitoring and Control

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:

- Menu-driven display with pushbutton navigation
- Real time clock (time and date)
- Alarm history with time and date stamp
- Battery backed-up memory

2.2.3.2 Metering

The following parameters shall be displayed:

- Input AC voltage line-to-line
- Input AC current for each phase
- Input frequency
- Battery voltage
- Battery charge/discharge current
- Output AC voltage line-to-line and line-to-neutral for each phase
- Output AC current for each phase
- Output frequency
- Apparent power
- Active power
- Battery time left during battery operation

2.2.3.3 Alarm Messages

The following alarm messages shall be displayed:

- Input power out of tolerance
- Battery charger problem
- Battery failed test
- Low battery warning
- Low battery shutdown
- DC bus overvoltage
- Bypass frequency out of range
- Load transferred to bypass
- Excessive retransfers attempted
- Static switch failure
- UPS output not synchronized to bypass power
- Output undervoltage
- Output overvoltage
- Output overcurrent
- System output overloaded
- Load transferred to bypass due to overload
- Overload shutdown
- Control error
- Critical power supply failure
- Load transferred due to internal protection
- External shutdown (remote EPO activated)
- Fan failure
- Overtemperature shutdown impending
- Overtemperature shutdown

An audible alarm shall be provided and activated by any of the above alarm conditions.

2.2.3.4 Status Messages

The following UPS status messages shall be displayed:

- Normal operation
- Load on maintenance bypass
- Load on UPS
- Load on static bypass
- System shutdown
- UPS on battery

2.2.3.5 Controls

UPS start-up, shutdown, and maintenance 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 screen shall be available on the LCD screen to depict a single-line diagram of the UPS, with switch positions and power flow.

2.2.3.6 On-Line Battery Test

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.

2.2.4 Static Transfer Switch

2.2.4.1 General

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 to clear a 20-ampere load branch circuit breaker.

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.

2.2.4.2 Uninterrupted Transfer

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:

- Inverter overload capacity exceeded
- Critical AC load overvoltage or undervoltage
- Battery protection period expired
- UPS fault condition

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:

- Inverter/bypass voltage difference exceeding preset limits
- Bypass frequency out of limits
- Bypass out-of-synchronization range with inverter output

2.2.4.3 Uninterrupted Retransfer

Retransfer of the critical AC load 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:

- Bypass out of synchronization range with inverter output
- Inverter/bypass voltage difference exceeding preset limits
- Overload condition exists in excess of inverter full load rating
- UPS fault condition present

2.2.5 Maintenance Bypass Switch

2.2.5.1 General

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 transfer switch.

2.2.5.2 Isolation

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 switch shall be provided when the UPS is in the maintenance bypass mode of operation.

2.2.5.3 Maintenance Capability

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 transfer switch. When the application calls for the Maintenance Bypass Switch to be bolted to the UPS cabinet, the interconnecting cables are to be provided, precut and prelugged.

2.2.6 Battery Power Pack

The battery power pack 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 shall be included for isolation of the battery pack from the UPS module. The UPS shall automatically be disconnected from the battery when the battery reaches the minimum discharge voltage level. Casters and leveling feet shall also be provided with the battery power pack 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 and prelugged.

2.2.7 Accessories (Optional Equipment)

2.2.7.1 Optional External Maintenance Bypass Cabinet

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: input and output circuit breakers, single rotary switch with auxiliary contacts, inter-cabinet wiring, casters, and leveling feet. Optional voltage matching transformers and isolation transformers are to be offered. 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.

2.2.7.2 Intellislot™ Relay Board

Five sets of isolated contacts shall be provided to indicate a change of status of the UPS. Contacts are provided for:

- On UPS
- On Battery
- Low Battery
- On Bypass
- Summary

2.2.7.3 Intellislot™ OC-485: Inteliislot 485 card. The Liebert IntelliSlot® 485 card family delivers Modbus and Liebert proprietary protocol for monitoring and control of your Liebert equipment through Liebert SiteScan Web or your Building Management System.

3.0 EXECUTION

3.1 FIELD QUALITY CONTROL

The following inspections and test procedures shall be performed by factory-trained field service personnel during the UPS startup.

3.1.1 Visual Inspection

- Inspect equipment for signs of damage.
- Verify installation per drawings.
- Inspect cabinets for foreign objects.
- Verify neutral and ground conductors are properly sized and configured.
- Inspect battery cases.
- Inspect battery for proper polarity.
- Verify all printed circuit boards are configured properly.

3.1.2 Mechanical Inspection

- Check all control wiring connections for tightness.

- Check all power wiring connections for tightness.
- Check all terminal screws, nuts, and/or spade lugs for tightness.

3.1.3 Electrical Inspection

- Check all fuses for continuity.
- Confirm input voltage and phase rotation is correct.
- Verify control transformer connections are correct for voltages being used.
- Assure connection and voltage of the battery string(s).

3.2 MANUFACTURER'S FIELD SERVICE

3.2.1 Service Personnel

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.

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.

An automated procedure shall be in place to ensure that the manufacturer is dedicating the appropriate technical support resources to match escalating customer needs.

3.2.2 Replacement Parts Stocking

Parts shall be available through an extensive network to ensure around-the-clock parts availability throughout the country.

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.

3.2.3 UPS Maintenance Training

Maintenance training courses for customer employees shall be available by the UPS manufacturer. The training is in addition to the basic operator training conducted as a part of the system start-up.

The training course shall cover UPS theory, location of subassemblies, safety, battery considerations and UPS operational procedures. The course shall include AC to DC conversion and DC to AC inversion techniques as well as control, metering, and feedback circuits to the Printed Circuit Board (PCB) level. Troubleshooting and fault isolation using alarm information and internal self-diagnostics should be stressed.

3.2.4 Maintenance Contracts

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. Warranty and preventive maintenance service shall be performed by factory-trained service personnel.

NOTE: These Guide Specifications comply with the format outlined by the Construction Specifications Institute per CSI MP-2-1 and CSI MP-2-2.

Appendix D

Terminals – Mech. Eq. Models for TR & MPOE Rooms

Make/model Specifications (or equiv.)
Mechanical HVAC System

Section 1. Telecom Room Mechanical HVAC Reqs. (final sizing TBD)

A. Mechanical – CHW Air Unit (w/ Reheat/Humidification)

Provide (1) 5 Ton ceiling-mounted (outside room) chilled water air unit, model Liebert Mini-mate2 MMD92CDAHELA. Unit shall have reheat and humidification with sensible capacity of 56,900 BTUH at 77F. 42% RH. 460V, 3-PH, 19.8 FLA, 24.8 WSA, 25A MFCB. Insulated Chilled Water Piping with 2 Way Modulating Control Valve – 350 PSI, 13.3 GPM, 6.8 PSI Pressure Drop, 1.5 HP Motor, 2,500 CFM @ 0.50 ESP

B. Mechanical – CHW Air Unit (Cooling Only Option)

Provide (1) 5 Ton ceiling-mounted (outside room) chilled water air unit, model Liebert Mini-mate2 MMD92CDA00LA. Unit shall have sensible capacity of 56,900 BTUH at 77F. 42% RH. 460V, 3-PH, 2.8 FLA, 3.5 WSA, 15A MFCB. Insulated Chilled Water Piping with 2 Way Modulating Control Valve – 350 PSI, 13.3 GPM, 6.8 PSI Pressure Drop, 1.5 HP Motor, 2,500 CFM @ 0.50 ESP

Section 2. MPOE Room Mechanical HVAC Reqs. (final sizing TBD)

A. Mechanical – CHW Air Unit (w/ Reheat/Humidification)

Provide (1) 8 Ton ceiling-mounted (outside room) chilled water air unit, model Liebert Mini-mate2 MMD8TCDAHELA. Unit shall have reheat and humidification with sensible capacity of 83,700 BTUH at 77F. 42% RH. 460V, 3-PH, 21.0 FLA, 26.3 WSA, 30A MFCB. Insulated Chilled Water Piping with 2 Way Modulating Control Valve – 350 PSI, 18.4 GPM, 4.4 PSI Pressure Drop, 2.0 HP Motor, 3,750 CFM @ 0.50 ESP

B. Mechanical – CHW Air Unit (Cooling Only Option)

Provide (1) 8 Ton ceiling-mounted (outside room) chilled water air unit, model Liebert Mini-mate2 MMD8TCDA00LA. Unit shall have sensible capacity of 83,700 BTUH at 77F. 42% RH. 460V, 3-PH, 3.1 FLA, 3.9 WSA, 15A MFCB. Insulated Chilled Water Piping with 2 Way Modulating Control Valve – 350 PSI, 18.4 GPM, 4.4 PSI Pressure Drop, 2.0 HP Motor, 3,750 CFM @ 0.50 ESP

Note: This specification defines the mechanical and electrical characteristics and requirements for an environmental control system. All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

Appendix E
Terminals – Mech. Eq. for Telecom Rooms
GUIDE SPECIFICATIONS

GENERAL

SUMMARY

These specifications describe requirements for an environmental control system. The system shall be designed to control temperature and relative humidity conditions within the room.

The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings.

System shall be supplied with CSA Certification to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for “Heating and Cooling Equipment” and marked with the
CSA c-us logo (60 Hz only).

This specification defines the mechanical and electrical characteristics and requirements for an environmental control system. All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

DESIGN REQUIREMENTS

The environmental control system shall be a Liebert Mini-Mate2 factory assembled unit. On direct expansion models, the refrigeration system shall be split, with the compressor located in a remote or close-coupled condensing unit.

The evaporator section shall be designed for above dropped-ceiling installation. Condensing units shall be designed for either outdoor or above-dropped-ceiling installation.

The system shall have a total cooling capacity of 61,000 BTU/hr and a sensible cooling capacity of 56,900 BTU/hr, based on the entering air condition of 77°F dry bulb and 62°F wet bulb.

The unit is to be supplied for operation on a 460 volt, 3 phase, 60 Hz power supply.

SUBMITTALS

Submittals shall be provided with the proposal and shall include: Dimensional, Electrical and Capacity data; and Piping and Electrical Connection Drawings.

QUALITY ASSURANCE

The specified system shall be factory-tested before shipment. Testing shall include, but shall not be limited to: Quality Control Checks, “Hi-Pot” Test (two times rated voltage plus 1000 volts, per NRTL agency requirements), and Metering Calibration Tests. The system shall be designed and manufactured according to world-class quality standards. The manufacturer shall be ISO 9001 certified.

PRODUCT

STANDARD FEATURES/ ALL SYSTEMS

Evaporator Cabinet Construction

The cabinet and chassis shall be constructed of heavy gauge galvanized steel, and shall be serviceable from one side. Mounting brackets shall be factory-attached to the cabinet. Internal cabinet insulation shall meet ASHRAE 62.1 requirements for Mold Growth, Humidity & Erosion, tested per UL 181 & ASTM 1338 standards.

Air Distribution

The fan shall be the centrifugal type, double width, double inlet. The shaft shall be heavy-duty steel with self-aligning ball bearings with minimum life of 100,000 hours. The fan motor shall be 1750 rpm and mounted on an adjustable base. The drive package shall be equipped with an adjustable motor pulley. The fan/motor assembly shall be mounted on vibration isolators.

The evaporator system shall be capable of delivering 2,500CFM at 0.5 inches of external static pressure. The fan motor shall be 1.5hp. System shall be suitable for ducted air distribution.

Microprocessor Control

The control system shall be microprocessor-based, factory-wired into the system and tested prior to shipment. The wall-mounted control enclosure shall include a 2-line by 16-character LCD providing continuous display of operating status and alarm condition. A 7-key membrane keypad for setpoint/program control and unit On/Off shall be located below the display. The control display shall be field-wired to the control board using 4-conductor field-supplied thermostat wire.

Temperature and humidity sensors shall be located in the wall box, which shall be capable of being located up to 300 ft. from the evaporator unit.

Monitoring

The LCD shall provide On/Off indication, operating mode indication (cooling, heating, humidifying, dehumidifying) and current day, time, temperature and humidity (if applicable) indication. The monitoring system shall be capable of relaying unit operating parameters and alarms to the Liebert SiteScan® monitoring system.

Control Setpoint Parameters

Temp. Setpoint 65-85°F (18 to 29°C)

Temp. Sensitivity 1 to 9.9°F (1 to 5°C)

Humidity Setpoint 20-80% RH

Humidity Sensitivity 1-30% RH

Unit Controls

2.1.3.3.1 Compressor Short-Cycle Control

The control system shall prevent compressor short-cycling by a 3 minute timer from compressor stop to the next start.

2.1.3.3.2 Common Alarm and Remote On/Off

A common alarm relay shall be provided to provide a contact closure to a remote alarm device. Two (2) terminals shall also be provided for remote On/Off control. Individual alarms shall be “enabled” or “disabled” from reporting to the common alarm.

2.1.3.3.3 Setback Control

The control shall be user configurable to use a manual setpoint control or a programmable time-based setback control. The setback control will be based on a 5 day/2 day program weekly schedule with capability of accepting 2 events per program day.

2.1.3.3.4 Temperature Calibration

The control shall include the capabilities to calibrate the temperature and humidity sensors and adjust the sensor response delay time from 10 to 90 seconds. The control shall be capable of displaying temperature values in °F or °C.

2.1.3.3.5 System Auto Restart

For startup after power failure, the system shall provide automatic restart with a programmable (up to 9.9 minutes in 6-second increments) time delay. Programming can be performed either at the wall-mounted controller or from the central site monitoring system.

Alarms

Unit Alarm

The control system shall monitor unit operation and activate an audible and visual alarm in the event of the following factory preset alarm conditions:

- High Temperature
- Low Temperature
- High Humidity
- Low Humidity
- High Water Alarm - Lockout Unit Operation
- High Head Pressure
- Loss of Power
- Compressor Short Cycle

Custom Alarms (2x)

- Humidifier Problem
- Filter Clog
- Water Detected
- Smoke Detected

User customized text can be entered for the two (2) custom alarms.

Alarm Controls

Each alarm (unit and custom) shall be separately enabled or disabled, selected to activate the common alarm (except for high head pressure).

Audible Alarm

The audible alarm shall annunciate any alarm that is enabled by the operator.

Common Alarm

A programmable common alarm shall be provided to interface user selected alarms with a remote alarm device.

Remote Monitoring

All alarms shall be communicated to the Liebert site monitoring system with the following information: date and time of occurrence, unit number and present temperature and humidity.

2.2 CHILLED WATER SYSTEM COMPONENTS

2.2.2 Chilled Water Control Valve (Modulating)

A (2-way) (3-way) modulating, non-spring return valve controlled by the microprocessor to position the valve in response to room conditions. Design pressure shall be 400psig static pressure, with a maximum close-off pressure of 72psi.

2.2.3 Chilled Water Coil

The cooling coil shall have a minimum of 5.6 sq.ft. face area, 4 rows deep. It shall be constructed of copper tubes and aluminum fins and have a maximum face velocity of 444 FPM (2.26 m/s) at 2,500 CFM. The coil shall be supplied with 45°F entering water temperature. The coil shall be supplied with 13.3GPM of chilled water and the pressure drop shall not exceed 6.8 psi. The coil assembly shall be mounted in a stainless steel condensate drain pan, with internally trapped drain line.

FACTORY-INSTALLED OPTIONS

Steam Generating Humidifier (Optional)

The environmental control system shall be equipped with a steam generating humidifier that is controlled by the microprocessor control system. It shall be complete with disposable canister, all supply and drain valves, steam distributor and electronic controls. The need to change canister shall be annunciated on the microprocessor wall box control panel. The humidifier shall have a capacity of 8.0lb./hr. . An LED on the humidifier assembly shall indicate cylinder full, overcurrent detection, fill system fault and end-of-cylinder-life conditions.

Electric Reheat (Optional)

The electric reheat shall be low-watt density, 304/304 stainless steel, finned-tubular and shall be capable of maintaining room dry bulb temperature conditions when the system is calling for dehumidification. The reheat section shall include a UL-approved safety switch to protect the system from overheating. The capacity of the reheat coils shall be 39,100 BTU/HR (11.5kW), with unit input voltage of 460V, controlled in one stage.

Disconnect Switch, Non-Locking

The non-automatic, non-locking, molded case circuit breaker shall be factory-mounted in the high-voltage section of the electrical panel. The switch handle shall be accessible from the front of the indoor unit.

Smoke Sensor

The smoke sensor shall immediately shut down the environmental control system and activate the alarm system when activated. The sensing element shall sense the return air conditions. This smoke sensor shall not function or replace any room smoke detector that may be required by local or national codes.

Filter Clog Switch

The filter clog switch senses pressure drop across the filters and shall annunciate the wall-box display upon reaching the adjustable setpoint.

SHIP-LOOSE ACCESSORIES

Air Filter Box/Duct Flange

The evaporator section shall be supplied with an air filter box for use with ducted installations. Two (2) filters shall be included 4" x 20" x 20" (102 mm x 508mm x 508mm) each, pleated type, with a MERV 8 rating, based on ASHRAE 52.2. A duct flange shall be supplied for use on the supply air opening of the unit.

Condensate Pump

The condensate pump shall have the capacity of 25GPH at 40 ft. head. It shall be complete with integral float switch, pump, motor assembly, discharge check valve, duct/wall mountable bracket and reservoir. A secondary float switch shall be provided to permit field wiring to the unit control to shut down the evaporator upon a high water level condition.

Condensate Pump Bracket

A condensate pump bracket shall be provided to mount condensate pump directly to the end of the unit, allowing for easier installation and alignment of the condensate pump.

Refrigerant Line Sweat Adapter Kit

Provide a sweat adapter kit to permit field brazing of refrigerant line connections.

Single Point Power Kit

A single point power kit shall be provided for a close-coupled system to allow a single electrical power feed to supply power to both the evaporator and indoor close-coupled condensing unit.

SiteScan Site Monitoring System (or equiv.)

A Liebert SiteScan Site Monitoring System Model Sitelink SSW-2E shall be provided for remote monitoring of the Liebert Mini-Mate2 unit and monitoring of other Liebert support equipment. The Liebert SiteScan shall have the capability to monitor and change (at the user direction) the temperature and humidity setpoints and sensitivities of each unit. It shall also be capable of being programmed to print out environmental conditions or operating modes at each unit.

Specifications Wiring Specifications
Ordering Information

Power 24VAC ±10%, 50 to 60Hz, 24VA, or 26VDC ±10%, 10W, 48VDC
Dimensions: W x D x H: in. (mm)
Module: 11.3 x 0.56 x 7.5”
Enclosure (brushed aluminum): 14.25 x 2.85 x 12

Communication Ports

• **Ethernet Port** 10/100Base-T Fast Ethernet port.

• **ARC156 Port** ARCNET156 or EIA-485 communication. In ARCNET156 mode, the port communicates via
BACnet ARC156.

• **TPI Port S1** EIA-232/422/485 configurable port for interaction with 3rd-party building automation systems
via software-selectable protocols. May also be configured for remote modem access.

• **EIA-422/485Ports 1-12** – for communication with equipment via software-selectable**.** Each port can be individually set for different protocols & baud rates. The number of ports varies by model:

SiteLink-2E (SSW-2E) **SiteLink-4E** (SSW-4E) **SiteLink-12E** (SSW-12E)
• **Ports 11-12**These two ports include an option for EIA-232 connection.
• **Ports 9-12** These four ports include an option for EIA-232 connection.
• **Ports 1-12** Four of these 12 ports (9-12) include an option for EIA-232 connection.

Environmental Operating Range
20°F to 140°F (-29°C to 60°C); 10 to 90% relative humidity, non-condensing

Note: Control modules should be installed within the building.

Memory 16 MByte non-volatile battery-backed SDRAM and 8 MByte Flash

Protection Built-in surge and transient protection circuitry - internal solid state polyswitches on incoming
power and network communications connections

Battery 3V lithium battery P/N CR-123A; battery shelf life is 10 years with 720 hours of continuous operation

Fault Detection Hardware watchdog timer

Agency Listings UL, cUL, CE, FCC

Connection Supported Wire Types Maximum Wire Length Rating
Ethernet 10 BaseT CAT 5 328 ft. (100m) N/A
BACnet Port MAGNUM Cable P/N A3-ARC-156-2 3000 ft. (915m) N/A
Port S1 EIA-485 18-22 AWG Stranded & Shielded; **18 AWG (recommended)**
Non Plenum - Belden 9461; Plenum - Belden 88761 1000 ft. (300m) N/A
Port S1 EIA-232 18-22 AWG Stranded & Shielded; **18 AWG (recommended)**
Non Plenum - Belden 9461; Plenum - Belden 88761 50 ft. (15m) N/A

Quantity Part # Description
SSW-2E SiteLink-2E with enclosure - communicates with up to 2 Liebert unit controllers.

EXECUTION

INSTALLATION OF AIR CONDITIONING UNIT

General

Install air conditioning unit in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored to support the unit's weight in location indicated and maintain manufacturer's recommended clearances. Do not mount units above sensitive electronic equipment to minimize risk of water overflow/leakage damage and improve maintenance/service access.

Electrical Wiring

Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor.

Piping Connections

Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.

Supply and Drain Water Piping

Connect water supply and drains to air conditioning unit. Unit drain shall be trapped internally and shall not be trapped externally.

Field-Supplied Pan

A field-supplied pan with drain shall be installed beneath cooling units and water/glycol condensing units.

FIELD QUALITY CONTROL

Factory Start Up air conditioning unit in accordance with manufacturer's startup instructions. Test controls and demonstrate compliance with requirements.

Appendix F
Terminals – Mech. Eq. for MPOE Rooms

GUIDE SPECIFICATIONS

GENERAL

SUMMARY

These specifications describe requirements for an environmental control system. The system shall be designed to control temperature and relative humidity conditions within the room.

The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings.

System shall be supplied with CSA Certification to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for "Heating and Cooling Equipment" and marked with the
CSA c-us logo (60 Hz only).

This specification defines the mechanical and electrical characteristics and requirements for an environmental control system. All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

DESIGN REQUIREMENTS

The environmental control system shall be a Liebert Mini-Mate2 factory assembled unit. The evaporator section shall be designed for ceiling installation.

The system shall have a total cooling capacity of 88,400 BTU/hr, and a sensible cooling capacity of 83,700 BTU/hr, based on the entering air condition of 77°F dry bulb, and 62°F wet bulb.

The unit is to be supplied for operation on a 460 volt, 3 phase, 60 Hz power supply.

SUBMITTALS

Submittals shall be provided with the proposal and shall include: Single-Line Diagrams; Dimensional, Electrical and Capacity data; Piping and Electrical Connection Drawings.

QUALITY ASSURANCE

The specified system shall be factory-tested before shipment. Testing shall include, but shall not be limited to: Quality Control Checks, “HiPot” Test (two times rated voltage plus 1000 volts, per NRTL agency requirements) and Metering Calibration Tests. The system shall be designed and manufactured according to world class quality standards. The manufacturer shall be ISO 9001 certified.

PRODUCT

STANDARD FEATURES/ALL SYSTEMS

Evaporator Cabinet Construction

The cabinet and chassis shall be constructed of heavy gauge galvanized steel and shall be serviceable from one side only. Mounting brackets shall be factory-attached to the cabinet.

Internal cabinet insulation shall meet ASHRAE 62.1 requirements for Mold Growth, Humidity and Erosion, tested per UL 181 and ASTM 1338 standards.

Air Distribution

The fan shall be the belt-drive, centrifugal type, double width, double inlet. The shaft shall be heavy-duty steel with self-aligning ball bearings with minimum life of 100,000 hours. The fan motor shall be 1750 rpm and mounted on an adjustable base. The drive package shall be equipped with an adjustable motor pulley. The fan/motor assembly shall be mounted on vibration isolators.

The evaporator system shall be capable of delivering 3,750 CFM at 0.50inches of external static pressure. The fan motor shall be 2.0 HP.

System shall be suitable for ducted air distribution.

Microprocessor Control

The control system shall be microprocessor-based, factory-wired into the system cabinet and tested prior to shipment. The wall-mounted control enclosure shall include a 2-line by 16-character liquid crystal display (LCD) providing continuous display of operating status and alarm condition which is wired into the control board using 4-conductor field-supplied wire. A 7-key membrane keypad for setpoint/program control and unit On/Off shall be located below the display. The control shall be capable of displaying values in °F or °C. The microprocessor shall provide three stages of cooling for direct expansion units by cycling the 3-ton compressor, 5-ton compressor and then both compressors. The microprocessor shall determine the optimal stage to run based on historical run data.

The microprocessor shall adjust the modulating chilled water valve on chilled water units. Temperature and humidity sensors shall be located in the wall box, which shall be capable of being located up to 300 ft. from the evaporator unit.

Monitoring

The LCD shall provide an On/Off indication, operating mode indication (cooling, heating, humidifying, dehumidifying) and current day, time, temperature and humidity (if applicable) indication. The monitoring system shall be capable of relaying unit operating parameters and alarms to the Liebert SiteScan® monitoring system.

Control Setpoint Parameters

Temp. Setpoint 65-85°F (18-29°C)

Temp. Sensitivity 1-9.9 °F (1-5°C)

Humidity Setpoint 20-80% RH

Humidity Sensitivity 1-30% RH

Unit Controls

2.1.3.3.1 Compressor Short-Cycle Control

The control system shall prevent compressor short-cycling by a 3-minute timer from compressor stop to the next start.

2.1.3.3.2 Common Alarm and Remote On/Off

A common alarm relay shall provide a contact closure to a remote alarm device. Two (2) terminals shall also be provided for remote On/Off control. Individual alarms shall be “enabled” or “disabled” from reporting to the common alarm.

2.1.3.3.3 Setback Control

The control shall be user-configurable to use a manual setpoint control or a programmable, time-based setback control. The setback control will be based on a 5 day/2 day programmed weekly schedule with capability of accepting 2 events per program day.

2.1.3.3.4 Temperature Calibration

The control shall include the capabilities to calibrate the temperature and humidity sensors and adjust the sensor response delay time from 10 to 90 seconds. The control shall be capable of displaying temperature values in °F or °C.

2.1.3.3.5 System Auto Restart

For startup after power failure, the system shall provide automatic restart with a programmable (up to 9.9 minutes in 6-second increments) time delay. Programming can be performed either at the wall-mounted controller or from the central, site-monitoring system.

Alarms

Unit Alarm

The control system shall monitor unit operation and activate an audible and visual alarm in the event of the following factory preset alarm conditions:

- High Temperature
- Low Temperature
- High Humidity
- Low Humidity
- High Water Alarm - Lockout Unit Operation
- High Head Pressure #1 and #2
- Loss of Power
- Compressor Short Cycle #1 and #2
- Humidifier Problem
- Filter Clog

Custom Alarms (3x)

- Smoke Detected
- Standby Unit On
- Water Flow Loss
- Standby GC Pump
- Custom 1
- Custom 2
- Custom 3

User-customized text can be entered for the three (3) custom alarms.

Alarm Controls

Each alarm (unit and custom) shall be individually enabled or disabled (except for high head pressure and high water in condensate pan) and can be programmed for a time delay of 0 to 255 seconds of continuous alarm condition to be recognized as an alarm. Each alarm can also be enabled or disabled to activate the common alarm (except high head pressure and high water in condensate pan).

Audible Alarm

The audible alarm shall annunciate at the LCD wall box any alarm that is enabled by the operator.

Common Alarm

A programmable common alarm shall be provided to interface user selected alarms with a remote alarm device. Alarms shall be enabled or disabled from reporting to the common alarm.

Remote Monitoring

All alarms shall be communicated to the Liebert site monitoring system with the following information: date and time of occurrence, unit number and present temperature and humidity.

2.2 CHILLED WATER SYSTEM COMPONENTS

2.2.1 Chilled Water Control Valve

A (2-way) (3-way) modulating, non-spring return valve shall be controlled by the microprocessor to position the valve in response to room conditions. Water-side design pressure shall be 400 psig static pressure.

2.2.2 Chilled Water Coil

The cooling coil shall have a minimum 7.6 sq.ft. face area, 4 rows deep, constructed of copper tubes and aluminum fins, and have a maximum face velocity of 491 ft. per minute at 3.750 CFM. The coil shall be supplied with 45°F entering water temperature. The coil shall be supplied with 18.4 GPM of chilled water and the pressure drop shall not exceed 4.8PSI. The coil assembly shall be mounted in a stainless steel condensate drain pan with internally trapped drain line. The evaporator drain pan shall include a factory-installed float switch to shutdown the evaporator upon high water condition.

FACTORY-INSTALLED OPTIONS

Steam Generating Humidifier (Optional)

The environmental control system shall be equipped with a steam generating humidifier that is controlled by the microprocessor control system. It shall be complete with disposable canister, all supply and drain valves, 1" air gap on fill line, inlet strainer, steam distributor and electronic controls. The need to change canister shall be annunciated on the microprocessor wall box control panel. The humidifier shall have a capacity of 10.0 lb/hr. An LED light on the humidifier assembly shall indicate cylinder full, overcurrent detection, fill system fault and end of cylinder life conditions.

Electric Reheat (Optional)

The electric reheat shall be low-watt density, 304/304 stainless steel, finned-tubular and shall be capable of maintaining room dry bulb conditions when the system is calling for dehumidification. The reheat section shall include an agency-approved safety switch to protect the system from overheating. The capacity of the reheat coils shall be 39,110 (11.5kW) BTU/HR, with unit input voltage of 460 V, controlled in two stages.

Disconnect Switch, Non-Locking

The non-automatic, non-locking, molded case circuit interrupter shall be factory mounted in the high-voltage section of the electrical panel. The switch handle shall be accessible from the unit front and mounted on the evaporator/chilled water unit.

Smoke Sensor

The smoke sensor shall immediately shut down the environmental control system and activate the alarm system when activated. The sensing element shall be located in the return air compartment. This smoke sensor shall not function or replace any room smoke detection system that may be required by local or national codes.

Filter Clog Switch

The filter clog switch senses pressure drop across the filters and shall annunciate the wall-box display upon exceeding the adjustable setpoint.

Air Filter Box

The evaporator section shall be supplied with an air filter box for use with ducted installations. Two (2) filters shall be included 4" x 20" x 25" (102 mm x 508mm x 635mm) each, deep-pleated type, with a MERV 8 rating, based on ASHRAE 52.2.

Condensate Pump

The condensate pump shall have the capacity of 25 GPH at 40 ft. head. It shall be complete with integral float switch, discharge check valve, pump, motor assembly and reservoir. A secondary float switch shall be provided to permit field wiring to the unit control to shut down the evaporator upon a high water level condition.

Condensate Pump Bracket

A condensate pump bracket shall be provided to mount condensate pump to the end of the unit and allow easy alignment and installation of the condensate pump.

SiteScan Site Monitoring System (or equiv.)

A Liebert SiteScan Site Monitoring System Model Sitelink SSW-2E shall be provided for remote monitoring of the Liebert Mini-Mate2 unit and monitoring of other Liebert support equipment. The Liebert SiteScan shall have the capability to monitor and change (at the user direction) the temperature and humidity setpoints and sensitivities of each unit. It shall also be capable of being programmed to print out environmental conditions or operating modes at each unit.

Specifications Wiring Specifications
Ordering Information

Power 24VAC ±10%, 50 to 60Hz, 24VA, or 26VDC ±10%, 10W, 48VDC
Dimensions
W x D x H: in.
Module: 11.3 x 0.56 x 7.5
Enclosure (brushed aluminum): 14.25 x 2.85 x 12

Communication Ports
• **Ethernet Port** 10/100Base-T Fast Ethernet port.

• **ARC156 Port** ARCNET156 or EIA-485 communication. In ARCNET156 mode, the port communicates via
BACnet ARC156.

• **TPI Port S1** EIA-232/422/485 configurable port for interaction with 3rd-party building automation systems
via software-selectable protocols. May also be configured for remote modem access.

• **EIA-422/485Ports 1-12** – for communication with equipment via software-selectable**.** Each port can be individually set for different protocols & baud rates. The number of ports varies by model:

SiteLink-2E (SSW-2E) **SiteLink-4E** (SSW-4E) **SiteLink-12E** (SSW-12E)
• **Ports 11-12**These two ports include an option for EIA-232 connection.
• **Ports 9-12** These four ports include an option for EIA-232 connection.
• **Ports 1-12** Four of these 12 ports (9-12) include an option for EIA-232 connection.

Environmental Operating Range
20°F to 140°F (-29°C to 60°C); 10 to 90% relative humidity, non-condensing

Note: Control modules should be installed within the building.

Memory 16 MByte non-volatile battery-backed SDRAM and 8 MByte Flash

Protection Built-in surge and transient protection circuitry - internal solid state polyswitches on incoming
power and network communications connections

Battery 3V lithium battery P/N CR-123A; battery shelf life is 10 years with 720 hours of continuous operation

Fault Detection Hardware watchdog timer

Agency Listings UL, cUL, CE, FCC

Connection Supported Wire Types Maximum Wire Length Rating
Ethernet 10 BaseT CAT 5 328 ft. (100m) N/A
BACnet Port MAGNUM Cable P/N A3-ARC-156-2 3000 ft. (915m) N/A
Port S1 EIA-485 18-22 AWG Stranded & Shielded; **18 AWG (recommended)**
Non Plenum - Belden 9461; Plenum - Belden 88761 1000 ft. (300m) N/A
Port S1 EIA-232 18-22 AWG Stranded & Shielded; **18 AWG (recommended)**
Non Plenum - Belden 9461; Plenum - Belden 88761 50 ft. (15m) N/A

Quantity Part # Description
SSW-2E SiteLink-2E with enclosure - communicates with up to 2 Liebert unit controllers.

EXECUTION

INSTALLATION OF AIR CONDITIONING UNIT

General

Install air conditioning unit in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored in location indicated, and maintain manufacturer’s recommended clearances.

Electrical Wiring

Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer’s electrical connection diagram submittal to electrical contractor. Install and wire per local and national codes.

Piping Connections

Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer’s piping connection diagram submittal to piping contractor.

Supply and Drain Water Piping

Connect water supply and drains to air conditioning unit. Unit drain shall be trapped internally and shall not be trapped externally.

Field-Supplied Pan

A field-supplied pan with drain shall be installed beneath cooling units and water/glycol condensing units.

FIELD QUALITY CONTROL

Startup air conditioning unit in accordance with manufacturer’s startup instructions. Test controls and demonstrate compliance with requirements.

End.

LOS ANGELES WORLD AIRPORTS

INFORMATION MANAGEMENT & TECHNOLOGY GROUP

IT Infrastructure Standards of Practice

Information Management & Technology Group
Infrastructure Technology Group
6053 W. Century Blvd.
Suite 200
Los Angeles CA, 90045

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I. Introduction

A. Scope

This Standards Document provides design guidelines and requirements for designing infrastructure for Information Technology and Security Systems within the City of Los Angeles at Los Angeles World Airports (LAWA).

Architects, engineers, planners, consultants, Installers, tenants, and staff are among the intended audience. The result of adhering to this specification is to provide infrastructure that:

- ♦ Is secure
- ♦ Provides for growth
- ♦ Conforms to industry standards
- ♦ Implements best practices
- ♦ Improves reliability
- ♦ Increases serviceability

B. Construction Approvals

Before the construction or installation of any IT facilities, construction approvals shall be obtained through the Tenant Approval Process. For more information on tenant projects, refer to the Tenant Project Approval Process Manual or call LAWA's Facilities Planning Division at (424) 646-7690.

Direct all correspondence as provided here: http://www.lawa.org/welcome_LAWA.aspx?id=4162

LAWA Information Management & Technology Group
Attention: Infrastructure Technology Group Manager
6053 W. Century Blvd., Suite 200
Los Angeles, California 90045
Phone: (310) 646-2067 Fax: (310) 646-1888

Subsurface utilities shall be located by calling:

- California Underground Service Alert South at (800) 227-2600, or
- One Call Referral Systems International at (888) 258-0808.

Orange is the uniform color code for utility flagging, painting, and identifying communications, alarms, signals, and CATV.

II. Codes, Standards, & References

A. General

All installations shall comply with the latest National Electric Code, the Los Angeles City Building and Safety Electric Code, and the codes, standards, and methodologies listed below. Except as specified, Standards and practices that prevail and are generally accepted within the industry shall be used to assure the highest quality materials, equipment and workmanship.

All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction only. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

If there is an apparent conflict between this specification, and any code or standard, then the NEC and City of Los Angeles Building and Safety Codes shall prevail.

B. References

List of Codes and Standards governing infrastructure installations:

ANSI C80-1	*Rigid Steel Conduit, Zinc-Coated.*
ANSI C80-3	*Electrical Metallic Tubing, Zinc-Coated.*
ANSI/ICEA S-83-596	*Fiber Optic Premises Distribution Cable Technical Requirements.*
ANSI/NEMA FS 1	*Fittings and Supports for Conduit and Cable Assemblies.*
ANSI/TIA/EIA 107	*Return Loss for Fiber Optic Components.*
ANSI/TIA/EIA-455-A	*Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components (FOTPs) Standard Test Procedures for Optical Fibers & Cables.*
ANSI/TIA/EIA 455-13	*Visual and Mechanical Inspection of Fiber Optic Components, Devices, and Assemblies (R2002).*
ANSI/TIA/EIA 455-57A	*Optical Fiber End Preparation and Examination.*
ANSI/TIA/EIA 455-59	*Measurement of Fiber Point Defects Using An OTDR.*
ANSI/TIA/EIA 455-60	*Measurement of Fiber or Cable Length Using An OTDR.*
ANSI/TIA/EIA 455-61	*Measurement of Fiber or Cable Attenuation Using An OTDR.*
ANSI/TIA/EIA 455-95	*Absolute Optical Power Test for Optical Fibers and Cables.*
ANSI/TIA/EIA 455-171	*Attenuation by Substitution Measurement - for Short-Length Multimode Graded-Index and Single-mode Optical Fiber Cable Assemblies.*
ANSI/TIA/EIA -526-7	*Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.*
ANSI/TIA/EIA 526-14	*Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.*
ANSI/TIA/EIA-568-B.1	*Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, April, 2001.*
ANSI/TIA/EIA-568-B.2	*Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components, April, 2001.*
ANSI/TIA/EIA-568-B.3	*Commercial Building Telecommunications Cabling Standard Part 3: Optical Fiber Cabling Components, April, 2000.*
ANSI/TIA/EIA –569-B	*Commercial Building Standard for Telecommunications Pathways and Spaces, February 2003.*
ANSI/TIA/EIA 598-B	*Optical Fiber Cable Color Coding, 2001.*
ANSI/TIA/EIA -604.2	*Fiber Optic Connector Intermateability Standard, 1997.*
ANSI/TIA/EIA -606-A	*Administration Standard for Commercial Telecommunications Infrastructure, 2002.*
ANSI/TIA/EIA -607	*Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994.*
ANSI/TIA/EIA –758	*Customer-Owned Outside Plant Telecommunications Cabling Standard, April 1999.*
ANSI/TIA/EIA – 854	*A Full Duplex Ethernet Specification for 1000Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling, 2001.*
ANSI/TIA/EIA – 862	*Building Automation Systems Cabling Standard for Commercial Buildings, 2002.*
ANSI/TIA/EIA-4750000B	*Generic Specifications for Fiber Optic Connectors. BICSI Telecommunications Distribution Methods Manual (Tenth Edition).*
FCC 47 Part 68	*Code of Federal Regulations, Title 47, Telecommunications.*
IEEE	*National Electrical Safety Code (NESC); 2002.*
LADBS	*Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code.*
NEMA 250	*Enclosures for Electrical Equipment (1000 V Maximum).*

NFPA-70	*National Electric Code; 2002.*
TIA/EIA TSB 67	*Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.*
TIA/EIA TSB 72	*Centralized Optical Fiber Cabling Guidelines.*
TIA/EIA TSB 75	*Additional Horizontal Cabling Practices for Open Offices.*
UL 1459	*Underwriters Laboratories Standard for Safety – Telephone Equipment.*
UL 1863	*Underwriters Laboratories Standard for Safety – Communications Circuit Accessories.*

The Codes listed above may not reflect the latest published versions. In preparing design and construction documents, you must reference and follow the latest prevailing codes and standards as published by the relevant agencies and organizations.

III. Abbreviations

ACAMS	Access Control and Monitoring System
ACR	Attenuation to Crosstalk Ratio
AWG	American Wire Gage
ANSI	American National Standards Institute
BTU	British Thermal Units
BICSI	Building Industry Consultants Service International
BOAC	Board of Airport Commissioners
CAT	Category e.g. CAT6
CATV	Cable Television
CCTV	Closed Circuit Television
CTA	Central Terminal Area of the airport
EFMD	Engineering & Facilities Management Division
EIA	Electronic Industries Association
ELFEXT	Equal Level Far End Crosstalk
EMT	Electrical Metal Tubing
FIS	Federal Inspection Services
FR-S	Fire Retardant Stamp
INS	Immigration and Naturalization Service
IT	Information Technology
IMTG	Information Management & Technology Group
LABC	Los Angeles Building Code
LADBS	Los Angeles Department of Building & Safety
MM	Multimode fiber optic cable
MPOE	Minimum Point Of Entry
MTR	Main Telephone room
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NEXT	Near End Crosstalk
O.D.	Outer Diameter
OSP	Outside Plant
OTDR	Optical Time Domain Reflectometry
PVC	Polyvinyl Chloride
SM	Single-mode fiber optic cable
TC	Telephone Closet
TDR	Time Domain Reflectometry
TR	Telephone room
UTP	Unshielded Twisted Pair
WAO	Work Area Outlets

IV. IT Rooms and Locations

A. Design Requirements

1. Environment (Surrounding/Exterior Elements)

    a. Critical requirement. The environment surrounding the location of the IT room must be free from sources of electromagnetic interference.

    b. Critical requirement. The immediate environment surrounding an IT room cannot contain equipment such as steam boilers, compressors, chilled/hot water pipes, elevator equipment, electrical co-generation equipment, or waste processing.

    c. Critical requirement. IT rooms need be located away from flying dirt and debris (i.e. airline equipment ramps). If that is not feasible, then the IT rooms shall have positive ventilation and magnetic gasketing.

    d. The location must be above any potential flood zones, including being located below rest rooms and restaurants.

    e. IT rooms need to be accessible from a corridor, stairwell, and/or a service elevator large enough for cabinet and equipment loading and servicing.

2. Location

    a. Critical requirement. The location and quantity of telecommunications rooms shall be designed so that the maximum distance from the IT room to any field device that the room supports shall not exceed 250 feet via the longest possible route (i.e. right angles) traveled by the cable from the room to the field device. This includes all work area outlets, ACAMS card readers, cameras, access points, displays, antennas, etc.

    b. Critical requirement. If the distance from the IT room to the furthest field device exceeds 250' via the longest possible route, then another IT room shall be installed to accommodate the distant field devices

    c. Critical requirement. Within a building, if there are two or more IT rooms per floor, then the distance from one IT room to an adjacent IT room shall not exceed 500 feet via the longest possible pathway route (i.e. right angles).

    d. All field devices shall be fed from an IT room on the same floor where that field device is installed. That is, where feasible, field devices should not be fed from IT rooms on levels above or below.

    e. Where feasible, to maximize coverage of an IT room, IT rooms should be located near the center of the floors that they serve, and there shall be a minimum of at least one IT room per floor.

    f. If more than one IT room is installed within a building, then a Main IT room shall be identified that shall be larger than the other IT rooms.

    g. In a multi-level building, IT rooms on different floors should stack on top of each other. Straight vertical cable risers should be established for the purpose of cable routing.

h. LAWA IT rooms, closets, or equipment rooms shall not be used by tenants for their equipment. Tenants shall install all communications equipment within their leasehold.
i. Buildings with special shapes and sizes shall be considered on an individual basis.

3. IT Room Size

a. Design standards shall address two room types/sizes:

- IT Rooms that contain six to seven equipment cabinets plus one or two UPS cabinets – 11' x 24' or approximately 264 sq. ft. It is preferable to have the UPS in one cabinet footprint – leaving seven equipment cabinets.

- Minimum Point of Entry (MPOE) Rooms that contain eight to nine equipment cabinets plus one to two UPS cabinets 12' x 30' or approximately 360 sq. ft. It is preferable to have the UPS in one cabinet footprint – leaving nine equipment cabinets.

b. Sizing IT rooms for office locations is different than sizing for rooms to support active equipment in a passenger terminal. IT rooms sizes for offices shall be based upon the number of work stations supported. Final room sizing, location, orientation, and layout shall be reviewed with LAWA for approval during the Tenant Approval Process.

c. All room sizes, orientation, and layout shall be reviewed with LAWA for approval at the 30 percent design review phase.

