



DULUTH INTERNATIONAL AIRPORT

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**DULUTH INTERNATIONAL AIRPORT
NEW PASSENGER TERMINAL
BID PACKAGE 2 B
ISSUE FOR BID**

RS&H PROJ. No. – 214.1882.091
CITY OF DULUTH BID No. 11-4403

**PROJECT MANUAL
VOLUME 3 OF 3**

Date: AUGUST 23, 2011



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**NEW PASSENGER TERMINAL
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 15051 - BASIC PLUMBING
MATERIALS AND METHODS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. This section is a part of all plumbing sections.

1.2 SUMMARY

- A. Work Included:
 - 1. The system shall include but not limited to the following: All plumbing fixtures and accessories, piping, fittings, valves, strainers, pumps, water distribution, gas distribution, water heaters, storm, sanitary, vents, interceptors, gages, thermometers, equipment and piping identification.
- B. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Mechanical demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Concrete bases.
 - 12. Supports and anchorages.

C. Related Work include the following:

1. Division 2, Section 02200, EARTHWORK.
2. Division 3, Section 03300, CAST-IN PLACE CONCRETE.
3. Division 5, Section 05500, METAL FABRICATIONS.
4. Division 7, Section 07841, FIRESTOPPING.
5. Division 7, Section 07920, SEALANTS AND CAULKING.
6. Division 9, Section 09900, PAINTING.
7. Division 16, ELECTRICAL.
8. Other Sections where applicable.

1.3 CODES, PERMITS AND INSPECTIONS

- A. All work shall meet or exceed the latest requirements of all national, state, county, municipal and other authorities exercising jurisdiction over construction work at the project.
- B. All required permits, approval and inspection certificates shall be obtained, paid for, and made available at the completion of the work, by the Plumbing Contractor.
- C. Installation procedures, methods, and conditions shall comply with the latest requirements of The Federal Occupational Safety and Health Act (OSHA).
- D. Prepare and submit to the building owner a set of "as-built" record drawings for approval, in a form acceptable to the building owner.
- E. The Contractor shall be responsible for the installation and filing until the installation has been approved by the authorities having such jurisdiction.
- F. Prepare and submit to the Engineer a set of "as-built" record drawings for approval, in a form acceptable to the Engineer.

1.4 GUARANTEES AND CERTIFICATIONS

- A. All work shall be guaranteed to be free from leaks and defects. Any defective materials or workmanship, as well as damage to the work of all trades resulting from same, shall be replaced or repaired as directed for the duration of stipulated guaranteed periods.
- B. The duration of guarantee periods following the date of beneficial use of the system shall be one year. Beneficial use is defined as operation of the system to obtain its intended use.

- C. The date of acceptance shall be the date of the final payment for the work or the date of a formal notice of acceptance, whichever is earlier.
- D. Non-durable replaceable items, such as water filter media, do not require replacement after the date of acceptance. If received in writing, requests to have earlier acceptance dates established for these items will be honored.
- E. Certification shall be submitted attesting to the fact that specified performance criteria are met by all items of plumbing equipment.

1.5 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. Piping: Pipe, fittings, flanges, valves, controls, hangers, drains, insulation, and items customarily required in connection with the transfer of fluids.
- G. By Other Trades: By persons or parties responsible for work at the project other than the party or parties who have been duly awarded the contract for the work of this Trade. In the event that this document is used to acquire work as part of a general construction contract the words "by other trades" shall mean by persons or parties who are not anticipated to be the sub-contractor for this trade working together with the general contractor. In this context the words "by other trades" shall not be interpreted to mean not included in the overall contract.
- H. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- I. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.

2. NBR: Acrylonitrile-butadiene rubber.

1.6 SUBMITTALS

- A. In accordance with Division 1, Section 15051, SUBMITTAL PROCEDURES, furnish the following:
- B. Prior to purchasing any equipment or materials, a list of their manufacturers shall be submitted for approval.
- C. Prior to assembling or installing the work, the following shall be submitted for approval:
 1. Scale drawings indicating insert and sleeve locations if required by Architect or Structural Engineer.
 2. Scale drawings showing all piping and duct runs with sizes, elevations and appropriate indication of coordination with other trades. This submission to us shall consist of one (1) original and (6) six prints.
 3. Catalog/internet information, factory assembly drawings and field installation drawings as required for a complete explanation and description of all items of equipment.
- D. Documents will not be accepted for review unless:
 1. They are submitted as a package where they pertain to related items.
 2. They are properly marked with service or function, project name, where they consist of catalog sheets displaying other items which are not applicable.
 3. They indicate the project name and address along with the Contractor's name, address and phone number.
 4. They are properly marked with external connection identification as related to the project where they consist of standard factory assembly or field installation drawings.
- E. Shop Drawing Review
 1. The purpose of the review of shop drawings is to maintain integrity of the design. Unless the contractor clearly points out changes, substitutions, deletions or any other differences between the submission and the Contract Documents in writing on the Contractor's letterhead, approval by the Engineer or Architect does not constitute acceptance. It is not to be assumed that the engineer has read the text nor reviewed the technical data

of a manufactured item and its components except where the Vendor has pointed out differences between his product and the specified model.

2. It is the responsibility of the contractor to confirm all dimensions, quantities, and the coordination of materials and products supplied by him with other trades. Approval of shop drawings containing errors does not relieve the contractor from making corrections at his expense.
3. Substitutions of equipment, systems, materials, must be in accordance with the substitutions section of these specifications and coordinated by the Contractor with his own or other trades which may be involved with the item, such as, but not limited to, equipment substitutions which change electrical requirements, or hanging or support weights or dimensions.
4. Any extra charges or credits which may be generated by other trades due to substitutions will not be accepted unless the Contractor has an agreement in writing with the Owner.
5. Substitutions of equipment, systems, etc. requiring approval of local authorities must comply with such regulations and be filed at the expense of the Contractor (should filing be necessary). Substitutions are subject to approval or disapproval by the Engineer. The Contractor in offering substitutions shall hold the Owner and Engineer harmless if the substituted item is an infringement of patent held by the specified item.
6. Shop drawings shall show all data required by NFPA.

F. Explanation of Shop Drawing Stamp

1. Reviewed indicates that we have not found any reason why this item should not be acceptable within the intent of the documents.
2. Make Corrections Noted indicates that we have found questionable components which if corrected or otherwise explained make the product acceptable.
3. Revise and Resubmit indicates that this item should be resubmitted for approval before further processing.
 - (a) If both "Reviewed As Noted" and "Revive and Resubmit" are checked, the resubmittal is for record purposes only.
4. No shop drawing stamp or note shall constitute an order to fabricate or ship. Such notification can only be performed by the Project Manager for Construction, the Contractor scheduling his own work, or the Owner.

G. Maintenance Data and Operating Instructions:

1. Maintenance and operating manuals in accordance with Division 1, Section 01400, QUALITY REQUIREMENTS, Paragraph, INSTRUCTIONS, for systems and equipment.
2. After all final tests and adjustments have been completed, fully instruct the

proper Owner's Representative in all details of operation for equipment installed. Supply qualified personnel to operate equipment for sufficient length of time to assure that Owner's Representative is properly qualified to take over operation and maintenance procedures. Supply qualified personnel to operate equipment for sufficient length of time as required to meet all governing authorities in operation and performance tests.

3. Furnish required number of manuals, in bound form containing data covering capacities, maintenance of operation of all equipment and apparatus. Operating instruction shall cover all phases of control and include the following:
 - (a) Performance Curves: For pumps, and similar equipment at the operating conditions.
 - (b) Lubrication Schedule: Indicating type and frequency of lubrication required.
 - (c) List of Spares: Recommended for normal service requirements.
 - (d) Parts List: Identifying the various parts of the equipment for repair and replacement purposes.
 - (e) Instruction Books may be standard booklets but shall be clearly marked to indicate applicable equipment.
 - (f) Wiring Diagrams: Generalized diagrams are not acceptable, submittal shall be specifically prepared for this Project.
 - (g) Automatic Controls: Diagrams and functional descriptions.
4. Where applicable, one set of operating and maintenance instructions shall be neatly framed behind glass and hung adjacent to the equipment concerned.

H. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

I. Welding certificates.

1.7 DELIVERY, STORAGE, HANDLING AND PROTECTION

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- C. This trade shall be responsible for its work and equipment until it is tested, has received final inspection and been accepted. Carefully store materials and equipment which are not immediately installed after delivery to site. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.
- D. This trade shall protect work and material of other trades from damage that might be caused by its work or workmen and make good damage thus caused.