4. Construction

a. General IT rooms within buildings may be constructed with materials similar to the surround architecture. Refer to the Los Angeles Building Code for requirements.

b. IT equipment rooms shall be constructed with concrete block walls and lined with an electromagnetic interference prevention material.

5. Ceiling

a. Drop or false ceilings are not permitted.

b. Minimum ceiling height is eight feet, six inches, (8' 6").

c. Minimum ceiling height is nine feet.

6. Flooring

a. Raised access floors shall not be permitted

b. Shall be covered with an anti-static vinyl.

c. Floor loading for general IT rooms shall be a minimum of 100 lbf/ft2

d. Floor loading for large IT equipment rooms shall be a minimum of 200 lbf/ft2

7. Seismic Bracing

   a. Contractors shall provide seismic restraint of all infrastructure and equipment installed in TR and MPOE rooms. All infrastructure supports and anchoring shall meet current LADBS code requirements with importance factor 1.5 for essential facility rating.

8. Walls

   a. Walls without plywood shall be painted white in a semi-gloss finish.

   b. Walls with plywood shall be covered with 3/4 inch x 4 ft x 8 ft, AC-grade, fire-retardant treated plywood, with the FR-S stamp on it.

   c. The “C” side shall face the studs so that the “fire retardant” stamp is visible on the “A” side.

   d. Cutouts for electrical switches and outlets shall be provided.

   e. **Important.** Plywood shall be painted with two coats of white, fire- retardant, low gloss, paint leaving the FR-S stamp(s) exposed for inspectors.

   f. Plywood shall be fastened with #12 flat-head sheet metal screws to metal studs, every 16 inches to 24 inches on center depending upon stud spacing.

   g. Plywood shall not be fastened with a nail gun or explosive-charge device.

9. Doors

   a. Minimum door size is 36 inches x 80 inches.

   b. Door should swing outward if local building codes allow. Refer to Chapter 10 of the LABC for allowable projection. Show swing of doors on plans.

   c. All doors shall have entry and exit ACAMS card reader access. Provide symbols on plans.

   d. All IT room doors shall be keyed to [TBD] locks to allow opening from the outside, and shall have a mechanism to manually enable and disable the key lock.

10. Windows

    a. Windows are not permitted without IMTG’s approval. Specify method of shading at the 30% review.

11. Power

    a. Design standards for IT rooms shall use a maximum 20kVA/16kW for conditioned user equipment loads as the basis for design. See appendices for UPS equipment specifications and requirements. Refer to the NEC for Load Calculation Requirements.

    b. Design standards for MPOE rooms shall use a maximum 30kVA/24kW for conditioned user equipment loads as the basis for design. See appendices for UPS equipment specifications and requirements.

c. Contractor shall design for the major electrical components including but not limited to:

- Electrical Distribution in Room (non-conditioned)
- Uninterruptible Power Supply w/ power distribution
- Electrical Panel (conditioned from UPS output)
- Electrical Distribution to cabinets (conditioned from UPS)
- Maintenance Bypass Circuit (if reqd. due to input voltage)
- Batteries (VRLA type)

d. Electrical panels serving the UPS shall be separate from those serving lighting and mechanical equipment.

e. A dedicated 200 amp electrical panel shall be installed within IT rooms up to 360 square feet.

f. Power requirements for larger rooms shall be calculated on an individual basis.

g. Excepting for special circuits, all panels shall be fully populated with 20 amp circuit breakers.

h. Excepting special power requirements, each individual equipment cabinet or equipment rack shall have two separate 120 VAC, 20 amp circuits feeding them.

i. Walls with backboards shall have 120 VAC, 20 amp, non-switched, quadplex wall outlets installed every six (6) feet.

12. Lighting

a. Lighting shall provide a minimum of 50 foot candles measured at three foot three inches (3’ 3”) above the floor.

b. Fluorescent fixtures shall use “cool white” lamps.

c. Dimmer switches shall not be used.

d. Light fixtures shall be centered in the aisles between the low-voltage cable tray segments mounted at a minimum of 8’ 6” above the finished floor. Lights shall not be mounted directly above cable tray.

e. A minimum of fifty percent of all fixtures shall be on emergency power.

13. Grounding/Bonding

a. Within the main telecommunications room there shall be installed a telecommunications main grounding busbar (TMGB).

b. The TMGB shall be grounded to both the electrical grounding entrance facility and the building’s steel exterior wall, or according to the local authority having jurisdiction. The TMGB shall also connect to a telecommunications grounding busbar (TGB) within each IT room via a telecommunications bonding backbone (TBB). Grounding conductors shall be installed to building steel with clamps designs for the purpose.

c. The TMGB shall be a copper busbar of a minimum 4 inches x 10 inches x ¼ inch with a minimum of eight (8) wire connection lugs attached to it. Busbar shall be insulated from its support.

d. The TGB shall be provided for each IT room, and shall be connected to both the closest grounding point in the building's electrical service panel or according to the local authority [LAEC & NEC] having jurisdiction, and the building's steel exterior wall. Show and note on plans.

e. The TBB shall be installed to connect the TMGB to each TGB. Separate conductors shall run from the TMGB to every level within a building. TBB's can be extended from the TGB's in IT rooms on the same level.

f. TBB's shall be sized according to the distance that they need to run, as follows:

- # 6 AWG for distances less than 13 feet
- # 4 AWG for distances between 13 and 20 feet
- # 3 AWG for distances between 20 and 26 feet
- # 2 AWG for distances between 26 and 33 feet
- # 1 AWG for distances between 33 and 44 feet
- # 1/0 AWG for distances between 44 and 52 feet
- # 2/0 AWG for distances between 52 and 66 feet
- # 3/0 AWG for distances greater than 66 feet

g. For TGB's, a minimum, #6 AWG, stranded, copper, green, insulated, conductor shall be provided to connect equipment racks and cabinets and cable tray intersystem bonding. All equipment racks and cabinets shall be bonded to each other and to the telecommunications grounding busbar.

h. All grounding conductors shall be protected by installing within 1/2" conduit.

i. Isolated grounds to reduce electrical noise shall be provided, only if specified. Isolated grounding receptacles shall be colored orange or marked with an orange triangle.

Codes/Standards Reference

NEC article 250
NEC article 800
ANSI J-STD-607-A

Acceptable Products:

B-Line #SB-477-K Busbar

14. Mechanical

a. Provide and install a dedicated ceiling-mounted air conditioning unit w/ reheat and humidification function. Unit shall be installed immediately outside of the IT space to provide for 24 hour service. See appendices for mechanical equipment specifications and requirements for both TR and MPOE rooms.

b. Air conditioning unit shall be chilled water type. If a suitable chilled water source does not exist, contractor shall submit to EFMD to specify a DX system based on existing conditions and using the same capacities as outlined. See current edition of LAWA's Design and Construction Handbook for mechanical engineering requirements and approved equipment suppliers.

c. Air units shall be sized according to max user equipment loads in the space as calculated by the UPS size in kW for both TR an MPOE rooms.

d. Inside temperature shall be maintained between 64°F to 75°F, at between 30% and 55% relative humidity.

e. A thermostat shall be provided within the room. Call out location on plans.

f. All IT room doors shall be sealed for dust-proofing, have positive ventilation, and all ventilation ducts into the room shall be filtered for dust abatement purposes.

g. Supply ducting and supply diffuser from air unit shall be located above cold aisle in TR and MPOE rooms. Return ducting to air unit shall be located above hot aisle in TR and MPOE rooms.

15. Fire Systems for IT Rooms

a. Provide self-contained double-interlocked pre-action riser system to support TR and MPOE spaces as required by owner. Location of pre-action cabinet shall be outside of TR and MPOE space and shall be coordinated with owner for approval. Refer to the Mechanical Code for Pre-Action System

- ♦ Double interlocked pre-action system shall have an electric/pneumatic valve requiring both low-air signal and detection signal to open the valve

- ♦ Double interlocked pre-action system shall have pressure gauges to indicate water supply pressure, priming water pressure, and air pressure, and shall contain an automatic air compressor to fill the system in prescribed time.

- ♦ Double interlocked pre-action system shall be provided with integral FM approved UL listed butterfly valve installed on the system riser outside of cabinet with test and drain assembly for full-flow testing.

- ♦ Pre-action valve shall have sight glass to visually confirm water flow upon system activation.

- ♦ Pre-action system shall be type Reliable Prepak or Viking TotalPac

b. Sprinklers heads shall have wire cages installed to prevent damage and accidental activation.

c. Specialty spaces may require a clean agent fire suppression system. Any clean agent system requirements shall be coordinated with the owner.

16. Monitoring Systems

a. Provide monitoring equipment to support both the UPS and mechanical unit. Monitoring equipment shall be compatible with the existing Sitelink system and Sitescan software used to monitor other IT spaces and critical infrastructure. Monitoring equipment shall have interface for future connectivity to BMS.

b. Provide and install SSW-2E Sitelink interface module (or equiv.) allowing for communication with UPS and Mechanical system for integration with Sitescan Web software via BACnet. Module shall be mounted in NEMA-1 wall-mount enclosure within room. Include one external power supply 120VAC/24VAC and startup services. One pair of EIA-422 cable required to both UPS and Air critical

17. Plumbing

    Excepting fire sprinklers required by code, no pipes intended to carry water or any other fluid shall be installed in or above the IT room ceiling. See Fire Section for plumbing requirements related to any pre-action sprinkler systems.

18. Security

    a. Entry and exit ACAMS card readers shall be provided for all IT room doors.

    b. All IT room doors shall also be keyed to LAWA A-2 locks to allow opening from the outside, and shall have a mechanism to manually enable and disable the key lock.

    c. All IT rooms shall have cameras within the room that connect to the VNET system.

    d. Some rooms shall have cameras mounted on the outside of the room watching the entry door.

    e. Some rooms may have intercoms that connect back to the network operations center.

19. Conduit Sleeves

    a. Conduit sleeves for backbone cabling are not permitted in new construction.

    b. All backbone conduits shall terminate either within equipment cabinets or lockable junction boxes with hinged covers, sized as follows:

    - One 36” x 36” x 12” deep junction box for 2 to 4 four inch conduits
    - Two 36” x 36” x 12” deep junction boxes for 5 to 8 four inch conduits

20. Clearances

    a. Clearances around all electrical and mechanical equipment shall satisfy all local, NEC, and manufacturer’s required clearances.

    b. IT equipment cabinets require a 36” aisle space in front of and behind each cabinet.

    Codes/Standards Reference

    NEC article 110.26
    NEC article 800
    ANSI J-STD-607-A

21. Cross-connect Facilities

    a. All VOICE backbone and horizontal cables shall be terminated on CAT6 rated, 110 style, punch-blocks. All data backbone and horizontal cables shall be terminated in jack-fields that are rack-mounted.

    b. Cables of similar type shall be terminated next to each other.

    c. Metal D-rings or some other IMTG approved patch cord management system shall provide patch cord management.

22. Cross-connect Color Coding

a. **LAWA IMTG does not follow Industry standards for color-coding backboards and cross-connects.**

b. Backboards shall be painted white until further notice. Note on plans.

B. Work Area Outlets

1. Work area outlets shall be connected by horizontal cabling, point-to-point, to the IT room/closet.

2. Work area outlets in office areas shall be located so that one outlet serves each 80 square feet of usable office space.

3. Work area outlets shall contain between 6 and 8, eight-position, RJ45 type modular jacks installed for each cubicle.

4. The top three/four jacks shall be for voice, and the bottom three/four jacks shall be for data. (Consult LAWA IMTG as this requirement may vary).

5. Work area outlet boxes shall be a minimum of 4S deep (4 inch square) boxes and shall be flush-mounted and located adjacent to a power recepticle.

6. Work area outlet boxes shall be fed with one 1 - 1.5 inch conduit depending upon the number of cable required to the outlet.

7. Work area outlets shall be mounted at the same height as the existing convenience outlets, unless required to meet ADA requirements.

8. All work area outlets shall be canted at a 45 to 55 degree exit.

9. Work area outlets shall be neatly and professionally labeled at the outlet, on the front of the wall plate and in the IT room/closet.

10. Work area outlets shall meet or exceed the performance criteria for the cable type used, i.e. CAT 6/6e/6A.

Acceptable Products:

♦ Panduit CAT6E CJ688TG or CAT6A CJ6X88TG or approved equal. Submit info by the 60% review.

V. Pathways

A. Safety

1. Protection Of Material And Work

a. The Installer shall protect all finished and unfinished work against loss or damage until the final acceptance of the completion of the entire project.

b. In the event of a loss or damage, the Installer shall promptly notify the LAWA ADG & IMTG Project Manager.

2. Protection Of Person(s) And Property

a. The Installer shall not interfere with the airlines and/or passenger circulation or tenants in front of or within the terminals, in the parking structures, or on the airfield during the course of the installation without obtaining prior permission from both LAWA ADG & IMTG and the airline or tenant.

b. The Installer shall protect all persons and all private and public property from hazardous conditions, damage, injury, and death during the course of the installation. These precautions shall include, but shall not be limited to cordoning off the Installer's construction area with lights, barricades, enclosures and sufficient guards at and about the construction site.

c. The Installer shall promptly notify the LAWA ADG & IMTG Project Manager after the occurrence of such damage, loss or injury and shall prepare a full and complete written report to the LAWA IMTG Project Manager within 24-hours.

3. Traffic Control (reference Transportation section)

The Installer shall comply with Department of Transportation standards and the requirements of the Airport Police in the control of traffic during installation.

B. Conduits

1. General

a. Critical requirement. All IT rooms shall connect to the main telecommunications room (MPOE) with a minimum of two 4-inch conduits.

b. Critical requirement. Adjacent IT rooms shall connect to each other with a minimum of two 4-inch conduits.

c. Critical requirement. Within passenger terminals, there shall be a minimum of two sets of two 4-inch, individual, physically separate, redundant, conduit riser pathways feeding each level of the building from the MPOE.

d. Every IT room on the level immediately below the rooftop shall provide for connectivity to the rooftop.

e. Power lines shall not run in communications conduits.

f. EMT and Rigid metallic conduit shall be reamed and have bushings installed.

g. Conduit shall be sized for forty percent of perfect fill.

h. The maximum number of cables that can be installed with two 90-degree bends is 40 percent of perfect fill.

i. Conduit fill shall be reduced by 15 percent for each additional 90-degree bend, not to exceed 360 degrees of bend.

j. Conduits shall not run more than 150 feet or have more than two 90 degree bends without pull-boxes.

k. Each conduit shall have a pull-string inserted and tied off at each end.

l. One 4 inch conduit entering the IT room and one 4 inch conduit leaving the IT room shall have three, 1-1/4", orange-colored, innerducts or four 1- inch orange-colored innerducts installed with pull-strings in each.

m. All conduit bends shall be long sweeping bends.

n. The inside bend radius for conduits sized 2 inches or less shall be a minimum of 6x the internal diameter of the conduit.

o. The inside bend radius of conduits sized greater than 2 inches shall be a minimum of 10x the internal diameter of the conduit.

p. All conduits shall be labeled on both origin and destination ends.

2. Underground minimum clearances

a. Minimum of 3 inches when near power, light, and other conduits.

b. Minimum of 6 inches when crossing oil, gas, water, and other pipes.

c. Minimum of 12 inches when running parallel to oil, gas, water, and other pipes.

d. Minimum of 12 inches when below the top of railroad rails.

e. Orange colored, detectable, plastic warning tapes shall be installed to prevent accidental dig-ups.

Codes/Standards Reference

NEC article 300.5

C. Pull Boxes

1. Sized according to the NEC, unless specific sizes are specified. Show size of pull boxes on plans.

2. The minimum size pull box for 3/4 inch conduit is 12 inches long x 4 inches wide x 3 inches deep. (12" x4" x 3").

3. The minimum size pull box for 4 inch conduit is 60 inches long x 15 inches wide x 8 inches deep. (60" x 15" x 8").

4. Conduits shall not run more than 150 feet or have more than two 90 degree bends without pull boxes.

5. Conduit entry points shall be placed at opposite ends of the pull box if possible.

D. Innerduct

1. Innerduct shall be installed in all conduit systems where fiber optic cable is placed. (See LAWA IMTG for details).

E. Ductbanks

1. If rigid nonmetallic PVC is used, all conduits and bends shall be 4-inch schedule 80 PVC and shall be encased.

2. Ductbank installation shall meet state general order #128 codes.

3. Conduits shall be encased in concrete and shall have an orange electronic marker strip for future location purposes.

4. A minimum of one 4-inch conduit shall be filled with three 1-1/4 inch innerducts along the installed pathway.

5. All conduits and innerducts shall have 1/2" poly pull rope installed and secured at each end.

F. Maintenance Holes

1. Shall have an H-20 or higher rating for deliberate heavy vehicular traffic for non-airfield installations.

2. Airfield installations shall have an aircraft rating. See LAWA Engineering & Facilities Management Division for specifications.

3. Maintenance holes shall be sized a minimum 4 feet long x 2 feet wide x 4 feet deep (4' x 2' x 4') to allow the coiling of 50' of extra fiber optic cable.

4. Maintenance holes shall be tested for explosive and oxygen-displacing gases, prior to entry.

5. Maintenance holes shall be exhausted and ventilated as required.

6. Maintenance holes having abnormal gas levels shall be reported to the IMTG Supervisor, Risk Mangement and Airfield Ops for record-keeping.

7. New maintenance hole dimensions shall not be less than 12 feet long x 6 feet wide x 10 feet high. (12' x 6' x 10")

8. Distances between maintenance holes shall not exceed 400 feet, (Consult LAWA IMTG, Airfield Ops).

9. Bend radii of conduit entering maintenance holes shall be 9 feet minimum.

10. New maintenance holes shall have cable rack supports, cable hangars, and a metal ladder secured to the structure.

11. Maintenance hole covers shall be numbered by welding the numbers on top of the maintenance hole cover. See LAWA IMTG for a numbering sequence.

12. Maintenance hole numbers shall also be painted on the inside collar of the maintenance hole.

G. Direct Burial

Direct burial shall not be used as a cable installation method on the LAWA campus.

H. Aerial Pathways

1. Poles shall not be set except for temporary projects and only then with approval from the LAWA Engineering & Facilities Management Division. Show proposed locations and height on the plan at the 30% design review.

2. Communications cable shall be mounted 40 inches below any power lines and 15.5 feet above streets and driveways.

3. Aerial cable spans shall not exceed 98 feet to the building.

4. Aerial cable entrances shall be limited to 100 pairs.

Codes/Standards Reference

NEC article 230
NEC article 830.10, 830.11

I. Cable Tray & Vertical Ladder Runway

1. Overhead Cable tray shall be a standard twelve inches wide and five inches deep and mounted at approximately 8' above finished floor. Ideally, cabletrays should be mounted at 12" above the cabinets being served.

2. In office areas, cable trays should be installed above the common corridor. In areas with diverse architecture, pre-approval for cabletray type and routing must be obtained.

3. Overhead cabletray installed within TR and MPOE rooms shall be installed around the perimeter of the room and over the center-line of the cabinets from wall to wall and tee off at intervals not to exceed six feet.

4. Cable tray shall be aluminum ladder-type flange-in cable tray type PW/Legrand Industries model 4E02 w/ 6 inch rung spacing and NEMA Class B rating.

5. Provide and install with the required radius bends and pre-fabricated corner and Tee fittings of the same type as linear sections to match layout as outlined in shop plans to be approved by owner.

6. Coordinate extact cable tray placement over cabinets to facilitate low-voltage cable plant installation via knockouts located on top of cabinets.

7. Cable tray installation shall shall be supported by a threaded rod trapeze sized and unistrut. All overhead cable tray installation and anchoring shall meet essential facility rating of current LADBS code with seismic importance factor 1.5.

8. Cabletrays parts shall be bonded to a number 6 AWG copper conductor and connected to the grounding busbar.

9. Vertical ladder runway shall be installed on the wall to facilitate cable routing from floor or O/H conduit sleeves to cable tray. In IT rooms, install 24 inch black CPI cable runway mounted to wall for all vertical pathways from floor/ceiling conduits to overhead runway. CPI part number 10250-724 or equal.

10. Cabletrays parts shall be bonded to a number 6 AWG copper conductor and connected to the grounding busbar.

J. Raised Access Floors

Telecom and MPOE rooms shall not have raised floors unless specifically noted by LAWA

K. Power Poles

1. Dual channel, vertical, power poles may be used to feed modular furniture that is not adjacent to a wall outlet.

2. EMT Conduits feeding power poles shall be sized according to the number of workstations supported by the power poles.

3. Power and communications shall be routed in separate channels.

L. Surface Mount

Surface-mount raceways shall be used only if there is no other alternative pathway for cables (Consult LAWA IMTG).

M. Fire Stopping

1. All penetrations made through fire-rated structures by conduits, cables, innerducts, cable trays, and duct banks shall be sealed with approved firestopping materials.

2. Firestopping materials shall be sufficient to restore the fire-rating of the penetrated structure.

3. Putty-type firestopping material is preferred for ease of firestop reentry.

4. STI Firestop E-Z Path or equal.

N. Core Drilling

1. Core drilling concrete floors may be permitted with approval from LAWA Engineering & Facilities Management Division provided that structural integrity is not compromised.

2. Ground Penetrating Radar Systems shall not be used.

3. The concrete shall be X-rayed prior to drilling, and that X-ray given to the Engineering & Facilities Management Division along with a request for core drilling.

4. The concrete slurry from the drilling operation shall not be allowed to stain anything either above or below it. Provisions shall be made to protect the environment and contain the slurry.

5. All spillage shall be cleaned up.

6. The core-drilled opening shall be properly firestopped.

O. Cabinets

1. Frame

    a. Cabinet Size (36” deep version) - 84.00" H x 28.00" W x 36.00"D (Overall height reflects distance from bottom of cabinet frame to top surface of roof and overall depth reflects distance from exterior front door surface to rear door exterior surface). Part Number: DAMAC CSN1284Z23077-3

    b. Cabinet Size (42” deep version) - 84.00" H x 28.00" W x 42.00"D (Overall height reflects distance from bottom of cabinet frame to top surface of roof and overall depth reflects distance from exterior front door surface to rear door exterior surface). Part Number: DAMAC CSN1284Z23079-3

    c. Frame Construction Profile - Tubular steel construction, fully welded chassis w/ gussets and custom mounting channels front/rear of rails.

    d. Equipment Mounting Rails - 45U, EIA Standard, with RMU markings, fully adjustable.

    e. Cabinet Configuration - High Air-flow cabinet design for hot and cold aisle installation. Special FloTrac hi-flow split mesh doors for future installation of FloTrac cooling system.

2. Roof

    a. Roof - Solid, CRS sheet metal, weld in and sealed, flush mounted into the cabinet frame.

3. Side Walls

    a. Side Panels - Solid, CRS sheet metal, recessed into cabinet frame. Installation/removal via (2) zinc plated philips truss machine screws at 38.75" from side panel top and 2.125" from side panel edge. (1) CH751 lock is included per side panel, keyed alike, located 1.25" from side panel top, centered.

4. Front & Rear Doors

    a. Front/Rear door - Perforated, CRS sheet metal, beveled edge high airflow mesh design for unrestricted air movement. Doors are split in the middle with door lock.

    b. Front/Rear Door Ventilation - 82% Perforation, split high air-flow mesh doors.

5. Door Locking Handles

a. Door Locking Handles - Door lock is recessed/mounted flush with the door surface and includes a spring-loaded handle and compression locking pawl. Lock protrudes no more than .125" off of door surface. Includes #751 key cylinder, keyed alike.

6. Equipment Mounting

a. Equipment Mounting - (4) Vertical 19" rackable, 45u, rails per EIA Standard. Rails are designed with 10-32 tapped equipment mounting holes. Rails are attached to (5) N700 unistrut horizontal sub-frame system for depth adjustability. Maximum rail adjustable depth is 32.50". Front rails are positioned approx. 6.00" from the front edge of the frame; rear rails will be set approx. 21.00" from front rail set location.

b. Rail Hardware - (30) 10-32 equipment mounting screws included.

7. Grounding

a. Grounding - (1) Grounding stud, threaded, located on rear-right floor mounting gusset. (1) rack-mount busbar, 3/16" -thick X 3/4" -high hard- drawn electrolytic tough pitch 110 alloy copper bar, installed on the bottom rear pair of mounting rails. Includes (18) 12-24 tapped lug mounting holes.

8. Floor Mounting

a. Floor Mounting - (4) corner floor mounting gussets, 8.00" W with 3.50" L X 1.00" W floor anchoring slots at 45 degree angles centered. Additional floor anchoring is located in the front and rear bottom, horizontal frame base with (2) 0.75" X 1.00" slots set at 20.00" X 34.00" on center.

9. PDU Cable Manager

a. PDU Cable Manager - (2) Vertical PDU/cable management plates, 71.75" H X 4.36" W, installed on rear left and right horizontal frame unistrut system. Includes (6) sets of PDU key-hole provisions for tool-less mounting of (1) vertical PDU and (16) sets of square mounting points for 1/4 turn, 3.00"W d- rings. Cabinet light mounting provision is also included.

10. Power Strip

a. Powerstrip - (2) 16-NEMA 5-20R outlets, 110V/20Amp, 66.00" in length with LED light and 10ft power cord w/ NEMA 5-20P plug. UL Listed.

b. Power strip shall be capable of being mounted within three inches of the rear of the cabinet.

11. Enclosure Light

a. (1) Luminaire 21.50" L enclosure light, 110V with on/off rocker switch. Installs on vertical PDU/cable management plate and can be used remotely. Includes power cord with a 15amp blade plug.

12. Enclosure Frame Baying

    a. Cabinet Coupling Kit - (1) top mounted cabinet to cabinet coupling kit with hardware included.

13. Paint

    a. Color - Kote 30 immersion cleaned and exterior epoxy powder coated in semi-gloss hammer black.

14. Approvals

    a. Cabinet shall have a NEMA 12 rating.

    b. Cabinets shall be UL listed.

    Cabinets shall be constructed in accordance with LADBS code requirements.

    Seismic Certification - Tested and Certified to Bellcore Seismic Testing in accordance with GR-63-CORE, Paragraph 4.4.1/5.4.1. at 900 lbs of essential equipment.

    Weight Capacity - 2000 lbs dynamic, 3000 lbs static

    Acceptable Products:

    DAMAC CSN1284Z23077-3 (36"D) and CSN 1284Z23079-3 (42"), Seismic Series

P. Racks

Any use of two-post open frame 19" racks shall be reviewed and approved by LAWA at 30% reveiw. Approved part numbers shall be determined at that time.

Q. Wall Mounting

In special circumstances, if cabinets and racks are not provided, wall mounting is acceptable provided that the equipment is small and the installation can be done securely to the plywood backboard. Any wall-mount equipment plans shall be reviewed and approved by LAWA beforehand.

R. Hardware

All fastening hardware used outdoors shall be stainless steel grade 18-8 or better.

VI. Fiber Optic Cabling

A. Design Requirements

1. Outdoor Backbone Cable

    a. Multimode optical fiber shall not be used.

b. 72 singlemode fibers is the minimum count permitted for backbone fibers fibers between major equipment rooms.

c. 24 singlemode fibers is the minimum count permitted for backbone fibers between other outdoor locations.

d. Fiber Optic cables that are run underground shall have fifty feed of cable coiled up in every other maintenance hole along the run. These cables shall be dressed neatly and secured to the inside walls of the maintenance hole.

Acceptable Products:

- Outdoor to indoor within fifty feet of the building entrance, CorningAltos™ Cable or approved equal.
- Outdoor to indoor beyond fifty feet of the building entrance, Corning Freedm™ Cable or approved equal.

2. Indoor Backbone Cable

a. Multimode optical fiber shall not be used except on an individual basis as approved by LAWA.

b. 72 singlemode fibers is the minimum count permitted for backbone fibers between major IT rooms with the passenger terminals.

c. 48 singlemode fibers is the minimum count permitted for backbone fibers between other IT rooms within the passenger terminals.

d. 24 singlemode fibers is the minimum count permitted for backbone fibers between all other IT rooms.

e. Fibers Optic cables that are run indoors shall have twenty-five feet of cable coiled up at each end of the run. These cables shall be dressed neatly and secured to the inside walls of junction boxes.

Acceptable Products:

- Corning MIC® Cable (OS2) – For 72 minimum use E88-T3131-29 for Plenum and E81-T3131-24 for Riser or approved equal.
- Corning MIC® Cable (OS2) – For 48 fiber use E88-61131-29 for Plenum and E81-61131-24 for Riser or approved equal.
- Corning MIC® Cable (OS2) – For 24 fiber use E88-33131-29 for Plenum and E81-33131-24 for Riser or approved equal.
- Corning SMF28e+ glass with clear Curve bend insensitive properties.

3. Horizontal Cable

a. Multimode optical fiber shall not be used except on an individual basis.

b. 6 singlemode fibers is the minimum count permitted for horizontal fibers between IT rooms and field devices such as work area outlets and surveillance cameras..

Acceptable Products:

Corning MIC® Cable Plenum rated (OS2) E88-31131-29 / Riser rated (OS2) E81-31131-24 or approved equal. (For additional fiber counts use: LAN-89-EN, LAN-92-EN specifications for Riser and LAN-88-EN, LAN-91-EN for Plenum)

4. Patch Panels

a. Wall-mount. All fibers shall be terminated with SC connectors in fiber patch panels. Terminations of all fiber optic cables shall conform to EIA/TIA-568SC standard. APC finish is standard, but UPC may be acceptable in special circumstances based on LAWA approval.

Acceptable Products:

- Corning EDC-12P-NH - 144 Port Wall Mount loaded with SC/APC Corning CCH-CP12-6C and splicing for 144 fibers - Corning M67-048 Splice Trays. For SC/UPC use CCH-CP12-59 panels.

- Corning EDC-06P-NH - 48 Port Wall Mount loaded with SC/APC Corning CCH-CP12-6C and splicing for 48 fibers - Corning M67-048 Splice Trays. For SC/UPC use CCH-CP12-59 panels.

- Corning 72 port patch panels – ICH-06P-IND loaded with SC/APC Corning CCH-CP12-6C. For SC/UPC use CCH-CP12-59 panels.

b. Rack-mount. All fibers shall be terminated with SC connectors in fiber patch panels. Terminations of all fiber optic cables shall conform to EIA/TIA-568SC standard.

Acceptable Products:

In existing IT equipment rooms, until further notice, use:

- Corning 72 port patch panels – PCH04U loaded with SC/APC Corning CCH-CP12-6C. For SC/UPC use CCH-CP12-59 panels.
- Lockable front covers are required: Corning HDWR-LOCK-KIT.

5. Fiber Optic Pigtails

a. Pre-polished connectorized pigtails are fusion spliced to the cable. Connectors shall not be installed and polished in the field.

b. Singlemode – Corning cable (or approved equal), 6 foot (2 meter) length, APC polish for new, Ultra PC polish for existing where specified, Corning “SC” connector, fusion spliced, heat shrink protected on the splice.

c. Multimode - Corning cable (or approved equal), 6 foot (2 meter) length, regular polish, Corning “SC” connector, fusion spliced, heat shrink protected on the splice.

Acceptable Products:

- New singlemode installations - Corning cable, 6 foot length, SC-APC polish, Corning connector, pigtails, fusion spliced, or approved equal.
- Existing singlemode installations - Corning cable, 6 foot length, APC or Ultra PC polish (where specified), Corning “SC” connector or whatever is required to match existing, pigtails, fusion spliced, or approved equal.
- Multimode installations - Corning cable, 6 foot length, Corning “SC” connector or whatever is required to match existing, pigtails, fusion spliced, or approved equal.

6. Fiber Optic Adapters

Fiber optic adapters shall be color coded to differentiate between singlemode and multimode. Adapters shall match termination/polish type of plant. Green-colored adapters shall be used for

singlemode angled-polished connections, and beige-colored adapters for existing multimode connections.

Acceptable Products:

- Corning "SC" adapter (coupler) plates.
- Corning Singlemode part number CCH-CP12-6C for APC or CCH-CP12-3C for UPC or approved equal.
- Corning Multimode part number CCH-CP12-91 for 62.5 or approved equal.

7. Fusion-splice Protection Sleeves

The Installer shall protect all fusion splices with rod-reinforced heat-shrink protective sleeves.

Acceptable Products:

Corning heat-shrink sleeves, part # 2806031-01 or approved equal.

8. Splice Trays

a. The Installer shall use metallic splice trays that will accept 60 mm single- fiber heat shrink fusion splice protectors (12 splices per tray).

b. Trays shall be stackable, contain a plastic polycarbonate protective cover, and have a hole in the center for vertical and horizontal mounting.

Acceptable Products:

Corning M67-048 (Clear cover M67-048-C) or approved equal.

9. Fiber Optic Jumpers/Patch Cables

a. The Installer shall not manufacture or assemble fiber optic jumpers. Fiber optic jumpers shall match the fiber optic plant type/performance and shall match the fiber optic connector polish/finish of the fiber optic plant.

b. Singlemode fiber optic jumpers shall be Angled-polished and have SC connectors (SC-APC). Multimode fiber optic jumpers shall be Ultra-PC polished and have SC connectors.

c. For single fiber circuits, use single strand jumpers. For duplex fiber circuits, use zipcord jumpers.

Acceptable Products:

Corning cable or approved equal.

B. Safety Requirements

1. Installation

a. All necessary safety precautions shall be taken to protect personnel from injury while fabricating, inspecting, or testing fiber optic cable assemblies. Protective equipment shall comply with the requirements of Occupational Safety and Health Administration.

b. As a minimum, personnel who may come in contact with bare fibers shall wear wrap-around safety goggles for eye protection.

c. Slivers of bare fiber shall be wrapped in a heavy tape (e.g., duct tape) and placed in a specially marked container for later disposal.

d. Fiber waste is an individual and collective safety concern. The Installer shall not allow slivers of bare fibers to be disposed of on the floors of the telecommunications rooms.

Codes/Standards Reference
OSHA, 29 CFR Part 1910

2. Testing

a. The Installer shall ensure that all employees and their subcontractors testing optical fiber comply with safety standards because some light sources used in testing and operating fiber optic cable assemblies may cause permanent eye damage.

b. Protection from eye exposure to light sources shall be in accordance with the American National Standard for the Safe Use of Lasers; and the Safe Use of Optical Fiber Communication Systems Utilizing Laser Diode and LED Sources.

Codes/Standards Reference
ANSI Z136.1, Z136.2

C. Installation Equipment Requirements

1. General

a. Tooling and equipment used in the termination of fiber optics shall not impart damage to the optical fiber, or to any part of the termination.

b. Equipment shall be appropriately stored and adequately protected when not in use. It shall be verified or recalibrated at established intervals to assure compliance and precision.

c. The Installer shall select tools and equipment used in fiber optic termination and cabling operations appropriate to their intended function, and shall clean and properly maintain equipment and tooling being used on installation.

d. Pulling lubricant shall be used on all fiber optic cable pulls.

e. All test equipment shall be calibrated by a certified laboratory, or the manufacturer, within one year of point of use, and such certification shall be submitted to LAWA prior to testing.

f. Tools requiring calibration shall have records that contain as a minimum:

- Date of calibration.
- Calibration due date.
- The identification of the organization performing the calibration.

g. Calibration shall be traceable to the National Institute of Standards and Technology (NIST). Calibration intervals shall be based on the type of tool and records of the tool calibration. Intervals may be lengthened or shall be shortened on the basis of stability demonstrated over previous calibration periods.

h. If the Installer requests deviation from this equipment list, the burden of proof shall be upon the Installer to demonstrate that any proposed substitute equipment meets or exceeds the specified parameters.

2. Fiber Optic Test Jumpers:

a. Singlemode

♦ The Installer shall use singlemode test jumpers that meet the requirements of the Telecommunications Industry Association.
♦ Singlemode test jumpers shall be of the same fiber type as the optical fiber cabling.

b. Multimode

♦ The Installer shall use multimode test jumpers that meet the requirements of the Telecommunications Industry Association.
♦ The fiber optic launch cables and adapters must be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.
♦ Multimode test jumpers shall be of the same fiber type as the optical fiber cabling.

Codes/Standards Reference

TIA/EIA-526-7
TIA/EIA-526-14A, section 3.3

Acceptable Products:

Corning fiber or approved equal.
Corning connectors or approved equal.
SC-APC polish for singlemode.
Connector types as required to adapt to existing equipment.
Lengths as required.

D. Installation Requirements

1. Pre-Testing

a. The Installer shall procure and install all new and un-refurbished materials.

b. LAWA has the right to observe and verify all tests. The Installer shall notify LAWA IMTG one week prior to testing so that testing can be observed. Submit results to IMTG within a week of conducting test.

c. Before installation, while fiber optic cable is still on the reel, the Installer shall test each individual fiber strand with an OTDR for transmission anomalies and length. Singlemode fiber shall be tested at 1310nm, and multimode fiber shall be tested at 850 nm.

d. Pre-installation test results shall be recorded and given to the LAWA IMTG, in electronic form, with the software to view the test results. These results shall be given to the LAWA prior to installation. There shall be no deviation from these initial test procedures.

e. Failures detected during the testing shall be recorded. Rectification of all damaged cable(s) shall include replacing damaged cable(s) with new cables. all damaged cables shall be removed from the project site.

2. Installation

a. During installation, the minimum bending radius shall be 20 times the cable diameter. After installation the minimum bending radius shall be 10 times the cable diameter.

b. If fiber optic cable is damaged during installation, movement or storage, the Installer shall replace the cable at the Installer's expense.

c. There shall be no repairs to damaged cable. Damaged cable shall be replaced.

d. Except for fusion-spliced, factory-connectorized, pre-terminated pigtails, the Installer shall not use fusion splicing or mechanical splicing to repair any damage to any part of the cable prior-to, during, or after installation.

e. Damage includes but is not limited to; breaks in the fiber opens, abrading the cable jacket to expose the fibers or conductors, bending the cable more than the manufacturer's specification for bend radius and exceeding the manufacturer's tensile load installation specification.

f. All installed lengths of fiber shall be brand new and continuous without any splicing. The Installer shall not fusion splice two short pieces of cable to make a longer piece.

g. Fibers Optic cables that are run underground shall have fifty feet of cable coiled up in every other maintenance hole along the run. These cables shall be dressed neatly and secured to the inside walls of the maintenance hole.

h. Fibers Optic cables that are run underground shall have three labels attached. One label shall be attached on the spare coiled-up fiber or in the center between the entrance and exit of the maintenance hole. One label shall be attached within twelve inches of the entrance and one label within twelve inches of the exit of the conduits in the maintenance hole.

3. Terminating

a. The Installer shall only fusion-splice pigtails that have had the connectors installed and polished by the manufacturer or local cable assembly house. The Installer shall not install or polish fiber optic connectors, either in the field or in his shop.

b. For singlemode fiber, only SC-APC, Angled-Polished pre-connectorized, pre-terminated, pigtails shall be fusion spliced to the cable. SC/UPC may be used in special circumstances as approved by LAWA.

c. For multimode fiber, only SC, Ultra-PC polished pre-connectorized, pre- terminated, pigtails shall be fusion spliced to the cable.

d. Fiber optic cable used in the assembly of the pigtails shall have similar optical characteristics as the installed fiber optic backbone cable.

e. Mechanical splices are not permitted.

f. Splices shall be protected with reinforced sleeves and installed in a specified splice tray as specified.

4. Cleaning

a. All connectors installed or accessed for testing shall be cleaned and then examined under a microscope to assure no contamination. Cleaning of optical connector shall be accomplished only with the highest grade optical tools and supplies.

b. All connectors shall have a smooth, polished, scratch free finish. Optical Fiber end face shall not show any signs of cracks or pistoning on optical endface surface at 200X magnification.

5. Connector Replacement

Any connector damaged or improperly installed shall be removed and replaced with a new connector. Damaged conditions will be determined by visual inspection and/or by certified meters for fiber optic power meter testing. LAWA IMTG shall make final decisions on the replacement of questionably damaged connectors.

E. Testing Requirements

1. General

a. LAWA has the right to observe and verify all fiber optic tests. The Installer shall notify LAWA ADG & IMTG one week prior to testing so that testing can be observed. LAWA will require the Installer to retest at the Installer's own expense if the tests are conducted without properly notifying the Project Manager.

b. The testing shall demonstrate that there are no errors, damaged or incorrectly installed components, that the installation is correctly labeled and that all of the installed components meet or exceed the criteria detailed in these specifications.

c. Any test that does not show that a component is satisfactorily installed, as per these specifications, shall be repeated. If a test procedure needs to be modified to satisfactorily test some components, the modifications shall be submitted for approval to the Project Manager, prior to the tests being conducted.

d. The Installer shall supply all test equipment required to carry all of these tests. The Installer shall include the cost of obtaining, calibrating, and maintaining test equipment , and the cost of carrying out and recording the tests detailed in the specification, including labor costs, in the total bid lump sum. No extra or additional costs will be considered.

e. If on submittal of the test results there are any missing test results or incorrectly named files, the test shall be repeated at no additional cost to LAWA.

f. The Installer shall test every fiber optic strand in the installation in accordance with the field test specifications defined by the TIA standard ANSI/TIA/EIA-568-B, or by the appropriate network application standard(s) whichever is more demanding.

g. The Installer shall offset-null the power meter before starting a testing session to eliminate the detector dark currents. Offset nulling shall be performed before every test session or when environmental conditions change.

h. The Installer shall use “Two Jumper reference” when referenced specification not directed by primary specification to create reference test levels. The reference connections resemble those used during the actual loss test, which means that the same detectors are matched to the same sources for both the reference and the test. See Appendix.

i. Before starting any new testing session or when a test jumper has been disconnected from the source port of either test set, the two jumper reference shall be repeated.

j. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.

k. The link test limits attenuation are based on the use of the Two Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method A and ANSI/TIA/EIA-526-7, Method A.1; or the equivalent method. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.

l. The Installer shall test 100% of the installed cabling links, all cabling links must pass the requirements of the standards mentioned. The Installer shall diagnose and correct all failing links. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.

m. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:

- The manufacturer of the fiber optic cable and/or the fiber optic connectors
- The manufacturer of the test equipment used for the field certification
- Training organizations authorized by BICSI (Building Industry Consulting Services International with headquarters in Tampa, Florida) or by the ACP (Association of Cabling Professionals™) Cabling Business Institute located in Dallas, Texas.

n. Test Jumpers shall have the core diameter and numerical aperture nominally equal to those of the cable plant being measured.

o. The fiber optic launch cables, test reference cables, test jumpers, test aids and adapters must be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters. All test or reference optical patch cords shall be 3 meters in length, no more than 0.25 dB of total insertion loss, and 0.15 dB of repeatability over 10 mating cycles.

p. Any test reference cable, launch cable or test aid used in the acquisition of a performance measurement of a fiber optic link or component shall never be coiled in a diameter less than 12 inches during testing.

q. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.

2. Fiber Optic Test Parameters

a. The maximum allowable splice loss = 0.3 dB

b. The maximum allowable connector loss = 0.50 dB

c. The link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA standard 568-B:

- Cable Attenuation (dB) = Attenuation Coefficient (dB/km) x Length (Km)
- Attenuation Coefficient for Single-mode is:
- 1310 nm = .65 (Depending on fiber)
- 1550 nm = .50 (Depending on fiber)
- Attenuation Coefficient for Multimode is:
- 850 nm = 3.5 (Depending on fiber)
- 1300 nm = 1.0 (Depending on fiber)
- Link Attenuation (dB) = Cable Attenuation + Connector Attenuation + Splice Attenuation
- Splice Attenuation (dB) = number of splices (S) x splice loss (dB)
- Connector Attenuation (dB) = number of connector pairs x connector loss (dB)

3. Singlemode Testing

a. The Installer shall perform the following tests on all singlemode fiber links.

- Bi-Directional Attenuation / Insertion Loss using an Optical Power Meter.
- Bi-Directional Optical Return Loss (ORL).
- Bi-Directional Optical performance Trace using an Optical Time Domain Reflectometer (OTDR).

b. Optical End Face visible inspection.

c. Singlemode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, Two Reference Jumper or the equivalent method. All singlemode links shall be certified with test tools using laser light sources at 1310 nm and 1550nm.

d. Singlemode links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, Two Reference Jumper cable Measurement.

e. All singlemode links shall be certified with test tools using laser light sources at 1310 nm and 1550nm.

f. The Installer shall test attenuation/insertion loss bi-directionally, in accordance with TIA/EIA-526-7, Method A –1.

g. The Installer shall test ORL bi-directionally in accordance with TIA/EIA 107, Return Loss for Fiber Optic Components.

h. The Installer shall perform an optical performance trace using an OTDR, bi-directionally, in accordance with TIA/EIA –455-59, “Measurement of Fiber Point Defects Using An OTDR”, TIA/EIA 455-60, “Measurement of Fiber or Cable Length Using An OTDR”, TIA/EIA 455-61, “Measurement of Fiber or Cable Attenuation Using An OTDR”.

4. Multimode Testing

a. The Installer shall perform the following tests on all multimode fiber links

b. Bi-Directional Attenuation / Insertion Loss using an Optical Power Meter.

c. Bi-Directional Optical performance Trace using an Optical Time Domain Reflectometer (OTDR).

d. Optical End Face visible inspection.

e. Multimode backbone links shall be tested at 850 nm and 1300 nm. All multimode links shall be certified with test tools using laser light sources at 850 nm and 1300 nm.

f. Multimode links shall be tested at 850 nm and 1300 nm in accordance with ANSI/TIA/EIA-526-14A, Method A..2, Two Reference Jumper cable Measurement.

g. All multimode links shall be certified with test tools using LED light sources at 850 nm and 1300nm.

h. Link segments less than 200 meters need only be tested at 850nm, because attenuation deltas due to wavelength are insignificant.

i. Bi-Directional Attenuation / Insertion Loss.

j. Bi-Directional Optical performance Trace using an Optical Time Domain Reflectometer (OTDR).

k. Optical End Face visible inspection.

5. Optical Fiber Test Results and Documentation

a. The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.

b. The test result records saved by the tester shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test. The popular ‘csv’ format (comma separated value format) does not provide adequate protection and shall not be acceptable.

c. The database for the completed job shall be stored and delivered on CD- ROM; this CD-ROM shall include the software tools required to view, inspect, and print any selection of test reports.

d. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:

- ♦ The identification of the link in accordance with the naming convention defined in the overall system documentation.
- ♦ The overall Pass/Fail evaluation of the link-under-test including the Attenuation worst case margin (margin is defined as the difference between the measured value and the test limit value).
- ♦ The date and time the test results were saved in the memory of the tester.

e. General Information to be provided in the electronic data base containing the test result information for each link:

- The identification of the customer site as specified by the end-user.
- The overall Pass/Fail evaluation of the link-under-test.
- The name of the standard selected to execute the stored test results.
- The cable type and the value of the 'index of refraction' used for length calculations.
- The date and time the test results were saved in the memory of the tester.
- The brand name, model and serial number of the tester.
- The revision of the tester software and the revision of the test standards database in the tester.

f. The detailed test results data to be provided in the electronic database for each tested optical fiber must contain the following information:

- The identification of the link/fiber in accordance with the naming convention defined in the overall system documentation.
- The insertion loss (attenuation) measured at each wavelength, the test limit calculated for the corresponding wavelength and the margin (difference between the measured attenuation and the test limit value).
- The link length shall be reported for each optical fiber for which the test limit was calculated.

g. Acceptance of the fiber cable installation is partially contingent on the review and approval of the fiber power meter/source test data submitted.

6. Performance Data

   a. Submit all performance data in feet.

   b. All tracings shall cover between 50% and 75% of the displayed scale on the tracing.

7. Submittals

   a. Submit product data for the following:

   - Optical Loss Test Set model and manufacturer.
   - OTDR model and manufacturer.
   - Submit certification or calibration data for the following:
   - Optical Loss Test Set.
   - OTDR.

VII. Copper Cabling

A. Design Requirements

1. Voice Backbone

   a. Install sufficient pairs of 22 AWG, 100 ohm, UTP, OSP, CAT3 UTP from the Main IT room to all other IT rooms, to cover current and future needs of telephone wires and data circuits for the area served by that particular IT room.

b. Sufficient telephone wire-pairs from IT service provider shall also be brought into MPOE of the building to cover current and future needs of telephone wires and data circuits for the building.

Acceptable Products:
General Cable or equal

2. Data Backbone

a. Copper cable is not normally used as backbone cable at LAWA.

3. Horizontal Cables

a. Sufficient 100 ohm, Category-6, 4-pair UTP shall be installed as a universal structured cable for the structured cable plant at each building.

b. Cat-6 cables shall be used as a universal cable for all IT needs, including telephone, data, fax, video, audio, etc. Cat-6, 4-pair, UTP cables shall be installed at all conceivable required Locations and for future expansion needs.

c. Each location shall be installed with a minimum of four, Cat-6, UTP cables.

d. Termination of the Cat-6 UTP cables shall be on CAT6 RJ45 jacks rated to cable performance on a six or eight position double-gang or six position single-gang faceplate. All terminations of Cat-6 UTP cables shall conform to EIA/TIA-568A (REVISED FROM 568B) standard.

Acceptable Products:
General Cable C6E GS6000E CMP or CAT6A GenSPEED 10 MTP or approved qual.
Commscope (Systimax) C6E 2071 or CAT6A 2091 or approved equal.

4. Data Patch Panels

a. All Cat-6/6e/6A Data UTP cables shall be terminated on CAT6/6e/6A RJ45 (or manufacturer specified) patch panels inside equipment rack.

b. All data UTP cable termination shall conform to EIA/TIA-568B standards. Wire-minders shall also be installed for cable management.

Acceptable Products:
- Panduit CAT6E DP48688TG (48 port) DP24688TG (24 port) CAT6A DP486X88TGY (48 port) DP246X88TGY (24 port) or approved equal
- Commscope (Systimax) CAT6E 360, GigaSPEED®XL1100GS3 CAT6A 360, GigaSPEED® X10D 1100GS5 or approved equal.

5. Patch Cords

a. Patch cord performance must match installed plant.

Acceptable Products:
PanGen or Commscope

6. Control/Low Voltage Cable

Follow manufacturer's recommendation.

Acceptable Products:

Belden or approved equal. West Penn or approved equal

7. Speaker Cable

14 AWG, unshielded twisted pair

Acceptable Products:

Belden or approved equal. West Penn or approved equal

8. Coaxial

a. Cable TV (CATV)

The cable used is dependent upon the length and type of the segment. Existing analog systems and new digital systems require different cable (coaxial and/or fiber). All CATV plant shall be approved by LAWA before installing either coaxial or optical cables.

Acceptable Products:

- If coaxial approved: Belden or Commscope coaxial
- If fiber required: Corning single mode fiber (see fiber optic section)

b. Closed Circuit TV (CCTV)

The cable used is dependent upon the length and type of the segment. Existing analog systems and new digital systems require different cable (coaxial and/or fiber). All CCTV plant shall be approved by LAWA before installing either coaxial or optical cables.

Acceptable Products:

- If coaxial approved: Belden or Commscope coaxial
- If fiber required: Corning single mode fiber (see fiber optic section)

9. Microwave

a. Consult LAWA IMTG.

Acceptable Products:

To be determined.

10. Antennas

a. See LAWA IMTG.

b. Consult BOAC Resolution No. 20466.

Acceptable Products:

To be determined.

B. Installation Requirements

1. Copper UTP Cables

a. Most LAWA cabling is required to be installed within conduit. However, there are some installations where "J" hooks are allowed if pre-approved by the IMTG Design and Engineering Division Manager at the 30% review.

b. In ceilings, copper cables shall be suspended either by prefabricated "J" hooks, a trapeze suspended from the ceiling with continuous rod, or some other approved and industry accepted practice. Ties and bridle rings shall not be used to support cable in ceilings.

c. Approved "J" hooks may be fastened to beams or to the deck above via dedicated hangers or rods.

d. Supports shall be space every 4 feet to minimize cable sag.

e. In ceilings, copper cables shall never be pulled directly over suspended ceiling tiles or fluorescent light fixtures.

f. Cable ties may not be used to permanently secure copper cables. Velcro fasteners shall be used to secure copper cables. Fasteners shall not be over-tighten so that cable performance (internal spacing/structure) is impacted.

g. Adhesive-mounts, one inch square, can be used on metallic surfaces to secure cable ties. e.g, equipment cabinets and racks.

h. Screw-mounts, one inch square, can be used on backboards provided that they are secured with flat-head mounting screws.

2. Coaxial Cables

Similar to copper.

3. Microwave

To be determined, Consult LAWA Engineering & Facilities Management Division and LAWA Information Management & Technology Group for details.

4. Wireless

To be determined, Consult LAWA Engineering & Facilities Management Division and LAWA Information Management & Technology Group for details at the 5% Concept Review Submittal.

5. Rooftops

One junction box for each Vertical Cable Riser with two 4" conduits for each junction box shall be provided on the building rooftop. Each IT junction box shall be connected to the closest IT room via two 4" conduits.

6. Antennas

a. Consult BOAC Resolution No. 20466.

b. Antenna Support: Install structural members on the roof near the rooftop IT junction box for the mounting of satellite antennas for each IT junction box.

c. Antenna transmission lines should follow the manufacturer's specifications on minimum bending radius, connector installation, and support requirements; wrap-lock or other smaller support equipment are not permitted.

C. Testing Requirements

All copper cabling shall meet or exceed all EIA/TIA performance standards and shall be tested in accordance with these standards using the most up-to-date testing criteria. All copper cabling and components testing must satisfy the requirements of the warranty and extended warranty programs of each component manufacturer.

1. CAT3 cabling w/ TDR

a. DC loop resistance b. Continuity
c. Length
d. Attenuation
e. Crosstalk or NEXT
f. Noise

2. CAT6/6e/6A Cabling

The contractor will perform a full channel test on the entire Cat6 cable plant with an automated test set according to the most up-to-date criteria from the ANSI/TIA/EIA standard. Parameters include, but are not limited to:

a. Wire Map.
b. Length.
c. Attenuation.
d. Near-End Crosstalk.
e. Propagation Delay/Delay Skew.
f. Power Sum NEXT.
g. ACR/Power Sum ACR.
h. ELFEXT.
i. Return Loss.

The data from each cable tested will be downloaded directly from the test set and printed showing all tests/parameters performed, the expected test result, and the actual test result achieved. Two hardcopies and two electronic copies of the test results must be provided.

3. Coaxial

A TDR test will be performed on all coaxial RG6 cable which will be swept to 1GHz. Parameters include, but are not limited to;

a. DC loop resistance
b. Length
c. TDR
d. Attenuation
e. Noise

The data from each coaxial cable segment tested will be downloaded directly from the test set and printed showing all tests/parameters performed, the expected test result, and the actual test result achieved. Two hardcopies and two electronic copies of the test results must be provided.

VIII. Administration

A. Submittals & Records

The contractor shall submit cut-sheets (submittals) for each component to be used before the installation begins. The cut-sheets must be organized in a binder with an index identifying each component. All components must be compatible with and meet the performance specifications outlined in this document. Index the material cut-sheets by manufacturer and type of component. The contractor will also submit final cut-sheets at the end of the project that include any changes or additional components. Three (3) hardcopies of these submittals must be provided in a binder at the 90% review.

The following project work activities should be documented and recorded:

- Statement of work to be performed
- Project schedules
- Minutes of meetings
- Cell phone numbers of all contractor's project supervisory staff
- Emergency contact lists
- Miscellaneous notes and photos

B. Labeling

1. General

All labels shall be computer or label maker generated. Labeling scheme shall be consistent with architectural plans and shall be approved by LAWA IMTG.

2. Conduit

All conduit runs shall be labeled on origin and destination ends.

3. Innerduct in Pull Boxes, Maintenance Holes

Every innerduct installed shall have a brass or plastic tag that contains the origin, destination, and the tenant. These tags shall be placed at both ends and in every pull box, handhole, or maintenance hole along the pathway. These tags shall be securely fastened so that they cannot be accidentally removed. Examples include:

- LAWA IT
- COM CTR TO ADMIN BSMT
- LAWA IT
- T4, RM 129 TO TBIT, MPOE
- Terminal 3 MPOE
- Terminal 4 MPOE
- XYZ Airlines

4. Cables

All cables shall be labeled with wrap-around labels on each end with the same labeling schedule provided on as-built prints.

5. Fiber Optic Jumpers

a. All Fiber patch panels will be labeled by LAWA IMTG.

b. All fibers in a jumper shall be identified with white heat shrink labels, 5/8" to 3/4" wide by 1 to 1 1/2" long, and shall be placed over the boot of the connector. The heat shrink label shall not be shrunk.

c. Labeling format for jumpers in the IT equipment room and the Records retention center are as follows:

- ♦ Line 1 is the near port of the jumper. The format is: AAA-RXX-Y-ZZ where AAA is the two or three letter building code, RXX is the rack number, Y is the shelf number, and ZZ is the port number.
- ♦ Line 2 is the far port of the jumper. The format is: AAA-RXX-Y-ZZ where AAA is the two or three letter building code, RXX is the rack number, Y is the shelf number, and ZZ is the port number.
- ♦ Line 3 is the circuit number. The format is #XXXX where XXXX is the circuit identification number as assigned by ITs.

CC-R59-3-25
CC-R53-1-10
CKT #3007

d. Labeling format for all other jumpers is on three lines and is as follows:

- ♦ Line 1 is the near port. The format is: XXX-YY-ZZ where XX is the two or three letter building code, YY is the patch panel number in that building, and ZZ is the port number in that panel.
- ♦ Line 2 is the far port. The format is XXX-YY-ZZ where XX is the two or three letter building code, YY is the patch panel number in that building, and ZZ is the port number in that panel.
- ♦ Line 3 is the circuit number. The format is #XXXX where XXXX is the circuit identification number as assigned by ITs.

AD-3-14
AD-4-22
CKT #2557

6. Work Areas

a. Work area cabling shall be labeled at each end.

b. Work area outlets shall be labeled on the front of the wall plate.

7. Tenant Areas with Existing IT Rooms

If IT rooms are shared with tenants, provide clear separation and identification of the equipment and terminations. Specify dimensions and all notations on plans at the 30% review. See Sec IV-A 2h for proposed IT Rooms.

8. Approved Labeling Scheme

The final labeling scheme for any/all components must be reviewed and approved by LAWA IMTG beforehand.

C. Documentation

1. General

a. Upon completion of installation and after the final acceptance of all systems, the Installer shall supply a complete set of as-built documentation as follows:

- ♦ Site plan
- ♦ System block diagram
- ♦ Interconnection diagram
- ♦ As-built prints of the conduit installation with routing
- ♦ Final acceptance test data sheet
- ♦ Updated Material List with quantities, model numbers and serial numbers
- ♦ Manufacturer manuals/data sheets/submittals on all equipment and materials used
- ♦ Manufacturer representatives and telephone numbers
- ♦ Operation manuals

b. The above documentation shall illustrate in details the interconnection of every component in its correct functional relationship showing the positional and geographical location. The above documentation shall also include the following information:

- ♦ All signal levels
- ♦ All cable numbers
- ♦ All grounding points

c. Two (2) full and half size “D” & “B” hard copies of the System block diagrams and Multi-wire Line diagrams must be submitted, along with one electronic copy in AutoCad (AutoCad 2007 minimum, but must adhere to the current LAWA CAD Standards) .dwg format on CD ROM. In addition, two (2) hard copies of all other documents shall be provided.

d. All information including, but not limited to, the definition of symbols, terms, acronyms shall be included to assist a clear understanding of the documentation.

e. The contractor must submit final certification that the system is complete, meets all functional and performance specifications, and has been accepted into all related warranty and extended warranty programs.

2. Fiber Documentation

a. The Contractor shall not assign any equipment names, numbers, or monikers without express written approval from LAWA IT. This shall include, but not be limited to: panel ID’s, cable, fiber, jumper and backbone ID’s.

The General Contractor shall:

- ♦ Provide completed, LAWA-provided, Excel-Form (Backbone Worksheet.xlsx) and fiber circuit templates (Circuit Worksheet.dwg) with the new LAWA fiber

infrastructure information that includes the fiber backbone cable and circuit installation(s).

♦ Contract Holbrook Enterprise Inc. (HEI), developer of LAWA-used Cable Management application called WireCAD, to verify and enter the new fiber infrastructure information into the LAWA WireCAD Server.

♦ Submit fiber backbone and/or circuit data to HEI in a format acceptable to HEI for verification and inclusion in the LAWA WireCAD Fiber Management System.

♦ Rectify, re-label, re-patch, re-test, or any other necessary remedy - at Contractor's sole expense - any inconsistencies, errors, and or omissions found as a result of entering contractor data into LAWA IT WireCAD system.

♦ Provide the necessary AutoCAD files (AutoCAD 2011 or earlier) representing the circuits to enter.

♦ Obtain from HEI a certificate of completion indicating that all work has been entered and that any conflicts have been resolved before Contractor may submit final billing.

b. Upon contracting Holbrook Enterprise Inc. (HEI), the following provides the HEI scope of work for the fiber As-built documentation:

Fiber Cable Backbone Creation

HEI shall review Contractor submitted Excel document for errors and inconsistencies, and shall verify that the document conforms to WireCAD standards and can be imported. If necessary, HEI shall submit reviewed spreadsheet to Contractor for correction. HEI shall take whatever measures necessary to import the conformed data into the LAWA WireCAD database.

♦ Deliverables to LAWA

- Conformed Excel spreadsheet.
- Imported backbone data in WireCAD.LAWA.CMS project database, on the LAWA WireCAD server.
- Imported manufacturer, equipment, I/O, and cable type data in the WireCAD.LAWA.CMS Global Equipment database on the LAWA WireCAD server.
- Produce a Layered digraph (X,Y graph showing termination points by location) CAD file graphically representing the LAWA backbone infrastructure.
- Copy of certificate of completion submitted to Contractor.

Circuit Data Creation

After the General Contractor has provided the necessary CAD files representing the circuits to enter, HEI shall review the documents for errors and inconsistencies, and shall verify that the document conforms to WireCAD standards and can be imported. If necessary, HEI shall submit reviewed documents to Contractor for correction. HEI shall take whatever measures necessary to import the conformed data into the LAWA WireCAD database. In the process HEI shall update the Global Database to include equipment definitions for the new Field/End and Head/End equipment found in the circuit CAD files.

- ♦ Deliverables to LAWA

    - Produce circuit data in WireCAD.LAWA.CMS project database on the LAWA WireCAD server.
    - Produce supporting global data in WireCAD.LAWA.CMS Global Equipment database on the LAWA WireCAD server.
    - Provide CAD file output of entered circuits.
    - Copy of certificate of completion submitted to Contractor.

IX. APPENDICES

A. Terminals - UPS Eq. Models for TR & MPOE rooms

B. Terminals - UPS Eq. for TR - Guide Specifications

C. Terminals - UPS Eq. for MPOE - Guide Specifications

D. Terminals - Mechanical Eq. Models for TR & MPOE rooms

E. Terminals - Mechanical Eq. for TR - Guide Specifications

F. Terminals - Mechanical Eq. for MPOE - Guide Specifications

Appendix A – Terminals, UPS Eq. Models for TR & MPOE rooms

Make/model Specifications (or equiv.) Three-Phase Uninterruptible Power System

Section 1. Telecom Room UPS Requirements

A. Electrical – UPS, 208V Input (4 wire plus ground)

Provide (1) 20kVA/16kW 120/208V-input, 3-phase UPS, model Liebert NX 38SB020C0CHX. Include internal VRLA battery capacity rated to 18 minutes at full load w/ disconnect facility for maintenance. UPS shall be packaged in a single 24" wide cabinet with automatic continuous static transfer switch and internal manual bypass. Include seismic anchoring and (1) OC-485 Webcard to interface w/ Sitelink system. Connect 120/208V output to single wall- mounted panel board.

Option 1.

Provide (1) external VRLA battery cabinet providing for a total of (41) minutes at 16kW load, model Liebert 38BP020RHX1BNR. Include DC cables so that 27" battery cabinet can be directly bolted to right side of UPS cabinet. Include seismic anchoring.

Option 2.

Provide (1) external maintenance bypass cabinet, model Liebert 38MB0200CC6AL. Include interconnecting cables for bolting to left side of UPS. Cabinet shall be 27" wide with single rotary switch interlocked for make-before-break manual transfers. Include seismic anchoring.

B. Electrical – UPS, 480V Input (3 wire plus ground)

Provide (1) 20kVA/16kW 480V-input, 120/208v output, 3-phase UPS. Model Liebert NX 38SB020C0CHX. Include internal VRLA battery capacity rated to 18 minutes at full load w/ disconnect facility for maintenance. UPS shall be packaged in a single 24" wide cabinet with automatic continuous static transfer switch and internal manual bypass. Include (1) OC-485 Webcard to interface w/ Sitelink system. Include (1) external maintenance bypass/transformer cabinet, model Liebert 38MB0200AC6DL. Include interconnecting cables for bolting to left side of UPS. Cabinet shall be 27" wide with 480V input isolation transformer and single rotary switch interlocked for make-before-break manual transfers. Include seismic anchoring for both cabinets. Connect 120/208V UPS output to single wall- mounted panelboard.

Option 1.

Provide (1) external VRLA battery cabinet providing for a total of (41) minutes at 16kW load, model Liebert 38BP020RHX1BNR. Include DC cables so that 27" battery cabinet can be directly bolted to right side of UPS cabinet. Include seismic anchoring.

Section 2. MPOE Room UPS Requirements

A. Electrical – UPS, 208V Input (4 wire plus ground)

Provide (1) 30kVA/24kW 120/208V-input, 3-phase UPS, model Liebert NX 38SB030C0CHX. Include internal VRLA battery capacity rated to 10 minutes at full load w/ disconnect facility for

maintenance. UPS shall be packaged in a single 24” wide cabinet with automatic continuous static transfer switch and internal manual bypass. Include seismic anchoring and (1) OC-485 Webcard to interface w/ Sitelink system. Connect 120/208V output to single wall- mounted panelboard.

Option 1.

Provide (1) external VRLA battery cabinet providing for a total of (26) minutes at 24kW load, model Liebert 38BP030RHX1BNR. Include DC cables so that 27” battery cabinet can be directly bolted to right side of UPS cabinet. Include seismic anchoring.

Option 2.

Provide (1) external maintenance bypass cabinet, model Liebert 38MB0300CC6AL. Include interconnecting cables for bolting to left side of UPS. Cabinet shall be 27” wide with single rotary switch interlocked for make-before-break manual transfers. Include seismic anchoring.

B. Electrical – UPS, 480V Input (3 wire plus ground)

Provide (1) 30kVA/24kW 480V-input, 120/208v output, 3-phase UPS. Model Liebert NX 38SB030C0CHX. Include internal VRLA battery capacity rated to 10 minutes at full load w/ disconnect facility for maintenance. UPS shall be packaged in a single 24” wide cabinet with automatic continuous static transfer switch and internal manual bypass. Include (1) OC-485 Webcard to interface w/ Sitelink system. Include (1) external maintenance bypass/transformer cabinet, model Liebert 38MB0300AC6DL. Include interconnecting cables for bolting to left side of UPS. Cabinet shall be 27” wide with 480V input isolation transformer and single rotary switch interlocked for make-before-break manual transfers. Include seismic anchoring for both cabinets. Connect 120/208V UPS output to single wall- mounted panel board.

Option 1.

Provide (1) external VRLA battery cabinet providing for a total of (26) minutes at 24kW load, model Liebert 38BP030RHX1BNR. Include DC cables so that 27” battery cabinet can be directly bolted to right side of UPS cabinet. Include seismic anchoring.

Note: All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

Appendix B – Terminals, UPS Eq. for TR – Guide Specifications

20 kVA
Three-Phase Uninterruptible Power System

1.0 General

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.

1.1 SUMMARY

All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

1.2 STANDARDS

The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

- ASME
- CSA 22.2, No. 107.1
- FCC Part 15, Class A
- IEC 1000-4-5
- ISO 9001
- National Electrical Code (NFPA-70)
- NEMA PE-1
- OSHA
- UL Standard 1778

The UPS shall be UL listed per UL Standard 1778, and shall be CSA certified.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements - UPS Module

A. Voltage. Input/output voltage specifications of the UPS shall be: Rectifier Input: 120/208 volts, three-phase, 4-wire-plus-ground. Output: 120/208 volts, three-phase, 4-wire-plus-ground.

B. Output Load Capacity. Specified output load capacity of the UPS shall be 20kVA/16kW at 0.8 lagging power factor.

1.3.2 Design Requirements - Battery

A. Battery Cells: Sealed, lead-acid, valve-regulated.

B. Reserve Time: 18 minutes at 16kW full load, with ambient temperature of 25°C.

C. Recharge Time: to 95% capacity within ten (10) times discharge time.

1.3.3 Modes of Operation

The UPS shall be designed to operate as an on-line, double-conversion, reverse-transfer system in the following modes:

A. Normal - The critical AC load is continuously supplied 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 the reserve battery.

B. Emergency - Upon failure of utility AC power, the critical AC load is supplied by the inverter, which, without any switching, obtains 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 assume the inverter and battery recharge loads.

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 transfer switch shall perform a reverse transfer of the load from the inverter to the bypass source with no interruption in power to the critical AC load.

1.3.4 Performance Requirements

1.3.4.1 AC Input to UPS

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 0.99 lagging at nominal input voltage and full rated UPS output load.

E. Inrush Current: 800% of full load current maximum.

F. Current Limit: 125% of nominal AC input current maximum.

G. Input Current Walk-In: 20 seconds to full rated input current maximum. Field selectable 5 through 20 seconds.

H. Current Distortion: 4% reflected THD maximum at full load.

I. Surge Protection: Sustains input surges without damage per criteria listed in IEC 1000-4-5.

1.3.4.2 AC Output, UPS Inverter

A. Voltage Configuration: three-phase, 4-wire plus ground

B. Voltage Regulation:

±1% 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.

±2% 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:

1.0 Hertz per second maximum.

Field selectable from 0.1 to 1.0 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.

<4% THD for 100% nonlinear loads (3:1 crest factor) without kVA/kW derating.

H. Load Power Factor Range: 0.7 lagging to 0.95 leading 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).

K. Inverter Output Voltage Adjustment: ±5% manual adjustment.

L. Voltage Transient Response:

100% load step	±4.0%.
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%.

1.4 ENVIRONMENTAL CONDITIONS

The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:

A. Operating Ambient Temperature

UPS Module: 32°F to 104°F (0°C to 40°C). Battery: 77°F ±9°F (25°C ±5°C).

B. 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)

C. Relative Humidity

0 to 95%, non-condensing.

D. Altitude

Operating: to 3300 ft. (1000 meters) above Mean Sea Level. Derated for higher altitude applications.

Storage/Transport: to 40,000 ft. (12,200 meters) above Mean Sea Level.

E. Audible Noise

Noise generated by the UPS under any condition of normal operation shall not exceed 54 dBA measured 1 meter from surface of the UPS.

1.5 SUBMITTALS

1.5.1 Proposal Submittals

Submittals with the proposal shall include:

- System configuration with single-line diagrams.
- Functional relationship of equipment including weights, dimensions, and heat dissipation.
- Descriptions of equipment to be furnished, including deviations from these specifications.
- Size and weight of shipping units to be handled by installing contractor.

- Detailed layouts of customer power and control connections.
- Detailed installation drawings including all terminal locations.

1.5.2 UPS Delivery Submittals

Submittals upon UPS delivery shall include a complete set of submittal drawings and one (1) set of instruction manuals 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.

1.6 WARRANTY

1.6.1 UPS Module

The UPS manufacturer shall warrant the UPS module against defects in materials and workmanship for 12 months after initial start-up or 18 months after ship date, whichever period expires first.

1.6.2 Battery

The battery manufacturer's standard warranty shall be passed through to the end user.

1.7 QUALITY ASSURANCE

1.7.1 Manufacturer Qualifications

A minimum of twenty years' 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.

1.7.2 Factory Testing

Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the specification.

2.0 Product

2.1 FABRICATION

2.1.1 Materials

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.

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.

2.1.2 Wiring

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.

Provision shall be made for power cables to enter or leave from the top or bottom of the UPS cabinet.

2.1.3 Construction and Mounting

The UPS unit, comprised of an input circuit breaker, rectifier/charger, inverter, static transfer switch 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 and adjustments. The UPS cabinet shall be structurally adequate and have provisions for hoisting, jacking, and forklift handling.

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.

2.1.4 Cooling

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. There shall be redundant fans.

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.

2.1.5 Grounding

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

2.2.1 Rectifier/Charger

2.2.1.1 General

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 solid-state SCR/IGBT type with constant voltage/current limiting control circuitry.

2.2.1.2 AC Input Current Limiting

The rectifier/charger unit shall be provided with AC input current limiting whereby the maximum input current shall be limited to 125% 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 125% of full load input current. In addition, the rectifier/charger shall have a battery current limit, adjustable from 0 to
25% of the full load input current.

2.2.1.3 Input Current Walk-In

The rectifier/charger shall contain a timed walk-in circuit that causes the unit to gradually assume the load over a 20-second time interval after input voltage is applied. Walk-in time shall be field selectable for 5 through 20 seconds.

2.2.1.4 DC Filter

The rectifier/charger shall have a 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 ensure 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.

2.2.1.5 Automatic Rectifier Restart

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 assume the inverter and battery recharge loads.

2.2.1.6 Battery Recharge

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.

2.2.1.7 Overvoltage Protection

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 load transfer to the static bypass line.

2.2.2 Inverter

2.2.2.1 General

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.

2.2.2.2 Overload Capability

The inverter shall be capable of supplying current and voltage for overloads exceeding 100%. The inverter is to provide 150% of full load for 1 minute and 125% of full load for 10 minutes. A status indicator and audible alarm shall indicate overload operation. The UPS shall transfer the load to bypass when overload capacity is exceeded.

2.2.2.3 Fault Clearing and Current Limit

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.

2.2.2.4 Step Load Response

The output voltage shall be maintained to within ±4% 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.

2.2.2.5 Voltage Distortion

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 4%. The output rating is not to be derated in kVA nor kW due to the 100% nonlinear load with 3:1 crest factor.

2.2.2.6 Phase Balance

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 2% and the phase displacement is to be 120 degrees within ±1 degree.

2.2.2.7 Fuse Failure Protection

Power semiconductors in the inverter unit shall be fused with fast-acting fuses, so that loss of any one power semiconductor will not cause cascading failures.

2.2.2.8 Inverter Shutdown

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.

2.2.2.9 Inverter DC Protection

The inverter shall be protected by the following disconnect levels:

- DC Overvoltage Shutdown
- DC Under voltage Warning (Low Battery Reserve), adjustable
- DC Undervoltage Shutdown (End of Discharge)

2.2.2.10 Inverter Output Voltage Adjustment

The inverter shall use a software control to adjust the output voltage from ±5% of the nominal value.

2.2.2.11 Output Frequency

The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall be temperature compensated and hold the inverter output frequency to ±0.1% for steady state and transient conditions. 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.

2.2.3 Display and Controls

2.2.3.1 Monitoring and Control

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:

- Menu-driven display with pushbutton navigation
- Real time clock (time and date)
- Alarm history with time and date stamp
- Battery backed-up memory

2.2.3.2 Metering

The following parameters shall be displayed:

- Input AC voltage line-to-line
- Input AC current for each phase
- Input frequency
- Battery voltage
- Battery charge/discharge current
- Output AC voltage line-to-line and line-to-neutral for each phase
- Output AC current for each phase
- Output frequency
- Apparent power
- Active power
- Battery time left during battery operation

2.2.3.3 Alarm Messages

The following alarm messages shall be displayed:

- Input power out of tolerance
- Battery charger problem
- Battery failed test
- Low battery warning
- Low battery shutdown

- DC bus overvoltage
- Bypass frequency out of range
- Load transferred to bypass
- Excessive retransfers attempted
- Static switch failure
- UPS output not synchronized to bypass power
- Output undervoltage
- Output overvoltage
- Output overcurrent
- System output overloaded
- Load transferred to bypass due to overload
- Overload shutdown
- Control error
- Critical power supply failure
- Load transferred due to internal protection
- External shutdown (remote EPO activated)
- Fan failure
- Overtemperature shutdown impending
- Overtemperature shutdown

An audible alarm shall be provided and activated by any of the above alarm conditions.

2.2.3.4 Status Messages

The following UPS status messages shall be displayed:

- Normal operation
- Load on maintenance bypass
- Load on UPS
- Load on static bypass
- System shutdown
- UPS on battery

2.2.3.5 Controls

UPS start-up, shutdown, and maintenance 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 screen shall be available on the LCD screen to depict a single-line diagram of the UPS, with switch positions and power flow.

2.2.3.6 On-Line Battery Test

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.

2.2.4 Static Transfer Switch

2.2.4.1 General

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 to clear a 20- ampere load branch circuit breaker.

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.

2.2.4.2 Uninterrupted Transfer

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:

- Inverter overload capacity exceeded
- Critical AC load overvoltage or undervoltage
- Battery protection period expired
- UPS fault condition

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:

- Inverter/bypass voltage difference exceeding preset limits
- Bypass frequency out of limits
- Bypass out-of-synchronization range with inverter output

2.2.4.3 Uninterrupted Retransfer

Retransfer of the critical AC load 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:

- Bypass out of synchronization range with inverter output
- Inverter/bypass voltage difference exceeding preset limits
- Overload condition exists in excess of inverter full load rating
- UPS fault condition present

2.2.5 Maintenance Bypass Switch

2.2.5.1 General

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 transfer switch.

2.2.5.2 Isolation

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 switch shall be provided when the UPS is in the maintenance bypass mode of operation.

2.2.5.3 Maintenance Capability

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 transfer switch. When the application calls for the Maintenance Bypass Switch to be bolted to the UPS cabinet, the interconnecting cables are to be provided, precut and prelugged.

2.2.6 Battery Power Pack

The battery power pack 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 shall be included for isolation of the battery pack from the UPS module. The UPS shall automatically be disconnected from the battery when the battery reaches the minimum discharge voltage level. Casters and leveling feet shall also be provided with the battery power pack 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 and prelugged.

2.2.7 Accessories (Optional Equipment)

2.2.7.1 Optional External Maintenance Bypass Cabinet

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: input and output circuit breakers, single rotary switch with auxiliary contacts, inter-cabinet wiring, casters, and leveling feet. Optional voltage matching transformers and isolation transformers are to be offered. 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.

2.2.7.2 Intellislot™ Relay Board (or equiv.)

Five sets of isolated contacts shall be provided to indicate a change of status of the UPS. Contacts are provided for:

- On UPS
- On Battery
- Low Battery
- On Bypass
- Summary

2.2.7.3 Intellislot™ OC-485 (or equiv.): Inteliislot 485 card. The IntelliSlot® 485 card family delivers Modbus and proprietary protocol for monitoring and control of your equipment through a custom interface and monitoring system or your Building Management System.

3.0 Execution

3.1 FIELD QUALITY CONTROL

The following inspections and test procedures shall be performed by factory-trained field service personnel during the UPS startup.

3.1.1 Visual Inspection

- Inspect equipment for signs of damage.
- Verify installation per drawings.
- Inspect cabinets for foreign objects.
- Verify neutral and ground conductors are properly sized and configured.
- Inspect battery cases.
- Inspect battery for proper polarity.
- Verify all printed circuit boards are configured properly.

3.1.2 Mechanical Inspection

- Check all control wiring connections for tightness.
- Check all power wiring connections for tightness.
- Check all terminal screws, nuts, and/or spade lugs for tightness.

3.1.3 Electrical Inspection

- Check all fuses for continuity.
- Confirm input voltage and phase rotation is correct.
- Verify control transformer connections are correct for voltages being used.
- Assure connection and voltage of the battery string(s).

3.2 MANUFACTURER'S FIELD SERVICE

3.2.1 Service Personnel

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.

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.

An automated procedure shall be in place to ensure that the manufacturer is dedicating the appropriate technical support resources to match escalating customer needs.

3.2.2 Replacement Parts Stocking

Parts shall be available through an extensive network to ensure around-the-clock parts availability throughout the country.

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.

3.2.3 UPS Maintenance Training

Maintenance training courses for customer employees shall be available by the UPS manufacturer. The training is in addition to the basic operator training conducted as a part of the system start-up.

The training course shall cover UPS theory, location of subassemblies, safety, battery considerations and UPS operational procedures. The course shall include AC to DC conversion and DC to AC inversion techniques as well as control, metering, and feedback circuits to the Printed Circuit Board (PCB) level. Troubleshooting and fault isolation using alarm information and internal self-diagnostics should be stressed.

3.2.4 Maintenance Contracts

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. Warranty and preventive maintenance service shall be performed by factory- trained service personnel.

NOTE: These Guide Specifications comply with the format outlined by the Construction Specifications Institute per CSI MP-2-1 and CSI MP-2-2.

Appendix C – Terminals, UPS Eq. for MPOE – Guide Specifications

30 kVA
Three-Phase Uninterruptible Power System

1.0 General

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.

1.1 SUMMARY

All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

1.2 STANDARDS

The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

- ASME
- CSA 22.2, No. 107.1
- FCC Part 15, Class A
- IEC 1000-4-5
- ISO 9001
- National Electrical Code (NFPA-70)
- NEMA PE-1
- OSHA
- UL Standard 1778

The UPS shall be UL listed per UL Standard 1778, and shall be CSA certified.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements - UPS Module

A. Voltage. Input/output voltage specifications of the UPS shall be: Rectifier Input: 120/208 volts, three-phase, 4-wire-plus-ground. Output: 120/208 volts, three-phase, 4-wire-plus-ground.

B. Output Load Capacity. Specified output load capacity of the UPS shall be 30kVA/24kW at 0.8 lagging power factor.

1.3.2 Design Requirements - Battery

A. Battery Cells: Sealed, lead-acid, valve-regulated.

B. Reserve Time: 10 minutes at 24kW full load, with ambient temperature of 25°C.

C. Recharge Time: to 95% capacity within ten (10) times discharge time.

1.3.3 Modes of Operation

The UPS shall be designed to operate as an on-line, double-conversion, reverse-transfer system in the following modes:

A. Normal - The critical AC load is continuously supplied 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 the reserve battery.

B. Emergency - Upon failure of utility AC power, the critical AC load is supplied by the inverter, which, without any switching, obtains 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 assume the inverter and battery recharge loads.

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 transfer switch shall perform a reverse transfer of the load from the inverter to the bypass source with no interruption in power to the critical AC load.

1.3.4 Performance Requirements

1.3.4.1 AC Input to UPS

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 0.99 lagging at nominal input voltage and full rated UPS output load.

E. Inrush Current: 800% of full load current maximum.

F. Current Limit: 125% of nominal AC input current maximum.

G. Input Current Walk-In: 20 seconds to full rated input current maximum. Field selectable 5 through 20 seconds.

H. Current Distortion: 4% reflected THD maximum at full load.

I. Surge Protection: Sustains input surges without damage per criteria listed in IEC 1000-4-5.

1.3.4.2 AC Output, UPS Inverter

A. Voltage Configuration: three-phase, 4-wire plus ground

B. Voltage Regulation:

±1% 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.

±2% 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: 1.0 Hertz per second maximum. Field selectable from 0.1 to 1.0 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.

<4% THD for 100% nonlinear loads (3:1 crest factor) without kVA/kW derating.

H. Load Power Factor Range: 0.7 lagging to 0.95 leading 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).

K. Inverter Output Voltage Adjustment: ±5% manual adjustment.

L. Voltage Transient Response:

100% load step	±4.0%.
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%.

1.4 ENVIRONMENTAL CONDITIONS

The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:

A. Operating Ambient Temperature

UPS Module: 32°F to 104°F (0°C to 40°C). Battery: 77°F ±9°F (25°C ±5°C).

B. 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)

C. Relative Humidity

0 to 95%, non-condensing.

D. Altitude

Operating: to 3300 ft. (1000 meters) above Mean Sea Level. Derated for higher altitude applications.

Storage/Transport: to 40,000 ft. (12,200 meters) above Mean Sea Level.

E. Audible Noise

Noise generated by the UPS under any condition of normal operation shall not exceed 54 dBA measured 1 meter from surface of the UPS.

1.5 SUBMITTALS

1.5.1 Proposal Submittals

Submittals with the proposal shall include:

- System configuration with single-line diagrams.
- Functional relationship of equipment including weights, dimensions, and heat dissipation.
- Descriptions of equipment to be furnished, including deviations from these specifications.
- Size and weight of shipping units to be handled by installing contractor.
- Detailed layouts of customer power and control connections.
- Detailed installation drawings including all terminal locations.

1.5.2 UPS Delivery Submittals

Submittals upon UPS delivery shall include a complete set of submittal drawings and one (1) set of instruction manuals 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.

1.6 WARRANTY

1.6.1 UPS Module

The UPS manufacturer shall warrant the UPS module against defects in materials and workmanship for 12 months after initial start-up or 18 months after ship date, whichever period expires first.

1.6.2 Battery

The battery manufacturer's standard warranty shall be passed through to the end user.

1.7 QUALITY ASSURANCE

1.7.1 Manufacturer Qualifications

A minimum of twenty years' 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.

1.7.2 Factory Testing

Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the specification.

2.0 Product

2.1 FABRICATION

2.1.1 Materials

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.

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.

2.1.2 Wiring

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.

Provision shall be made for power cables to enter or leave from the top or bottom of the UPS cabinet.

2.1.3 Construction and Mounting

The UPS unit, comprised of an input circuit breaker, rectifier/charger, inverter, static transfer switch 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 and adjustments. The UPS cabinet shall be structurally adequate and have provisions for hoisting, jacking, and forklift handling.

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.

2.1.4 Cooling

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. There shall be redundant fans.

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.

2.1.5 Grounding

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

2.2.1 Rectifier/Charger

2.2.1.1 General

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 solid-state SCR/IGBT type with constant voltage/current limiting control circuitry.

2.2.1.2 AC Input Current Limiting

The rectifier/charger unit shall be provided with AC input current limiting whereby the maximum input current shall be limited to 125% 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 125% of full load input current. In addition, the rectifier/charger shall have a battery current limit, adjustable from 0 to
25% of the full load input current.

2.2.1.3 Input Current Walk-In

The rectifier/charger shall contain a timed walk-in circuit that causes the unit to gradually assume the load over a 20-second time interval after input voltage is applied. Walk-in time shall be field selectable for 5 through 20 seconds.

2.2.1.4 DC Filter

The rectifier/charger shall have a 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 ensure 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.

2.2.1.5 Automatic Rectifier Restart

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 assume the inverter and battery recharge loads.

2.2.1.6 Battery Recharge

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.

2.2.1.7 Overvoltage Protection

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 load transfer to the static bypass line.

2.2.2 Inverter

2.2.2.1 General

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.

2.2.2.2 Overload Capability

The inverter shall be capable of supplying current and voltage for overloads exceeding 100%. The inverter is to provide 150% of full load for 1 minute and 125% of full load for 10 minutes. A status indicator and audible alarm shall indicate overload operation. The UPS shall transfer the load to bypass when overload capacity is exceeded.

2.2.2.3 Fault Clearing and Current Limit

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.

2.2.2.4 Step Load Response

The output voltage shall be maintained to within ±4% 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.

2.2.2.5 Voltage Distortion

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 4%. The output rating is not to be derated in kVA nor kW due to the 100% nonlinear load with 3:1 crest factor.

2.2.2.6 Phase Balance

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 2% and the phase displacement is to be 120 degrees within ±1 degree.

2.2.2.7 Fuse Failure Protection

Power semiconductors in the inverter unit shall be fused with fast-acting fuses, so that loss of any one power semiconductor will not cause cascading failures.

2.2.2.8 Inverter Shutdown

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.

2.2.2.9 Inverter DC Protection

The inverter shall be protected by the following disconnect levels:

- DC Overvoltage Shutdown
- DC Undervoltage Warning (Low Battery Reserve), adjustable
- DC Undervoltage Shutdown (End of Discharge)

2.2.2.10 Inverter Output Voltage Adjustment

The inverter shall use a software control to adjust the output voltage from ±5% of the nominal value.

2.2.2.11 Output Frequency

The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall be temperature compensated and hold the inverter output frequency to ±0.1% for steady state and transient conditions. 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.