1.8 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

1.9 COORDINATION DRAWINGS:

- A. Prepare coordination drawings in accordance with Division 1 Section "PROJECT COORDINATION," to a scale of 3/8"=1'-0" or larger; detailing major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components in spaces such as typical floor and mechanical rooms. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
 - 1. Indicate the proposed locations of piping, equipment, and materials. Include the following:
 - (a) Planned piping layout, including valve and specialty locations and valve stem movement.
 - (b) Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
 - (c) Equipment connections and support details.
 - (d) Exterior wall and foundation penetrations.
 - (e) Fire-rated wall and floor penetrations.
 - (f) Sizes and location of required concrete pads and bases.
 - (g) Clearances as required by Electric Code.
 - 2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

3. Prepare reflected ceiling plans to coordinate and integrate sprinkler installations, air outlets and inlets, light fixtures, communication systems components and other ceiling-mounted items.

B. Plumbing Coordination Drawings

1. This trade shall add to Coordination Drawings prepared by the HVAC Contractor showing all of the plumbing work (equipment, piping, conduit, etc.) to be installed as part of the work of this section of the specifications.
2. This Trade after showing all of the plumbing work shall forward the reproducible Coordination Drawings to the Electrical Contractor.
3. The sequence of coordination drawings shall be HVAC-PLBG-FP-ELEC-CM.
4. The plumbing Contractor shall attend a series of meetings arranged by the General Contractor/Construction Manager to resolve any real or apparent interferences or conflicts with the work of the other Contractors.
5. The plumbing Contractor shall then make adjustments to his work on the Coordination Drawings to resolve any real or apparent interferences or conflicts.
6. After any real or apparent interferences and conflicts have been incorporated into the Coordination Drawings, the plumbing Contractor shall "sign-off" the final Coordination Drawings.
7. The plumbing Contractor shall not install any of his work prior to "sign-off" of final Coordination Drawings. If the plumbing work proceeds prior to sign-off of Coordination Drawings, any change to the plumbing work to correct the interferences and conflicts which result will be made by the Plumbing Contractor at no additional cost to the project.
8. Coordination Drawings are for the Contractor's and Architects use during construction and shall not be construed as replacing any shop "as-built", or Record Drawings required elsewhere in these Contract Documents.
9. Architect's review of Coordination Drawings shall not relieve Contractor from his overall responsibility for coordination of all work performed pursuant to the Contract or from any other requirements of the Contract.

C. Record Drawings

1. As part of the required plumbing work, a complete set of "as-built" or record drawings shall be made up and delivered to the architect.
2. The drawings shall show:-
 - (a) All work installed exactly in accordance with the original design.
 - (b) All installed as a modification or addition to the original design.

- (c) The dimensional information necessary to delineate the exact location of all piping runs which are so concealed as to be untraceable by inspection through the regular means of access established for inspection and maintenance.
- 3. Where shop drawings have been prepared and approved, the "as-built" drawings shall be cross referenced to the respective shop drawing.
- 4. As-built record drawings shall include the updating of all equipment schedule sheets.
- 5. The record drawings shall be of legible reproducible and durable type.
- 6. The Contractor shall make arrangements with the Engineer to obtain design drawings on compact diskettes in AutoCad format for use as a basis for the "as-built" drawings. These documents remain the property of Cosentini Associates, Inc. and shall be used for no other purpose without expressed, written consent. The contractor shall assume all liabilities resulting from unauthorized use or modifications to the drawings.
- 7. Prior to developing any "as-built" drawings, the contractor shall coordinate with the Owner and the Architect Engineer the drawing layers, colors, etc., of the CAD drawings.
- 8. "As-built" information shall be submitted as follows:
 - (a) Drawing files on compact diskettes in AutoCad format.
 - (b) One (1) set of reproducible drawings.
 - (c) Two (2) sets of plots.
- 9. The quantity of design drawings which are made available shall in no way be interpreted as setting a limit to the number of drawings necessary to show the required "as-built" information.
- 10. Progress prints of record drawings shall be submitted monthly during the construction period for Architect's approval.
- 11. This trade shall submit the "as-built" set for approval by the Engineer in a form acceptable to the Engineer.
- 12. Final acceptance of the fire protection systems by the authority having jurisdiction will not be implemented until "as-built" drawings are on site.

1.10 INTERPRETATION OF THE DRAWINGS AND SPECIFICATIONS

- A. As used in the drawings and specifications, certain non technical words shall be understood to have specific meanings as follows:
 - 1. "Furnish"-----Purchase and coordinate deliver to the project site complete with every necessary appurtenance and support.

2. "Install"-----Unload at the coordinated delivery point and time at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project.
 3. "Provide"-----"Furnish" and "Install".
- B. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.
 - C. It shall be understood that the specifications and drawings are complementary and are to be taken together for a complete interpretation of the work. Where there are conflicts between the drawings and specifications or within the specifications or drawings themselves, the items of higher standard shall govern.
 - D. No exclusions from, or limitations, in the language used in the drawings or specifications shall be interpreted as meaning that the appurtenances or accessories necessary to complete any required system or item of equipment are to be omitted.
 - E. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance with the diagrammatic intent expressed on the drawings, and in conformity with the dimensions indicated on final architectural and structural working drawings and on equipment shop drawings.
 - F. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.
 - G. Certain details appear on the drawings which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not obviate field coordination for the indicated work.
 - H. Information as to the general construction shall be derived from structural and architectural drawings and specifications only.
 - I. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred to.
 - J. In the event that extra work is authorized, and performed by this trade, work shown on drawings depicting such work, and/or described by Bulletin is subject to the base building specifications in all respects.

1.11 SEPARATION OF WORK BETWEEN TRADES

- A. The Specifications for the overall construction delineate various items of work under separate trade headings. The list below sets forth this delineation to the extent that it affects the Plumbing Work.
- B. In the absence of more detailed information, this list shall be taken as a specific

instruction to the Plumbing trade to include the work assigned to it.

C. Indications that the Plumbing trade is to perform an item of work mean that it is to perform the work for its own accommodation only, except as specifically noted otherwise.

D. Oth = Other than electrical or mechanical
 Plb = Plumbing
 FP = Fire Protection
 Htg = Heating, Ventilating & Air Conditioning
 Elec = Electrical
 f = Furnished
 I = Installed
 p = Provided (furnished and installed)

Item	Oth	Plb	FP	Htg	Elec	Notes
Motor for plumbing equipment		p				
Motor controls for plumbing equipment.		f			I	Specifications and drawings delineate detailed exceptions.
Wiring for plumbing equipment motors and motor controls.					p	Specifications and drawings delineate detailed exceptions.
Temporary heat	p					
Temporary Water	p					
Temporary light and power.	P					
Temporary toilets.	P					
Natural gas piping and valves for gas fired equipment.		P				Final connections by the Plumbing contractor.
Hoisting	p					
Rigging	p					
Bracing of building for safe rigging.		p				
Cutting, chasing and patching	p					Cost where due to late installation, or improper coordination of work is the responsibility of the delinquent trade.
Framed slots and openings in walls decks and slabs.	P					
Sleeves through slabs, decks and walls.		P				

Item	Oth	Plb	FP	Htg	Elec	Notes
Sleeves through membraned and waterproofed slabs, decks and walls.		P				
Waterproof sealing of pipes passing through sleeves.		P				
Waterproof sealing of sleeves through membraned through membraned and water proofed slabs.		P				
Fireproof sealing of excess openings in slabs, decks and fire rated walls.		P				
Excavation and backfill inside buildings.	P					
Excavation and backfill outside buildings.	P					
Keeping site and excavations free from water during construction.	P					To accommodate the overall project.
Fastenings		p				
Supports		p				
Concrete encasement of underground runs.	P					
Subsoil drainage inside building (footing drains)	p					To accommodate overall project.
Venting for gas tranes on gas fired equipment.				p		Complete.
Subsoil drainage outside building (footing drains)	p					To accommodate overall project.
Sewer manholes (interior)		p				Furnishing of covers, associated frames and other hardware included in the Plumbing Contractor.
Floor drain flashing		p				
Base flashing for roof drains and all piping penetrating roof.	P					
Cap flashing for all piping penetrating roof.		P				
Concrete foundations, pads and bases.	P					Furnishing of anchors and vibration mounts included in the Plumbing Contractor.
Concrete (masonry) pits.	P					Plumbing Contractor to furnish sizes and locations.
Pit frames, covers, pumps, and controls.	P					Special covers sewage ejector pumps, sump pump, pumps, controls, covers and frames furnished by the Plumbing Contractors.

Item	Oth	Plb	FP	Htg	Elec	Notes
Trenches in building foundation.	P					
Field touch up painting of damaged shop coats.		P				
Prime coating hangers and supports.		P				
Rustproofing field cut and assembled iron supporting frames and racks.		P				
Finished painting	p					
Finished wall and ceiling access doors, panels and supporting frames.	P					Supplying list locating all required access doors (none to be less than 16" x 16") Included in Plumbing Contractor.
Cat walks to mechanical equipment.	P					Supplying list of locations where required included in the Plumbing Contractor.
Ladders to equipment and valves.	P					Supplying list of locations where required to be installed by the Plumbing Contractor.
Domestic make-up water piping for heating and air conditioning systems.		P				Final connections included in heating trade.
Toilet Room accessories.	f					Install certain toilet room accessories as required by local trade union jurisdiction.
Window washing machines	p					Required water outlet provided by Plumbing Contractor.
Plumbing fixtures and accessories.		P				
Soap dispensers on plumbing fixtures.		P				
Food service equipment.	P					
Rubbish removal.		P				Where one trade finishes and another installs, the installing trade removes the shipping and packaging materials which accumulate.
Special tools for equipment maintenance.		P				
Laboratory casework and equipment.	p					Plumbing Contractor to provide roughing and final connections.
Balance recirculation system(s).		P				Plumbing Contractor to provide equipment and labor.

Item	Oth	Plb	FP	Htg	Elec	Notes
Garage drainage and venting system to include gasoline and oil interceptor and venting.		P				Pit(s) provided by General Contractor.
Domestic water service from street main, including valve and valve bo. To capped OS&Y valve connection and water meter inside building.		P				
Electric heating cables for pipe tracing.					p	Insulation over heat tracing by Plumber.

- E. The Plumbing Contractor is required to supply all necessary supervision and coordination information to any other trades who are to supply work to accommodate the Plumbing installation.
- F. Where the Plumbing Trade is required to install items which it does not purchase, it shall include for such items:
1. The co-ordination of their delivery.
 2. Their unloading from delivery trucks driven in to any designated point on the property line at grade level.
 3. Their safe handling and field storage up to the time of permanent placement in the project.
 4. The correction of any damage, defacement or corrosion to which they may have been subjected.
 5. Their field assembly and internal connection as may be necessary for their proper operation.
 6. Their mounting in place including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.
 7. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.
 8. Items which are to be installed but not purchased as part of the work of the Plumbing Contractor shall be carefully examined by this trade upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of work of the Plumbing Contractor will be considered only if presented in writing within one week of the date of delivery to the project of the items in question. The work of the Plumbing Contractor shall include all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

1.12 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

Reference	Definition
ASTM	American Society for Testing Materials
ASPE	American Society of Plumbing Engineers
NFPA	National Fire Protection Association
UL	Underwriters Laboratories, Inc.
NEMA	National Electrical Manufacturers Assn.
FM	Factory Mutual
USAS	United States of America Standards Institute
ANSI	American National Standards Institute
AWWA	American Water Works Association
F.S.	Federal Specifications, US Government
I.S.O.	Insurance Services Organization
C.S.	Commercial Standards issued by the United States Department of Commerce.
M.S.S.	Manufacturers Standardization Society of the Valve and Fittings Industry
A.G.A.	American Gas Association, Inc.
A.S.H.R.A.E.	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
P.D.I.	Plumbing and Drainage Institute
N.S.F.	National Sanitation Foundation
A.S.S.E.	American Society of Sanitary Engineering
I.A.P.M.O.	International Association of Plumbing and Mechanical Officials
C.I.S.P.I.	Cast Iron Soil Pipe Institute
A.A.S.H.O.	American Association of State Highway Officials

1.13 GUARANTEES AND CERTIFICATIONS

- A. All work shall be guaranteed to be free from leaks or defects. Any defective materials or workmanship as well as damage to the work of all trades resulting from same shall be replaced or repaired as directed for the duration of stipulated guaranteed periods.
- B. The duration of guarantee periods following the date of beneficial use of the system shall be one year. Beneficial use is defined as operation of the system to obtain its intended use.
- C. The date of acceptance shall be the date of the final payment for the work or the date of a formal notice of acceptance, whichever is earlier.
- D. Certification shall be submitted attesting to the fact that specified performance criteria are met by all items of Plumbing equipment.

1.14 EXAMINATION OF SITE AND CONTRACT DOCUMENTS

- A. Before submitting prices or beginning work, thoroughly examine the site and the Contract Documents.
- B. No claim for extra compensation will be recognized if difficulties are encountered which examination of site conditions and Contract Documents prior to executing the Contract would have revealed.

1.15 WORKMANSHIP

- A. The entire work provide in this Specification shall be constructed and finished in every aspect in a workmanlike and substantial manner.
- B. It is not intended that the Drawings shall show every pipe, fitting and appliance. Plumbing Contractor shall furnish and install all such parts as may be necessary to complete the systems in accordance with the best trade practice.
- C. Keep other trades fully informed as to shape, size and position of all openings required for apparatus and give full information to the General Contractor and other trades in a timely manner so that all opening may be built in advance. Furnish and install all sleeves, supports and the like as specified or as required.
- D. In case of failure on the part of the Plumbing Contractor to give proper and timely information as required above, he shall do his own cutting and patching or have same done by the General Contractor, but in any case, without extra expense to the Owner.
- E. Obtain detailed information from the manufacturers of apparatus as to the proper method of installing and connecting same. Obtain all information from the General Contractor and other trades which may be necessary to facilitate work and completion of the whole project.

1.16 CONTINUITY OF SERVICES

- A. Do not interrupt existing services without Owner's Representative approval.
- B. Schedule interruptions in advance, according to Owner's Representative instructions. Submit, in writing, with request for interruption, methods proposed to minimize impact on Owner's operations. Interruptions shall also be coordinated with the local fire department.
- C. Interruptions shall be scheduled at such times of day and work to minimize impact on Owner's operations.

1.17 QUALITY ASSURANCE:

- A. Products Criteria
 - 1. All equipment furnished as part of the work shall comply with the latest editions of all applicable state and municipal "energy codes." Provide certification from the equipment suppliers for all energy-consuming equipment that the equipment fully complies with these codes. Equipment submissions will not be accepted for review unless accompanied by such certification in writing.
 - 2. All equipment and materials shall be new and without blemish or defect.
 - 3. New equipment and materials shall be Underwriters Laboratories, Inc. (U.L.) labeled and/or listed where specifically called for or where normally subject to such U.L. labeling and/or listing services.
 - 4. Asbestos
 - (a) All equipment and materials shall be free of asbestos.
 - 5. Electrical equipment and materials shall be products which will meet with the acceptance of the agency inspecting the electrical work. Where such acceptance is contingent upon having the products examined, tested and certified by Underwriters or other recognized testing laboratory, the product shall be examined, tested and certified. Where no specific indication as to the type or quality of materials or equipment is indicated, a first class standard article shall be furnished.
 - 6. It is the intent of these specifications that wherever a manufacturer of a product is specified, and the terms "other approved" or "or approved equal" or "equal" are used, the substituted item must conform in all respects to the specified item. Consideration will not be given to claims that the substituted item meets the performance requirements with lesser construction (such as lesser heat exchange surface, etc.). Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance. In many cases equipment is oversized to allow for pick-up loads which cannot be delineated under the minimum performance.

7. All equipment of one type such as drains, pumps, fixtures, etc. shall be the products of one Manufacturer.
8. Substituted equipment or optional equipment where permitted and approved, must conform to space requirements. Any substituted equipment that cannot meet space requirements, whether approved or not, shall be replaced at the Contractor's expense. Any modifications of related systems as a result of substitutions shall be made at the Contractor's expense.
9. Note that the approval of shop drawings, or other information submitted in accordance with the requirements hereinbefore specified, does not assure that the Engineer, Architect, or any other Owner's Representative, attests to the dimensional accuracy or dimensional suitability of the material or equipment involved or the ability of the material or equipment involved or the mechanical performance of equipment. Approval of Shop Drawings does not invalidate the plans and specifications if in conflict, unless a letter requesting such change is submitted and approved on the Engineer's letterhead.
10. Substitutions of equipment for that shown on the schedules or designated by model number in the specifications will not be considered if the item is not a regular cataloged item shown in the current catalog of the manufacturer.
11. Prohibition of Lead
 - (a) The presence and use of lead is strictly prohibited in potable water systems.
 - (b) Potable water shall not be subject to contact with lead in any form.
 - (c) The design and manufacture of all materials and equipment (piping, fittings, joints, connections, solders, fixtures, accessories, etc.) provided, shall not contain lead in any form.
 - (d) Contractor shall be responsible for all costs involved in testing and certifying that potable water systems, materials and equipment are lead free.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 15 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - (a) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - (b) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include purple primer according to ASTM F 656.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Manufacturers:
 - (a) Cascade Waterworks Mfg. Co.