2.2.3 Display and Controls

2.2.3.1 Monitoring and Control

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:

- Menu-driven display with pushbutton navigation
- Real time clock (time and date)
- Alarm history with time and date stamp
- Battery backed-up memory

2.2.3.2 Metering

The following parameters shall be displayed:

- Input AC voltage line-to-line
- Input AC current for each phase
- Input frequency
- Battery voltage
- Battery charge/discharge current
- Output AC voltage line-to-line and line-to-neutral for each phase
- Output AC current for each phase
- Output frequency
- Apparent power
- Active power
- Battery time left during battery operation

2.2.3.3 Alarm Messages

The following alarm messages shall be displayed:

- Input power out of tolerance
- Battery charger problem
- Battery failed test
- Low battery warning
- Low battery shutdown
- DC bus overvoltage
- Bypass frequency out of range
- Load transferred to bypass
- Excessive retransfers attempted
- Static switch failure
- UPS output not synchronized to bypass power
- Output undervoltage
- Output overvoltage
- Output overcurrent
- System output overloaded
- Load transferred to bypass due to overload
- Overload shutdown
- Control error

- Critical power supply failure
- Load transferred due to internal protection
- External shutdown (remote EPO activated)
- Fan failure
- Overtemperature shutdown impending
- Overtemperature shutdown

An audible alarm shall be provided and activated by any of the above alarm conditions.

2.2.3.4 Status Messages

The following UPS status messages shall be displayed:

- Normal operation
- Load on maintenance bypass
- Load on UPS
- Load on static bypass
- System shutdown
- UPS on battery

2.2.3.5 Controls

UPS start-up, shutdown, and maintenance 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 screen shall be available on the LCD screen to depict a single-line diagram of the UPS, with switch positions and power flow.

2.2.3.6 On-Line Battery Test

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.

2.2.4 Static Transfer Switch

2.2.4.1 General

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 to clear a 20- ampere load branch circuit breaker.

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.

2.2.4.2 Uninterrupted Transfer

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:

- Inverter overload capacity exceeded
- Critical AC load overvoltage or undervoltage
- Battery protection period expired
- UPS fault condition

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:

- Inverter/bypass voltage difference exceeding preset limits
- Bypass frequency out of limits
- Bypass out-of-synchronization range with inverter output

2.2.4.3 Uninterrupted Retransfer

Retransfer of the critical AC load 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:

- Bypass out of synchronization range with inverter output
- Inverter/bypass voltage difference exceeding preset limits
- Overload condition exists in excess of inverter full load rating
- UPS fault condition present

2.2.5 Maintenance Bypass Switch

2.2.5.1 General

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 transfer switch.

2.2.5.2 Isolation

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 switch shall be provided when the UPS is in the maintenance bypass mode of operation.

2.2.5.3 Maintenance Capability

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 transfer switch. When the application calls for the Maintenance Bypass Switch to be bolted to the UPS cabinet, the interconnecting cables are to be provided, precut and prelugged.

2.2.6 Battery Power Pack

The battery power pack 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 shall be included for isolation of the battery pack from the UPS module. The UPS shall automatically be disconnected from the battery when the battery reaches the minimum discharge voltage level. Casters and leveling feet shall also be provided with the battery power pack 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 and prelugged.

2.2.7 Accessories (Optional Equipment)

2.2.7.1 Optional External Maintenance Bypass Cabinet

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: input and output circuit breakers, single rotary switch with auxiliary contacts, inter-cabinet wiring, casters, and leveling feet. Optional voltage matching transformers and isolation transformers are to be offered. 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.

2.2.7.2 Intellislot™ Relay Board

Five sets of isolated contacts shall be provided to indicate a change of status of the UPS. Contacts are provided for:

- On UPS
- On Battery
- Low Battery
- On Bypass
- Summary

2.2.7.3 Intellislot™ OC-485: Inteliislot 485 card. The Liebert IntelliSlot® 485 card family delivers Modbus and Liebert proprietary protocol for monitoring and control of your Liebert equipment through Liebert SiteScan Web or your Building Management System.

3.0 Execution

3.1 FIELD QUALITY CONTROL

The following inspections and test procedures shall be performed by factory-trained field service personnel during the UPS startup.

3.1.1 Visual Inspection

- Inspect equipment for signs of damage.
- Verify installation per drawings.
- Inspect cabinets for foreign objects.
- Verify neutral and ground conductors are properly sized and configured.
- Inspect battery cases.
- Inspect battery for proper polarity.
- Verify all printed circuit boards are configured properly.

3.1.2 Mechanical Inspection

- Check all control wiring connections for tightness.
- Check all power wiring connections for tightness.
- Check all terminal screws, nuts, and/or spade lugs for tightness.

3.1.3 Electrical Inspection

- Check all fuses for continuity.
- Confirm input voltage and phase rotation is correct.
- Verify control transformer connections are correct for voltages being used.
- Assure connection and voltage of the battery string(s).

3.2 MANUFACTURER'S FIELD SERVICE

3.2.1 Service Personnel

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.

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.

An automated procedure shall be in place to ensure that the manufacturer is dedicating the appropriate technical support resources to match escalating customer needs.

3.2.2 Replacement Parts Stocking

Parts shall be available through an extensive network to ensure around-the-clock parts availability throughout the country.

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.

3.2.3 UPS Maintenance Training

Maintenance training courses for customer employees shall be available by the UPS manufacturer. The training is in addition to the basic operator training conducted as a part of the system start-up.

The training course shall cover UPS theory, location of subassemblies, safety, battery considerations and UPS operational procedures. The course shall include AC to DC conversion and DC to AC inversion techniques as well as control, metering, and feedback circuits to the Printed Circuit Board (PCB) level. Troubleshooting and fault isolation using alarm information and internal self-diagnostics should be stressed.

3.2.4 Maintenance Contracts

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. Warranty and preventive maintenance service shall be performed by factory- trained service personnel.

NOTE: These Guide Specifications comply with the format outlined by the Construction Specifications Institute per CSI MP-2-1 and CSI MP-2-2.

Appendix D – Terminals, Mechanical Eq. Models for TR & MPOE rooms

Make/model Specifications (or equiv.) Mechanical HVAC System

Section 1. Telecom Room Mechanical HVAC Reqs. (final sizing TBD)

A. Mechanical – CHW Air Unit (w/ Reheat/Humidification)

Provide (1) 5 Ton ceiling-mounted (outside room) chilled water air unit, model Liebert Mini-mate2 MMD92CDAHELA. Unit shall have reheat and humidification with sensible capacity of 56,900 BTUH at 77F. 42% RH. 460V, 3-PH, 19.8 FLA, 24.8 WSA, 25A MFCB. Insulated Chilled Water Piping with 2 Way Modulating Control Valve – 350 PSI, 13.3 GPM, 6.8 PSI Pressure Drop, 1.5 HP Motor, 2,500 CFM @ 0.50 ESP

B. Mechanical – CHW Air Unit (Cooling Only Option)

Provide (1) 5 Ton ceiling-mounted (outside room) chilled water air unit, model Liebert Mini-mate2 MMD92CDA00LA. Unit shall have sensible capacity of 56,900 BTUH at 77F. 42% RH. 460V, 3-PH, 2.8 FLA, 3.5 WSA, 15A MFCB. Insulated Chilled Water Piping with 2 Way Modulating Control Valve – 350 PSI, 13.3 GPM, 6.8 PSI Pressure Drop, 1.5 HP Motor, 2,500 CFM @ 0.50 ESP

Section 2. MPOE Room Mechanical HVAC Reqs. (final sizing TBD)

A. Mechanical – CHW Air Unit (w/ Reheat/Humidification)

Provide (1) 8 Ton ceiling-mounted (outside room) chilled water air unit, model Liebert Mini-mate2 MMD8TCDAHELA. Unit shall have reheat and humidification with sensible capacity of 83,700 BTUH at 77F. 42% RH. 460V, 3-PH, 21.0 FLA, 26.3 WSA, 30A MFCB. Insulated Chilled Water Piping with 2 Way Modulating Control Valve – 350 PSI, 18.4 GPM, 4.4 PSI Pressure Drop, 2.0 HP Motor, 3,750 CFM @ 0.50 ESP

B. Mechanical – CHW Air Unit (Cooling Only Option)

Provide (1) 8 Ton ceiling-mounted (outside room) chilled water air unit, model Liebert Mini-mate2 MMD8TCDA00LA. Unit shall have sensible capacity of 83,700 BTUH at 77F. 42% RH. 460V, 3-PH, 3.1 FLA, 3.9 WSA, 15A MFCB. Insulated Chilled Water Piping with 2 Way Modulating Control Valve – 350 PSI, 18.4 GPM, 4.4 PSI Pressure Drop, 2.0 HP Motor, 3,750 CFM @ 0.50 ESP

Note: This specification defines the mechanical and electrical characteristics and requirements for an environmental control system. All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

Appendix E – Terminals, Mechanical Eq. for TR – Guide Specifications

1.0 General

SUMMARY

These specifications describe requirements for an environmental control system. The system shall be designed to control temperature and relative humidity conditions within the room.

The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings.

System shall be supplied with CSA Certification to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for “Heating and Cooling Equipment” and marked with the CSA c-us logo (60 Hz only).

This specification defines the mechanical and electrical characteristics and requirements for an environmental control system. All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

DESIGN REQUIREMENTS

The environmental control system shall be a Liebert Mini-Mate2 factory assembled unit. On direct expansion models, the refrigeration system shall be split, with the compressor located in a remote or close-coupled condensing unit.

The evaporator section shall be designed for above dropped-ceiling installation. Condensing units shall be designed for either outdoor or above-dropped-ceiling installation.

The system shall have a total cooling capacity of 61,000 BTU/hr and a sensible cooling capacity of 56,900 BTU/hr, based on the entering air condition of 77°F dry bulb and 62°F wet bulb. The unit is to be supplied for operation on a 460 volt, 3 phase, 60 Hz power supply.

SUBMITTALS

Submittals shall be provided with the proposal and shall include: Dimensional, Electrical and Capacity data; and Piping and Electrical Connection Drawings.

QUALITY ASSURANCE

The specified system shall be factory-tested before shipment. Testing shall include, but shall not be limited to: Quality Control Checks, “Hi-Pot” Test (two times rated voltage plus 1000 volts, per NRTL agency requirements), and Metering Calibration Tests. The system shall be designed and manufactured according to world-class quality standards. The manufacturer shall be ISO 9001 certified.

2.0 Product

STANDARD FEATURES/ ALL SYSTEMS

Evaporator Cabinet Construction

The cabinet and chassis shall be constructed of heavy gauge galvanized steel, and shall be serviceable from one side. Mounting brackets shall be factory-attached to the cabinet. Internal cabinet insulation shall meet ASHRAE 62.1 requirements for Mold Growth, Humidity & Erosion, tested per UL 181 & ASTM 1338 standards.

Air Distribution

The fan shall be the centrifugal type, double width, double inlet. The shaft shall be heavy-duty steel with self-aligning ball bearings with minimum life of 100,000 hours. The fan motor shall be 1750 rpm and mounted on an adjustable base. The drive package shall be equipped with an adjustable motor pulley. The fan/motor assembly shall be mounted on vibration isolators. The evaporator system shall be capable of delivering 2,500CFM at 0.5 inches of external static pressure. The fan motor shall be 1.5hp. System shall be suitable for ducted air distribution.

Microprocessor Control

The control system shall be microprocessor-based, factory-wired into the system and tested prior to shipment. The wall-mounted control enclosure shall include a 2-line by 16-character LCD providing continuous display of operating status and alarm condition. A 7-key membrane keypad for setpoint/program control and unit On/Off shall be located below the display. The control display shall be field-wired to the control board using 4-conductor field-supplied thermostat wire. Temperature and humidity sensors shall be located in the wall box, which shall be capable of being located up to 300 ft. from the evaporator unit.

Monitoring

The LCD shall provide On/Off indication, operating mode indication (cooling, heating, humidifying, dehumidifying) and current day, time, temperature and humidity (if applicable) indication. The monitoring system shall be capable of relaying unit operating parameters and alarms to the Liebert SiteScan® monitoring system.

Control Setpoint Parameters

Temp. Setpoint 65-85°F (18 to 29°C)
Temp. Sensitivity 1 to 9.9°F (1 to 5°C)
Humidity Setpoint 20-80% RH
Humidity Sensitivity 1-30% RH

Unit Controls

Compressor Short-Cycle Control

The control system shall prevent compressor short-cycling by a 3 minute timer from compressor stop to the next start.

Common Alarm and Remote On/Off

A common alarm relay shall be provided to provide a contact closure to a remote alarm device. Two (2) terminals shall also be provided for remote On/Off control. Individual alarms shall be "enabled" or "disabled" from reporting to the common alarm.

Setback Control

The control shall be user configurable to use a manual setpoint control or a programmable time-based setback control. The setback control will be based on a 5 day/2 day program weekly schedule with capability of accepting 2 events per program day.

Temperature Calibration

The control shall include the capabilities to calibrate the temperature and humidity sensors and adjust the sensor response delay time from 10 to 90 seconds. The control shall be capable of displaying temperature values in °F or °C.

System Auto Restart

For startup after power failure, the system shall provide automatic restart with a programmable (up to 9.9 minutes in 6-second increments) time delay. Programming can be performed either at the wall-mounted controller or from the central site monitoring system.

Alarms

Unit Alarm

The control system shall monitor unit operation and activate an audible and visual alarm in the event of the following factory preset alarm conditions:

- High Temperature
- Low Temperature
- High Humidity
- Low Humidity
- High Water Alarm - Lockout Unit Operation
- High Head Pressure
- Loss of Power Compressor
- Short Cycle

Custom Alarms (2x)

- Humidifier Problem Filter Clog
- Water Detected
- Smoke Detected
- User customized text can be entered for the two (2) custom alarms.

Alarm Controls

Each alarm (unit and custom) shall be separately enabled or disabled, selected to activate the common alarm (except for high head pressure).

Audible Alarm

The audible alarm shall annunciate any alarm that is enabled by the operator.

Common Alarm

A programmable common alarm shall be provided to interface user selected alarms with a remote alarm device.

Remote Monitoring

All alarms shall be communicated to the Liebert site monitoring system with the following information: date and time of occurrence, unit number and present temperature and humidity.

CHILLED WATER SYSTEM COMPONENTS

Chilled Water Control Valve (Modulating)

A (2-way) (3-way) modulating, non-spring return valve controlled by the microprocessor to position the valve in response to room conditions. Design pressure shall be 400psig static pressure, with a maximum close-off pressure of 72psi.

Chilled Water Coil

The cooling coil shall have a minimum of 5.6 sq.ft. face area, 4 rows deep. It shall be constructed of copper tubes and aluminum fins and have a maximum face velocity of 444 FPM (2.26 m/s) at 2,500 CFM. The coil shall be supplied with 45°F entering water temperature. The coil shall be supplied with 13.3GPM of chilled water and the pressure drop shall not exceed 6.8 psi. The coil assembly shall be mounted in a stainless steel condensate drain pan, with internally trapped drain line.

FACTORY-INSTALLED OPTIONS

Steam Generating Humidifier (Optional)

The environmental control system shall be equipped with a steam generating humidifier that is controlled by the microprocessor control system. It shall be complete with disposable canister, all supply and drain valves, steam distributor and electronic controls. The need to change canister shall be annunciated on the microprocessor wall box control panel. The humidifier shall have a capacity of 8.0lb./hr. . An LED on the humidifier assembly shall indicate cylinder full, overcurrent detection, fill system fault and end-of-cylinder-life conditions.

Electric Reheat (Optional)

The electric reheat shall be low-watt density, 304/304 stainless steel, finned-tubular and shall be capable of maintaining room dry bulb temperature conditions when the system is calling for dehumidification. The reheat section shall include a UL-approved safety switch to protect the system from overheating. The capacity of the reheat coils shall be 39,100 BTU/HR (11.5kW), with unit input voltage of 460V, controlled in one stage.

Disconnect Switch, Non-Locking

The non-automatic, non-locking, molded case circuit breaker shall be factory-mounted in the high-voltage section of the electrical panel. The switch handle shall be accessible from the front of the indoor unit.

Smoke Sensor

The smoke sensor shall immediately shut down the environmental control system and activate the alarm system when activated. The sensing element shall sense the return air conditions. This smoke sensor shall not function or replace any room smoke detector that may be required by local or national codes.

Filter Clog Switch

The filter clog switch senses pressure drop across the filters and shall annunciate the wall-box display upon reaching the adjustable setpoint.

SHIP-LOOSE ACCESSORIES

Air Filter Box/Duct Flange

The evaporator section shall be supplied with an air filter box for use with ducted installations. Two (2) filters shall be included 4" x 20" x 20" (102 mm x 508mm x 508mm) each, pleated type, with a MERV 8 rating, based on ASHRAE 52.2. A duct flange shall be supplied for use on the supply air opening of the unit.

Condensate Pump

The condensate pump shall have the capacity of 25GPH at 40 ft. head. It shall be complete with integral float switch, pump, motor assembly, discharge check valve, duct/wall mountable bracket and reservoir. A secondary float switch shall be provided to permit field wiring to the unit control to shut down the evaporator upon a high water level condition.

Condensate Pump Bracket

A condensate pump bracket shall be provided to mount condensate pump directly to the end of the unit, allowing for easier installation and alignment of the condensate pump.

Refrigerant Line Sweat Adapter Kit

Provide a sweat adapter kit to permit field brazing of refrigerant line connections.

Single Point Power Kit

A single point power kit shall be provided for a close-coupled system to allow a single electrical power feed to supply power to both the evaporator and indoor close-coupled condensing unit.

SiteScan Site Monitoring System (or equiv.)

A Liebert SiteScan Site Monitoring System Model Sitelink SSW-2E shall be provided for remote monitoring of the Liebert Mini-Mate2 unit and monitoring of other Liebert support equipment. The Liebert SiteScan shall have the capability to monitor and change (at the user direction) the temperature and humidity setpoints and sensitivities of each unit. It shall also be capable of being programmed to print out environmental conditions or operating modes at each unit.

Specifications / Wiring Specifications

Ordering Information

- Power 24VAC ±10%, 50 to 60Hz, 24VA, or 26VDC ±10%, 10W, 48VDC
- Dimensions: W x D x H: in. (mm)
  - Module: 11.3 x 0.56 x 7.5”
  - Enclosure (brushed aluminum): 14.25 x 2.85 x 12

Communication Ports

- Ethernet Port. 10/100Base-T Fast Ethernet port.
- ARC156 Port. ARCNET156 or EIA-485 communication. In ARCNET156 mode, the port communicates via BACnet ARC156.
- TPI Port S1. EIA-232/422/485 configurable port for interaction with 3rd-party building automation systems via software-selectable protocols. May also be configured for remote modem access.
- EIA-422/485Ports 1-12 for communication with equipment via software-selectable. Each port can be individually set for different protocols & baud rates. The number of ports varies by model:

  SiteLink-2E (SSW-2E) SiteLink-4E (SSW-4E) SiteLink-12E (SSW-12E)

  - Ports 11-12 These two ports include an option for EIA-232 connection.
  - Ports 9-12 These four ports include an option for EIA-232 connection.
  - Ports 1-12 Four of these 12 ports (9-12) include an option for EIA-232 connection.

Environmental Operating Range

20°F to 140°F (-29°C to 60°C); 10 to 90% relative humidity, non-condensing

Note: Control modules should be installed within the building.

Memory

16 MByte non-volatile battery-backed SDRAM and 8 MByte Flash

Protection

Built-in surge and transient protection circuitry - internal solid state polyswitches on incoming power and network communications connections

Battery

3V lithium battery P/N CR-123A; battery shelf life is 10 years with 720 hours of continuous operation

Fault Detection Hardware

Watchdog Timer

Agency Listings

UL, cUL, CE, FCC

Connection Supported Wire Types Maximum Wire Length Rating

- Ethernet 10 BaseT CAT 5 328 ft. (100m) N/A
- BACnet Port MAGNUM Cable P/N A3-ARC-156-2 3000 ft. (915m) N/A
- Port S1 EIA-485 18-22 AWG Stranded & Shielded; 18 AWG (recommended)
- Non Plenum - Belden 9461; Plenum - Belden 88761 1000 ft. (300m) N/A
- Port S1 EIA-232 18-22 AWG Stranded & Shielded; 18 AWG (recommended)
- Non Plenum - Belden 9461; Plenum - Belden 88761 50 ft. (15m) N/A

Quantity Part # Description

SSW-2E SiteLink-2E with enclosure - communicates with up to 2 Liebert unit controllers.

3.0 Execution

INSTALLATION OF AIR CONDITIONING UNIT

General

Install air conditioning unit in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored to support the unit's weight in location indicated and maintain manufacturer's recommended clearances. Do not mount units above sensitive electronic equipment to minimize risk of water overflow/leakage damage and improve maintenance/service access.

Electrical Wiring

Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor.

Piping Connections

Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.

Supply and Drain Water Piping

Connect water supply and drains to air conditioning unit. Unit drain shall be trapped internally and shall not be trapped externally.

Field-Supplied Pan

A field-supplied pan with drain shall be installed beneath cooling units and water/glycol condensing units.

FIELD QUALITY CONTROL

Factory Start Up air conditioning unit in accordance with manufacturer's startup instructions. Test controls and demonstrate compliance with requirements.

Appendix F – Terminals, Mechanical Eq. for MPOE – Guide Specifications

1.0 General

SUMMARY

These specifications describe requirements for an environmental control system. The system shall be designed to control temperature and relative humidity conditions within the room.

The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings.

System shall be supplied with CSA Certification to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for "Heating and Cooling Equipment" and marked with the CSA c-us logo (60 Hz only).

This specification defines the mechanical and electrical characteristics and requirements for an environmental control system. All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

DESIGN REQUIREMENTS

The environmental control system shall be a Liebert Mini-Mate2 factory assembled unit. The evaporator section shall be designed for ceiling installation.

The system shall have a total cooling capacity of 88,400 BTU/hr, and a sensible cooling capacity of 83,700 BTU/hr, based on the entering air condition of 77°F dry bulb, and 62°F wet bulb.

The unit is to be supplied for operation on a 460 volt, 3 phase, 60 Hz power supply.

SUBMITTALS

Submittals shall be provided with the proposal and shall include: Single-Line Diagrams; Dimensional, Electrical and Capacity data; Piping and Electrical Connection Drawings.

QUALITY ASSURANCE

The specified system shall be factory-tested before shipment. Testing shall include, but shall not be limited to: Quality Control Checks, “HiPot” Test (two times rated voltage plus 1000 volts, per NRTL agency requirements) and Metering Calibration Tests. The system shall be designed and manufactured according to world class quality standards. The manufacturer shall be ISO 9001 certified.

2.0 Product

Standard Features / All Systems

Evaporator Cabinet Construction

The cabinet and chassis shall be constructed of heavy gauge galvanized steel and shall be serviceable from one side only. Mounting brackets shall be factory-attached to the cabinet.

Internal cabinet insulation shall meet ASHRAE 62.1 requirements for Mold Growth, Humidity and Erosion, tested per UL 181 and ASTM 1338 standards.

Air Distribution

The fan shall be the belt-drive, centrifugal type, double width, double inlet. The shaft shall be heavy-duty steel with self-aligning ball bearings with minimum life of 100,000 hours. The fan motor shall be 1750 rpm and mounted on an adjustable base. The drive package shall be equipped with an adjustable motor pulley. The fan/motor assembly shall be mounted on vibration isolators.

The evaporator system shall be capable of delivering 3,750 CFM at 0.50inches of external static pressure. The fan motor shall be 2.0 HP.

System shall be suitable for ducted air distribution.

Microprocessor Control

The control system shall be microprocessor-based, factory-wired into the system cabinet and tested prior to shipment. The wall-mounted control enclosure shall include a 2-line by 16- character liquid crystal display (LCD) providing continuous display of operating status and alarm condition which is wired into the control board using 4-conductor field-supplied wire. A 7-key membrane keypad for setpoint/program control and unit On/Off shall be located below the display. The control shall be capable of displaying values in °F or °C. The microprocessor shall provide three stages of cooling for direct expansion units by cycling the 3-ton compressor, 5-ton compressor and then both compressors. The microprocessor shall determine the optimal stage to run based on historical run data.

The microprocessor shall adjust the modulating chilled water valve on chilled water units. Temperature and humidity sensors shall be located in the wall box, which shall be capable of being located up to 300 ft. from the evaporator unit.

Monitoring

The LCD shall provide an On/Off indication, operating mode indication (cooling, heating, humidifying, dehumidifying) and current day, time, temperature and humidity (if applicable) indication. The monitoring system shall be capable of relaying unit operating parameters and alarms to the Liebert SiteScan® monitoring system.

Control Setpoint Parameters

Temp. Setpoint 65-85°F (18-29°C)
Temp. Sensitivity 1-9.9 °F (1-5°C)
Humidity Setpoint 20-80% RH
Humidity Sensitivity 1-30% RH

Unit Controls

Compressor Short-Cycle Control

The control system shall prevent compressor short-cycling by a 3-minute timer from compressor stop to the next start.

Common Alarm and Remote On/Off

A common alarm relay shall provide a contact closure to a remote alarm device. Two (2) terminals shall also be provided for remote On/Off control. Individual alarms shall be “enabled” or “disabled” from reporting to the common alarm.

Setback Control

The control shall be user-configurable to use a manual setpoint control or a programmable, time- based setback control. The setback control will be based on a 5 day/2 day programmed weekly schedule with capability of accepting 2 events per program day.

Temperature Calibration

The control shall include the capabilities to calibrate the temperature and humidity sensors and adjust the sensor response delay time from 10 to 90 seconds. The control shall be capable of displaying temperature values in °F or °C.

System Auto Restart

For startup after power failure, the system shall provide automatic restart with a programmable (up to 9.9 minutes in 6-second increments) time delay. Programming can be performed either at the wall-mounted controller or from the central, site-monitoring system.

Alarms

Unit Alarm

The control system shall monitor unit operation and activate an audible and visual alarm in the event of the following factory preset alarm conditions:

- High Temperature
- Low Temperature
- High Humidity
- Low Humidity
- High Water Alarm - Lockout Unit Operation
- High Head Pressure #1 and #2
- Loss of Power
- Compressor Short Cycle #1 and #2
- Humidifier Problem
- Filter Clog

Custom Alarms (3x)

- Smoke Detected
- Standby Unit On
- Water Flow Loss
- Standby GC Pump
- Custom 1
- Custom 2
- Custom 3

User-customized text can be entered for the three (3) custom alarms.

Alarm Controls

Each alarm (unit and custom) shall be individually enabled or disabled (except for high head pressure and high water in condensate pan) and can be programmed for a time delay of 0 to 255 seconds of continuous alarm condition to be recognized as an alarm. Each alarm can also be enabled or disabled to activate the common alarm (except high head pressure and high water in condensate pan).

Audible Alarm

The audible alarm shall annunciate at the LCD wall box any alarm that is enabled by the operator.

Common Alarm

A programmable common alarm shall be provided to interface user selected alarms with a remote alarm device. Alarms shall be enabled or disabled from reporting to the common alarm.

Remote Monitoring

All alarms shall be communicated to the Liebert site monitoring system with the following information: date and time of occurrence, unit number and present temperature and humidity.

CHILLED WATER SYSTEM COMPONENTS

Chilled Water Control Valve

A (2-way) (3-way) modulating, non-spring return valve shall be controlled by the microprocessor to position the valve in response to room conditions. Water-side design pressure shall be 400 psig static pressure.

Chilled Water Coil

The cooling coil shall have a minimum 7.6 sq.ft. face area, 4 rows deep, constructed of copper tubes and aluminum fins, and have a maximum face velocity of 491 ft. per minute at 3.750 CFM. The coil shall be supplied with 45°F entering water temperature. The coil shall be supplied with 18.4 GPM of chilled water and the pressure drop shall not exceed 4.8PSI. The coil assembly shall be mounted in a stainless steel condensate drain pan with internally trapped drain line. The evaporator drain pan shall include a factory-installed float switch to shutdown the evaporator upon high water condition.

FACTORY-INSTALLED OPTIONS

Steam Generating Humidifier (Optional)

The environmental control system shall be equipped with a steam generating humidifier that is controlled by the microprocessor control system. It shall be complete with disposable canister, all supply and drain valves, 1" air gap on fill line, inlet strainer, steam distributor and electronic controls. The need to change canister shall be annunciated on the microprocessor wall box control panel. The humidifier shall have a capacity of 10.0 lb/hr. An LED light on the humidifier assembly shall indicate cylinder full, overcurrent detection, fill system fault, and end of cylinder life conditions.

Electric Reheat (Optional)

The electric reheat shall be low-watt density, 304/304 stainless steel, finned-tubular and shall be capable of maintaining room dry bulb conditions when the system is calling for dehumidification. The reheat section shall include an agency-approved safety switch to protect the system from overheating. The capacity of the reheat coils shall be 39,110 (11.5kW) BTU/HR, with unit input voltage of 460 V, controlled in two stages.

Disconnect Switch, Non-Locking

The non-automatic, non-locking, molded case circuit interrupter shall be factory mounted in the high-voltage section of the electrical panel. The switch handle shall be accessible from the unit front and mounted on the evaporator/chilled water unit.

Smoke Sensor

The smoke sensor shall immediately shut down the environmental control system and activate the alarm system when activated. The sensing element shall be located in the return air compartment. This smoke sensor shall not function or replace any room smoke detection system that may be required by local or national codes.

Filter Clog Switch

The filter clog switch senses pressure drop across the filters and shall annunciate the wall-box display upon exceeding the adjustable setpoint.

Air Filter Box

The evaporator section shall be supplied with an air filter box for use with ducted installations. Two (2) filters shall be included 4" x 20" x 25" (102 mm x 508mm x 635mm) each, deep-pleated type, with a MERV 8 rating, based on ASHRAE 52.2.

Condensate Pump

The condensate pump shall have the capacity of 25 GPH at 40 ft. head. It shall be complete with integral float switch, discharge check valve, pump, motor assembly and reservoir. A secondary float switch shall be provided to permit field wiring to the unit control to shut down the evaporator upon a high water level condition.

Condensate Pump Bracket

A condensate pump bracket shall be provided to mount condensate pump to the end of the unit and allow easy alignment and installation of the condensate pump.

SiteScan Site Monitoring System (or equiv.)

A Liebert SiteScan Site Monitoring System Model Sitelink SSW-2E shall be provided for remote monitoring of the Liebert Mini-Mate2 unit and monitoring of other Liebert support equipment. The Liebert SiteScan shall have the capability to monitor and change (at the user direction) the temperature and humidity setpoints and sensitivities of each unit. It shall also be capable of being programmed to print out environmental conditions or operating modes at each unit.

Specifications / Wiring Specifications

Ordering Information

- Power 24VAC ±10%, 50 to 60Hz, 24VA, or 26VDC ±10%, 10W, 48VDC
- Dimensions W x D x H: in.
  - Module: 11.3 x 0.56 x 7.5
  - Enclosure (brushed aluminum): 14.25 x 2.85 x 12

Communication Ports

- Ethernet Port 10/100Base-T Fast Ethernet port.
- ARC156 Port ARCNET156 or EIA-485 communication. In ARCNET156 mode, the port communicates via BACnet ARC156.
- TPI Port S1 EIA-232/422/485 configurable port for interaction with 3rd-party building automation systems via software-selectable protocols. May also be configured for remote modem access.
- EIA-422/485Ports 1-12 for communication with equipment via software-selectable. Each port can be individually set for different protocols & baud rates. The number of ports varies by model:

  SiteLink-2E (SSW-2E) SiteLink-4E (SSW-4E) SiteLink-12E (SSW-12E)

  - Ports 11-12 These two ports include an option for EIA-232 connection.
  - Ports 9-12 These four ports include an option for EIA-232 connection.
  - Ports 1-12 Four of these 12 ports (9-12) include an option for EIA-232 connection.

Environmental Operating Range

20°F to 140°F (-29°C to 60°C); 10 to 90% relative humidity, non-condensing

Note: Control modules should be installed within the building.

Memory

16 MByte non-volatile battery-backed SDRAM and 8 MByte Flash

Protection

Built-in surge and transient protection circuitry - internal solid state polyswitches on incoming power and network communications connections

Battery

3V lithium battery P/N CR-123A; battery shelf life is 10 years with 720 hours of continuous operation

Fault Detection Hardware

Watchdog Timer

Agency Listings

UL, cUL, CE, FCC

Connection Supported Wire Types Maximum Wire Length Rating

- Ethernet 10 BaseT CAT 5 328 ft. (100m) N/A
- BACnet Port MAGNUM Cable P/N A3-ARC-156-2 3000 ft. (915m) N/A
- Port S1 EIA-485 18-22 AWG Stranded & Shielded; 18 AWG (recommended)
- Non Plenum - Belden 9461; Plenum - Belden 88761 1000 ft. (300m) N/A
- Port S1 EIA-232 18-22 AWG Stranded & Shielded; 18 AWG (recommended)
- Non Plenum - Belden 9461; Plenum - Belden 88761 50 ft. (15m) N/A

Quantity Part # Description

SSW-2E SiteLink-2E with enclosure - communicates with up to 2 Liebert unit controllers.

3.0 Execution

INSTALLATION OF AIR CONDITIONING UNIT

General

Install air conditioning unit in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored in location indicated, and maintain manufacturer’s recommended clearances.

Electrical Wiring

Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer’s electrical connection diagram submittal to electrical contractor. Install and wire per local and national codes.

Piping Connections

Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer’s piping connection diagram submittal to piping contractor.

Supply and Drain Water Piping

Connect water supply and drains to air conditioning unit. Unit drain shall be trapped internally and shall not be trapped externally.

Field-Supplied Pan

A field-supplied pan with drain shall be installed beneath cooling units and water/glycol condensing units.

FIELD QUALITY CONTROL

Startup air conditioning unit in accordance with manufacturer’s startup instructions. Test controls and demonstrate compliance with requirements.

End

RESTROOMS, DESIGN INTENT

The following recommendations shall serve as minimum standards and in no way are intended to limit the Design Professional's creativity or their success in meeting the objectives.

1. Restroom shall have a minimum of 15 air changes per hour. Separate single use Family Restrooms shall be provided in new construction and where space is available for renovation projects.

2. All Public Restrooms to be equipped with a diaper changing station.

3. Diaper changing station to be fixed-type, constructed of stainless steel at all new restrooms, and where possible in remodel projects. "Fold down" type will be acceptable in space confined stalls.

4. Lighting should be ample but comfortable. There should be no areas that appear dark and unlit. Special lighting may be required at baby change stations, entry vestibules, and in front of mirrors.

5. Unless otherwise required by Code or unique space constraints exist, doors shall not be used to enter restrooms. Vestibules shall have 48" wide minimum clear openings that are arranged to allow free-flow traffic without sightlines into the restrooms.

6. Wall Finish assembly should be full height ceramic tile or stone – glass mosaic or other approved accent finish may be used

7. Where feasible, metal studs should be set on a raised 6" concrete curb

8. Stainless Steel (306, No 6 Finish) corner guards shall be used at all outside corner walls at a minimum of 42" AFFL. Corner guard shall be installed above the base tile.

9. Ceiling heights shall be 9'-0" minimum, except in stall compartment area where the soffit should be 8'-0".

10. Porous ceiling materials are not acceptable. Ceiling shall be cement plaster or water-resistant drywall. All ceilings to be painted.

11. Access for water shut-off valves, temperature control valves, electrical transformers, etc. shall be located near a ceiling access panel to the extent possible.

12. All doors, frames and hardware shall be in compliance with the door and lock specifications provided in Section 08 00 00 of the Guide Specifications (Design & Construction Handbook).

13. Provide ADA and LAFD approved Emergency Strobe Lights and Speakers as required.

14. New restroom designs shall incorporate a pipe chase with a 30" minimum door.

November 7, 2012

PUBLIC RESTROOMS, DESIGN INTENT

1.01 STRUCTURAL

A. Where feasible, metal stud partitions will be constructed on a 6" high concrete curb.

1.02 MECHANICAL

A. Restrooms will have a minimum of 15 air changes per hour.

1.03 PLUMBING

A. To the extent possible, water shut-off valves, temperature control valves, electrical transformers, etc. will be located within 30 horizontal inches of a ceiling access panel.
B. Alternative location of access panel will be located under the lavatory countertop concealed behind the stainless steel skirt.
C. Restroom Layouts in new construction and restroom renovations where space permits, will incorporate a plumbing service chase with a minimum clearance of 18" from point of access to and behind all plumbing fixtures.
D. Plumbing service chase access will be through a door no less than 30" wide. Access to plumbing chase from inside restrooms rooms will be avoided.

1.04 ELECTRICAL

A. At least one (1) convenience GFI electrical outlet will be provided in at least one (1) ADA stall and one (1) above each diaper changing station.

1.05 LIGHTING

A. Continuous, wall to wall, indirect linear lighting will be installed above all lavatories, water closets, urinals and feature walls as the primary means of illuminating these areas.
B. All other required lighting is to be fully recessed within the ceiling.
C. Self-illuminating mirror, mirror edge lighting, wall sconce, or candelabra fixtures will not be used.

1.06 DOORS

A. Unless otherwise required by Building Code or if unique space constraints exist, doors will not be used to enter restrooms.
B. Restroom entry vestibules will have 48" wide minimum clear openings that are arranged to allow free-flow traffic without sightlines into the restrooms.
C. Where doors are required, doors, frames and hardware will be in compliance with the door and lock specifications provided in Section 08 00 00 of the Guide Specifications (Design & Construction Handbook).

1.07 CEILINGS

A. Ceiling heights will be 9'-0" minimum above finished floor.
B. Porous ceiling materials are not acceptable.
C. Ceiling will be cement plaster or water resistant gypsum board.
D. All ceilings will be painted.
E. All access panels, registers and grills will be painted to match ceiling.

1.08 TOILET PARTITIONS

A. Toilet partitions will be stainless steel as per specifications provided in section 10 21 13 of the Guide Specifications (Design & Construction Handbook).
B. Typical toilet stalls in new construction and in new restroom layouts in existing structures where space permits will be 3'-6" x 6'-6" as shown in *Figure 1.08B.*
C. Ambulatory and accessible stall widths will be sized to meet the applicable code requirements. In existing structures where spatial constraints do not permit the above, code requirements will govern.

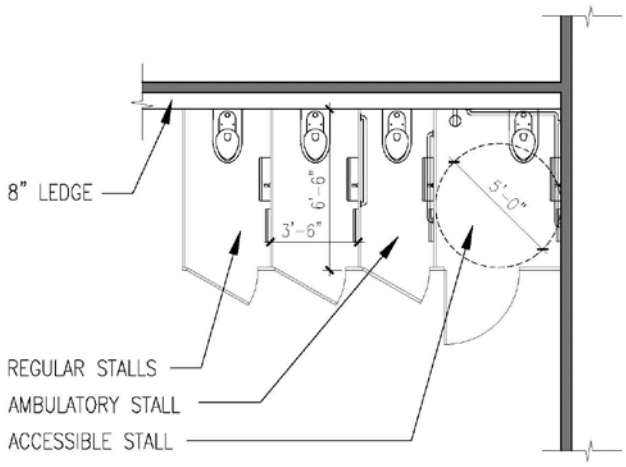


Figure 1.08B
PREFERRED TOILET STALL SIZES

D. Toilet partitions will be ceiling hung and rigidly fastened to structural steel supports concealed in ceiling plenum.
E. To limit partition racking, additional floor pedestal supports will be provided every 2-3 stalls.

1.09 FINISHES

1.09.1 Design Color Palette

A. Restrooms colors will be limited to three (3) distinguishable values of white to grey color scale (preferably warm grey), a single accent color in specific locations and natural finished stainless steel.
B. Restroom Vestibule/entry walls will be the darkest and richest value (i.e. Dark Grey). Floors and bases are to be the middle value (i.e. Medium Grey). Ceilings, wall field tile and lavatory/counters will be the lightest value (i.e. White).
C. Accent colors are to be a single hue or color of glass tile and are limited to above the water closets and on feature walls defined as single plane walls without openings, fixtures or accessories.
D. Each restroom is limited to (1) one color.

1.09.2 Walls

A. Wall tile finish assembly will be per the specifications provided in Section 09 30 00 of the Guide Specifications (Design & Construction Handbook).
B. Wall field tile will be ceramic tile laid up in a horizontally balanced and consistent pattern from corner to corner and bottom to top. Rectangular tiles will be laid horizontally. Horizontal stack bond pattern is preferred. Wall field tile will start with a full tile above the wall base tile.
C. Wall field tile will be square or rectangular with no dimension less than 4".
D. Behind water closets, the wall field tile will be from top of wall base tile to approximately 60" above finish floor (AFF) and end with a full tile.
E. Behind water closets where wall field tile ends (approx. 60" AFF) glass color accent tile, starting with a full height tile, will run to the ceiling as shown in *Figure 1.09.2B.*
F. Glass Tile will be square or rectangular and with no dimension less than 4". Size and bond pattern of glass tile will match the field tile pattern where possible and course out with field tile in all cases.
G. If accent tile is used, it will be above 60" and run to the ceiling. If accent tile is not used, wall field tile will run to ceiling. No exposed wall finishes will be painted gypsum board.
H. Tile grout will be white for wall field tile and accent color tile.
I. Colored accent tile will only be used above urinals where urinals and water closets are on a common wall. In such cases, the ledges and accent color tile will be consistent from inside corner to inside corner.
J. Restroom layouts in new construction will have a solid surface ledge at approximately 60" AFF behind water closets and urinals and in existing structures where space permits. Ledge solid surface material will match the lavatory countertops.
K. Transitions from one material to another, or one color to another, will only occur at inside corners and at stainless steel cased openings between two adjacent spaces. The use of two colors or dissimilar

materials is not permitted on walls in the same plane regardless of whether they are separated by a floor to ceiling stainless steel cased opening

L. Stainless Steel (306, No 6 Finish) flush corner guards will be used at all outside corner of all tile walls from top of wall base to ceiling. At the end of tiled partitions, single stainless steel end cap installed flush to the surface of the tile can be used in lieu of two flush corner guards.