- (b) Dresser Industries, Inc.; DMD Div.
 - (c) Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - (d) JCM Industries.
 - (e) Smith-Blair, Inc.
 - (f) Viking Johnson.
- 2. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
- 3. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
- 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturer:
 - (a) Eslon Thermoplastics.
- C. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Manufacturers:
 - (a) Cascade Waterworks Mfg. Co.
 - (b) Fernco, Inc.
 - (c) Mission Rubber Company.
 - (d) Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
 - 1. Manufacturers:
 - (a) Capitol Manufacturing Co.
 - (b) Central Plastics Company.
 - (c) Eclipse, Inc.
 - (d) Epco Sales, Inc.
 - (e) Hart Industries, International, Inc.

- (f) Watts Industries, Inc.; Water Products Div.
 - (g) Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - (a) Capitol Manufacturing Co.
 - (b) Central Plastics Company.
 - (c) Epco Sales, Inc.
 - (d) Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Manufacturers:
 - (a) Advance Products & Systems, Inc.
 - (b) Calpico, Inc.
 - (c) Central Plastics Company.
 - (d) Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 - 1. Manufacturers:
 - (a) Calpico, Inc.
 - (b) Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 - 1. Manufacturers:
 - (a) Perfection Corp.
 - (b) Precision Plumbing Products, Inc.
 - (c) Sioux Chief Manufacturing Co., Inc.
 - (d) Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:
 - (a) Advance Products & Systems, Inc.
 - (b) Calpico, Inc.
 - (c) Metraflex Co.
 - (d) Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM or interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. General

1. Provide sleeves for each pipe passing through walls, partitions, floors, and roofs.

B. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

F. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

G. PVC Pipe: ASTM D 1785, Schedule 40.

H. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

I. Sleeve Materials

Type Designation

- | | |
|---|--|
| 1 | Galvanized steel sheet. |
| 2 | Standard weight galvanized steel pipe. |

- | | |
|---|--|
| 3 | Standard weight galvanized steel pipe 1/4" steel plate extending from outside of sleeve a minimum of 2" all around, similar to F&S Mfg. Corp. Fig. 204. |
| 4 | Cast iron pipe sleeve with center flange, similar to James B. Clow & Sons No. F-1430 and F-1435. |
| 5 | Standard weight galvanized steel pipe with flashing clamp device welded to pipe sleeve or watertight sleeves, similar to Zurn 195-10 with oakum and lead caulking as required. |
| 6 | Metal deck and wall sleeves. Similar to Adjust-to-Crete Manuf., Co. |

J. Sleeve Sizes

1. Floors and required fire rated partitions - 1/2" maximum clearance between outside of pipe (or insulation on insulated pipes) and inside of sleeve.
2. Partitions not fire rated - 1-1/2" maximum clearance between outside of pipe (or insulation on insulated pipes) and inside of sleeve.

K. Sleeve Lengths

Location	Sleeve Length
Floors	Equal to depth of floor construction including finish. In waterproof floor construction sleeves to extend minimum of 2" above finished floor level.
Roofs	Equal to depth of roof construction including insulation.
Walls & Partitions	Equal to depth of construction and terminated flush with finished surfaces.

L. Sleeve Caulking & Packing

Type Designation	Caulking & Packing Requirements
A	Space between pipe and sleeve packed with oakum or hemp and caulked watertight with lead.

B

Space between pipe or pipe covering and sleeve shall be caulked with an incombustible permanently plastic, waterproof non-staining smooth appearance or pack with mineral wool or other equally approved fire resistive material to within ½" of both wall faces and provide caulking compound as per above.

M. Sleeve Application

Sleeve Type Thru Required Fire Rated Construction	Sleeve Type Thru Non-Fire Rated Construction	Location	Sleeve Caulking & Packing Type Designation	Sleeve Caulking & Packing Type Thru Fire Rated Construction
5	5	Membrane waterproof floor, roof & wall construction.	B	B
5	5	Non-membrane waterproof floor, roof & wall construction where flashing is required.	A or B	B
2	1, 2	Interior walls, partitions & floors.	B	B
3 or 4	3 or 4	Exterior walls.	A	A
2	6	Cellular metal deck floors.	B	B

1	1	Precast concrete floor with poured concrete topping. Note: Sleeves to have flat flanges and/or guides which rest on top of precast slab.	B	B
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2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

2.10 FIRESTOPPING

- A. In addition to fire protection means specified elsewhere in this specification, this trade shall comply with the following.
- B. All spaces between pipes and their respective sleeves shall be packed full depth with mineral wool, or other equally fire resistant material, and compressed firmly in place. Fiberglass shall not be used. Sleeve clearances shall not exceed ½ inch between pipes and sleeves. Use individual sleeves for each pipe or duct. Before escutcheons are attached caulking must be available for inspection and notification should be made.
- C. Fire Stopping material and installed configuration shall maintain the fire rating of the penetrated wall, floor or ceiling.
- D. All pipe penetrations requiring Fire Stopping shall be "UL" approved thru-wall fire stop assemblies.
- E. Fire stop assemblies shall be Rectorseal, 3M, Hilti, Tremco or approved equal.
- F. Contractor shall provide assembly for each type of pipe material thru fire-rated wall thickness.
- G. Fire Stopping assemblies shall be approved by the authority having jurisdiction.

2.11 TOOLS AND LUBRICANTS

- A. Furnish special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Lubricants: A minimum of one quart of oil, and one pound of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

2.12 ACCESS DOORS IN FINISHED CONSTRUCTION

- A. Access doors as required for operation and maintenance of concealed equipment, valves, controls, etc. will be provided by another trade.
 - 1. This Trade is responsible for access door location, size and its accessibility to the valves or equipment being served.
 - 2. Coordinate and prepare a location, size, and function schedule of access doors required and deliver to a representative of the installing trade.
 - 3. Access doors shall be of ample size, minimum of 16" x 16".

2.13 FOUNDATIONS

A. General

1. All equipment, piping, etc., mounted on/or suspended from approved foundations and supports, as specified, as shown on the drawings.
2. All concrete foundations and supports (and required reinforcing and forms) will be provided by another trade. This trade shall furnish shop drawings showing adequate concrete reinforcing steel details and templates for all concrete foundations and supports, and all required hanger bolts and other appurtenances necessary for the proper installation of his equipment. Although another trade will complete all concrete work, all such work shall be shown in detail on the shop drawings, prepared by this trade, which drawings shall be submitted showing the complete details of all foundations including necessary concrete and steel work, etc.

B. In seismic zones, provide lateral support for earthquake forces.

2.14 FOUNDATION

A. For all outdoor applications and all indoor applications in a harsh environment, refer to Section 09 09960 "High Performance Coatings."

2.15 TOOLS AND LUBRICANTS

- A. Furnish special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery finished.
- B. Lubricants: A minimum of one quart of oil, and one pound of grease, of equipment manufacturer's recommended grade type, in unopened containers and properly identified as to use for each different application.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - (a) Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - (b) Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - (c) Insulated Piping: One-piece, stamped-steel type with spring clips.
 - (d) Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - (e) Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - (f) Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - (g) Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
 - (h) Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - (i) Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - (j) Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - (k) Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.

- (l) Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through poured concrete and masonry walls, gypsum-board partitions, and poured concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - (a) Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - (a) Steel or Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
 - (b) Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
 - (c) Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
 - (1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section #'s "Joint Sealants" for materials and installation.
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- U. No installation shall be permitted which blocks or otherwise impedes access to any existing machine or system. Except as otherwise indicated, emergency switches and alarms shall be installed in conspicuous locations. All indicators, to include gauges, meters, and alarms shall be mounted in order to be easily visible by people in the area.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 9 Section.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Provide prime coat painting for the following:
 - 1. Miscellaneous steel and iron provided by the Plumbing Contractor.
 - 2. Hangers and supports provided by the Plumbing Contractor.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.10 TESTS

- A. Provide all designating signs for shutoff valves, control valves, alarms, and the like, as required by the agencies having jurisdiction.
- B. Testing of Systems
 - 1. Perform all required tests in the manner prescribed by and to the satisfaction of the local building department and local plumbing inspector, Owners Insurance Underwriters, and all authorities having jurisdiction. Owners and Architects representatives shall be present to inspect tests. Obtain all required certificates of approval and pay any fees or costs in conjunction therewith.
 - 2. Provide and pay for all devices, materials, supplies, labor and power required in connection with all tests. All tests shall be made in the presence and to the satisfaction of the Architect and inspectors having jurisdiction.