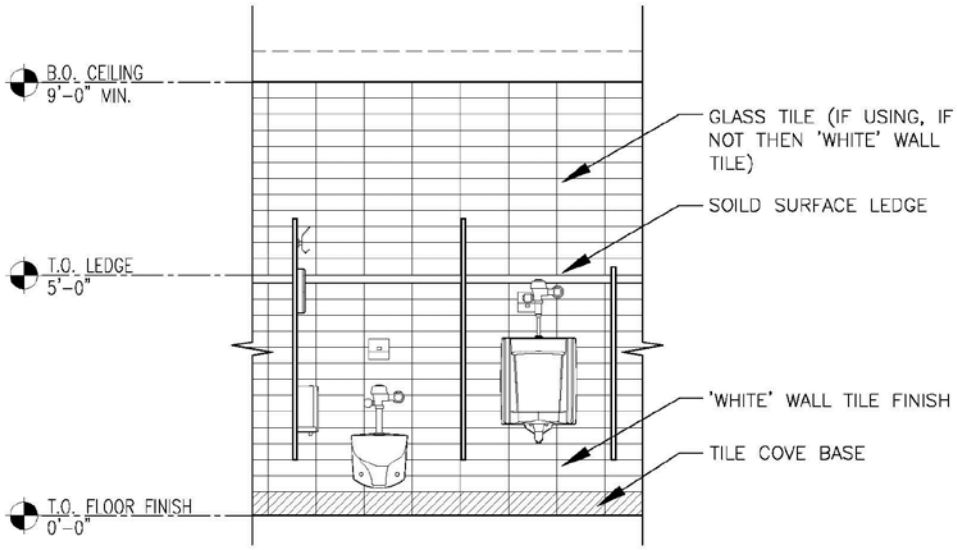


Figure 1.09.2B
WALL FINISH AT URINALS AND WATER CLOSETS

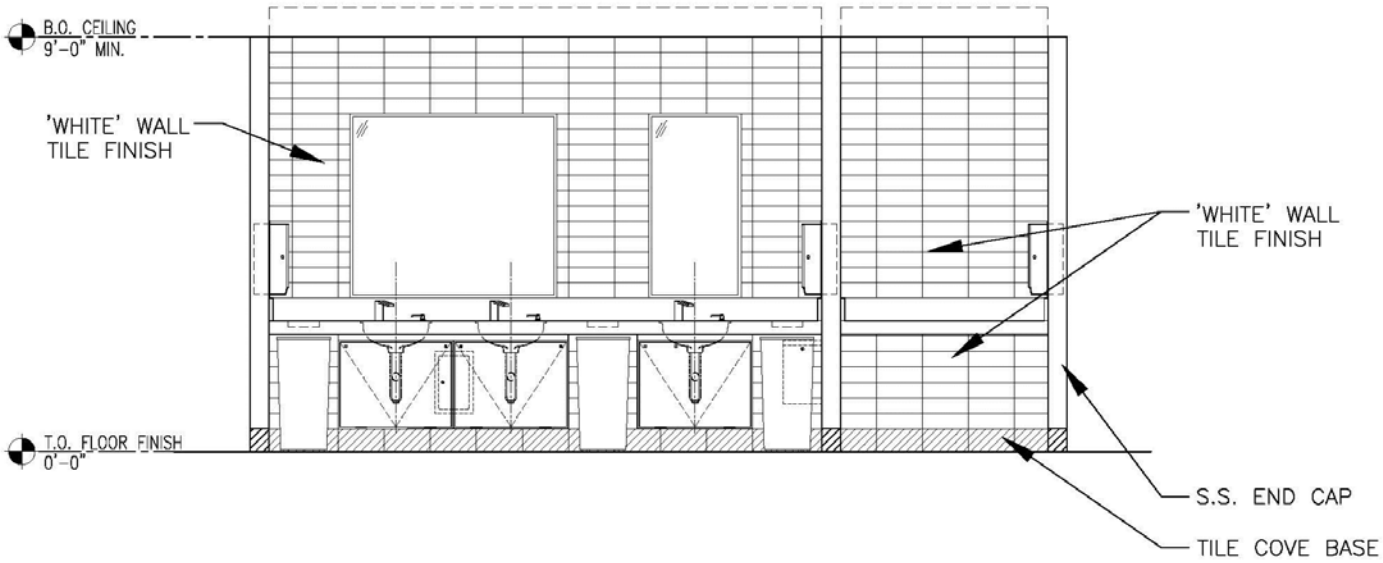


Figure 1.9.2C
WALL FINISH AT LAVATORIES

1.09.3 Floors

A. Floor tile finish assembly will be per the specifications provided in Section 09 30 00 of the Guide Specifications (Design & Construction Handbook).
B. Floor finish will have positive slope to floor drain(s).
C. Floor tile finish color will be **'Medium Grey'**.
D. Tile cove base will be provided and match floor tile and extend up the wall as shown in *Figure 1.9.3C.* Non-tile cove bases and cove strips are not acceptable.

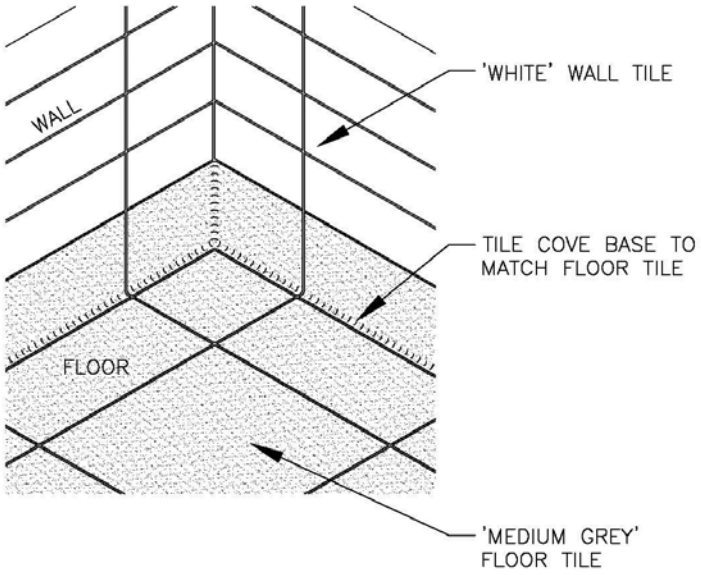


Figure 1.9.3C
TILE COVE BASE

1.10 UNDER COUNTERTOP LAVATORIES/TRASH DROP LAYOUTS

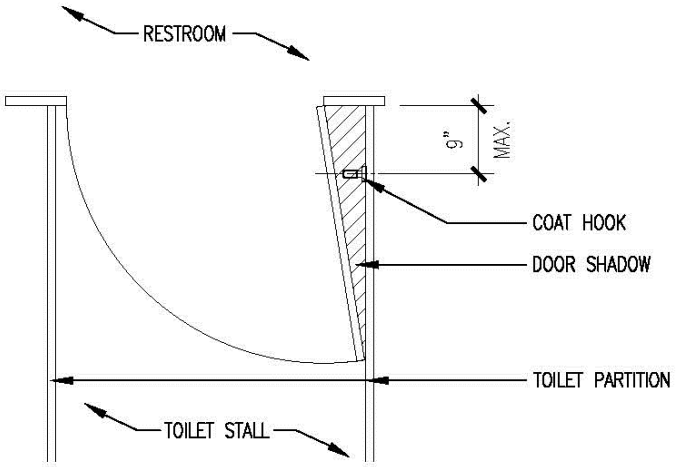
A. Restroom countertops will be per specifications provided in section 06 61 16 of the Guide Specifications (Design & Construction Handbook).
B. Restroom countertops will be solid surface acrylic polymer product.
C. Engineered stone is not acceptable.
D. Countertops will all have positive slope to lavatories.
E. A continuous 6 inch integral splash will be provided at all walls adjacent to lavatories and trash drops.
F. A minimum 8 inch shelf will be provided above each lavatory.
G. Integrally mixed automatic faucet and soap dispenser will be installed at 45 degree angle from centerline of lavatory.
H. A circular stainless steel finished thru counter trash drops will be provided at the end of each pair of lavatory /wash stations.
I. A standard removable stainless steel trash receptacle will be provided under each trash drop.
J. Stainless steel trash receptacles shall be at least 29 inches tall, no more than 15 inches deep and no more than 14 inches wide.
K. No enclosure will be provided in front of trash receptacles.
L. One (1) bulk soap dispensing reservoir accessible with removal of the trash receptacle will be provided at each restroom.
M. A removable stainless steel skirting (matching the S.S. toilet partition pattern and finish) will meet ADA code requirements and will be provided under each lavatory to allow access to plumbing for maintenance purposes.
N. Clear dimension of 30-1/2” will be maintained from finish floor to bottom of counter for the full length of counter.
O. Floor finish will be sloped to and from this line of demarcation to achieve positive slope to floor drain(s).

1.11 ACCESSORIES

A. All Public Restrooms will be equipped with a diaper changing station. Location of diaper changing station preferential order:
    (i) Along main circulation path: solid surface fixed-type ledge/countertop with no depressions, stainless steel with a front lip

(ii) Along main circulation path: Recessed, stainless steel, “flip down” model
(iii) In ADA stall: Recessed, stainless steel, “flip down” model

B. Coat hooks will bear 150# weight, installed on latch side of the toilet stall where partition door opens out. If partition door opens in, coat hook will be installed on the hinge side in the door shadow free and clear of partition door impact as shown in *Figure 1.11C*. At end conditions where adjacent wall is demising, coat hook to be on adjacent demising wall and clear of partition door impact. Coat hooks will be anchored to integral structural members inside the toilet partitions sized to carry the load.
D. Paper Towel Dispensers will be located over the lavatory countertop, adjacent to lavatory stations on the side wall to minimize hand water drip accumulation along the passenger circulation paths. Provide a Paper Towel Dispenser in compliance with ADA requirements.
E. Paper Towel Dispensers will be the primary drying source. Hand Dryer(s) are a secondary drying source and will be per specifications provided in section 10 28 00 of the Guide Specifications (Design & Construction Handbook).
F. Wall mounted soap dispensers are not allowed.
G. Restroom Layouts in new construction and restroom renovations where space permits will have thru counter trash drops located at both ends of lavatory/counters and typically at every two lavatory stations.
H. In restroom renovations where spatial limitations prohibit *item 1.11.G* above, a minimum two (2) trash drops for every three (3) wash stations will be provided.
I. Under exceptional circumstances and only when approved by LAWA, one (1) trash drop will be provided for every three (3) wash stations. Individual stainless steel framed mirrors (24”x48”) will be provided as shown in *Figure 1.9.2C* in new construction or sized and mounted from top of splash in restroom renovations.



NOTE: PREFERRED TOILET PARTITION DOOR WILL SWING OUT.
IN THE EVENT THAT SPACE DOES NOT PERMIT THIS AND A PARTITION DOOR MUST SWING IN, THIS DIAGRAM ILLUSTRATES THE COAT HOOK PLACEMENT IN THE DOOR SHADOW PREVENTING DOOR AND COAT HOOK IMPACT.

Figure 1.11C
SWING-IN PARTITION DOOR COAT HOOK

1.12 CIRCULATION SPACE

A. Circulation space between lavatory counter and toilet compartments will be 7’-0” minimum where feasible as shown in *Figure 1.12D.*

1.13 LACTATION ROOM

A. Restroom layouts in new construction and renovation projects will provide one (1) private Lactation Room for nursing mothers post security in each Terminal.
B. The Lactation Room will not be accessible from inside the Restrooms. It will be accessible from the main public circulation path or directly from the entrance vestibule to the Women’s Restroom.
C. Lactation Room door will not open directly onto Concourse or Ticketing areas as shown in *Figure 1.12D.*

D. A water closet is not allowed inside the Lactation Room.
E. The Lactation Room will have the following minimum amenities (in compliance with ADA requirements):
    i. Lavatory
    ii. Diaper Changing countertop
    iii. Paper Towel dispenser
    iv. Trash container/trash can
    v. Convenience GFI electrical duplex outlet located above the diaper changing countertop
    vi. One (1) single seat padded bench that will fit under the diaper changing countertop
F. Lactation Room finishes will match the Family Restroom as shown in *Figure 1.14*.

1.14 FAMILY RESTROOMS

A. One (1) separate single use Family Restroom will be provided in new construction and restroom renovations where space is available.
B. Family Restroom doors will not open directly onto Concourse or Ticketing areas as shown in *Figure 1.12D and 1.14*
C. A diaper changing countertop will be provided.
D. One (1) duplex outlet will be provided above the diaper changing countertop.
E. One (1) adult size ADA water closet will be provided.
F. One (1) child size water closet will be provided space permitting.
G. One (1) distress button in close proximity to the water closet with data connection to the LAX Airport Response Coordination Center (ARCC) will be provided.
H. One (1) single seat padded bench that will fit under the diaper changing countertop will be provided.

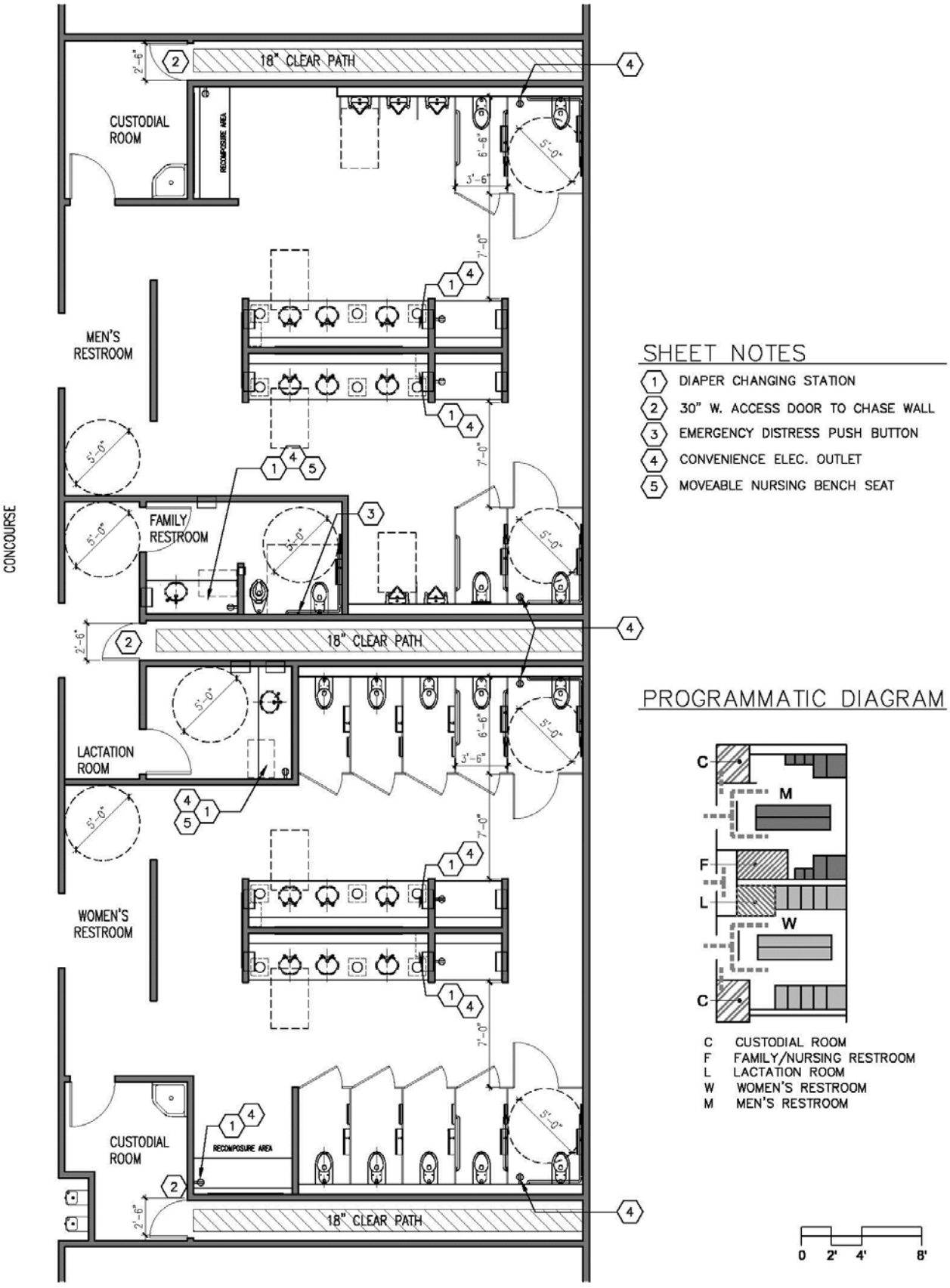


Figure 1.12D
RESTROOM CIRCULATION AND FLOOR PLAN PROGRAM

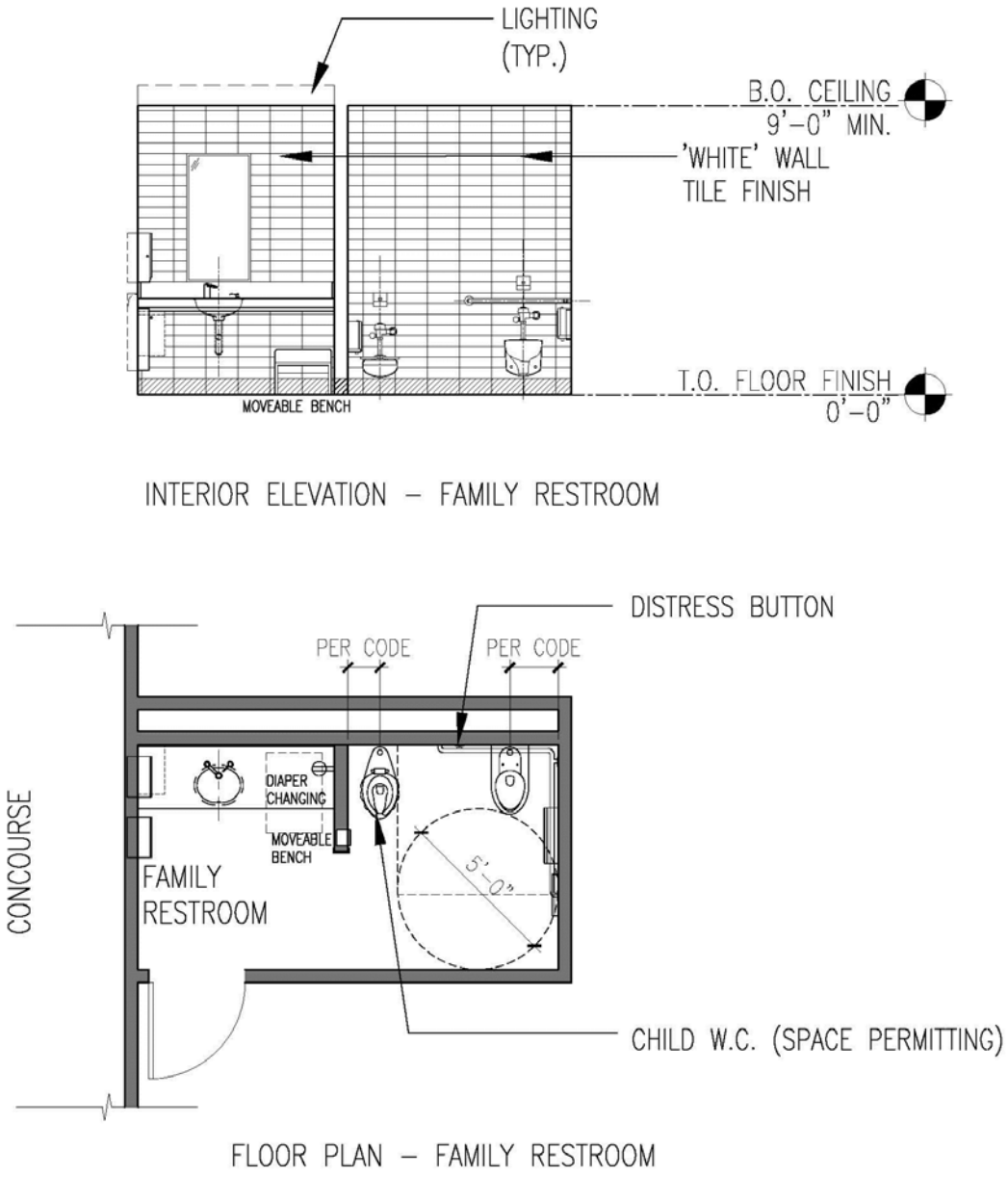


Figure 1.14
FAMILY RESTROOM PLAN AND ELEVATION

END OF SECTION

PUBLIC RESTROOMS, DESIGN INTENT

1.01 STRUCTURAL

A. Where feasible, metal stud partitions will be constructed on a 6" high concrete curb.

1.02 MECHANICAL

A. Restrooms will have a minimum of 15 air changes per hour.

1.03 PLUMBING

A. To the extent possible, water shut-off valves, temperature control valves, electrical transformers, etc. will be located within 30 horizontal inches of a ceiling access panel.
B. Alternative location of access panel will be located under the lavatory countertop concealed behind the stainless steel skirt.
C. Restroom Layouts in new construction and restroom renovations, where space permits, will incorporate a plumbing service chase with a minimum clearance of 18" from point of access to and behind all plumbing fixtures.
D. Plumbing service chase access will be through a door no less than 30" wide. Access to plumbing chase from inside restrooms rooms will be avoided.

1.04 ELECTRICAL

A. At least one (1) convenience GFI electrical outlet will be provided in at least one (1) ADA stall and one (1) above each diaper changing station.

1.05 LIGHTING

A. Continuous, wall to wall, indirect linear lighting will be installed above all lavatories, water closets, urinals and feature walls as the primary means of illuminating these areas.
B. All other required lighting is to be fully recessed within the ceiling.
C. Self-illuminating mirror, mirror edge lighting, wall sconce, or candelabra fixtures will not be used.

1.06 DOORS

A. Unless otherwise required by Building Code or if unique space constraints exist, doors will not be used to enter restrooms.
B. Restroom entry vestibules will have 48" wide minimum clear openings that are arranged to allow free-flow traffic without sightlines into the restrooms.
C. Where doors are required, doors, frames and hardware will be in compliance with the door and lock specifications provided in Section 08 00 00 of the Guide Specifications (Design & Construction Handbook).

1.07 CEILINGS

A. Ceiling heights will be 9'-0" minimum above finished floor.
B. Porous ceiling materials are not acceptable.
C. Ceiling will be cement plaster or water resistant gypsum board.
D. All ceilings will be painted.
E. All access panels, registers and grills will be painted to match ceiling.

1.08 TOILET PARTITIONS

A. Toilet partitions will be stainless steel as per specifications provided in section 10 21 13 of the Guide Specifications (Design & Construction Handbook).
B. Typical toilet stalls in new construction and in new restroom layouts in existing structures where space permits will be 3'-6" x 6'-6" as shown in *Figure 1.08B.*
C. Ambulatory and accessible stall widths will be sized to meet the applicable code requirements. In existing structures where spatial constraints do not permit the above, code requirements will govern.

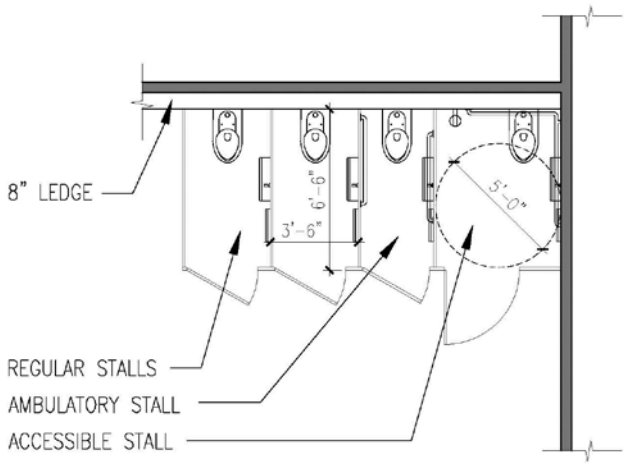


Figure 1.08B
PREFERRED TOILET STALL SIZES

D. Toilet partitions will be ceiling hung and rigidly fastened to structural steel supports concealed in ceiling plenum.
E. To limit partition racking, additional floor pedestal supports will be provided every 2-3 stalls.

1.09 FINISHES

1.09.1 Design Color Palette

A. Restrooms colors will be limited to three (3) distinguishable values of white to grey color scale (preferably warm grey), a single accent color in specific locations and natural finished stainless steel.
B. Restroom Vestibule/entry walls will be the darkest and richest value (i.e. Dark Grey). Floors and bases are to be the middle value (i.e. Medium Grey). Ceilings, wall field tile and lavatory/counters will be the lightest value (i.e. White).
C. Accent colors are to be a single hue or color of glass tile and are limited to above the water closets and on feature walls defined as single plane walls without openings, fixtures or accessories.
D. Each restroom is limited to (1) one color.

1.09.2 Walls

A. Wall tile finish assembly will be per the specifications provided in Section 09 30 00 of the Guide Specifications (Design & Construction Handbook).
B. Wall field tile will be ceramic tile laid up in a horizontally balanced and consistent pattern from corner to corner. Tile layout will start in the middle of the field (corner to corner) with either a grout joint or at the half point of a full tile; whichever will result in the widest end tiles. End tiles at each corner will have the same horizontal dimension. Rectangular tiles will be laid horizontally. Horizontal stack bond pattern is preferred. Wall field tile will start with a full tile above the wall base tile.
C. Wall field tile will be square or rectangular with no dimension less than 4".
D. Behind water closets, the wall field tile will be from top of wall base tile to approximately 60" above finish floor (AFF) and end with a full tile.
E. Behind water closets where wall field tile ends (approx. 60" AFF) glass color accent tile, starting with a full height tile, will run to the ceiling as shown in *Figure 1.09.2B.*
F. Glass Tile will be square or rectangular and with no dimension less than 4". Size and bond pattern of glass tile will match the field tile pattern where possible and course out with field tile in all cases.
G. If accent tile is used, it will be above 60" and run to the ceiling. If accent tile is not used, wall field tile will run to ceiling. No exposed wall finishes will be painted gypsum board.
H. Tile grout will be white for wall field tile and accent color tile.
I. Colored accent tile will only be used above urinals where urinals and water closets are on a common wall. In such cases, the ledges and accent color tile will be consistent from inside corner to inside corner.
J. Restroom layouts in new construction will have a solid surface ledge at approximately 60" AFF behind water closets and urinals and in existing structures where space permits. Ledge solid surface material will match the lavatory countertops.

K. Transitions from one material to another, or one color to another, will only occur at inside corners and at stainless steel cased openings between two adjacent spaces. The use of two colors or dissimilar materials is not permitted on walls in the same plane regardless of whether they are separated by a floor to ceiling stainless steel cased opening

L. Stainless Steel (306, No 6 Finish) flush corner guards will be used at all outside corner of all tile walls from top of wall base to ceiling. At the end of tiled partitions, single stainless steel end cap installed flush to the surface of the tile can be used in lieu of two flush corner guards.

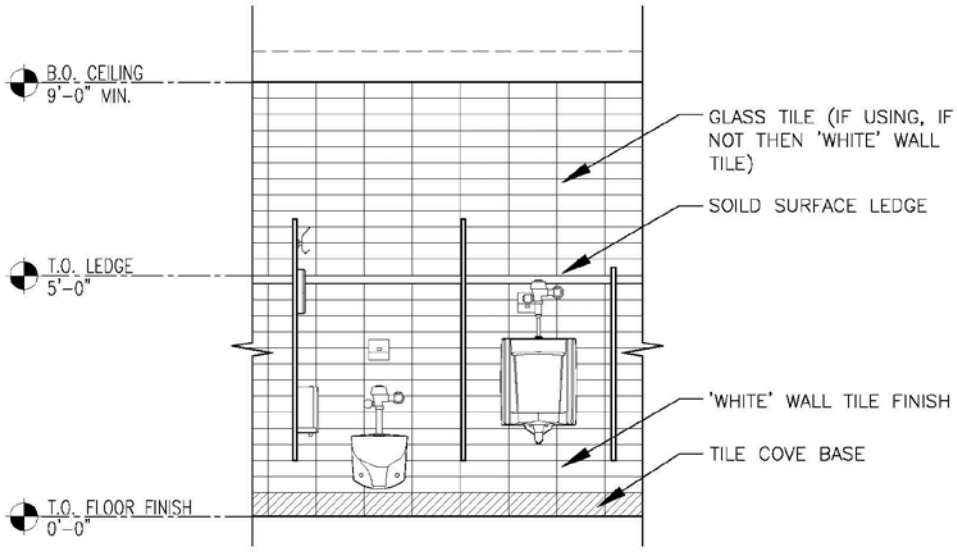


Figure 1.09.2B
WALL FINISH AT URINALS AND WATER CLOSETS

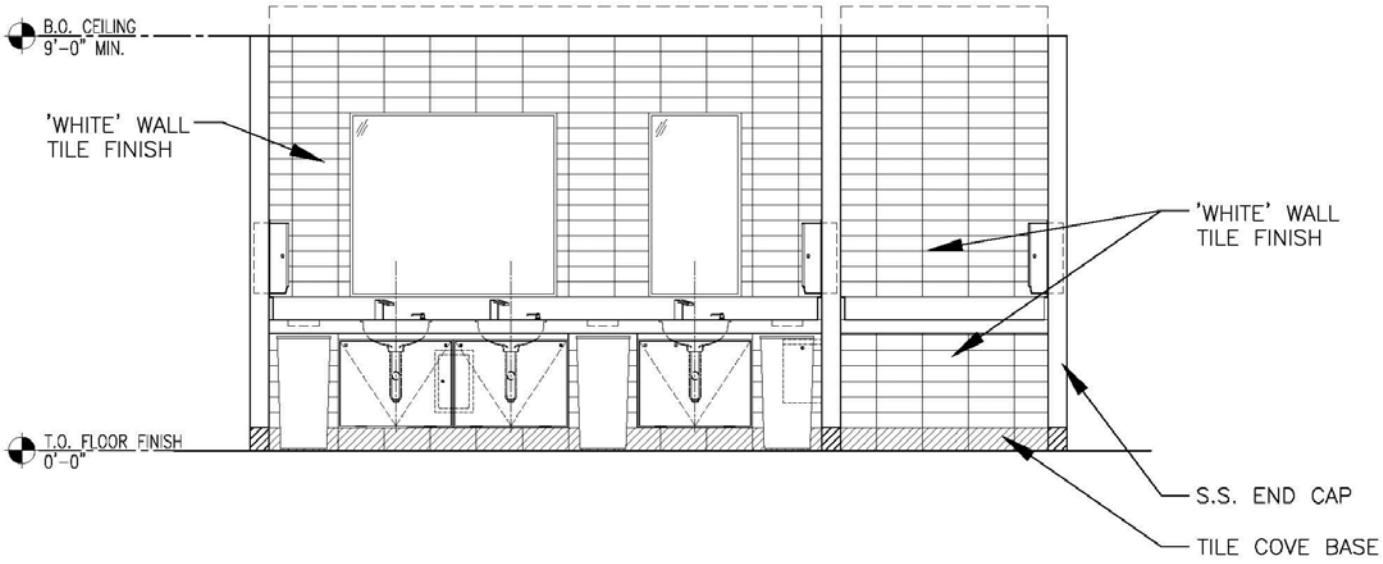


Figure 1.9.2C
WALL FINISH AT LAVATORIES

1.09.3 Floors

A. Floor tile finish assembly will be per the specifications provided in Section 09 30 00 of the Guide Specifications (Design & Construction Handbook).

B. Floor finish will have positive slope to floor drain(s).

C. Floor tile finish color will be **'Medium Grey'**.

D. Tile cove base will be provided and match floor tile and extend up the wall as shown in *Figure 1.9.3C.* Non-tile cove bases and cove strips are not acceptable.

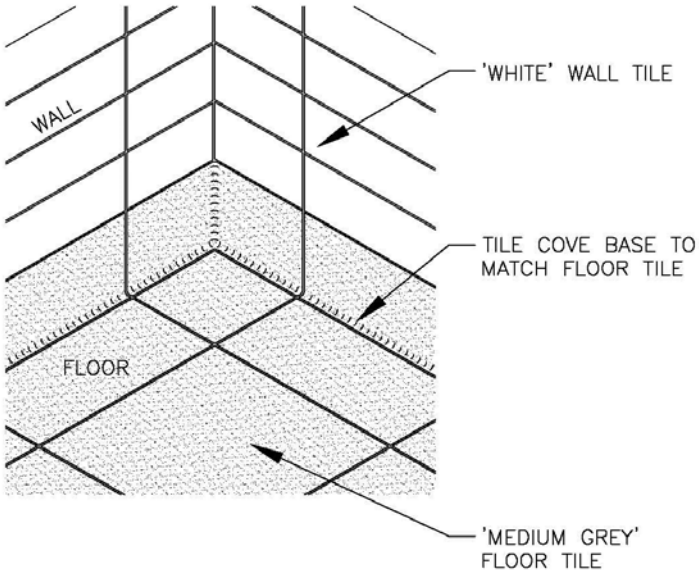


Figure 1.9.3C
TILE COVE BASE

1.10 UNDER COUNTERTOP LAVATORIES / TRASH DROP LAYOUTS

A. Restroom countertops will be per specifications provided in section 06 61 16 of the Guide Specifications (Design & Construction Handbook).
B. Restroom countertops will be solid surface acrylic polymer product.
C. Engineered stone is not acceptable.
D. All surfaces will have positive slope to drain(s).
E. A continuous integral splash will be provided at all walls adjacent to lavatories and trash drops.
F. A minimum 8 inch shelf will be provided above each lavatory.
G. Automatic faucet and soap dispenser will be installed at 45 degree angle from centerline of lavatory.
H. A circular stainless steel finished thru counter trash drops will be provided at the end of each pair of lavatory /wash stations.
I. A standard removable stainless steel trash receptacle will be provided under each trash drop.
J. Stainless steel trash receptacles shall be at least 29 inches tall, no more than 15 inches deep and no more than 14 inches wide.
K. No enclosure will be provided in front of trash receptacles.
L. One (1) bulk soap dispensing reservoir accessible with removal of the trash receptacle will be provided at each restroom.
M. A removable stainless steel skirting (matching the S.S. toilet partition pattern and finish) will meet ADA code requirements and will be provided under each lavatory to allow access to plumbing for maintenance purposes.
N. Clear dimension of 30-1/2" will be maintained from finish floor to bottom of counter for the full length of counter. Floor finish will be sloped to and from this line of demarcation to achieve positive slope to floor drain(s).

Alternate

1.10. LINEAR LAVATORIES / TRASH DROP LAYOUTS

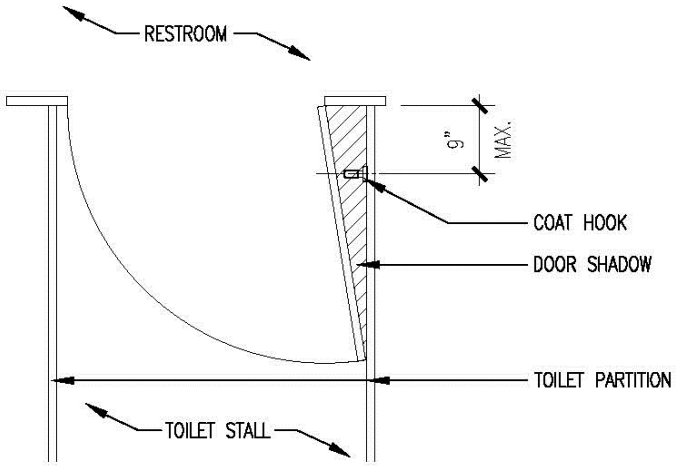
A. Linear lavatories will be provided in pairs and will be solid surface acrylic polymer solid product over suitable water resistant structure.
B. Engineered stone is not acceptable.
C. All surfaces of linear lavatories will all have positive slope to drain(s).
D. Linear lavatories will have a minimum of two drains located at opposite ends of the lavatory.
E. A continuous positive draining deck will be provided at the rear of the lavatory for mounting of faucet and soap dispenser.

F. A continuous integral splash will be provided at all walls adjacent to lavatories and trash drops.
G. A minimum 8 inch deep shelf will be provided above each lavatory.
H. Automatic faucet will be located on centerline of each wash station.
I. A soap dispenser will be provided at each lavatory wash station and located between the faucet and the drain point. Soap dispenser finish will match the faucet.
J. A circular stainless steel finished thru-counter trash drops will be provided at the end of each pair of lavatory/wash stations.
K. A standard removable stainless steel trash receptacle will be provided under each trash drop.
L. Stainless steel trash receptacles wall be at least 29 inches tall, no more than 15 inches deep and no more than 14 inches wide.
M. No enclosure is to be provided in front of trash receptacles.
N. One (1) bulk soap dispensing reservoir accessible with removal of the trash receptacle will be provided at each restroom.
O. A removable stainless steel skirting (matching the S.S. toilet partition pattern and finish) meeting ADA code requirements will be provided under each lavatory to allow access to plumbing for maintenance purposes.
P. Clear dimension of 30-1/2" will be maintained from finish floor to bottom of counter for the full length of counter. Floors will be sloped to and from this line of demarcation to achieve positive flow to floor drain(s).

See separate 'Linear Lavatory' document

1.11 ACCESSORIES

A. All Public Restrooms will be equipped with a diaper changing station. Location of diaper changing station preferential order:
   (i) Along main circulation path: solid surface fixed-type ledge/countertop with no depressions, stainless steel with a front lip
   (ii) Along main circulation path: Recessed, stainless steel, "flip down" model
   (iii) In ADA stall: Recessed, stainless steel, "flip down" model
B. Coat hooks will bear 150# weight, installed on latch side of the toilet stall where partition door opens out. If partition door opens in, coat hook will be installed on the hinge side in the door shadow free and clear of partition door impact as shown in *Figure 1.11C*. At end conditions where adjacent wall is demising, coat hook to be on adjacent demising wall and clear of partition door impact. Coat hooks will be anchored to integral structural members inside the toilet partitions sized to carry the load.
D. Paper Towel Dispensers will be located over the lavatory countertop, adjacent to lavatory stations on the side wall to minimize hand water drip accumulation along the passenger circulation paths. Provide a Paper Towel Dispenser in compliance with ADA requirements.
E. Paper Towel Dispensers will be the primary drying source. Hand Dryer(s) are a secondary drying source and will be per specifications provided in section 10 28 00 of the Guide Specifications (Design & Construction Handbook).
F. Wall mounted, liquid or foam filled, self-contained soap dispensers are not allowed. Soap reservoir with tubing system to each soap dispenser located adjacent to lavatory faucets will be used. The soap dispenser finish will match lavatory faucet finish.
G. Restroom Layouts in new construction and restroom renovations where space permits will have thru counter trash drops located at both ends of lavatory/counters and typically at every two lavatory stations.
H. In restroom renovations where spatial limitations prohibit *item 1.11.G* above, a minimum two (2) trash drops for every three (3) wash stations will be provided.
I. Under exceptional circumstances and only when approved by LAWA, one (1) trash drop will be provided for every three (3) wash stations. Individual stainless steel framed mirrors (24"x48") will be provided as shown in *Figure 1.9.2C* in new construction or sized and mounted from top of splash in restroom renovations.



NOTE: PREFERRED TOILET PARTITION DOOR WILL SWING OUT.
IN THE EVENT THAT SPACE DOES NOT PERMIT THIS AND A PARTITION DOOR MUST SWING IN, THIS DIAGRAM ILLUSTRATES THE COAT HOOK PLACEMENT IN THE DOOR SHADOW PREVENTING DOOR AND COAT HOOK IMPACT.

Figure 1.11C
SWING-IN PARTITION DOOR COAT HOOK

1.12 CIRCULATION SPACE

A. Circulation space between lavatory counter and toilet compartments will be 7'-0" minimum where feasible as shown in *Figure 1.12D.*

1.13 LACTATION ROOM

A. Restroom layouts in new construction and renovation projects will provide one (1) private Lactation Room for nursing mothers post security in each Terminal.
B. The Lactation Room will not be accessible from inside the Restrooms. It will be accessible from the main public circulation path or directly from the entrance vestibule to the Women's Restroom.
C. Lactation Room door will not open directly onto Concourse or Ticketing areas as shown in *Figure 1.12D.*
D. A water closet is not allowed inside the Lactation Room.
E. The Lactation Room will have the following minimum amenities (in compliance with ADA requirements):
    i. Lavatory
    ii. Diaper Changing countertop
    iii. Paper Towel dispenser
    iv. Trash container/trash can
    v. Convenience GFI electrical duplex outlet located above the diaper changing countertop
    vi. One (1) single seat padded bench that will fit under the diaper changing countertop
F. Lactation Room finishes will match the Family Restroom as shown in *Figure 1.14*.

1.14 FAMILY RESTROOMS

A. One (1) separate single use Family Restroom will be provided in new construction and restroom renovations where space is available.
B. Family Restroom doors will not open directly onto Concourse or Ticketing areas as shown in *Figure 1.12D and 1.14*
C. A diaper changing countertop will be provided.
D. One (1) duplex outlet will be provided above the diaper changing countertop.
E. One (1) adult size ADA water closet will be provided.
F. One (1) child size water closet will be provided space permitting.
G. One (1) distress button in close proximity to the water closet with data connection to the LAX Airport Response Coordination Center (ARCC) will be provided.
H. One (1) single seat padded bench that will fit under the diaper changing countertop will be provided.

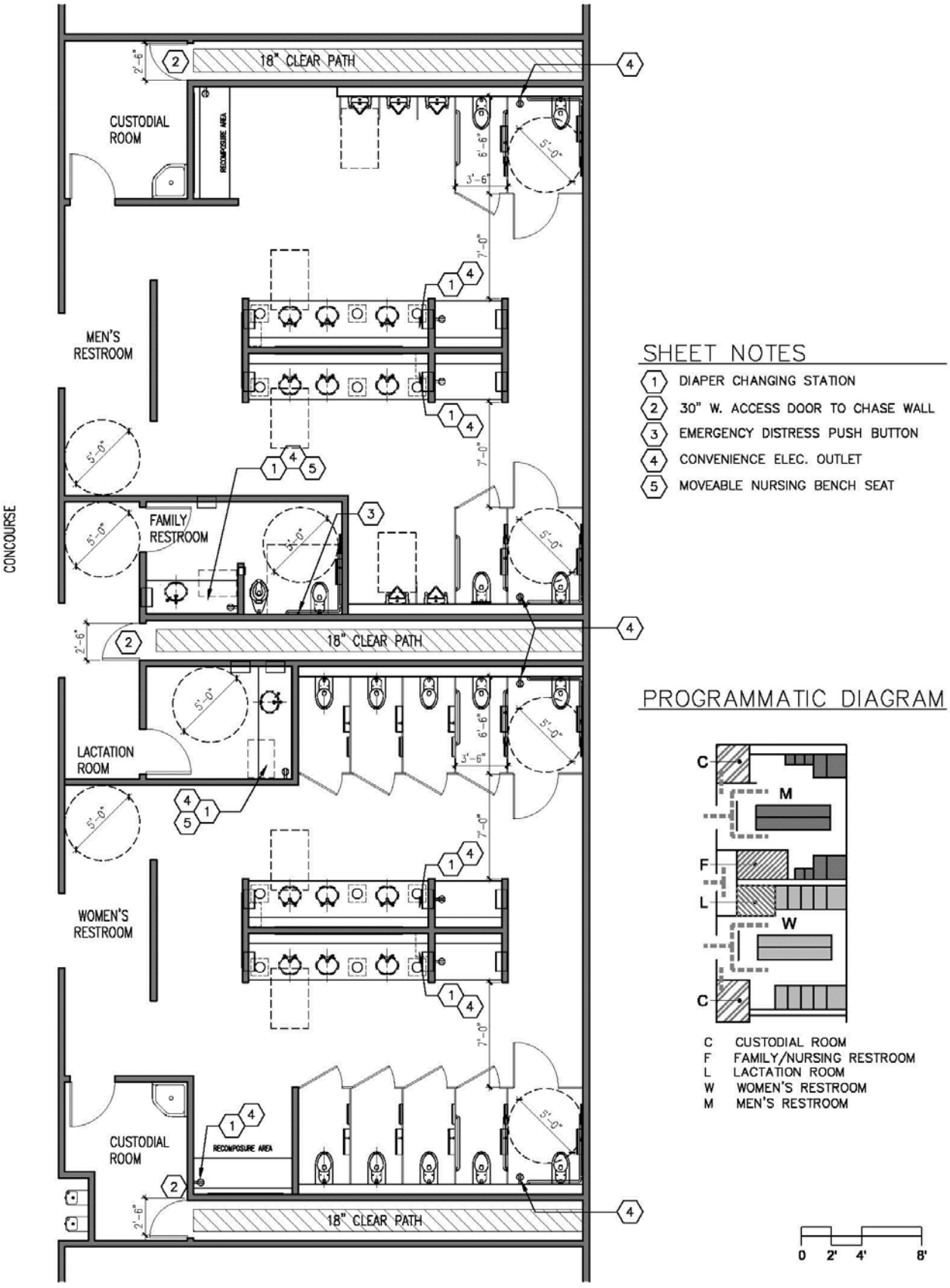
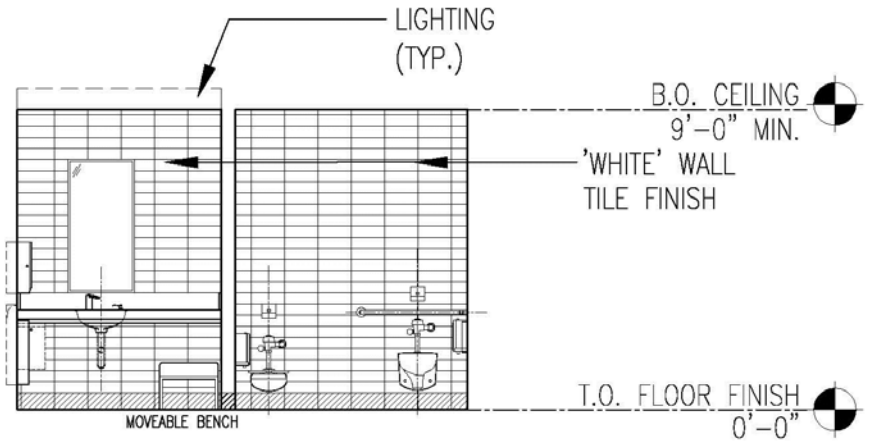
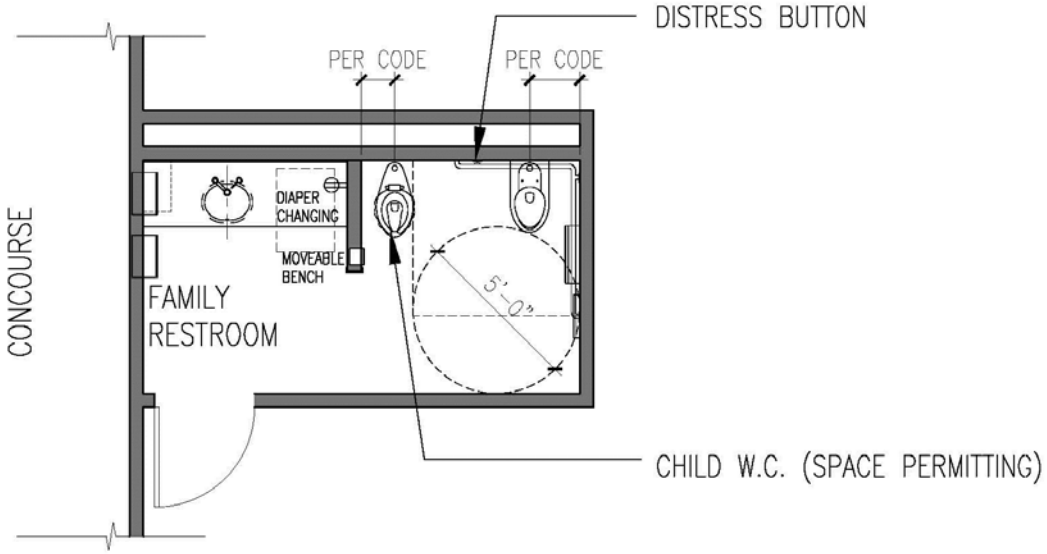


Figure 1.12D
RESTROOM CIRCULATION AND FLOOR PLAN PROGRAM



INTERIOR ELEVATION – FAMILY RESTROOM



FLOOR PLAN – FAMILY RESTROOM

Figure 1.14
FAMILY RESTROOM PLAN AND ELEVATION

END OF SECTION

LAWA DESIGN GUIDELINES FOR LINEAR LAVATORIES

Los Angeles World Airports

DRAFT

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Introduction

Over the last several months a great deal of effort has been expended to develop a linear lavatory design that is compatible with the New LAWA Toilet Room Standards. This guideline document is the culmination of that effort and is to be used in laying out future public toilet rooms through LAX.