3. Defects disclosed by the tests shall be repaired, or if required by the Architect, defective work shall be replaced with new work without extra charge to the Owner. Tests shall be repeated as directed, until all work is proven satisfactory.
4. This Contractor shall also be responsible for the work of other trades that may be damaged or disturbed by the tests, or the repair or replacement of his own work, and he shall, without extra charge to the Owner, restore to its original condition, work of the trades so damaged and disturbed, engaging the original Contractors to do the work of restoration.

3.11 INSTALLATION

- A. Coordinate location of piping, sleeves, inserts, hangers and equipment. Locate piping, sleeves, inserts, hangers, and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.

3.12 PROTECTION AND CLEANING

- A. Cleaning of Piping System (General)
 1. During construction, properly cap, plug and cover all openings in pipe, lines and equipment nozzles so as to prevent the entrance of sand, dirt, and foreign matter. Each system of piping shall be flushed (for the purpose of removing grit, dirt, sand, and foreign matter from the piping), for as long a time as is required to thoroughly clean the systems.
- B. Adjusting (General)
 1. After the entire installation has been completed, make all required adjustments to balancing valves, air vents, automatic controls, circulators, flush valves, faucets, pressure reducing valves, etc., until all performance requirements are met. All water circulating systems shall be properly balanced.
- C. All bearings of all equipment shall be oiled or greased as recommended by the manufacturer, after installation.
- D. The alignment of each centrifugal pump shall be checked and each pump shall be properly aligned after the pumps are placed in service. Mechanical seals and shaft sleeves shall be replaced by this Contractor without charge in the event that unusual wear or faulty operation occurs during the guarantee period.
- E. Cleaning (General)
 1. Upon completion of the work, all fixtures, trimmings and equipment shall be thoroughly cleaned, polished and left in first class condition for final acceptance.

3.13 EQUIPMENT PROVIDED UNDER OTHER SECTIONS OF THE WORK THAT REQUIRES PLUMBING

- A. Certain equipment may be supplied under other sections of the work. This Contractor shall provide as described below the requirements and all necessary services roughing and final connections as shown on the plans and as required.
- B. Installation of the equipment shall be performed in the following manner.
 - 1. Roughing: Provide all water, waste and vent piping complete in accordance with detailed dimensioned drawings, to be provided by the equipment suppliers. This roughing shall be left ready for final connection to tables and equipment terminated at a point and height indicated by the Equipment Suppliers drawings.
 - 2. Setting of Equipment: The Equipment Supplier will furnish and set in place and secure all equipment.
 - 3. Final Connection: This trade shall make all final connections after the equipment has been set in place.
 - 4. Trim: The Equipment Supplier will furnish all specialized appliances and trim such as faucets, tailpieces, strainers, service outlet bibbs, cocks, serrated hose connections and other related trim. This Trade shall coordinate and check with the Equipment Supplier and shall provide all valve, traps, stops, escutcheons, branch control valves, floor and funnel drains, nipples, fittings, tailpieces, pressure reducing valves, vacuum breakers, check valve, and other appurtenances which are not supplied by the Equipment Supplier and are necessary to the operating characteristics of the equipment being furnished. Also install all trim furnished with the equipment, as required, in accordance with the manufacturer's recommendations.
 - 5. All exposed to view final connection piping, fittings, valves, etc., shall be chrome plated with finish matching equipment rim finishes. Submit finish samples to Architect for approval. Attention is hereby drawn to the Equipment Specifications being prepared under other sections of the work.
- C. Review all Architectural drawings and equipment cuts for all equipment locations & services required at each piece of equipment.

3.14 EXCAVATION AND BACKFILL

- A. Instructions:
 - 1. Trenches shall be excavated so that pipe can be laid to the alignment and depth indicated on the drawings, and shall be excavated only so far in advance of pipe laying as approved.

2. Width of trenches shall be held to a minimum consistent with the type of material encountered and the size of the pipe being laid, but the width at the top of the pipe shall not be more than 2'-0" plus outside diameter of pipe. Excavation for manholes and other accessories shall have 12" minimum and a 24" maximum clearance on all sides.
3. Before fill or backfilling commences, all trash, debris and other foreign material shall be removed from trenches to be backfilled by this Trade. Fill material shall be free from timber, rocks 3" or larger, organic material, frozen material, and other unsuitable material as determined by the Architect. Filling shall not be done in freezing weather, unless specifically approved. No filling shall be done when material already in place is frozen.
4. In filling around pipe, deposit backfill material in successive horizontal layers not exceeding 6" in thickness before compaction. Compact each layer thoroughly by means of approved mechanical tampers. Take special care to obtain compaction under pipe haunches. Deposit backfill adjacent to pipes on both sides to approximately same elevation at the same time. Continue this method of filling and compacting until backfill is at least 18" above top of pipe.
5. Backfilling for the remainder of pipe trenches to subgrades of paved or landscaped areas shall be done by mechanical tamping and rolling equipment, except that the use of such equipment is prohibited when said use may result in damage to pipelines or structures.
6. Backfill shall be moistened as necessary for proper compaction. Water settling of fill will not be permitted.
7. Complete backfilling of pipe trenches as soon as possible after the pipe is laid and tested.
8. Existing pavements, roadways, walkways, curbs and landscaped areas disturbed during the progress of the excavation and backfill work shall be restored to their original condition at no additional cost to the Owner.
9. Backfill shall be compacted to a minimum of 90% of modified AASHTO maximum density as defined by ASTM D-1557. Any layer of fill, or portion thereof, which is not compacted to the required density shall be recompacted until the specified density is achieved, or the layer shall be removed.

3.15 APPLIANCES, TOILET ROOM ACCESSORIES AND TRIM

- A. Handle and install all Plumbing connected appliances claimed under Plumber's jurisdiction from tailboard delivery, including hoisting and rigging to designated locations.
- B. Handle and install all accessories and trim claimed under Plumber's jurisdiction.
- C. Dispose of all appliance and accessories packing crates and debris off of the site.

3.16 ARCHITECTURAL COORDINATION AND SAMPLES

- A. All devices and appurtenances which are to be installed in all finished areas must be coordinated with the Architect for final approval as it relates to location, finish, materials, color, texture, etc.
- B. Submit samples of all materials requested by the Architect.
- C. Samples shall be prepared and submitted with all postage and transportation costs paid by the Contractor submitting same. Label each sample with identifying numbers and titles.
- D. Submit samples of:
 - 1. All exposed to view finishes such as cleanout plates, access covers, drain grates and tops, fixture trim, fresh air inlet plates, etc.

END OF SECTION 15051

**NEW PASSENGER TERMINAL
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

SECTION 15410 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY REFER TO SCHEDULE ON DRAWINGS

- A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for showers and sinks.
2. Laminar-flow faucet-spout outlets.
3. Flushometers.
4. Toilet seats.
5. Protective shielding guards.
6. Fixture supports.
7. Interceptors.
8. Shower receptors.
9. Disposers.
10. Drinking fountain.
11. Urinals.
12. Lavatories.
13. Commercial sinks..
14. Individual showers.
15. Service sinks.
16. Mop receptor.

- B. Related Sections include the following:

1. Division 10 Section "Commercial Toilet Accessories."
2. Division 15 Section "Plumbing Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- F. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- G. Fixture: Plumbing unit connected to water and waste.
- H. FRP: Fiberglass-reinforced plastic.
- I. PMMA: Polymethyl methacrylate (acrylic) plastic.
- J. PVC: Polyvinyl chloride plastic.
- K. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.
- L. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.
- M. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act" and local code; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers: for style classifications.
- H. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- I. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.
- J. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Mop-Service Basins: ANSI Z124.6.
 - 3. Plastic Shower Enclosures: ANSI Z124.2.
 - 4. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 5. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 6. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 - 7. Vitreous-China Fixtures: ASME A112.19.2M.
 - 8. Water-Closet, Flush Valve, Trim: ASME A112.19.5.

- K. Comply with the following applicable standards and other requirements specified for lavatory and/or sink faucets:
1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 2. Faucets: ASME A112.18.1.
 3. Hose-Connection Vacuum Breakers: ASSE 1011.
 4. Hose-Coupling Threads: ASME B1.20.7.
 5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 6. NSF Potable-Water Materials: NSF 61.
 7. Pipe Threads: ASME B1.20.1.
 8. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 9. Supply Fittings: ASME A112.18.1.
 10. Brass Waste Fittings: ASME A112.18.2.
- L. Comply with the following applicable standards and other requirements specified for bathtub and/or shower faucets:
1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 3. Faucets: ASME A112.18.1.
 4. Hand-Held Showers: ASSE 1014.
 5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Manual-Control Antiscald Faucets: ASTM F 444.
 8. Pipe Threads: ASME B1.20.1.
 9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- M. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Manual-Operation Flushometers: ASSE 1037.
 4. Plastic Tubular Fittings: ASTM F 409.
 5. Brass Waste Fittings: ASME A112.18.2.
 6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- N. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Flexible Water Connectors: ASME A112.18.6.
 2. Floor Drains: ASME A112.6.3.
 3. Grab Bars: ASTM F 446.
 4. Hose-Coupling Threads: ASME B1.20.7.
 5. Off-Floor Fixture Supports: ASME A112.6.1M.

6. Pipe Threads: ASME B1.20.1.
7. Plastic Shower Receptors: ANSI Z124.2.
8. Plastic Toilet Seats: ANSI Z124.5.
9. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
 3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
 4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
 5. Toilet Seats: Equal to 5 percent of amount of each type installed.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

- A. Lavatory Faucets: To be provided by Owner and installed under this contract.
 1. Manufacturer:
 - a. Technical Concepts, Division of Rubbermaid" "Milano", Model No. 500615.
 2. Description: Electronic Thermostatic mixing valve. Single hole mount coordinate outlet with spout and fixture receptor, sensor operated with 0.5 GPM flow control and electronic soap dispenser.

2.2 SHOWER FAUCETS

- A. Shower Faucets:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Delta Faucet Company.
 - b. Leonard Valve Company.
 - c. Powers; a Watts Industries Co..
 - d. Speakman Company.
 - e. Symmons Industries, Inc.
2. Description: Single-handle thermostatic or thermostatic and pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and with 1.5 GPM flow control.

2.3 SINK FAUCETS

- A. Sink Faucets:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Delta Faucet Company.
 - b. Just Manufacturing Company.
 - c. Kohler Co.
 - d. Speakman Company.
 - e. Symmons
 - 2. Description: Kitchen faucet with spray, three-hole fixture or kitchen faucet with spray, four-hole fixture, gooseneck spout and wrist paddles. Include hot and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor with 1.5 GPM flow control.

2.4 WHEELCHAIR USER LAVATORY FAUCETS

- A. Wheel chair user Lavatory Faucets to be provided by Owner and installed under this contract.
- 1. Manufacturers:
 - a. Technical Concepts, Division of Rubbermaid: "Venetian 5.5" No. 750353.
 - 2. Description: Gooseneck, single hole mount, thermostatic mixing valve, sensor operated, with electronic soap dispenser with 0.5 GPM flow control.

2.5 FLUSHOMETERS

A. Flushometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sloan Valve Company.
 - b. Zurn Plumbing Products Group; Commercial Brass Operation.
 - c. Hydrotek International, Inc.
 - d. Sloan Valve Company.
 - e. TOTO USA, Inc.
2. Description: Flushometer for urinal and water-closet-type fixtures. Include brass body with corrosion-resistant internal components, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts, touchless sensor operated with 1.28 GPM for urinal.

2.6 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Bemis Manufacturing Company.
 - c. Church Seats.
 - d. Eljer.
 - e. Kohler Co.
3. Description: White-open front.

2.7 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers: Provide at each wheelchair user lavatory.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
3. Description: Manufactured plastic wraps for covering plumbing exposed fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.8 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Josam Company.
 2. MIFAB Manufacturing Inc.
 3. Smith, Jay R. Mfg. Co.
 4. Tyler Pipe; Wade Div.
 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Water-Closet Supports:
 1. Description: Combination carrier designed for accessible or standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
- C. Urinal Supports:
 1. Description: Urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
 2. Accessible-Fixture Support: Include rectangular steel uprights.
- D. Lavatory Supports:
 1. Description: Lavatory carrier with exposed arms and tie rods, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Sink Supports:

1. Description: Sink carrier with exposed arms and tie rods for sink-type fixture. Include steel uprights with feet.

2.9 INTERCEPTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Sediment Interceptors:

1. Description: Manufactured unit with removable screens or strainer and removable cover; designed to trap and retain waste material.
 - a. Material: Cast-iron or steel body with acid-resistant lining and coating or carbon-steel body with acid-resistant lining and coating or stainless-steel.
 - b. Pipe Connections: 6".

2.10 SHOWER RECEPTORS

A. Shower Receptors:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Plumbing, L.L.C./Fiat Products.
 - b. Florestone Products Co., Inc.
 - c. Aker Plastics Co., Inc.
 - d. LASCO Bathware.
 - e. Mustee, E. L. & Sons, Inc.
 - f. Sterling Plumbing Group, Inc.
 - g. Swan Corporation (The).

2. Description: Cast-polymer or FRP or PMMA or Precast-terrazzo or Solid-surface base for built-up-type shower fixture.
 - a. Type: Standard or residential or Handicapped/wheelchair.
 - b. Size **36 by 36 inches (914 by 914 mm)**
 - c. Color: White.
 - d. Outlet: Cast-in-floor drain or Drain with **NPS 1-1/2 (DN 40)** or **NPS 2 (DN 50)** or **NPS 3 (DN 80)** outlet.

2.11 WATER CLOSETS

A. Water Closets:

1. Low flow type wall hung WC 1.28 GPF with white vitreous china, siphon jet, elongated bowl.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Plumbing, L.L.C./Fiat Products.
 - b. American Standard Companies, Inc.
 - c. Briggs Plumbing Products, Inc.
 - d. Kohler Co.
 - e. TOTO USA, Inc.

B. Urinals:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Low flow 0.5 GPF - white vitreous china, siphon jet with integral flushing rim, top spud, integral trap.
 - a. American Standard Companies, Inc.
 - b. Kohler Co.
 - c. Mansfield Plumbing Products, Inc.: Model 421
 - d. TOTO USA, Inc.: Model UT104E

2.12 LAVATORIES

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay
 - b. Kohler Co.
 - c. Just Manufacturing Co.
 - d. Decolav
 - e. Neo-Metro Division of Acorn
 - f. Houzer, Inc.
2. Basis of Design: Just Manufacturing Model No. UCIF-ADA-14, 18 gauge stainless steel circular lavatory under mount with overflow.

2.13 COMMERCIAL SINKS - STAINLESS STEEL

A. Commercial Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Tabco.
 - b. Elkay Manufacturing Co.
 - c. Just Manufacturing Company.
 - d. Metal Masters Food service Equipment Co., Inc.

B. (4) Self-rimming, 18 gauge, stainless steel 15"x17" deep compartment undercoated, 3-hole.

C. Also: 33" x 19" x 7-1/2 double compartment.

2.14 SERVICE SINKS

A. Service Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Commercial Enameling Company.
 - c. Crane Plumbing, L.L.C./Fiat Products.
 - d. Eljer.
 - e. Kohler Co.

2.15 MOP RECEPTOR

A. Mop Receptor:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. Florestone Products Co., Inc.
 - d. Precast Terrazzo Enterprises, Inc.
 - e. Stern-Williams Co., Inc.
 - f. Mustee, E. L. & Sons, Inc.
 - g. Swan Corporation (The).
 - h. Zurn Plumbing Products Group; Light Commercial Operation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
 - 4. Use mounting frames for recessed water coolers, unless otherwise indicated.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install wall-mounting fixtures with tubular waste piping attached to supports.
- E. Install counter-mounting fixtures in and attached to casework.
- F. Install fixtures level and plumb according to roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 15 Section "Valves."
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

- K. Install toilet seats on water closets.
- L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- M. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- N. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- P. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- Q. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- R. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 16 Section "Grounding and Bonding."
- D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.
- F. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.
- D. Install fresh batteries in sensor-operated mechanisms.
- E. Adjust drinking fountain/water cooler fixture flow regulators for proper flow and stream height.
- F. Adjust water cooler temperature settings.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.
- C. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 15410

**NEW PASSENGER TERMINAL
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 15412 - PLUMBING
EMERGENCY FIXTURES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following emergency plumbing fixtures:
 - 1. Emergency showers.
 - 2. Eyewash equipment.
 - 3. Eye/face wash equipment.
 - 4. Combination units.
 - 5. Water-tempering equipment.
- B. Related Sections include the following:
 - 1. Division 15 Section "Plumbing Specialties" for backflow preventers and floor drains.

1.3 DEFINITIONS

- A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.
- D. Tepid: Moderately warm.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.

- C. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For emergency plumbing fixtures to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act;" or local code for plumbing fixtures for people with disabilities.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Flushing-Fluid Solution: Separate lot and equal to at least 200 percent of amount of solution installed for each self-contained unit.