The design reflected in this document has been developed to address, LAWA's aesthetic vision for the future, ergonomics, compliance with ADA, convenience, durability, aesthetics, durability of materials, performance and ease of maintenance. To the greatest extent possible it is prescriptive to insure consistency which best serves LAWA.

There a number of significant elements to the approved design. One of the most significant is the incorporation of multiple thru counter tr*a*sh drops immediately adjacent to each wash station to minimize water on the floor and maximize hidden waste towel capacity. Another significant element of the design is the incorporation of a shelf above and behind the cleaning station immediately under the mirror. The following is a list of significant elements that are important to the multitude of stakeholders who have been a part of this exercise.

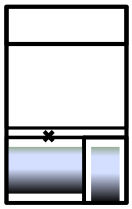
1. Ergonomics
2. ADA compliance
3. One to one relationship of wash stations to trash drops
4. Purse shelf
5. Mechanically fastened framed mirrors
6. Continuous recessed linear light fixture
7. 30 inch tall trash receptacles with no surrounding enclosure
8. No stainless steel ring at trash drop
9. Easily removable, light weight, keyed stainless steel skirt panels to conceal plumbing
10. White solid surface material lavatory (Dupont Corian: Antarctic or equivalent)
11. Wall mounted automatic faucet with polished chrome finish
12. Wall mounted pump soap dispenser with polished chrome finish
13. Easily accessible Bobrick concealed soap reservoir
14. Solid surface drain cover
15. Semi recessed paper towel dispenser

Layout and Configuration

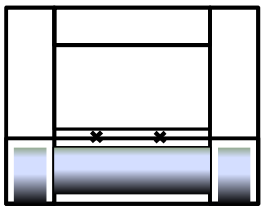
In new toilet room layouts the use of standard lavatory/trash drop configurations are mandated. Where space constraints make compliance with the preferred standard layout of wash stations and trash drops, in either stand alone or ganged configuration, non-standard layout configurations may be used with LAWA authorization. LAWA authorization will be on a case by case basis. Permission to deviate from the standard in one location is not universal or applicable to other toilet room layouts.

Stand-Alone Modules

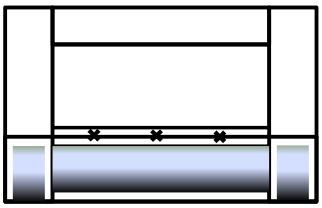
There are three Standard Stand-Alone Modules; A Standard Single, Double and Triple Module. The Standard Single Module is asymmetrical with a trash drop to the side of a single wash station and a wall to wall mirror and purse shelf. The Standard Double and Triple Modules are symmetrical with trash drops flanking two wash stations.



Single



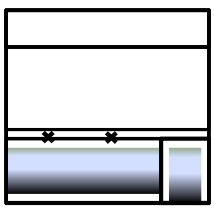
Double



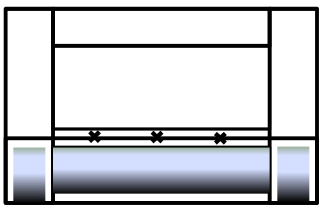
Triple

Non-Standard Stand-Alone Modules

There are two atypical Non-Standard Stand-Alone Modules for use where space and/or fixture requirements make compliance with the preferred standard layout of wash stations and trash drops impossible or excessive. The Non-Standard Double has two wash stations with a single trash drop to one side and a wall to wall purse shelf and mirror. The Non-Standard Triple has three wash stations with trash drops at each end.



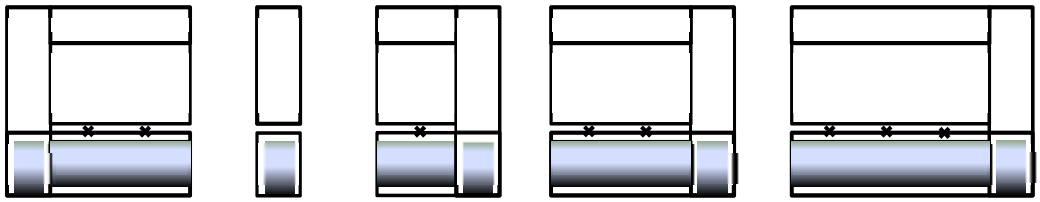
Double



Triple

Standard Gang Configurations

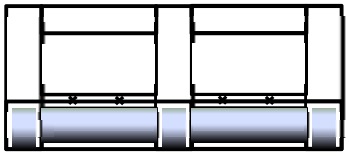
Where more than three wash (lavatory) stations are required, standard single, double and triple modules are to be ganged together or added to a Double Gang Base Module.



Double Gang Base | Intermed Drop | Single Gang | Double Gang | Triple Gang

Standard Ganged Configurations for 4, 5, 6 and 7 wash station configurations are shown for your convenience.

4



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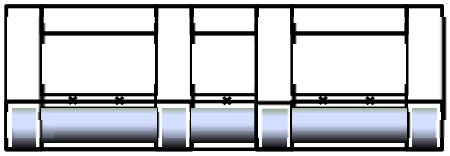

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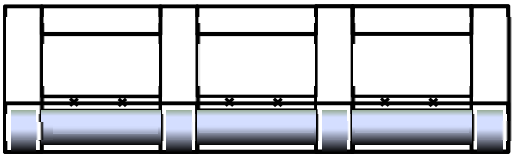

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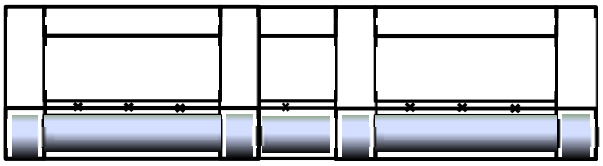
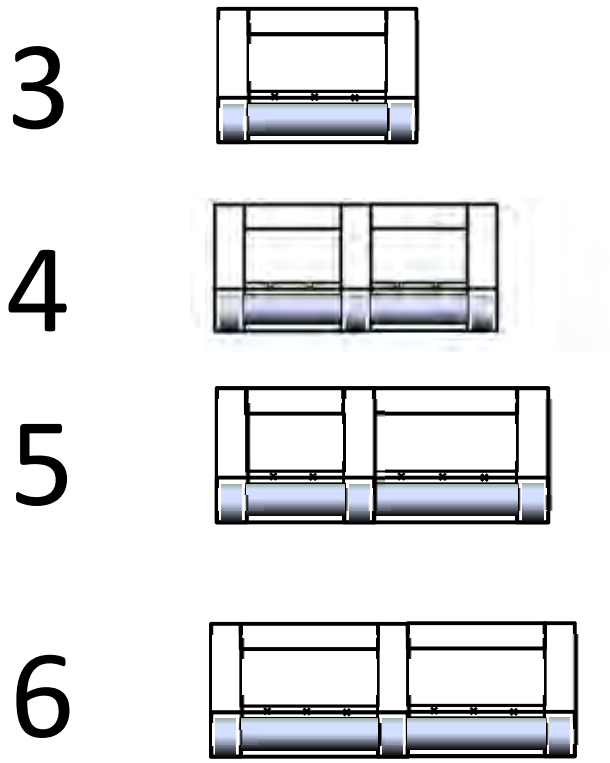


Limited Space Applications

Limited Width

The following are Non-standard Gang Configurations for use where space constraints make compliance with the preferred standard gang configurations **impossible** the following can be used with LAWA authorization.



Non-Standard Gang Configurations

Limited Depth

In existing space constraints in existing toilets make compliance with the preferred lavatory with purse shelf **impossible**, the purse shelf may be omitted and all other aspects of the design remain unchanged. This will save approximately 9 inches in depth but makes it impossible to mount the soap reservoir under the trash drop as preferred. In such cases a remote location must be found in the immediate area for the soap reservoir. In some cases the reservoir may be located in an adjacent janitor's closet, under the counter in the family restroom or a designated closet accessible to maintenance staff.

Materials, Finishes, Hardware, Fixtures and Accessories

Tile:	Product: Ceramic white rectilinear tile. Installation: stack bond preferred.
Grout:	Product: Urethane Based Grout (non- sanded) Finish: White
End Wall Cap:	Product: 14 Gauge, 304 Stainless Steel Finish: No. 6 Brushed
Tile Corner:	Product: Schluter Jolly Trim (or equal) Finish: Stainless Steel or PVC White.
Solid Surface Material:	Product: Du Pont Corian (or equal) Finish: Antarctica White
Stainless Steel Skirt:	Product: 304 Stainless Steel adhered to ½" phenolic panel backing. Finish: Stamped Pattern 5wl

Hardware

Lock:	Product: Keyed Cam Lock with removable Key Core per LAWA Standards. Finish: Chrome Plated
Hinges:	Product: 2-1/4" – 3" Lift-Off Case Hinges Finish: 304 Stainless Steel

Fixtures

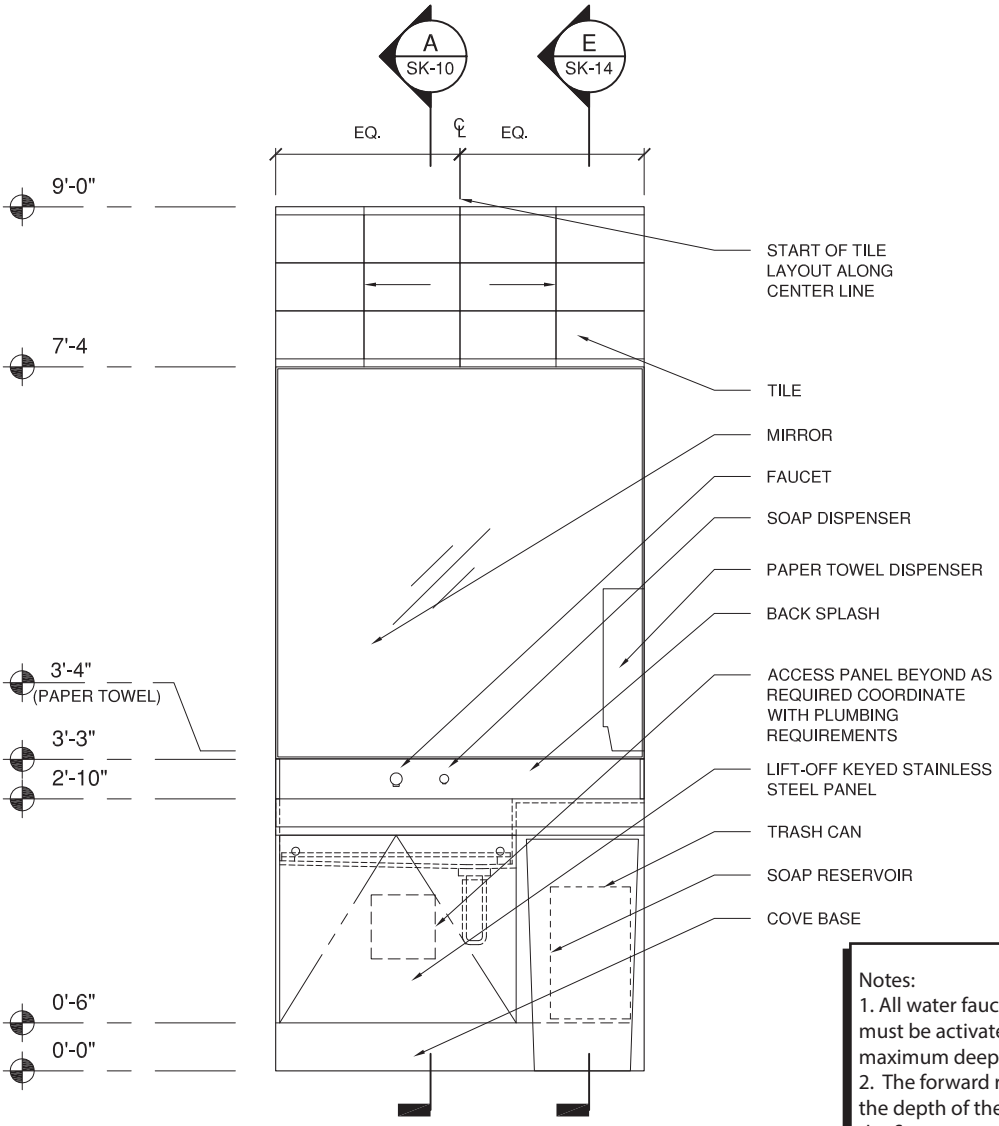
Automatic Faucet:	Product: Wall Mounted Electronic Sensor Faucet, Finish: Polish Chrome. Reference: Section 22 40 00-Plumbing Fixtures of the LAWA DCH
Soap Dispenser:	Product: Wall Mounted Pump Activated Soap Dispenser Finish: Polished chrome. Reference: Section 22 40 00 Plumbing Fixtures, LAWA DCH

Accessories

Trash Can:	Product: 14 x 14 x 30 Stainless Steel Trash Bin Finish: Brushed Reference: Section 10 28 00 Toilet Accessories, LAWA DCH
Towel Dispenser:	Product : Finish: Brushed Stainless Steel Reference Section 10 28 00 Toilet Accessories, LAWA DCH

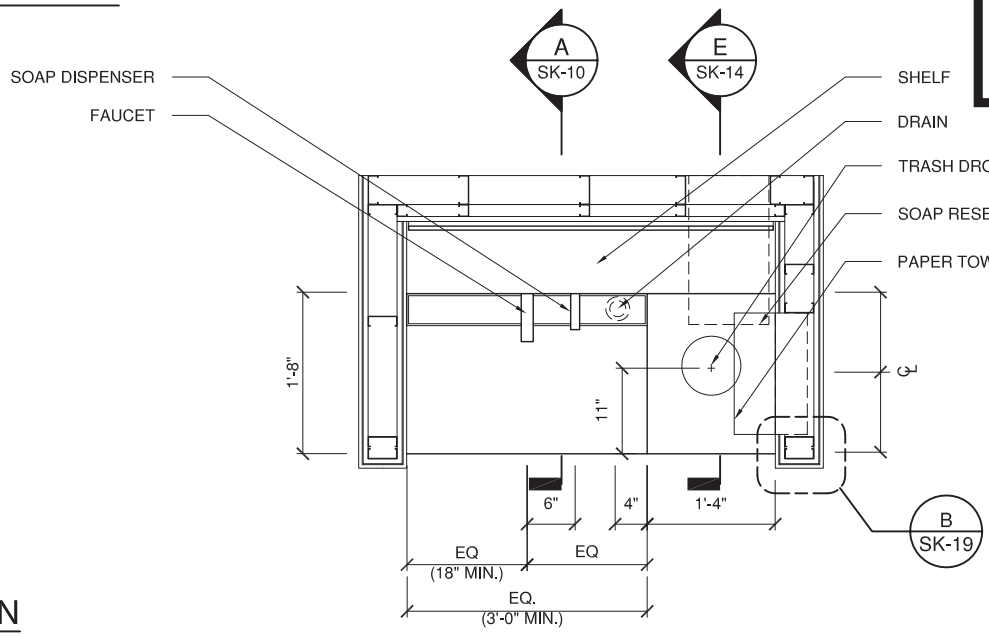
Accessories Cont.:

Soap Delivery System:	Product: Soap Dispensing System Reference Section 10 28 00 Toilet Accessories, LAWA DCH
Mirror:	Product: Mechanically Hung Vandal Resistant Framed Mirror Finish: Polished SS Frame Reference: Section 10 28 00 Toilet Accessories, LAWA DCH



ELEVATION

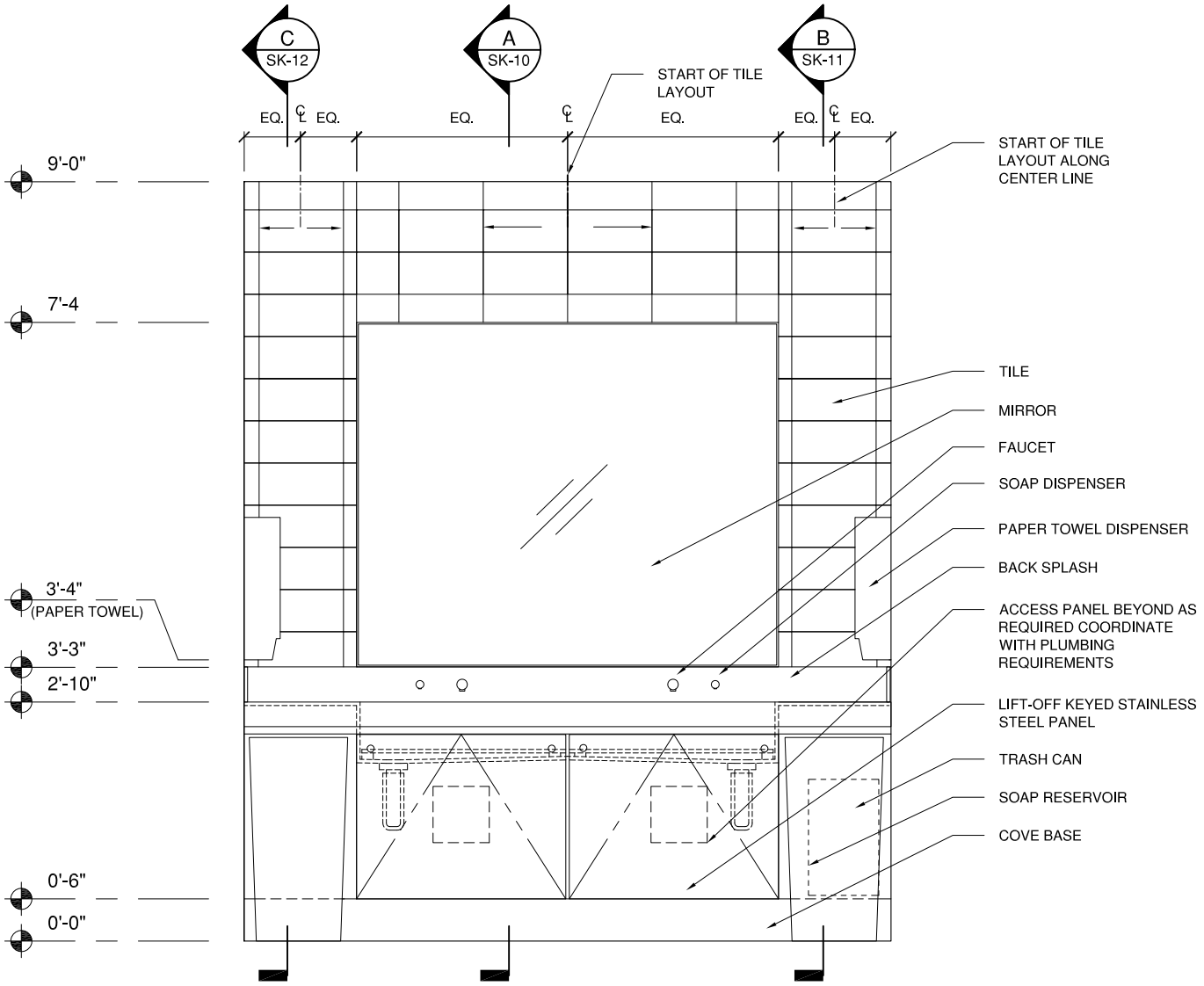
Notes:
1. All water faucets and soap dispensers must be activated within the 17″ ADA maximum deep reach.
2. The forward reach depth may not exceed the depth of the clear floor space beneath the fixture.
3. Paper towel dispensers must be mounted so that its highest operable part is within 40″ AFF per ADA.



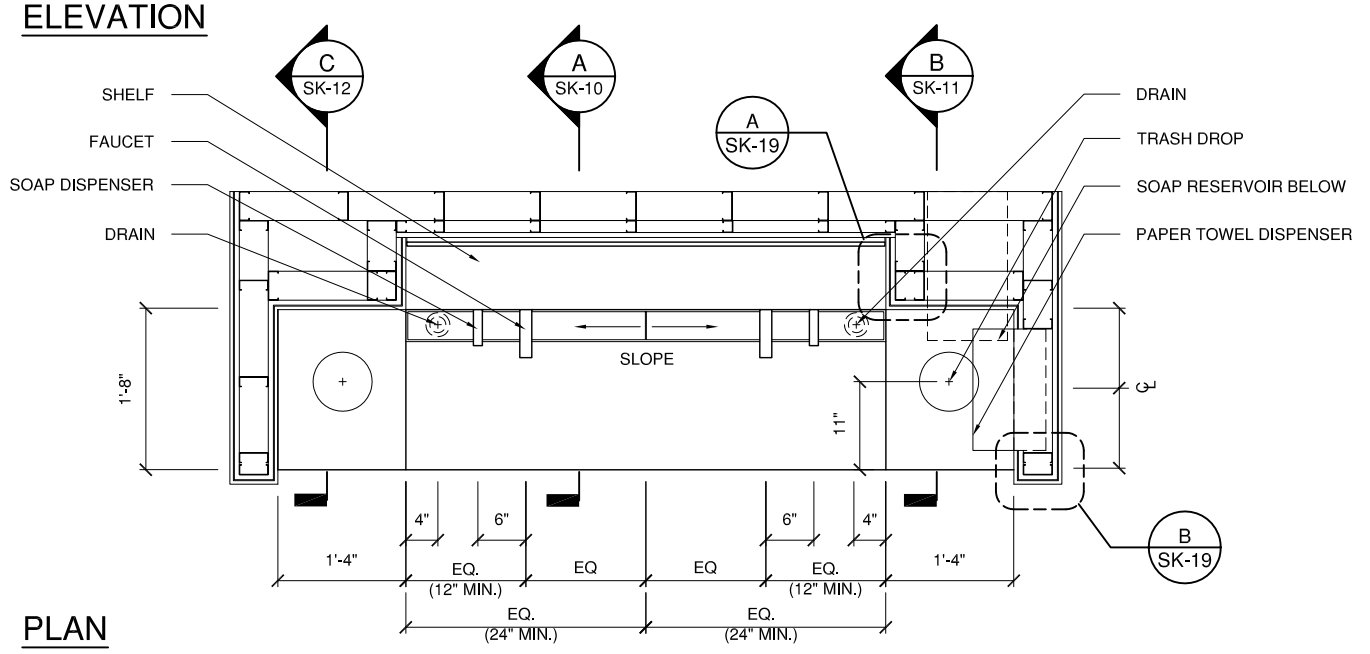
PLAN

SINGLE STAND-ALONE MODULE

SHEET
SK-01



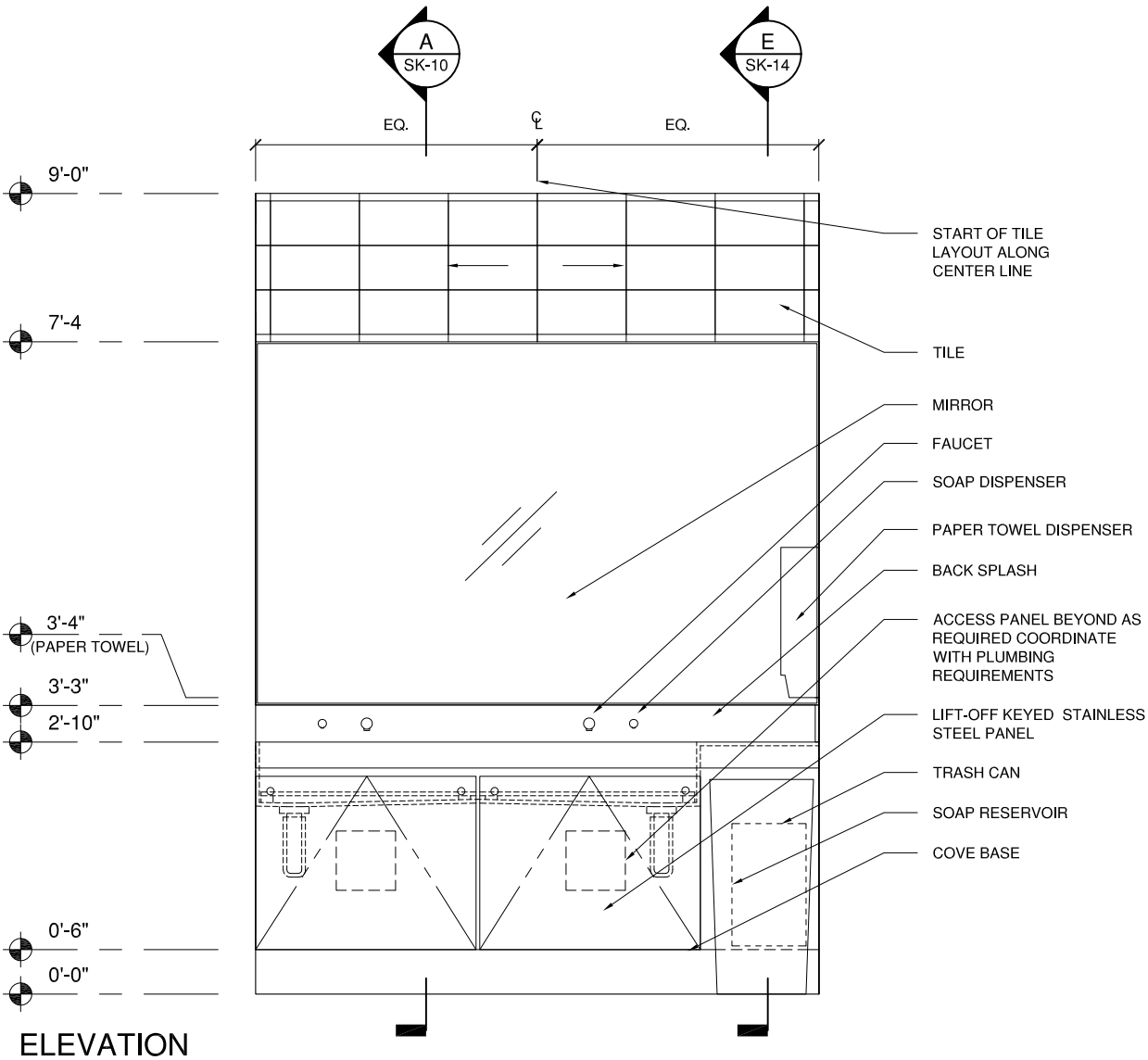
ELEVATION



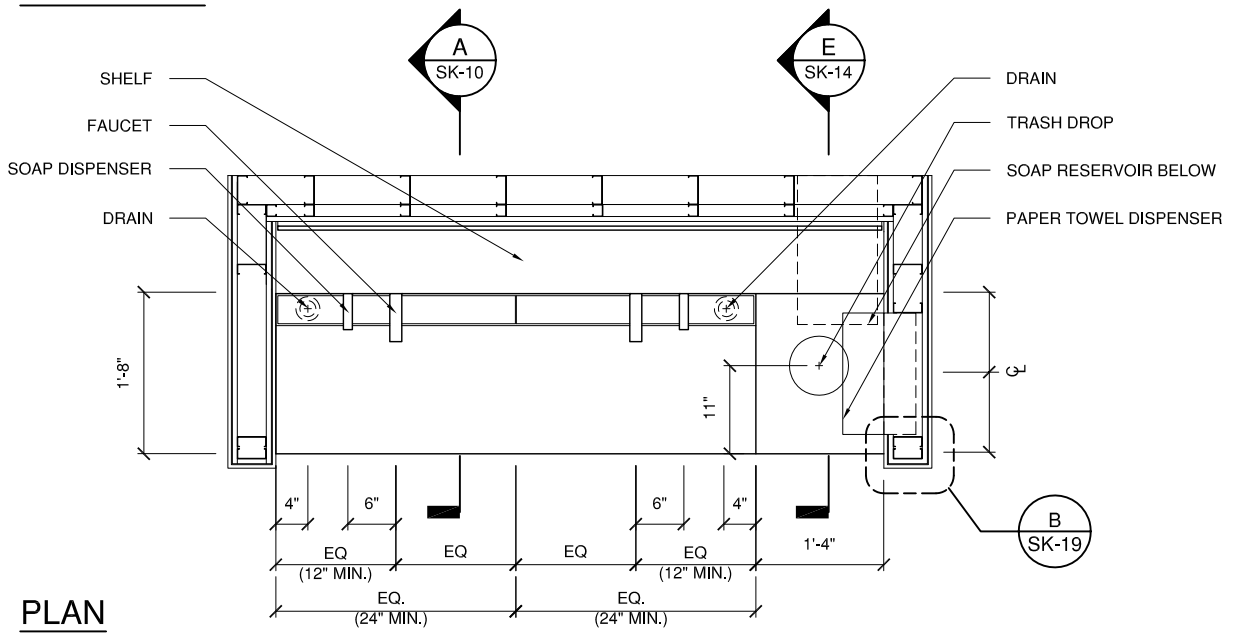
PLAN

DOUBLE STAND-ALONE MODULE

SHEET
SK-02



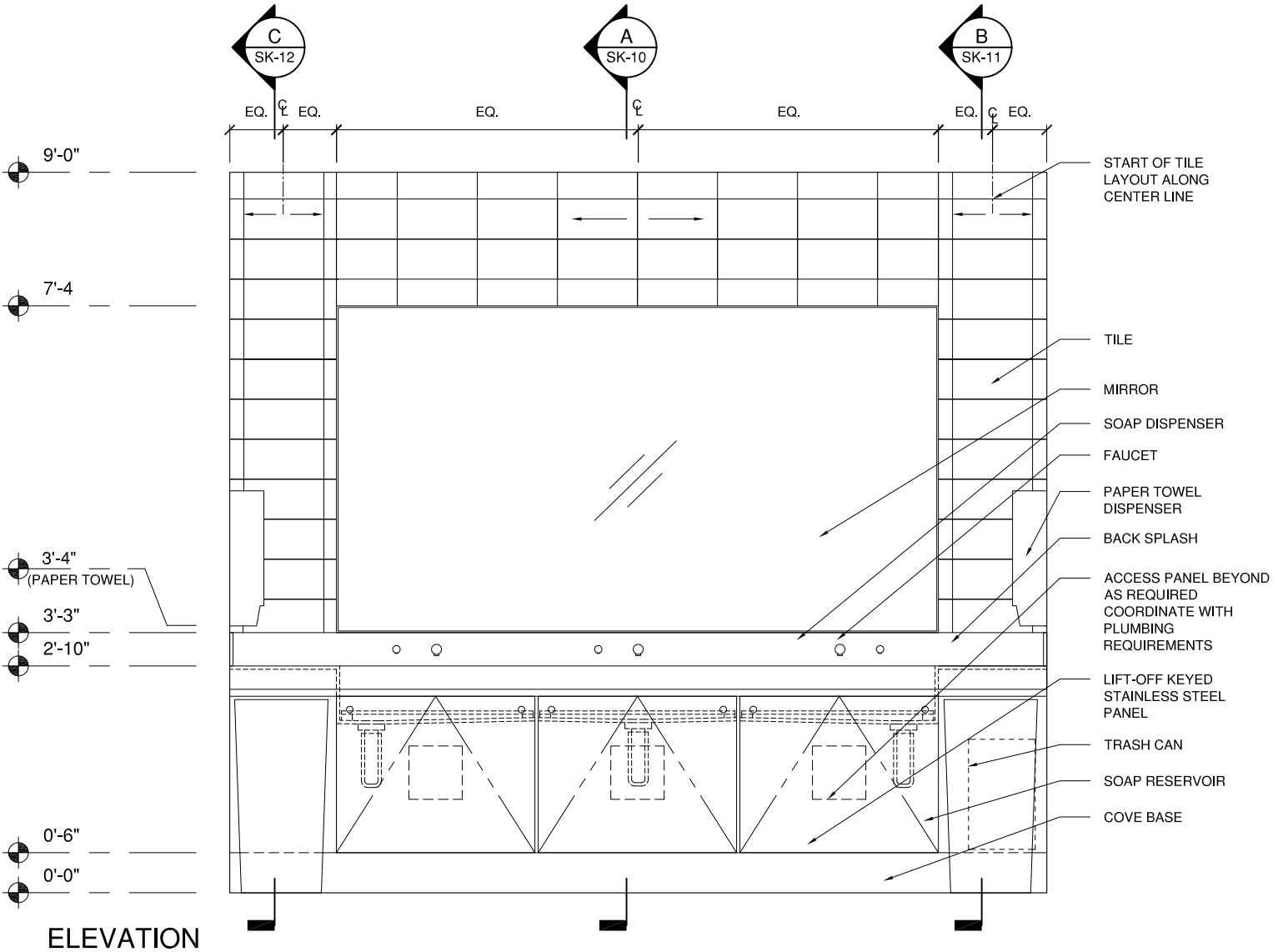
ELEVATION



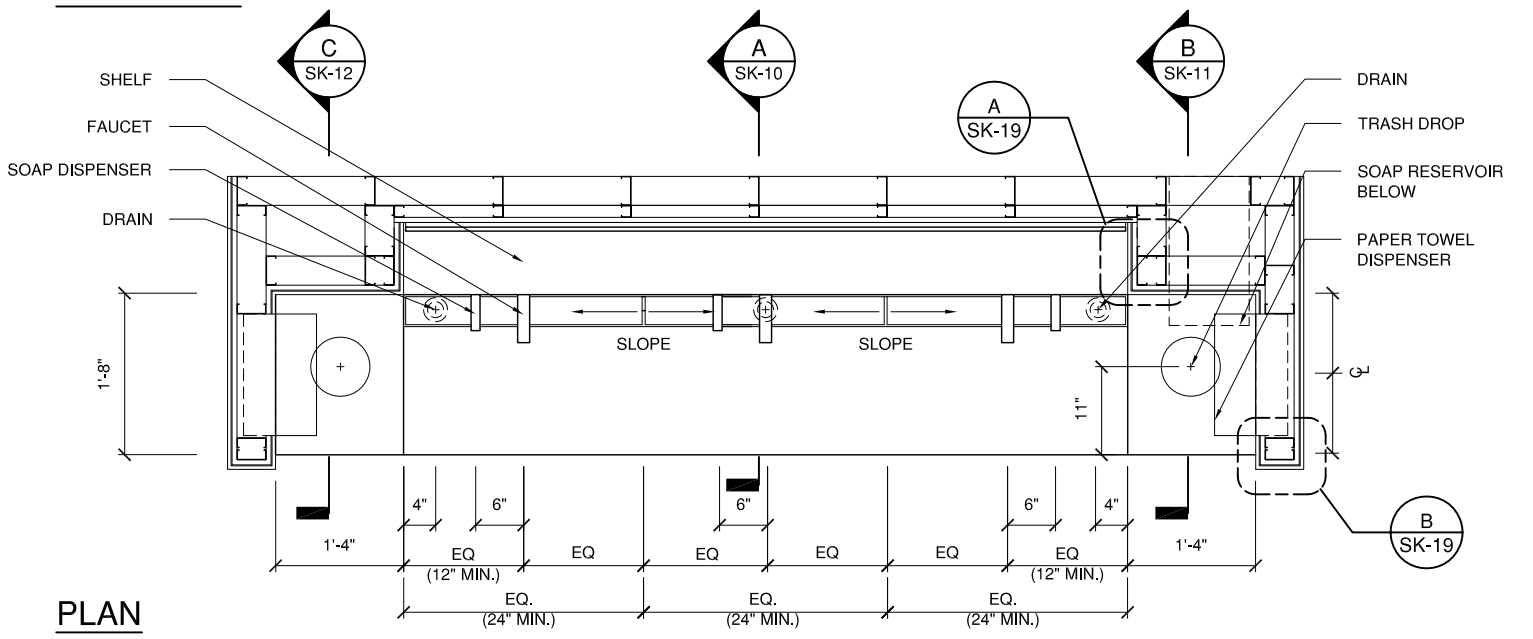
PLAN

NON STANDARD
DOUBLE STAND-ALONE MODULE

SHEET
SK-03



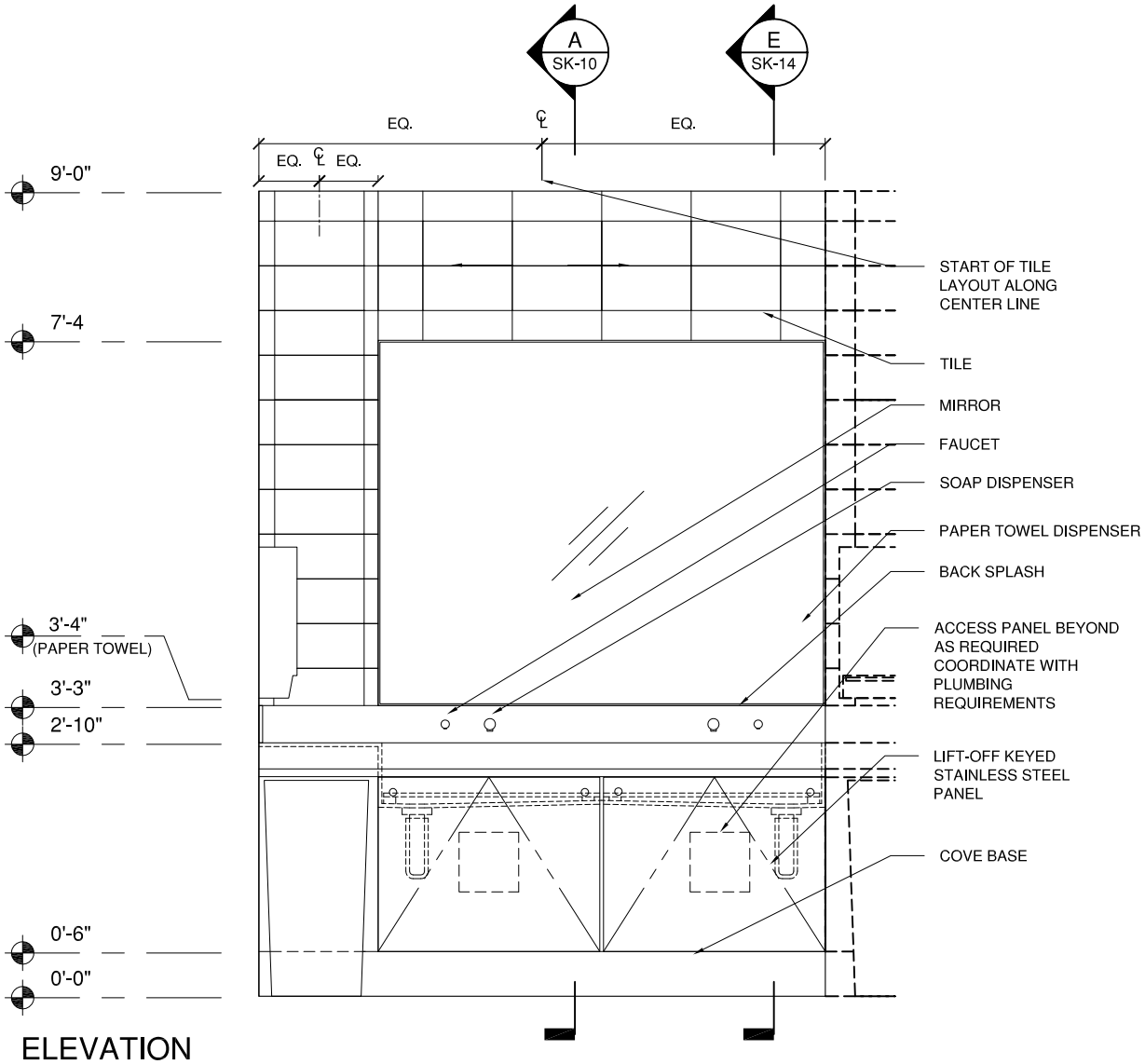
ELEVATION



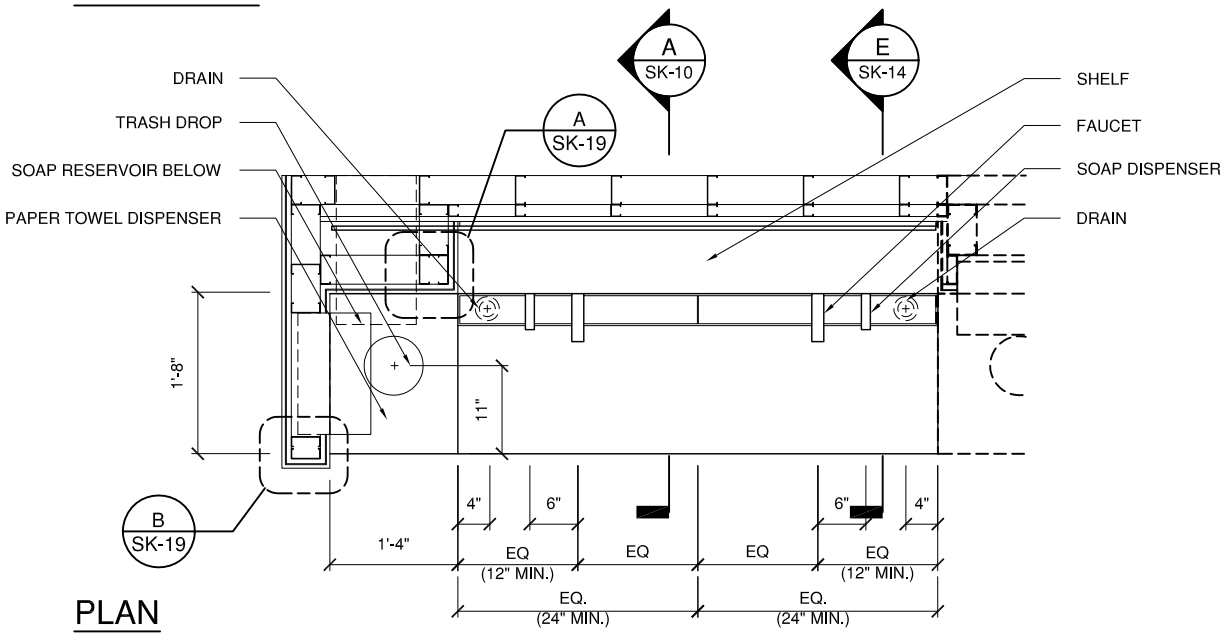
PLAN

NON STANDARD
TRIPLE STAND-ALONE MODULE

SHEET
SK-04



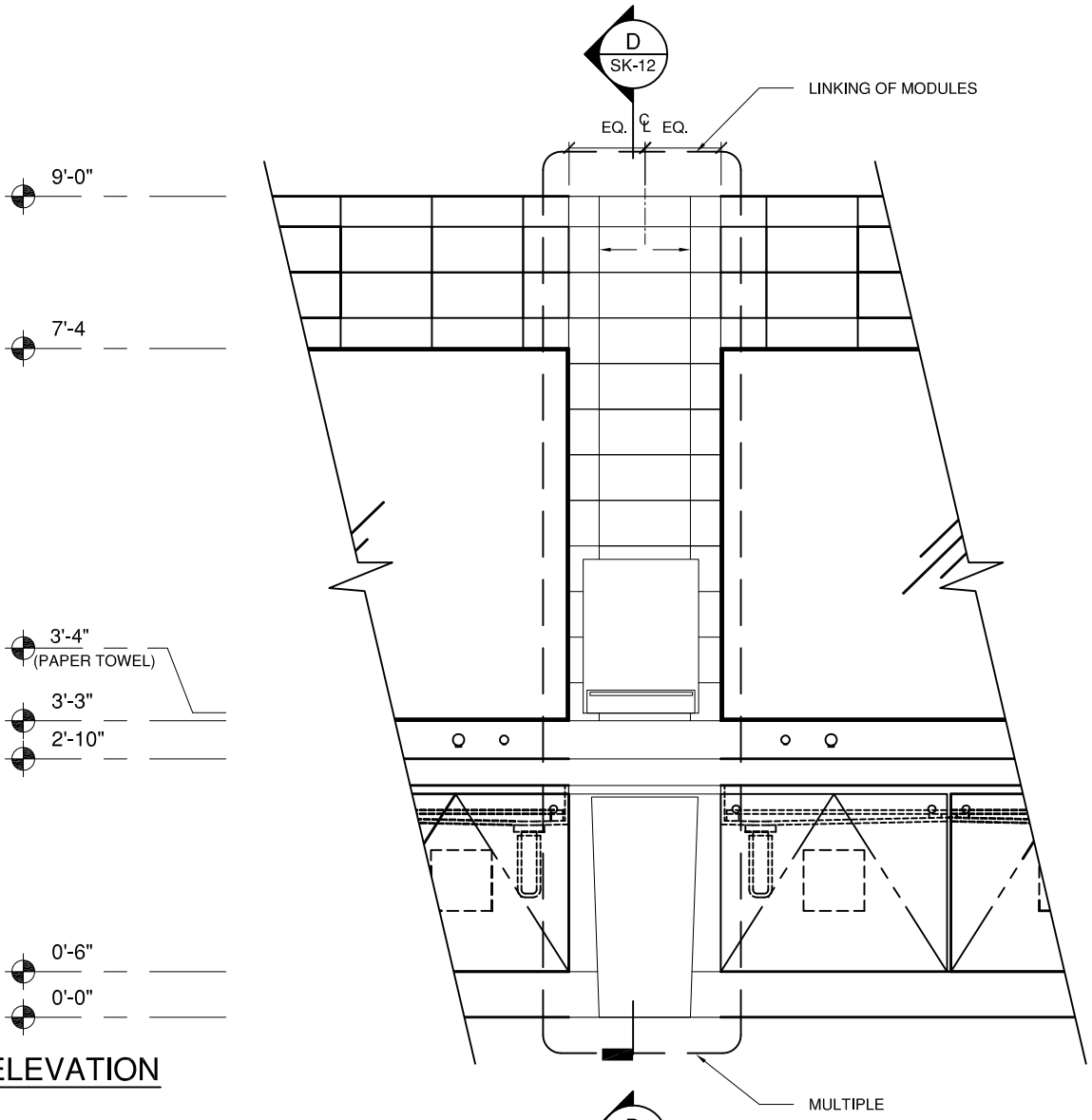
ELEVATION



PLAN

DOUBLE GANG BASE

SHEET
SK-05



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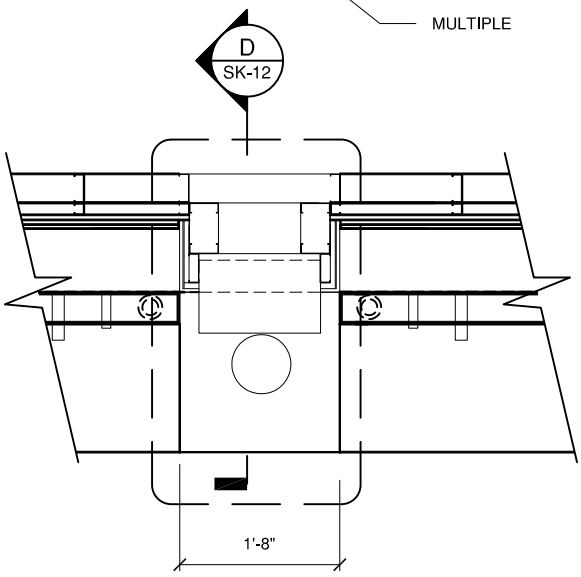
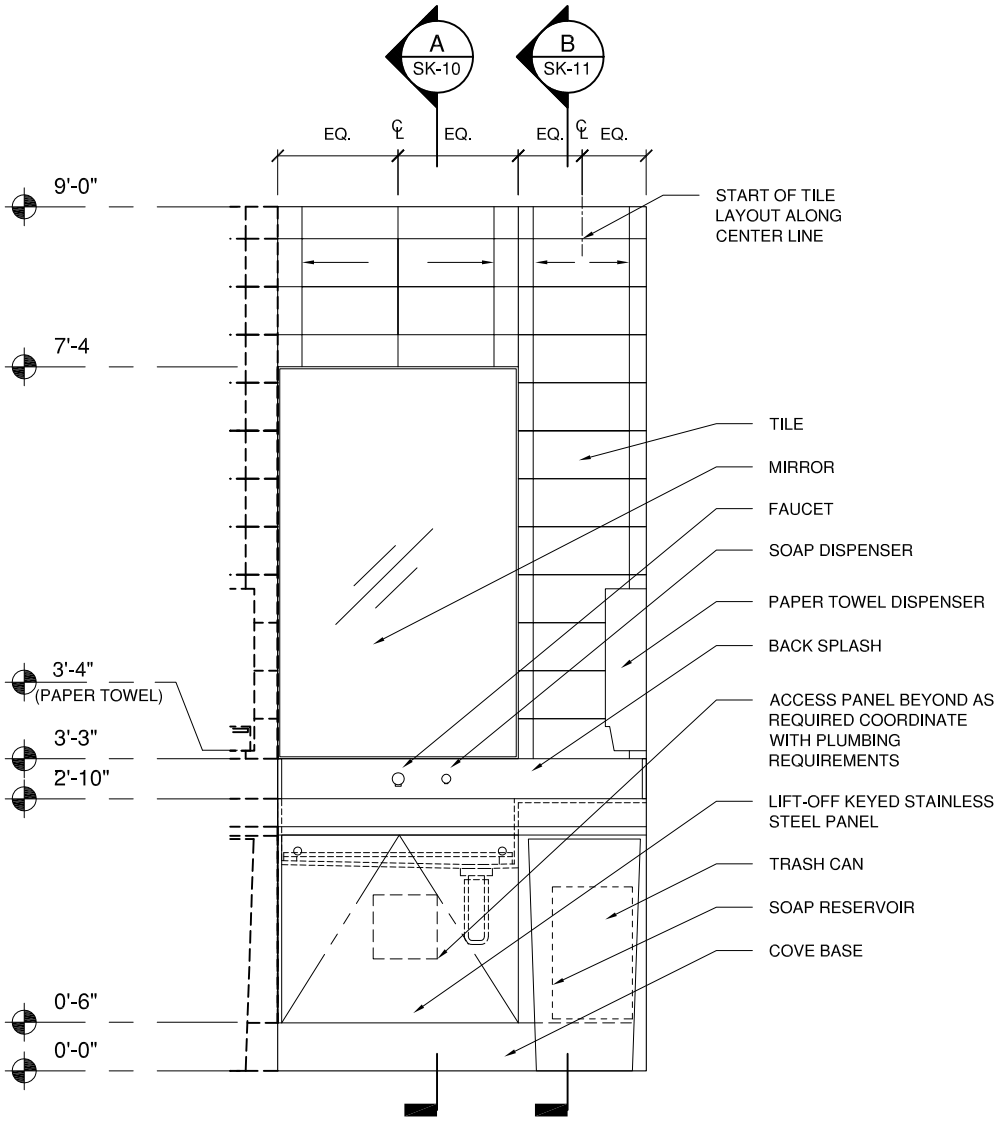


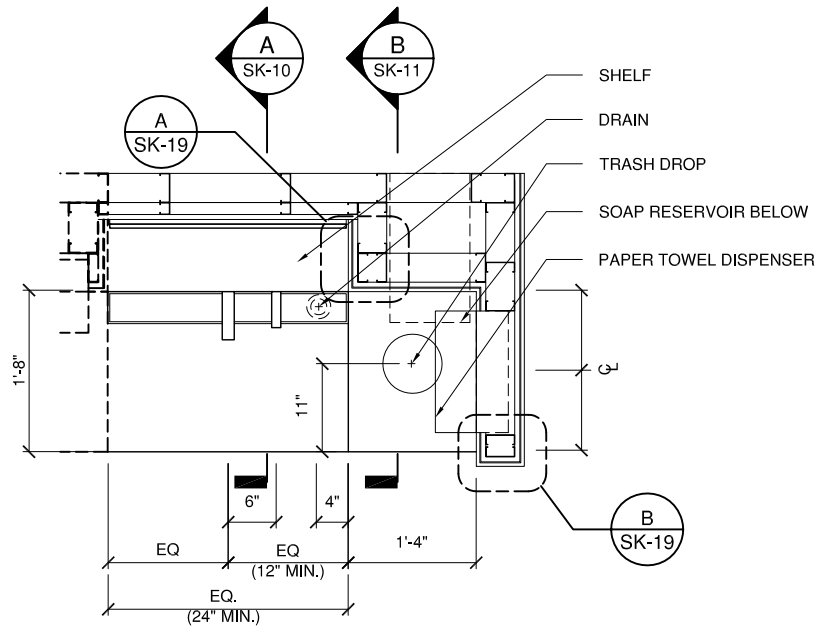
PLAN

INTERMEDIATE TRASH DROP
FOR USE BETWEEN GANGED MODULES

SHEET
SK-06



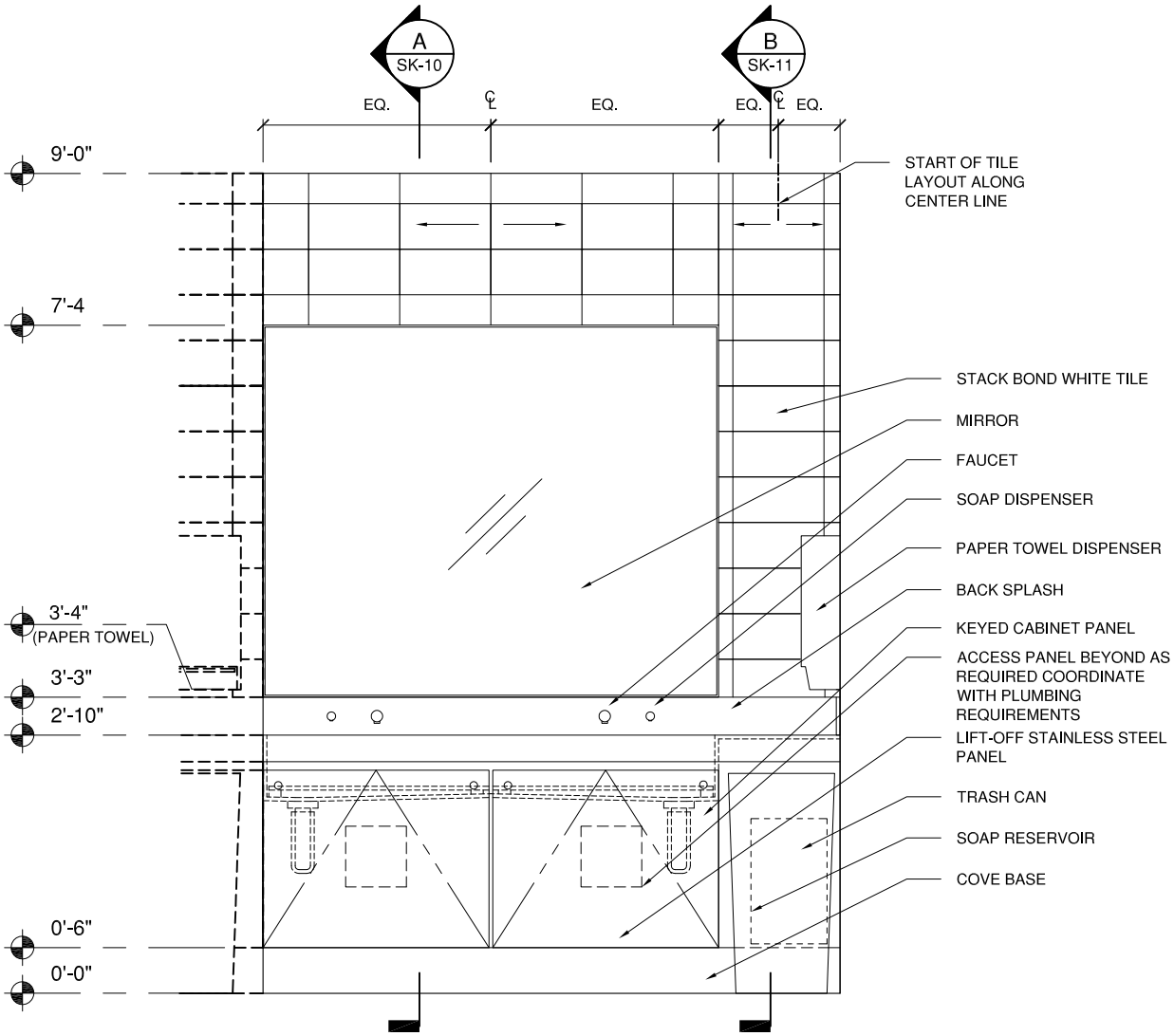
ELEVATION



PLAN

SINGLE GANG MODULE

SHEET
SK-07



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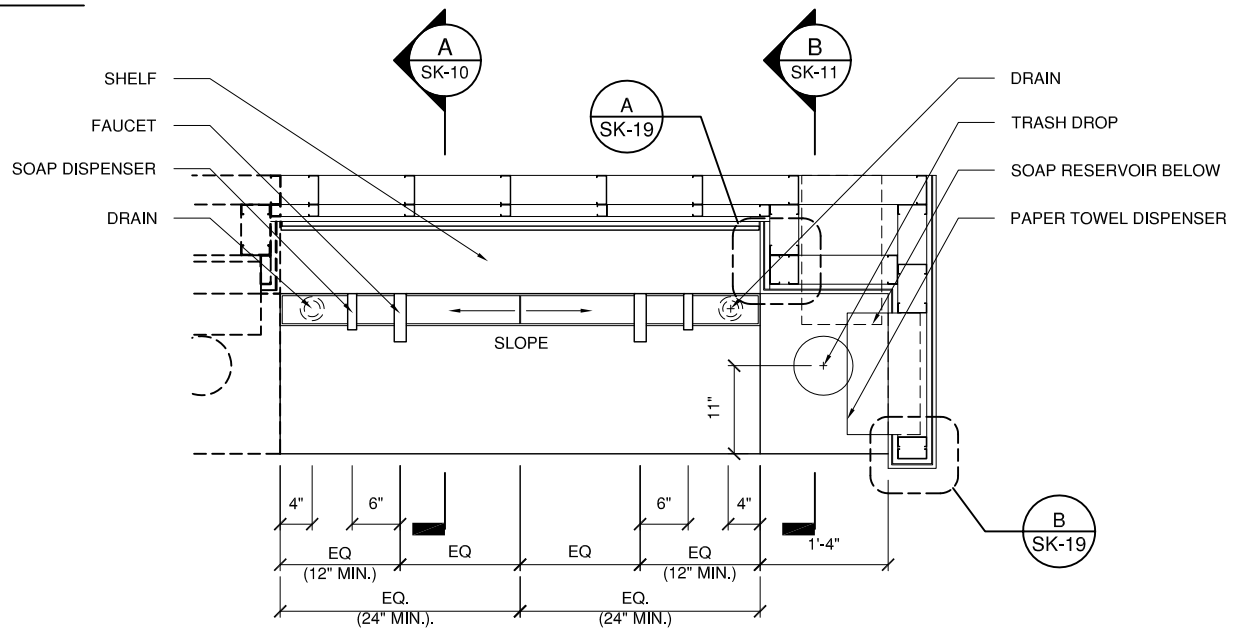
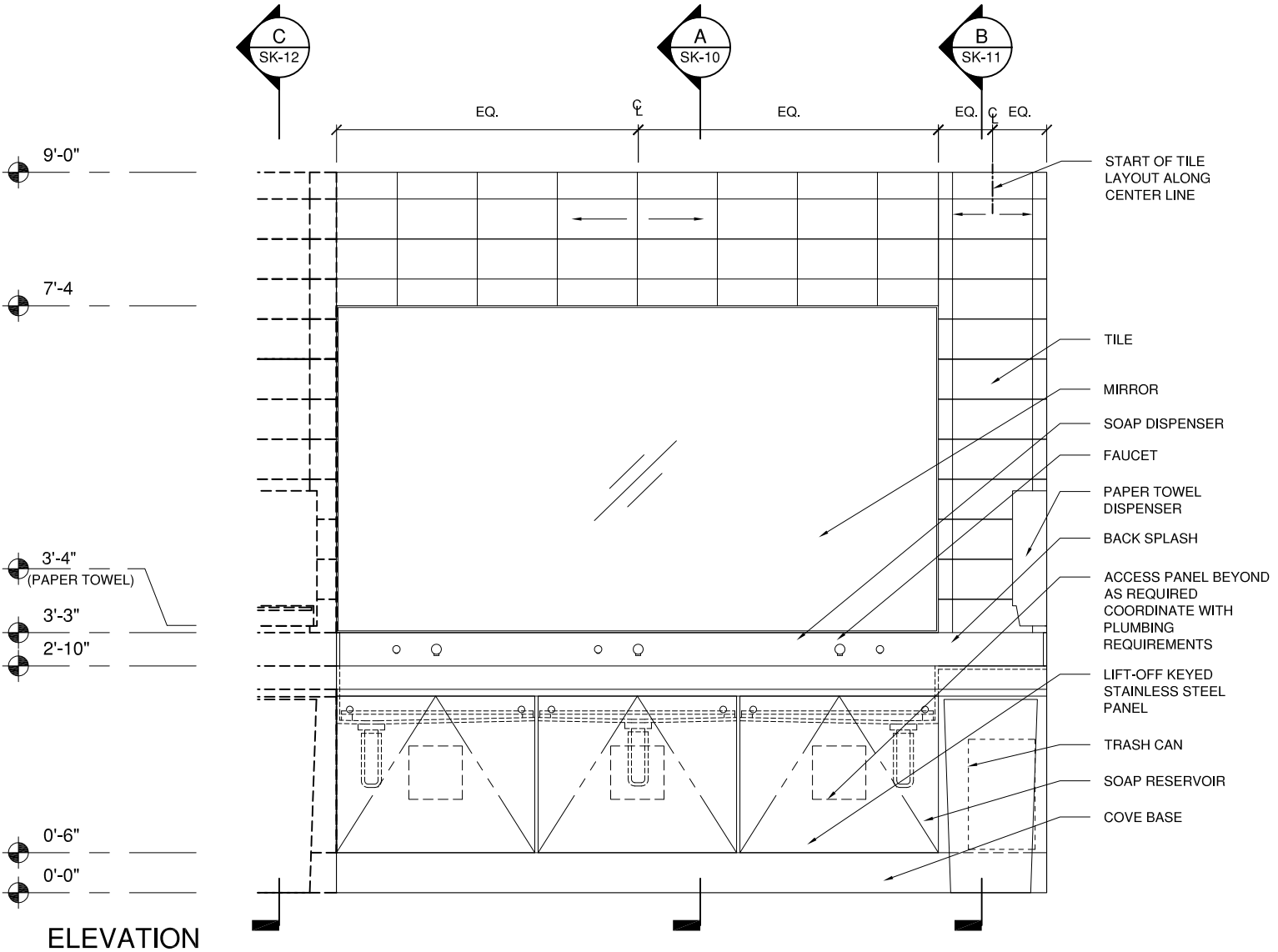


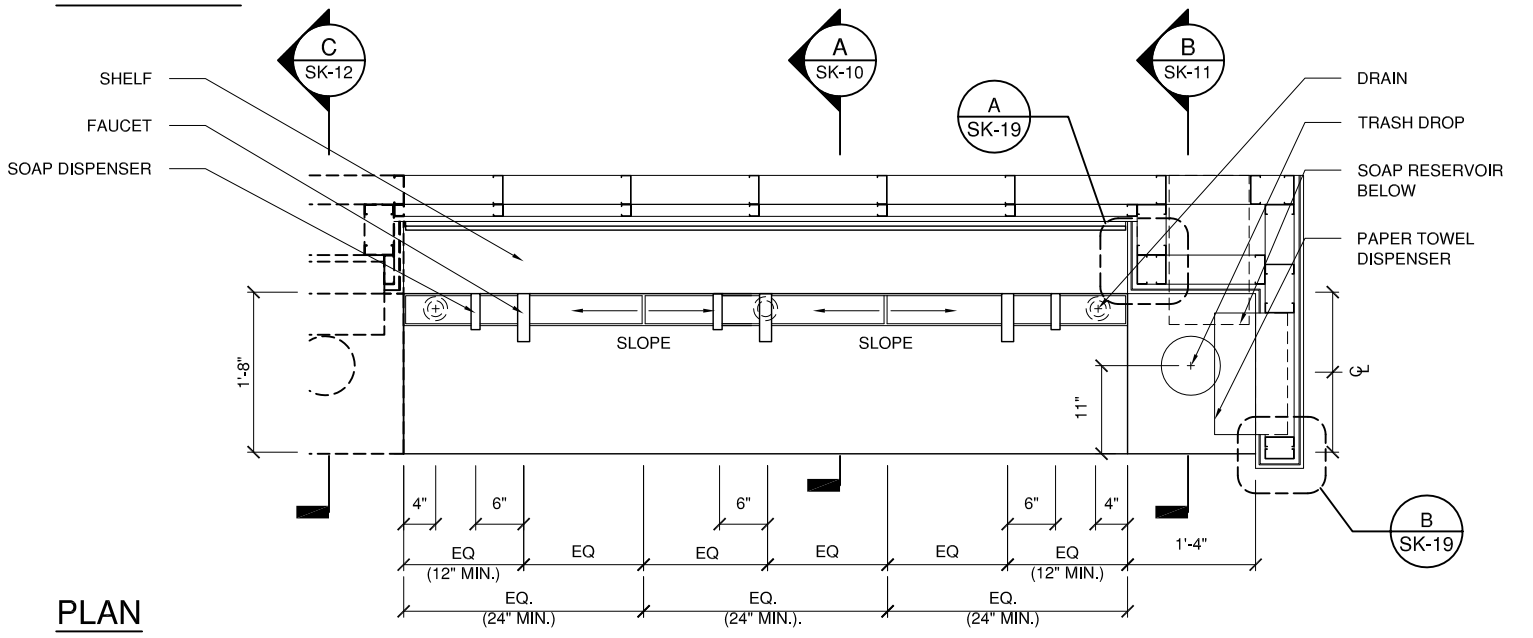
PLAN

DOUBLE GANG MODULE

SHEET
SK-08



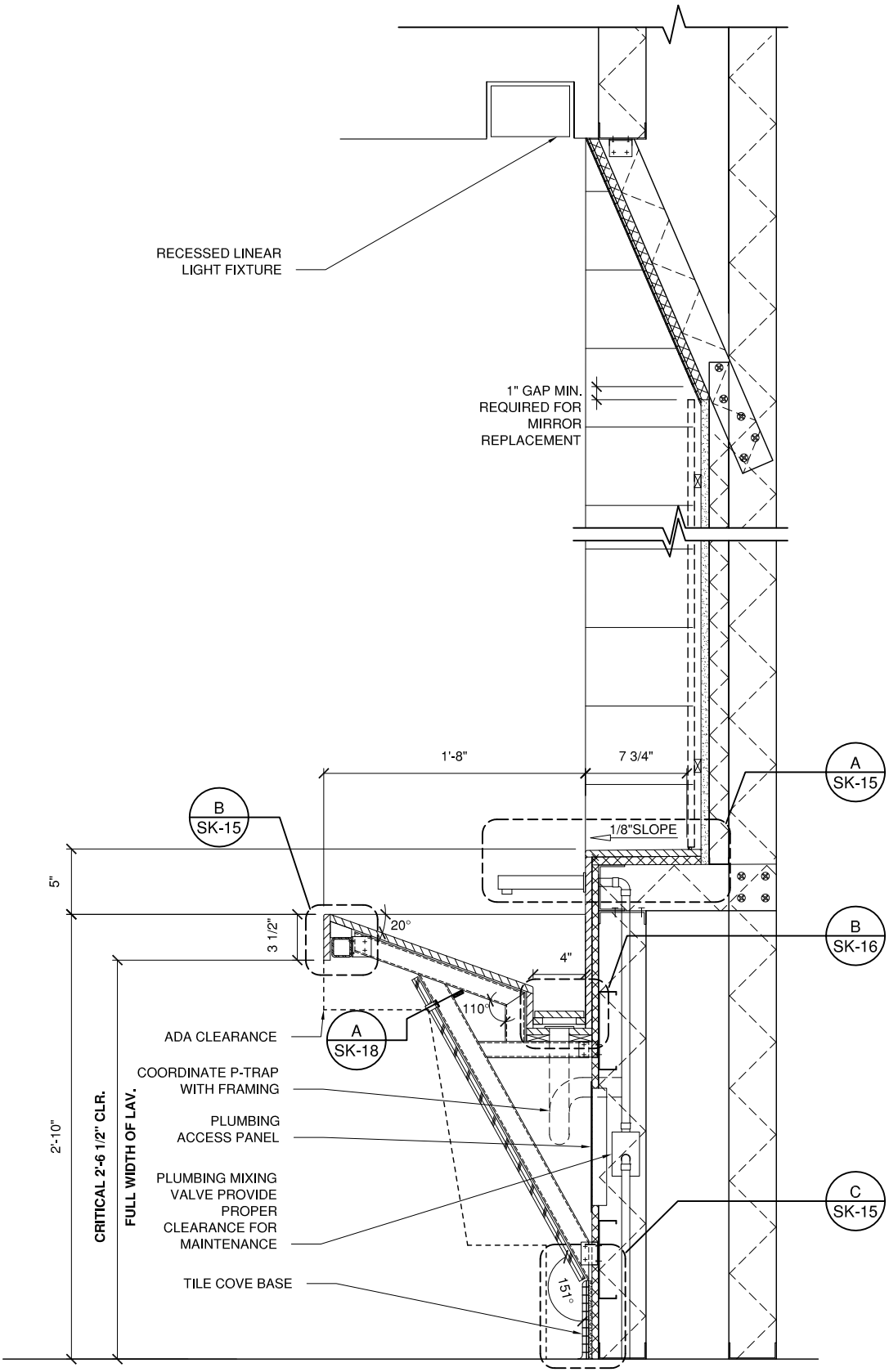
ELEVATION



PLAN

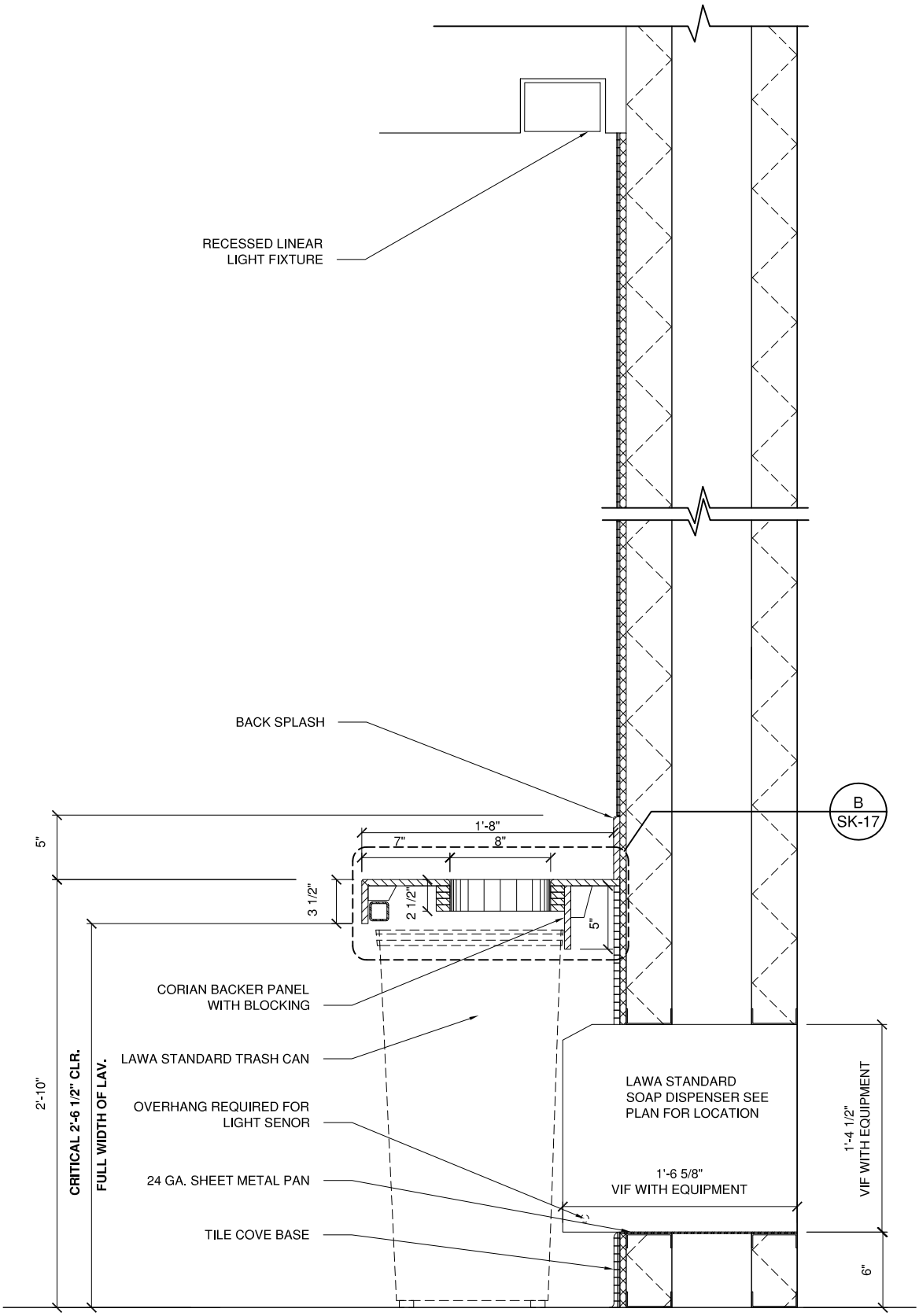
NON STANDARD
TRIPLE GANGED MODULE

SHEET
SK-09



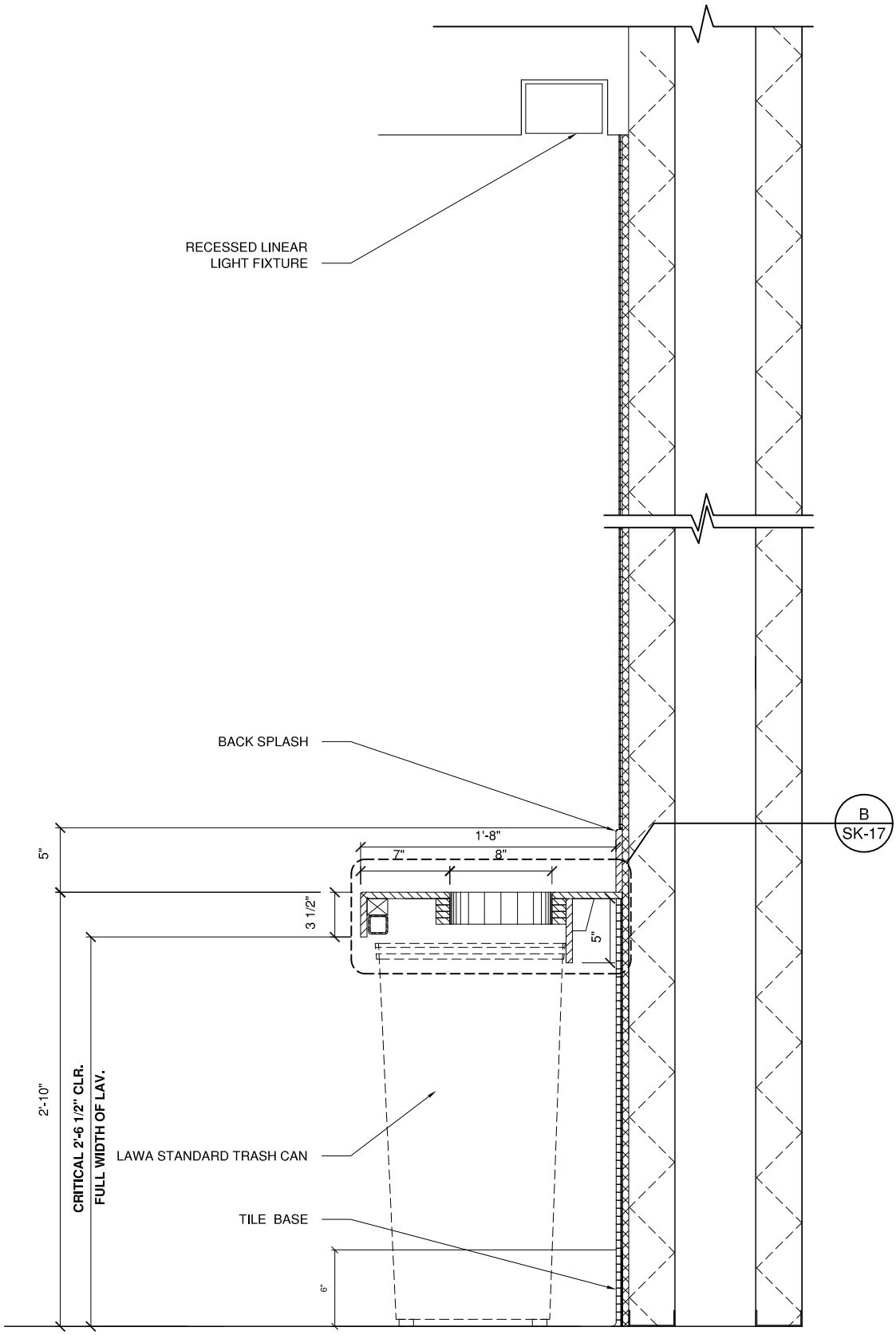
(A) TYP. SECTION @ SINK

SHEET
SK-10



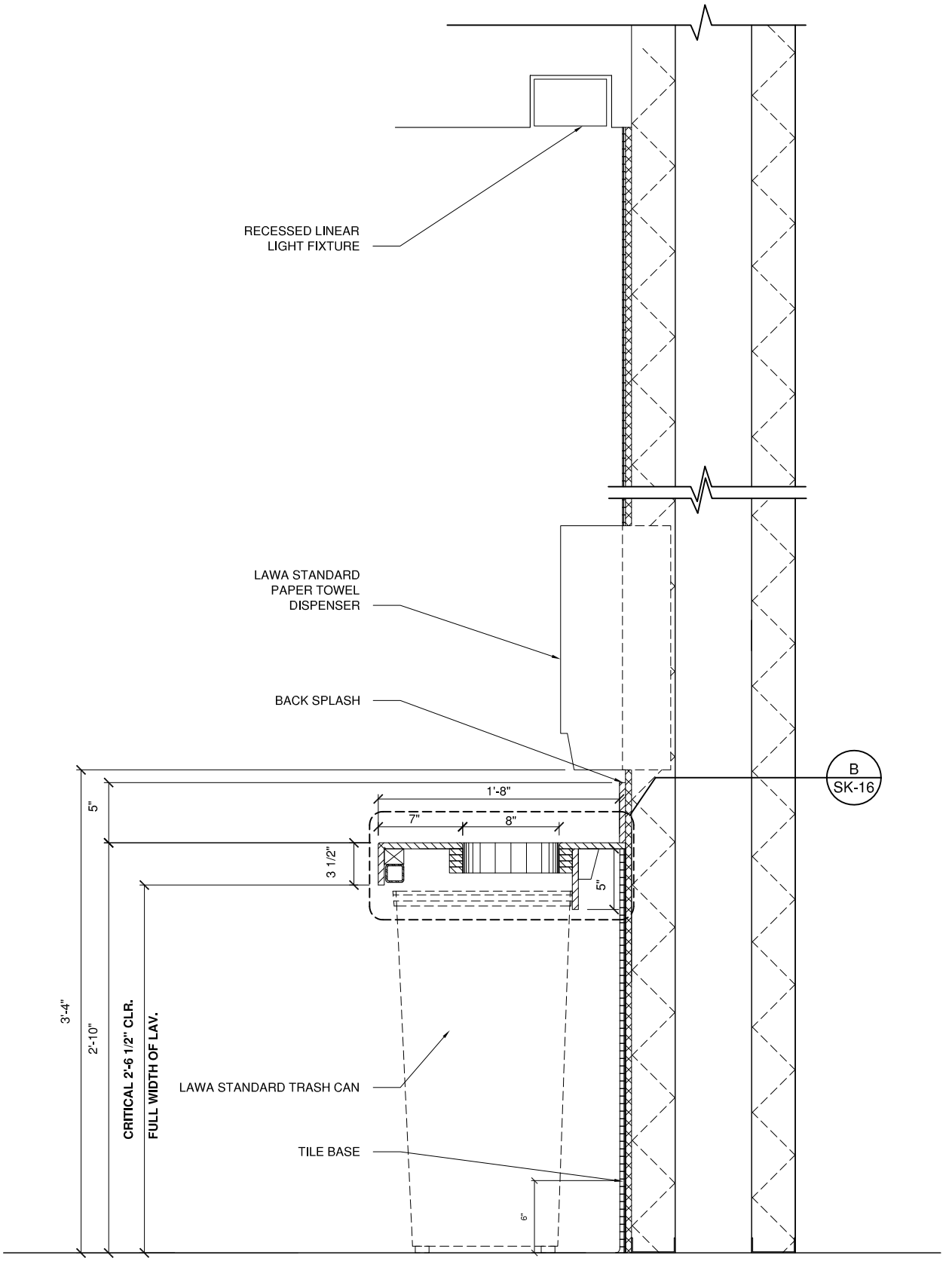
(B) SECTION @ TRASH DROP WITH SOAP RESERVOIR

SHEET
SK-11



C SECTION @ TRASH DROP NO SOAP RESERVOIR

SHEET
SK-12

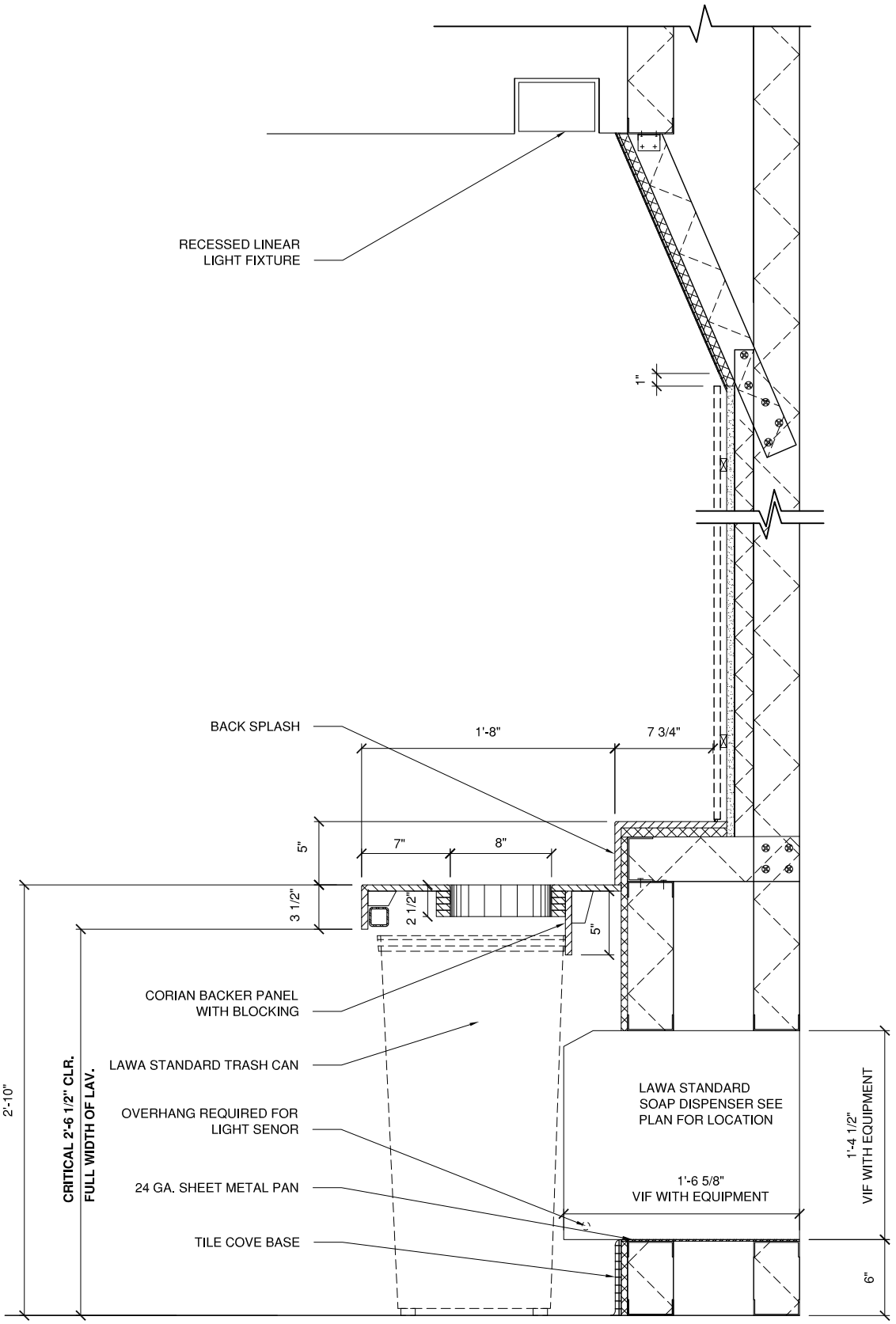


D
-
SECTION @ PAPER TOWEL DISP. ON WALL

Scale: 1"=1'-0"