PART 2 - PRODUCTS

2.1 EMERGENCY SHOWERS - SEE SCHEDULE ON DRAWINGS

- A. Emergency Showers, Single Shower Head:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation.
 - b. Chicago Faucets.
 - c. Encon Safety Products.
 - d. Guardian Equipment Co.
 - e. Haws Corporation.

- f. Lab Safety Supply Inc.
 - g. Murdock, Inc.
 - h. Sellstrom Manufacturing Co.
 - i. Speakman Company.
 - j. WaterSaver Faucet Co.
 - k. Western Emergency Equipment.
2. Description: Plumbed, single-shower-head horizontal, wall-mounting or vertical, ceiling-mounting or freestanding emergency shower.
- a. Capacity: Deliver potable water at rate not less than 20 gpm (76 L/min.) for at least 15 minutes.
 - b. Supply Piping: NPS 1 (DN 25), NPS 1-1/4 (DN 32), galvanized steel, chrome-plated brass or stainless steel, PVC with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Pull rod, chain.
 - d. Shower Head: 8-inch (200-mm) minimum diameter, chrome-plated brass or stainless steel, plastic.

2.2 EYEWASH EQUIPMENT

A. Eyewash Equipment, Free Standing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Bradley Corporation.
 - b. Chicago Faucets.
 - c. Encon Safety Products.
 - d. Guardian Equipment Co.
 - e. Haws Corporation.
 - f. Lab Safety Supply Inc.
 - g. Murdock, Inc.
 - h. Sellstrom Manufacturing Co.
 - i. Speakman Company.
 - j. WaterSaver Faucet Co.
 - k. Western Emergency Equipment.
2. Description: Plumbed, freestanding eyewash equipment.
- a. Capacity: Deliver potable water at rate not less than 0.4 gpm (1.5 L/min.) for at least 15 minutes.
 - b. Supply Piping: NPS 1/2 (DN 15) chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle, Push bar, Treadle.
 - d. Receptor: Chrome-plated brass or stainless-steel, Plastic bowl.
 - e. Drain Piping: [NPS 1-1/4 (DN 32) minimum, chrome-plated brass, receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2, Omit drain piping, Include galvanized-steel indirect connection to drainage system.

B. Eyewash Equipment, Wall Mounted:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation.
 - b. Chicago Faucets.
 - c. Encon Safety Products.
 - d. Guardian Equipment Co.
 - e. Haws Corporation.
 - f. Lab Safety Supply Inc.
 - g. Sellstrom Manufacturing Co.
 - h. Speakman Company.
 - i. WaterSaver Faucet Co.
 - j. Western Emergency Equipment.
2. Description: Plumbed, accessible, wall-mounting eyewash equipment with receptor and wall bracket.
 - a. Capacity: Deliver potable water at rate not less than 0.4 gpm (1.5 L/min.) for at least 15 minutes.
 - b. Supply Piping: NPS 1/2 (DN 15) chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle.
 - d. Receptor: Chrome-plated brass or stainless-steel, Plastic bowl.
 - e. Drain Piping: NPS 1-1/4 (DN 32) minimum, chrome-plated brass, receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2.

2.3 EYE/FACE WASH EQUIPMENT

A. Eye/Face Wash Equipment, Free Standing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation.
 - b. Encon Safety Products.
 - c. Guardian Equipment Co.
 - d. Haws Corporation.
 - e. Lab Safety Supply Inc.
 - f. Murdock, Inc.
 - g. Sellstrom Manufacturing Co.
 - h. Speakman Company.
 - i. WaterSaver Faucet Co.
 - j. Western Emergency Equipment.
2. Description: Plumbed, freestanding, pedestal eye/face wash equipment.
 - a. Capacity: Deliver potable water at rate not less than 3.0 gpm (11.4 L/min.) for at least 15 minutes.

- b. Supply Piping: **NPS 1/2 (DN 15)** chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
- c. Control-Valve Actuator: Paddle, Push bar, Treadle.
- d. Receptor: Chrome-plated brass or stainless-steel, Plastic bowl.
- e. Drain Piping: **NPS 1-1/4 (DN 32)** minimum, chrome-plated brass, receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2. Include galvanized-steel indirect connection to drainage system.

B. Eye/Face Wash Equipment, Wall Mounted:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation.
 - b. Chicago Faucets.
 - c. Encon Safety Products.
 - d. Guardian Equipment Co.
 - e. Haws Corporation.
 - f. Lab Safety Supply Inc.
 - g. Sellstrom Manufacturing Co.
 - h. Speakman Company.
 - i. WaterSaver Faucet Co.
 - j. Western Emergency Equipment.
2. Description: Plumbed, accessible, wall-mounting eye/face wash equipment with receptor and wall bracket.
 - a. Capacity: Deliver potable water at rate not less than **3.0 gpm (11.4 L/min.)** for at least 15 minutes.
 - b. Supply Piping: **NPS 1/2 (DN 15)** chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - c. Control-Valve Actuator: Paddle.
 - d. Receptor: Chrome-plated brass or stainless-steel, Plastic bowl.
 - e. Drain Piping: **NPS 1-1/4 (DN 32)** minimum, chrome-plated brass, receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2.

C. Eye/Face Wash Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation.
 - b. Encon Safety Products.
 - c. Guardian Equipment Co.
 - d. Haws Corporation.
 - e. WaterSaver Faucet Co.
2. Description: Plumbed, accessible, wall-mounting eye/face wash equipment without receptor and with wall bracket.

- a. Capacity: Deliver potable water at rate not less than **3.0 gpm (11.4 L/min.)** for at least 15 minutes.
- b. Supply Piping: **NPS 1/2 (DN 15)** chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
- c. Control-Valve Actuator: Paddle.

2.4 COMBINATION UNITS

A. Combination Units, Free Standing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation.
 - b. Chicago Faucets.
 - c. Encon Safety Products.
 - d. Guardian Equipment Co.
 - e. Haws Corporation.
 - f. Lab Safety Supply Inc.
 - g. Murdock, Inc.
 - h. Sellstrom Manufacturing Co.
 - i. Speakman Company.
 - j. WaterSaver Faucet Co.
 - k. Western Emergency Equipment.
2. Description: Plumbed, accessible, freestanding, with emergency shower and eyewash, eye/face wash, drench hose equipment.
 - a. Piping: Galvanized steel, Chrome-plated brass or stainless steel, PVC.
 - 1) Unit Supply: **NPS 1-1/4 (DN 32)** minimum, **NPS 1-1/2 (DN 40)** from top, side.
 - 2) Unit Drain: Outlet at side near bottom.
 - 3) Shower Supply: **NPS 1 (DN 25)** with flow regulator and stay-open control valve.
 - 4) Eyewash, Eye/Face Wash, Drench Hose Supply: **NPS 1/2 (DN 15)** with flow regulator and stay-open control valve.
 - b. Shower Capacity: Deliver potable water at rate not less than **20 gpm (76 L/min.)** for at least 15 minutes.
 - 1) Control-Valve Actuator: Pull rod, Pull chain, Treadle.
 - 2) Shower Head: **8-inch (200-mm)** minimum diameter, chrome-plated brass or stainless steel, plastic.
 - c. Eyewash Equipment: With capacity to deliver potable water at rate not less than **0.4 gpm (1.5 L/min.)** for at least 15 minutes.
 - 1) Control-Valve Actuator: Paddle, Push bar.
 - 2) Receptor: Chrome-plated brass or stainless-steel, Plastic bowl.

- d. Eye/Face Wash Equipment: With capacity to deliver potable water at rate not less than **3.0 gpm (11.4 L/min.)** for at least 15 minutes.
 - 1) Control-Valve Actuator: Paddle, Push bar.
 - 2) Receptor: Chrome-plated brass or stainless-steel, Plastic bowl.
- e. Hand-Held Drench Hose: With capacity to deliver potable water at rate not less than **3.0 gpm (11.4 L/min.)** for at least 15 minutes.
 - 1) Hose: Rubber or plastic.
 - 2) Control-Valve Actuator: Hand-held squeeze valve.
 - 3) Spray Head(s): Single, Twin.

2.5 WATER-TEMPERING EQUIPMENT

A. Water-Tempering Equipment:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Bradley Corporation.
 - c. Encon Safety Products.
 - d. Haws Corporation.
 - e. Lawler Manufacturing Co., Inc.
 - f. Leonard Valve Company.
 - g. Powers, a Watts Industries Co.
 - h. Speakman Company.
 - i. Therm-Omega-Tech, Inc.
 - j. Western Emergency Equipment.
- 2. Description: Factory-fabricated, hot- and cold-water-tempering equipment with thermostatic mixing valve.
 - a. Thermostatic Mixing Valve: Designed to provide **85 deg F (29 deg C)** tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus **5 deg F (3 deg C)** throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.