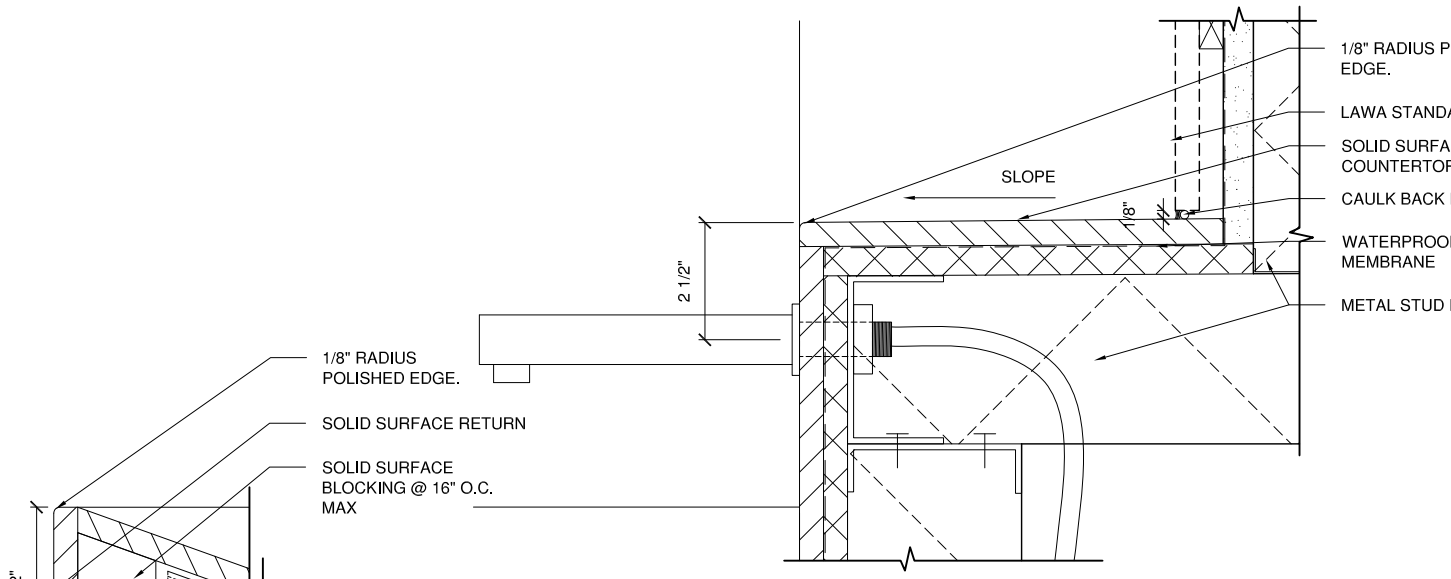
(D) SECTION @ INTERMEDIATE TRASH DROP WITH TOWEL DISPENSER

SHEET
SK-13



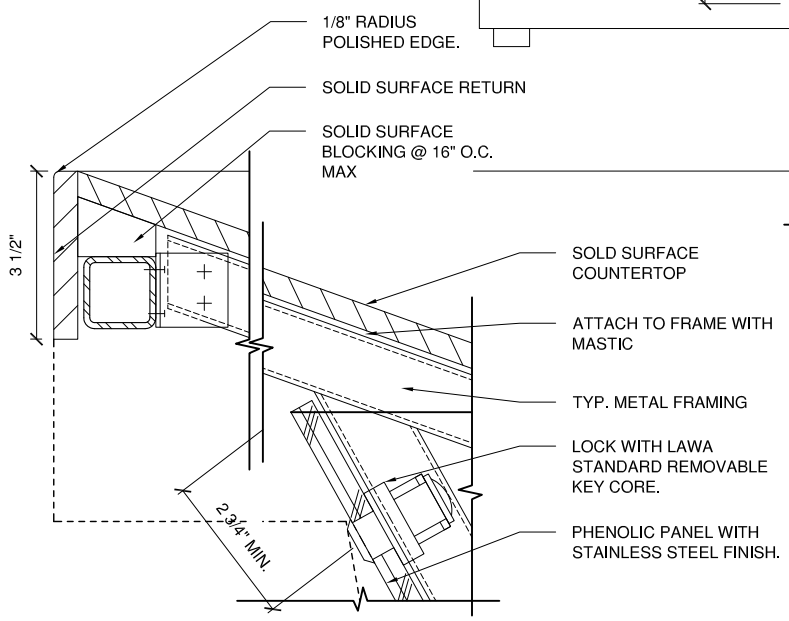
(E) SECTION @ TRASH DROP WITH RESERVOIR AND SHELF

SHEET
SK-14



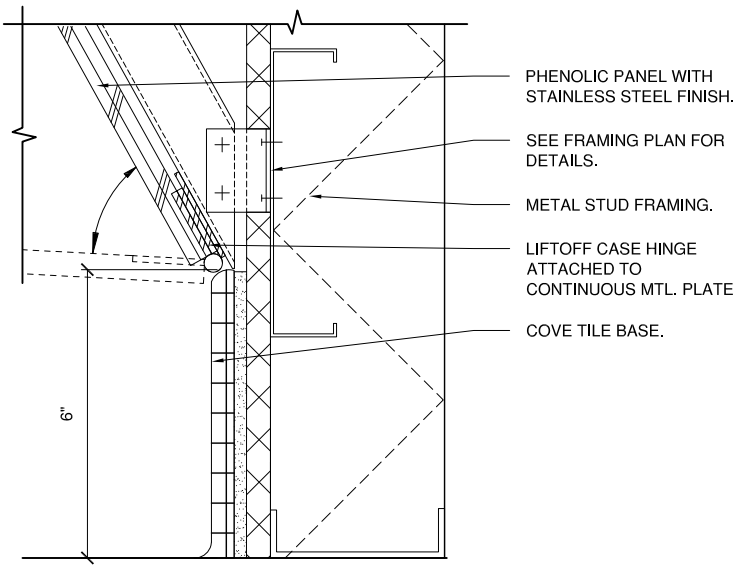
A - SECTION AT SPLASH DETAIL

Scale: 3"=1'-0"



B - SECTION AT REMOVABLE PANEL

Scale: 3"=1'-0"

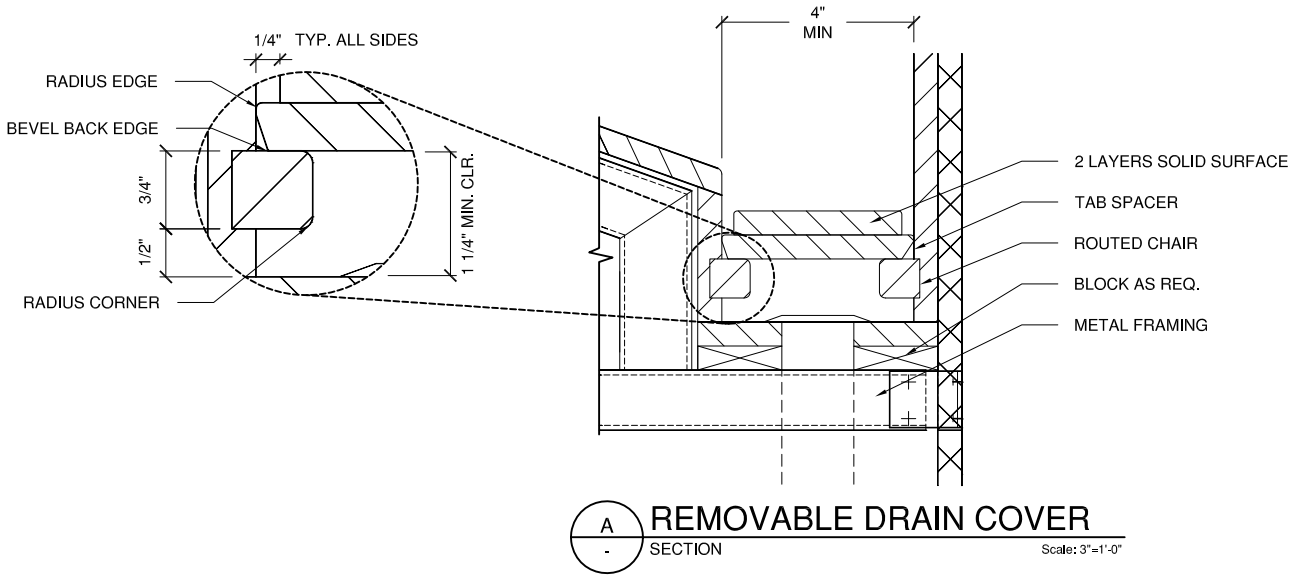


C - SECTION AT BASE

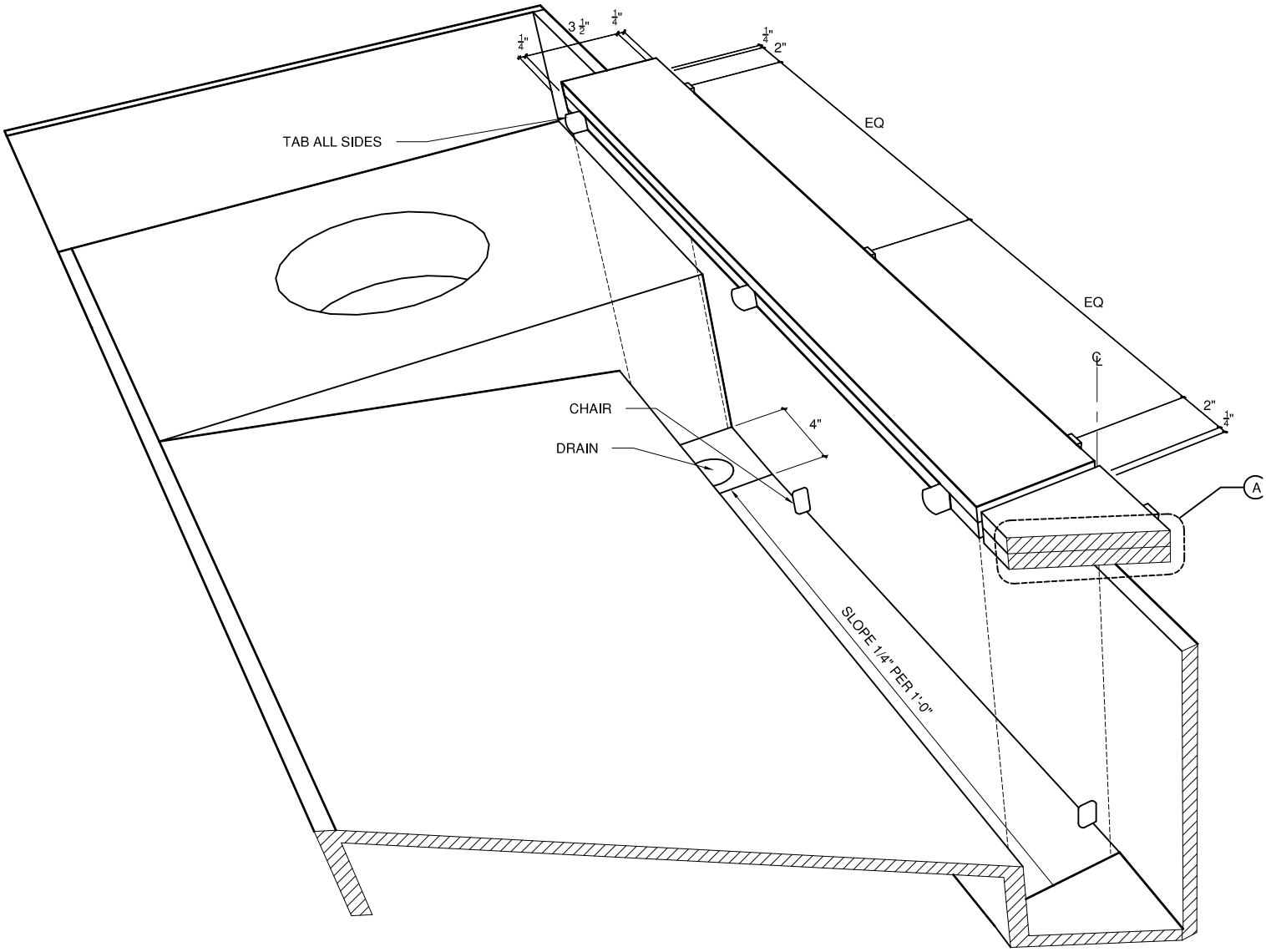
Scale: 3"=1'-0"

SECTION DETAILS

SHEET
SK-15

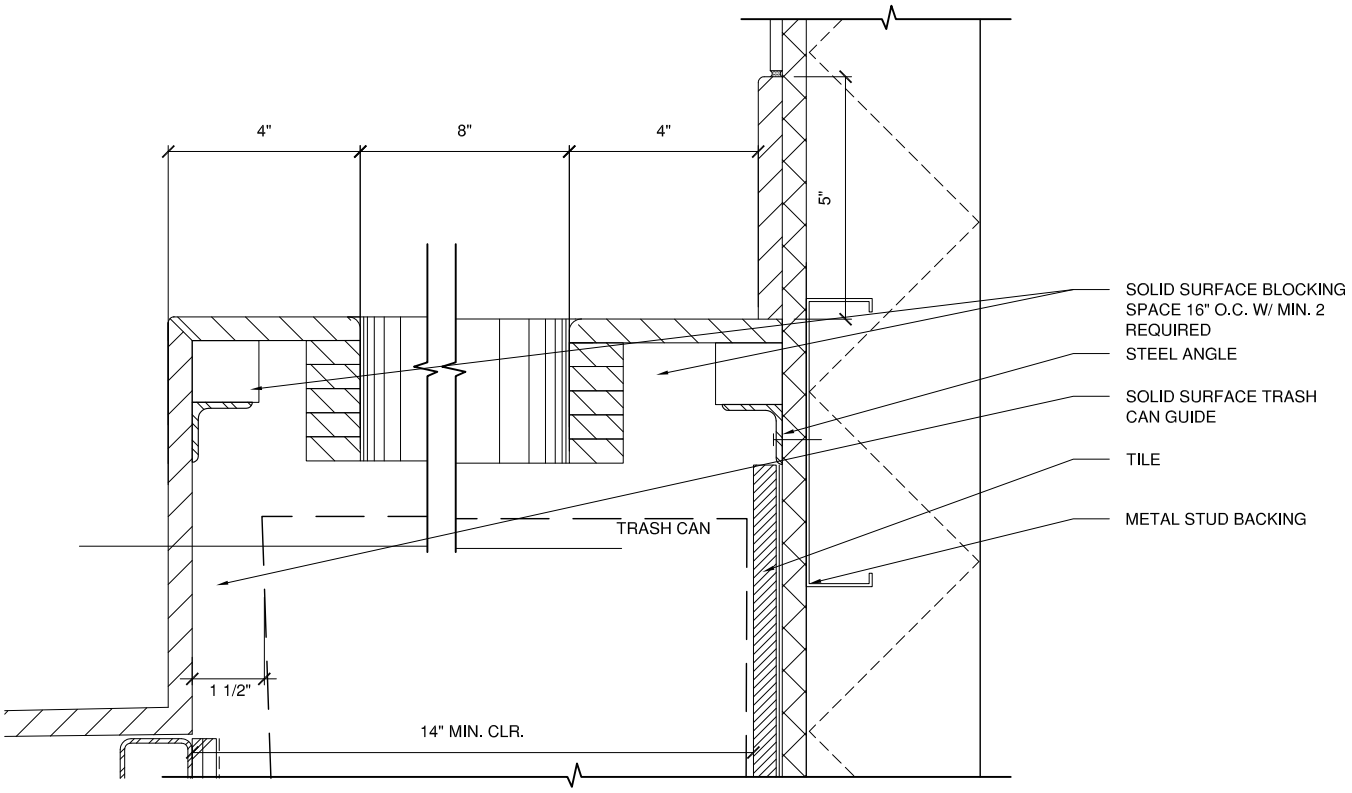


A / - REMOVABLE DRAIN COVER
SECTION
Scale: 3"=1'-0"



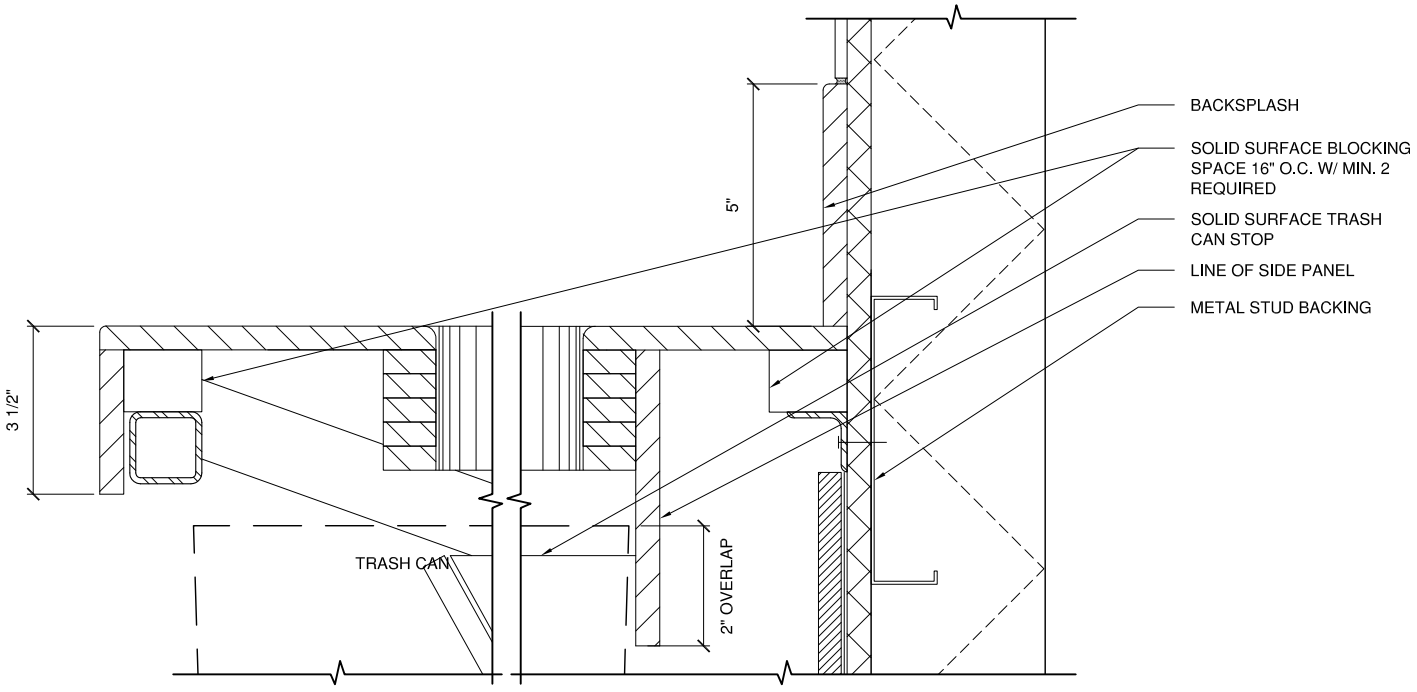
REMOVABLE DRAIN COVER

SHEET
SK-16



A - COUNTER EDGE DETAIL

Scale: 3"=1'-0"

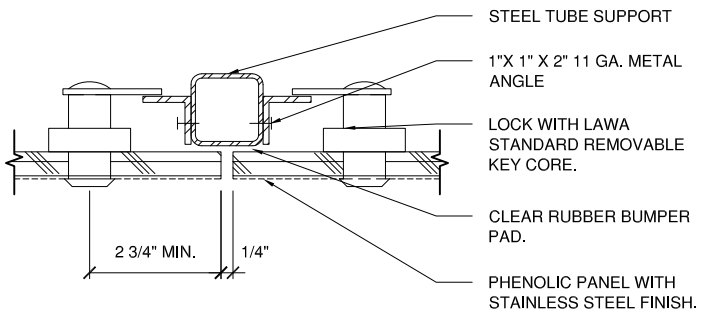


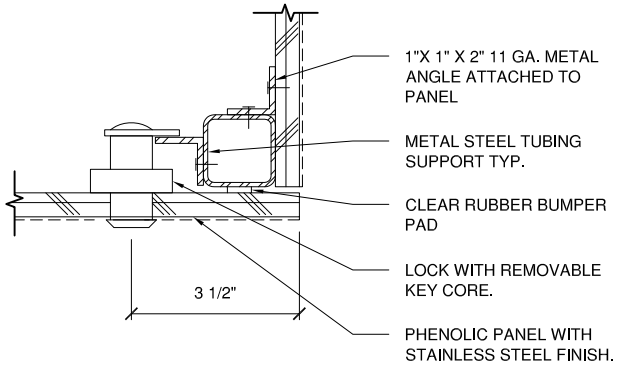
B - COUNTER EDGE DETAIL

Scale: 3"=1'-0"

ENLARGED SECTION DETAILS

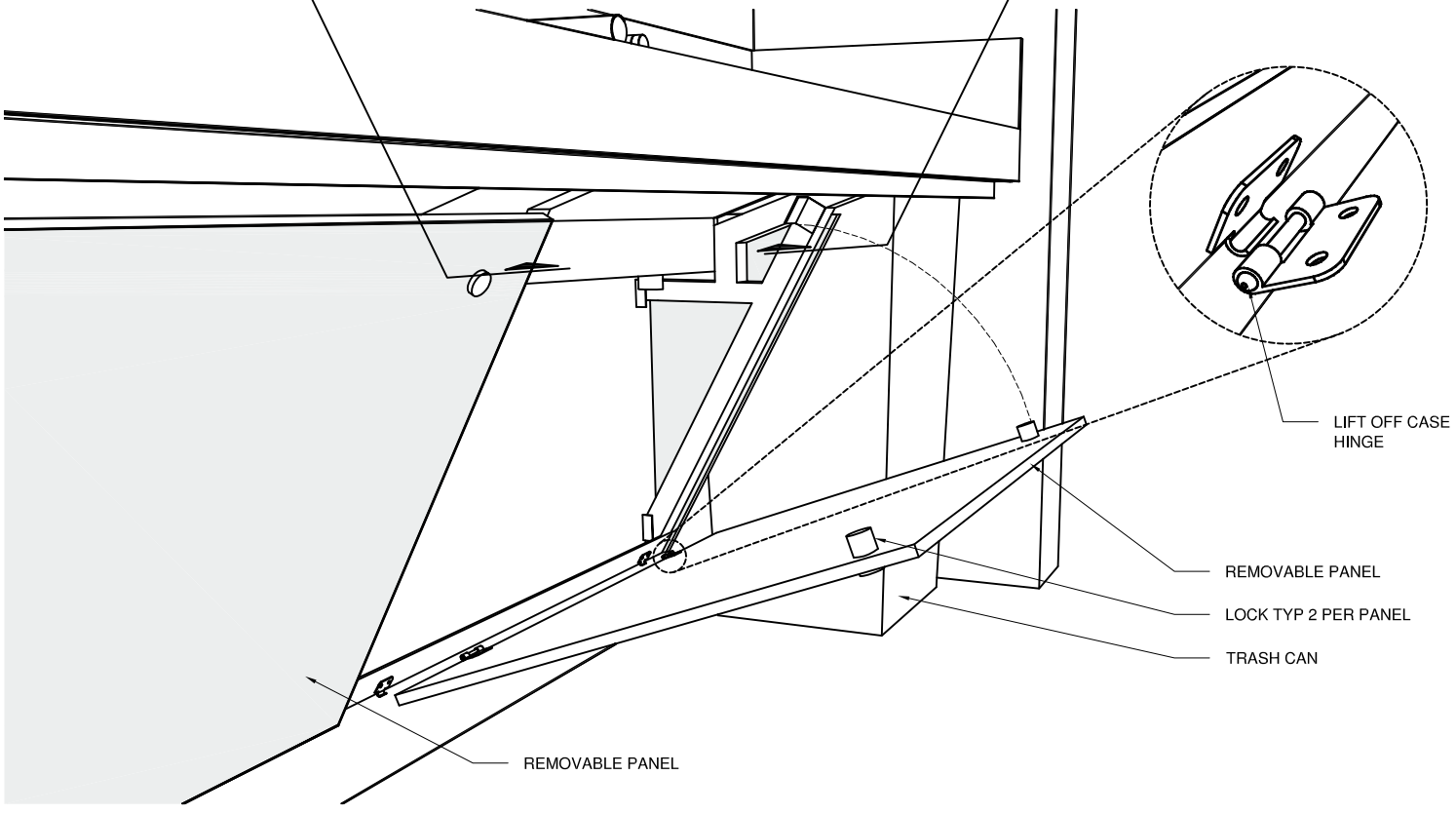
SHEET SK-17





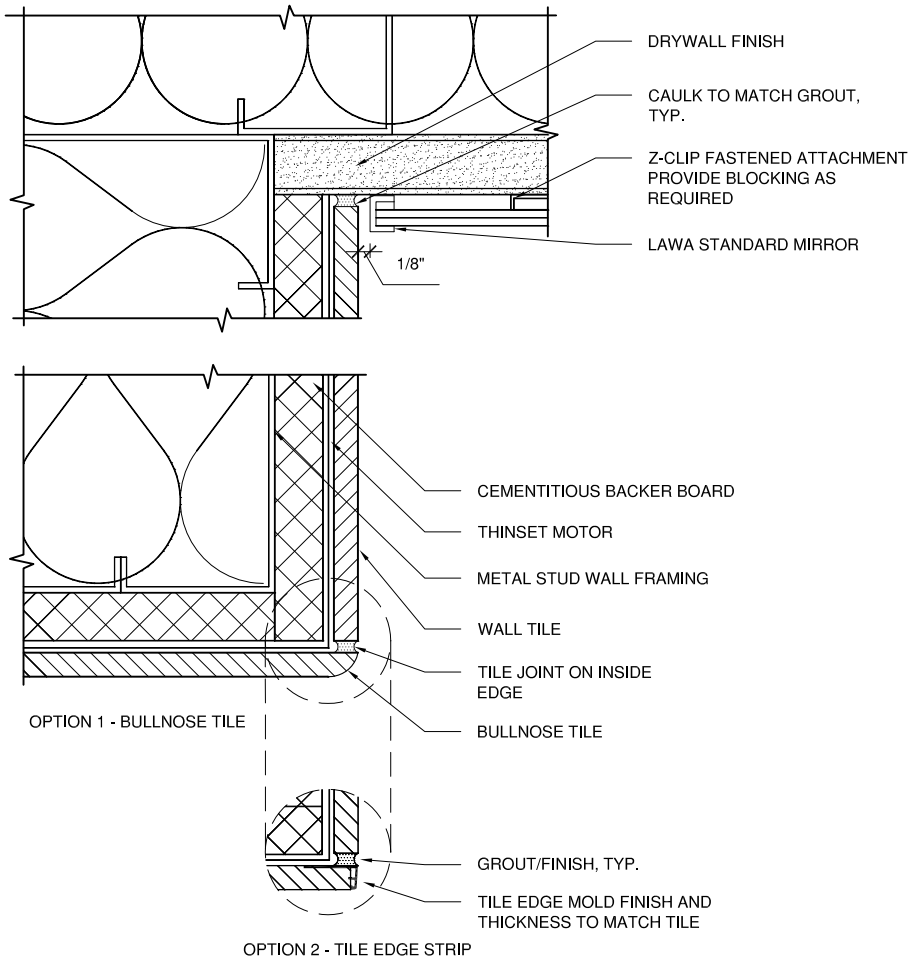
PLAN SECTION @ CENTER POST

PLAN SECTION @ EDGE CONDITION



SKIRT PANEL SYSTEM

SHEET
SK-18

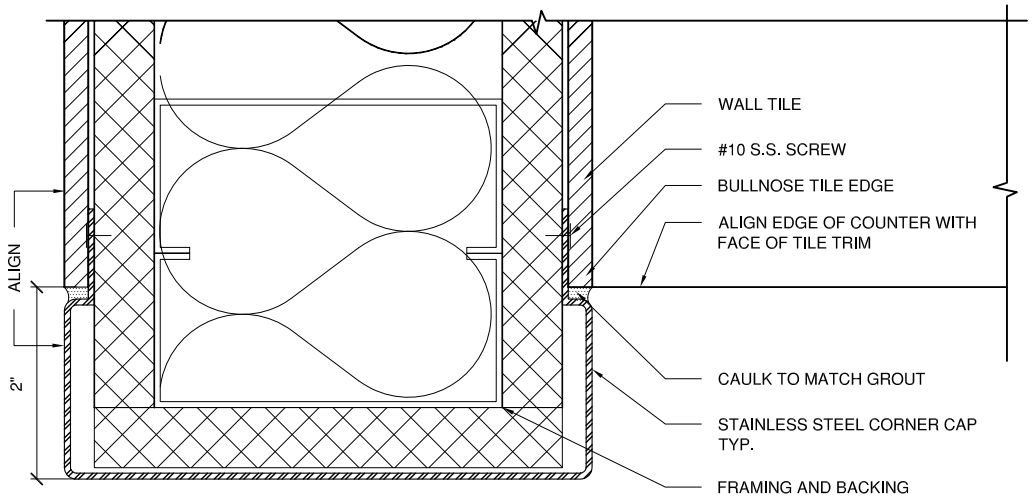


A
-

TILE CORNER DETAILS

OPTION 1 AND OPTION 2

Scale: 6"=1'-0"



B
-

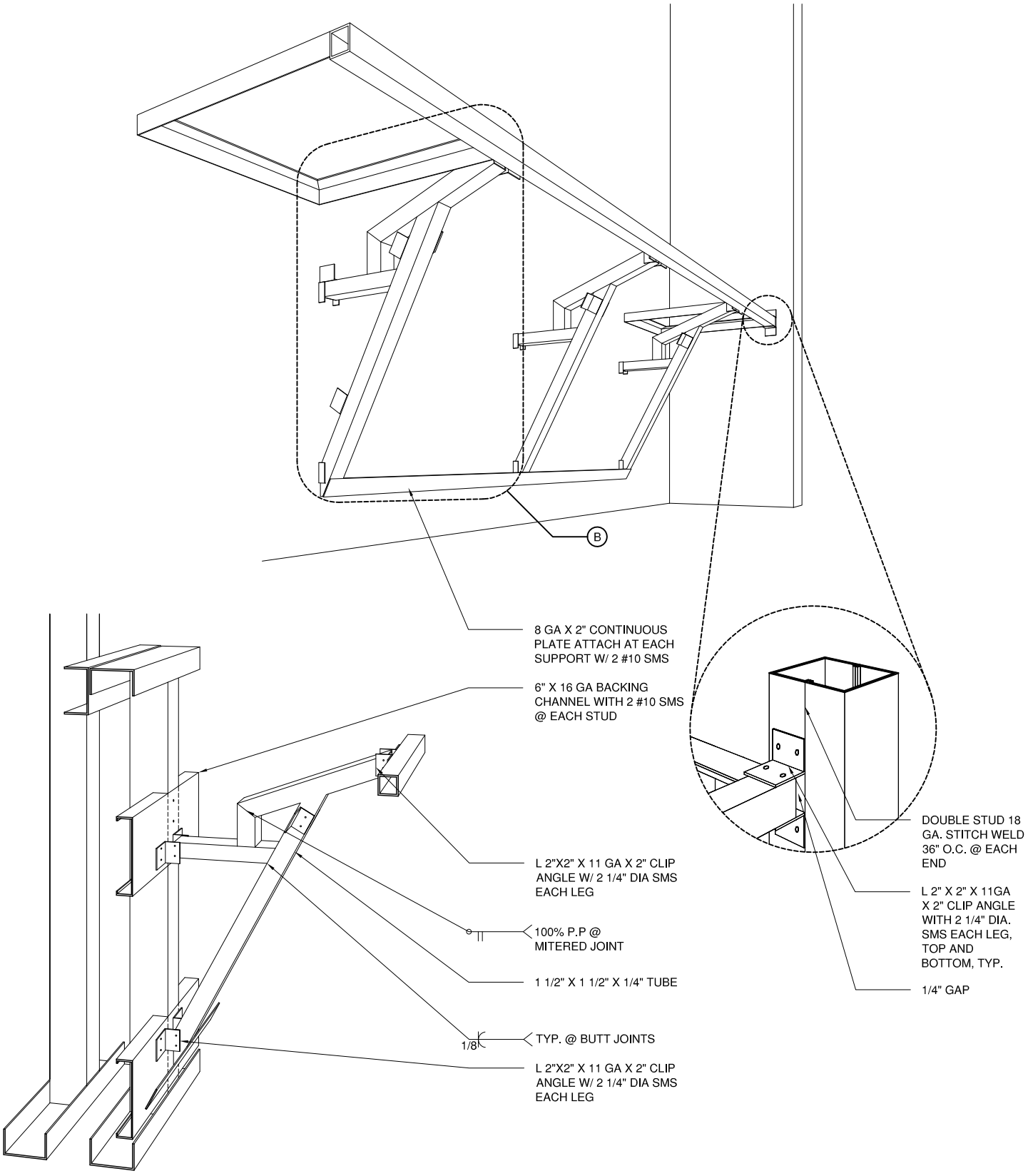
TILE CORNER DETAILS

@ END WALL CONDITION

Scale: 6"=1'-0"

TILE EDGE CONDITION DETAILS

SHEET
SK-19



STRUCTURAL FRAME

SHEET
SK-20

Master Exhibits for Tenant Improvements

Master exhibits identifying tenant space(s), use and occupancy are available for [Terminals 4, 5, 7, & 8]. All Tenants are required to comply with the requirements and modifications outlined therein. The master exhibits demonstrate Code compliance for each terminal with respect to the 2011 LABC and the following:

- Required exits and exit paths, including occupant loading
- Disabled access path of travel, restrooms, etc.
- Plumbing fixture counts based on the defined occupant load

Zoning & Entitlements

Required Conditional Use Permit – Conditional Use for Beverages (for the sale, consumption of alcoholic beverages on the premises).

Commercial Development Group - General Requirements for all Tenant Projects

Here is a summary of the items we include:

Executed Agreement: The Tenant (Permittee) shall not undertake any work within the premises until and unless an agreement covering the property upon which the construction is being performed has been fully executed by all parties.

Ownership of Improvements and Alterations: Ownership of all improvements and alterations constructed or installed by the Tenant (Permittee), or at the Tenant's (Permittee's) direction shall be and remain with the City of Los Angeles. The Tenant (Permittee) understands that it may be required to remove its equipment, modifications, installations, and alterations from any area of the terminal at any time upon notice from LAWA.

Reimbursements: None of the costs incurred for this construction shall be reimbursable by LAWA, through rent or by any other means, unless otherwise stipulated in the agreement/Tariff/UTC or under a separate construction reimbursement agreement.

Sublease (If applicable): An executed copy of the Tenant's sublease agreement has been submitted to LAWA and that the Sublessee shall not undertake any work within the premises until and unless a consent to sublease covering the property upon which the construction is being performed has been fully executed by all parties (Lessee, Sublessee, and LAWA) prior to construction.

Modifications: The Tenant (Permittee) is aware that LAWA may make modifications to the improvements and alterations at any time.

Utility Meters: Tenant (Permittee) shall install private utility meters, where applicable, or utility sub-meters per your agreement and that a complete listing of meter numbers and locations (room numbers) are provided to LAWA upon the substantial completion of the project.

Electrical Submeter: The electrical contractor shall install an electrical sub-meter for monitoring your electrical usage in a LAWA designated location. Sub-meters shall be fully digital and shall display the kilowatt-hour/demand, as approved by LAWA. An acceptable sub-meter manufacturer is E-Mon D-Mon, Class 2100, with built in wireless transceiver and demand reading option. The sub-meter must be labeled with an identification number and master lease exhibit and number for the area served.

Mid-Term Refurbishment Documentation: Upon completion of the project, detailed documentation of all mid-term refurbishment expenses shall be submitted to LAWA to demonstrate compliance with the mid-term refurbishment obligations of your Concession Agreement. The documentation shall include all documents needed for LAWA to readily confirm that you have complied with the mid-term refurbishment requirements of your Concession Agreement. The documentation shall include but be limited to a spreadsheet summarizing and cross-referencing clearly marked attached invoices, cancelled checks, and receipts.

Interference with Wiring of Other Terminal Occupants; Renovation, equipment, and conduit will be installed in a manner that will not interfere or interrupt the wiring of other terminal occupants (including concessionaires) and equipment in the concourse. Any interference with other terminal occupant's wiring caused by proposed renovation, equipment, and/or conduit installation shall be removed and/or relocated by the Tenant (Permittee) at no cost to LAWA.

Advertising: a) No advertising of any kind shall be permitted; b) The Tenant (Permittee) shall provide in detail what content will be displayed on the monitors (Self Service Kiosk, FIDS, etc.) during the passive/active mode; and, c) No audio of any kind is permitted from any monitors at the pylons, gates, or from back screen monitors.

Non-Exclusive Use: Unless otherwise restricted by other agreement, at LAWA's discretion, equipment installed by the Tenant (Permittee) may be used by other occupants.

And, below is language from the Tariff/Lease that may also need to be included.

1. Alterations, etc.

1.1. Landlord's Consent. The Tenant may make alterations, installations, additions and improvements in and to the Tenant Areas (referred to as "Alterations") provided that the Tenant complies with the provisions of this Section 1 and, except as provided in Section 1.2, provided that the Tenant first obtain the Landlord's consent in accordance with Section 1.3.

1.2. Alterations not Requiring Consent. The Tenant may, without the Landlord's consent, make Alterations in the Demised Premises (but not in any of the other Tenant Areas) consisting of furniture, furnishings, painting, carpeting, wall coverings and other decorative changes.

1.3. Alterations Requiring Consent. If the Landlord's consent is required for any Alteration, the Tenant's initial request for the consent shall include reasonably detailed preliminary plans for the Alteration. If the Landlord shall approve the preliminary plans, the Tenant will prepare working drawings and specifications that are in all respect accurate reflections of the approved preliminary plans and will submit for approval to the Landlord two copies of the working drawings and one copy of the specifications. The Tenant will not commence work on the proposed Alteration until the Landlord shall have approved the working drawings and specifications, as well as (in the Landlord's reasonable discretion) the identity of the architects, engineers, contractors and major subcontractors who the Tenant proposes to construct the Alteration. No material modifications shall be made to the working drawings or specifications, or in the construction of the Alteration described by them, without the prior consent of the Landlord, which consent shall not be unreasonably withheld. The Tenant will pay to the Landlord, within 30 days after demand therefor, the Landlord's actual and reasonable out of pocket costs (as well as a reasonable allowance for the internal costs of the Landlord's use of its own employees) incurred in reviewing or considering any Alterations, and inspecting construction of the Alterations.

1.4. Performance of Alterations. Before the commencement of any Alteration, the Tenant will obtain and deliver to the Landlord (i) all required permits, (ii) insurance for the contractor for such coverages and in such amounts as may be reasonably acceptable to the Landlord, and (iii) surety bonds or other security in such amounts and otherwise reasonably satisfactory to the Landlord. All of the Tenant's Alterations shall be (i) effected at the Tenant's expense and promptly and fully paid for by the Tenant, (ii) performed with due diligence, in a good and workmanlike manner and in accordance with all Legal Requirements and Insurance Requirements, (iii) made under the supervision of a licensed architect or licensed professional engineer reasonably satisfactory to the Landlord, and (iv) performed without unreasonably interfering with (A) the use and occupation or conduct of the business of any other tenant or occupant of the Building, (B) any construction work being performed elsewhere in the Building by the Landlord or by any other tenant or occupant of the Building, or (C) ingress and egress to, in and from the Building or any other premises demised in the Building. In the course of effecting any Alterations the Tenant will use good faith efforts to minimize noise and dust and will keep the Tenant Areas, Building Common Areas, and Vertical Areas clean and neat. Upon completion of the Alteration, the Tenant will furnish to the Landlord, at no charge, two complete reproducible sets of record or as-built drawings of the Alterations, and one complete set in an electronic format that complies with the then current computer aided design standards of the Landlord. The drawings must include any applicable permit numbers, the structural and other improvements installed by the Tenant in the Tenant Areas, and the location and details of installation of all equipment, utility lines, heating, ventilating, and air-conditioning ducts and related matters. The Tenant will keep the record or as-built drawings current by updating them in order to reflect any changes or modifications that may later be made in or to the Tenant Areas. Within 120 days following the Completion of the Alteration, the Tenant will prepare and submit to the Landlord a construction report including the following information regarding the Alteration: (1) a description of the type of improvements constructed or altered, (2) the floor area or capacity of the improvements constructed or altered, (3) the total cost of the Alteration, (4) the completion date for the Alteration, and (5) a copy of the certificate of occupancy for the Alteration (or for the Tenant Areas, after giving effect to the Alteration). Without limiting the generality of the remedies available to the Landlord for any breach, if the Tenant shall fail to timely and completely perform its obligations under the immediately preceding sentence of this Section 1.4 and the failure shall continue for more than 5 days after the Tenant receives written notice from the Landlord of such failure, the Tenant will pay to the Landlord, as additional rent, a late charge equal to $500 for each day for which the failure continues.

1.5. Ownership of Improvements and Alterations. Other than Tenant's Property, ownership of all improvements and equipment existing in the Tenant Areas on the Lease Commencement Date is and shall be in the Landlord. Ownership of all improvements, additions, alterations and equipment constructed or installed in the Tenant Areas at the Landlord's expense after the Lease Commencement Date shall be and remain in the Landlord. During the Term, the Tenant shall own all Alterations constructed or installed at the Tenant's expense unless the Tenant has transferred its ownership interests to the Landlord in which case the ownership of such Alterations shall be in the Landlord. Except as otherwise agreed to in the Settlement Agreement, upon the expiration or earlier termination of the Term, all Alterations, other than equipment, trade fixtures and similar installations that are removable without material damage to the Tenant Areas, shall become the property of the Landlord (without compensation to the Tenant), unless the Landlord requests that the Tenant remove some or all of the equipment, trade fixtures, and similar installations, in which case the Tenant will promptly remove them at the Tenant's expense. All items of Tenant's Property remaining in the Tenant Areas or at the Building shall, if not removed by the Tenant within three Business Days following the end of the Term, be deemed abandoned and shall, at the Landlord's election (i) be disposed of in any manner selected by the Landlord, at the Tenant's expense, or (ii) become the property of the Landlord. The Tenant will promptly repair any damage to the Tenant Areas or the Building resulting from the removal of any items of Tenant's Property.

Environmental / Land Use / CEQA

This section is not used. Please see Quick Links CEQA – NEPA Reviews.

Document Date: May 31, 2012

Low Impact Development (LID) &
Standard Urban Stormwater Mitigation Plan (SUSMP)

These are two independent requirements. There is overlap, so either, both or neither may be applicable to a given project.

A. The Contractor shall comply with **Low Impact Development Ordinance No. 181,899**, adopted by the Los Angeles City Council. The LID handbook, along with all other related educational materials and documents, are posted online at ***http://www.lastormwater.org/green-la/low-impact-development/lid-documents/***

The objectives of the LID are summarized as:

a) Reducing storm water runoff and pollutant discharge;
b) Capturing storm water to increase groundwater recharge;
c) Reducing flood damage from heavy rainfall events; and
d) Enhancing safe & recreational environments

The LID ordinance is applicable to all projects that create or add or replace 500 square feet or more of impervious area. It covers all construction projects requiring a building permit. The LID requires that ¾" inch storm water runoff be mitigated, captured or infiltrated, or treated or reused. Suggested compliance strategies include rain barrels, bio-filtration systems, planter boxes, permeable pavement, rainwater storage tanks, infiltration swales, curb bump outs, etc.

The Contractor (and/or leasehold/tenant) is responsible for the LID compliance. The LID shall be considered at the initial proposal stage to identify Best Management Practices (BMPs) most appropriate to the project. Subsequently, the proposed LID/BMP elements shall be incorporated into engineering design and submitted to Watershed Division, Bureau of Sanitation of City of Los Angeles for obtaining a LID permit.

The submittal of the engineering design plans consists of plot plan, landscape, architectural /structural plan, elevation, mechanical/plumbing & utilities, including but not limited to:

a) Location of all BMPs on plans, elevations and drainage patterns
b) Details of all BMPs, including type, model, size, and capacity
c) Manufacturer's product specifications if any equipment is proposed
d) Stenciling note and detail
e) Trash enclosure location and details
f) Landscaping areas
g) Flow calculations determining the volume of storm water runoff
h) Operation & maintenance plan

The operation & maintenance of the LID/BMP system (equipment) shall be based on manufacturer's O&M manual, specifications and/or notes in the design plans and other commonly acceptable operations & maintenance practices.

B. The Contractor shall also comply with the **SUSMP (Standard Urban Stormwater Mitigation Plan)** requirements, adopted by the State Regional Water Quality Control Board, prior to LID. SUSMP documents are posted online at http://www.lastormwater.org/green-la/standard-urban-stormwater-mitigation-plan/.

SUSMP is applicable to projects into any of these following categories:

a) Industrial /Commercial developments with one acre or more of impervious surface area
b) Automotive service facilities
c) Restaurants

d) Parking lots of 5,000 square feet or more of surface area or with 25 or more parking spaces
e) Projects with 2,500 square feet or more of impervious area that are located in, adjacent to, or draining directly to designated Environmentally Sensitive Areas (ESA)

The Contactor is required to incorporate storm water mitigation measures into their design plans and submit the plans to the City for review and approval. Any project that cannot comply with the Low Impact Development Ordinance requirements shall be required to comply with, at a minimum, all applicable SUSMP requirements in order to maximize onsite compliance.