B. Water-Tempering Equipment:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Encon Safety Products.
 - b. Therm-Omega-Tech, Inc.
- 2. Description: Factory-fabricated, steam and cold-water, water-tempering equipment with thermostatic mixing valve.

- a. Thermostatic Mixing Valve: Designed to provide 85 deg F (29 deg C) tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F (3 deg C) throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, steam controls, heat exchanger, high-temperature-limit and freeze-protection devices, metal piping, and corrosion-resistant enclosure.

C. Water-Tempering Equipment:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chronomite Laboratories, Inc.
- 2. Description: Factory-fabricated, water-tempering equipment with electric heating.
 - a. Heating System: Electric, designed to provide 85 deg F (29 deg C) tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F (3 deg C) throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, heating coils, high-temperature-limit device, metal piping, and corrosion-resistant enclosure.
 - 1) Electrical Characteristics: [208-V ac, 38] [220-V ac, 40] [277-V ac, 32] A, single phase, 60 Hz.

2.6 SOURCE QUALITY CONTROL

- A. Certify performance of plumbed and/or self-contained emergency plumbing fixtures by independent testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.

- D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 15 Section "Plumbing - Valves."
 - 1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency plumbing fixture.
 - 2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.
- E. Install shutoff valve and strainer in steam piping and shutoff valve in condensate return piping.
- F. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Dielectric fittings are specified in Division 15 Section "Basic Plumbing Materials and Methods."
- G. Install thermometers in supply and outlet piping connections to water-tempering equipment. Thermometers are specified in Division 15 Section "Plumbing - Meters and Gages."
- H. Install trap and waste to wall on drain outlet of fixture receptors that are indicated to be directly connected to drainage system.
- I. Install indirect waste piping to wall on drain outlet of fixture receptors that are indicated to be indirectly connected to drainage system. Drainage piping is specified in Division 15 Section "Sanitary Waste and Vent Piping."
- J. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Escutcheons are specified in Division 15 Section "Basic Plumbing Materials and Methods."
- K. Fill self-contained fixtures with flushing fluid.
- L. Install equipment nameplates or equipment markers on fixtures and equipment signs on water-tempering equipment. Identification materials are specified in Division 15 Section "Mechanical Identification."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment.
- C. Connect hot- and cold-water-supply piping to hot- and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.

- D. Connect cold-water and steam supply and condensate return piping to steam and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.
- E. Connect cold water and electrical power to electric heating water-tempering equipment.
- F. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary drainage and vent piping.
- G. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary or storm drainage piping.
- H. Ground equipment according to Division 16 Section "Grounding and Bonding."
- I. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.
- B. Electrical-Component Testing: After electrical circuitry has been energized, test for compliance with requirements.
 - 1. Test and adjust controls and safeties.
- C. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.
- D. Report test results in writing.

3.5 ADJUSTING

- A. Adjust or replace fixture flow regulators for proper flow.
- B. Adjust equipment temperature settings.

END OF SECTION 15412

**NEW PASSENGER TERMINAL
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 15413 - PLUMBING
SECURITY FIXTURES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following security plumbing fixtures and related components:
 - 1. Combination units.
- B. Related Sections include the following:
 - 1. Division 10 Section "Commercial Toilet Accessories."
 - 2. Division 15 Section "Plumbing Fixtures."
 - 3. Division 15 Section "Plumbing - Emergency Fixtures."

1.3 DEFINITIONS

- A. Accessible Fixture: Security plumbing fixture that can be approached and used by people with disabilities.
- B. Back-Mounting-Type Fixture: Security plumbing fixture designed to mount on wall sleeve built into wall so installation and removal of fixture and piping and other components are only accessible from service space behind wall.
- C. Front-Mounting-Type Fixture: Security plumbing fixture designed to mount on fixture support with installation and removal from fixture side of wall, and piping and other components are accessible from access panels in fixture or wall.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include furnished specialties and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For security plumbing fixtures to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act;" or local code about security plumbing fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.
- D. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Flushometer Valves: Equal to 10 percent of amount installed for each type indicated, but no fewer than 2 units.
 - 2. Mechanical and Air-Operated Valves: Equal to 10 percent of amount installed for each type indicated, but no fewer than 2 units.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS - SEE SCHEDULE ON DRAWINGS

- A. Security Combination Units:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Bradley Corporation.
 - c. Metcraft Industries Inc.
 - d. Willoughby Industries, Inc.
 - 2. Description: Back-mounting, cabinet, security plumbing fixture with integral water closet and lavatory; fabricated from **0.109-inch (2.8-mm)** thickness, ASTM A 666, Type 304 stainless steel. Include SSINA No. 4 polished finish on exposed surfaces, and corrosion-resistant metal for internal piping and bracing.
 - a. Water Closet: Comply with IAPMO PS 61 for water-closet component.
 - 1) Bowl: Elongated, with back inlet, integral trap, siphon-jet design with back outlet and contoured seat.

- a) Seat Surface: SSINA No. 7 polished finish.
 - b) Punching: Provide two holes for installation of separate toilet seat.
 - c) Drain: **NPS 4 (DN 100)**, horizontal with cleanout and slip joint.
- 2) Flushing Device: Concealed flushometer valve with stainless-steel access panel, push-button mechanism, and **1.6-gal./flush (6.0-L/flush)** consumption. Refer to "Flushometer Valves" Article.
- b. Lavatory: In top of cabinet.
 - 1) Receptor: Oval bowl with integral soap depression.
 - 2) Hot- and Cold-Water Supply Valves: Mechanical-metering type with push-button actuation and individual check stop.
 - 3) Filler Spout: Backsplash mounted.
 - 4) Drain: Integral punched grid with **[NPS 1-1/4 (DN 32)]** minimum horizontal waste and trap complying with ASME A112.18.2
- c. Cabinet Configuration: Rectangular apron, made for on-floor installation and with backsplash.
 - 1) Water-Closet Bowl Location: See architectural details of apron.
 - 2) Toilet Paper Holder: Recessed, **0.063-inch (1.6-mm)** minimum thickness, stainless steel complying with ASTM A 666, Type 304 and located under lav of apron.
- d. Wall Sleeve: Galvanized-steel frame of dimensions required to match and support entire fixture. Include steel bars or other design that will prevent escape if fixture is removed.

2.2 FIXTURE SUPPORTS

A. Off-Floor, Plumbing Fixture Supports:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Description: ASME A112.6.1M carriers with dimensions and trim matching fixture.
 - a. Stainless-Steel, Front-Mounting Fixtures: With modifications.
 - 1) Drinking Fountains: Type I drinking fountain carrier.
 - 2) Lavatories: Type III lavatory carrier.
 - 3) Shampoo Bowls: Type II sink carrier.

- 4) Urinals: Type I urinal carrier with inlet seal unless Type II is required.
- 5) Water Closets: Combination support and waste fitting assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before security plumbing fixture installation.
- B. Examine floors and walls for suitable conditions where security plumbing fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SECURITY PLUMBING FIXTURE INSTALLATION

- A. Install back-mounting-type, stainless-steel security plumbing fixtures as follows:
 - 1. Install wall sleeve in wall.
 - 2. Install fixture on wall sleeve; mount components on or attached to wall sleeve with access from accessible service space.
 - 3. Extend supply piping from service space to fixture.
 - 4. Install soil and waste piping from fixture and extend into service space.
 - 5. Install fixture trap in service space instead of below fixture drain.
- B. Install front-mounting-type, stainless-steel security plumbing fixtures as follows:
 - 1. Install fixture support or mounting bracket.
 - 2. Install fixture on support; mount components inside of or attached to fixture.
 - 3. Extend supply piping from pipe space to fixture.
 - 4. Install trap below fixture and extend soil and waste piping into pipe space.
- C. Install security plumbing fixture outlets with gasket seals.
- D. Install fixtures designated "accessible" according to ICC A117.1 for heights, dimensions, and clearances.
- E. Install fixtures level and plumb.
- F. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 15 Section "Valves."
- G. Install dielectric fittings in water-supply piping to fixtures if piping and fixture connections are made of different metals. See Division 15 Section "Basic Mechanical Materials and Methods" for dielectric fittings.
- H. Install toilet seats on combination units if seats are indicated.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot- and cold-water supply piping to security plumbing fixtures. Include supply stops, if specified, or ball valve on each supply. Ball valves are specified in Division 15 Section "Plumbing - Valves."
- C. Connect soil and waste piping to security plumbing fixtures.
- D. Ground equipment according to Division 16 Section "Grounding and Bonding."
- E. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Testing: After installing security plumbing fixtures and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Remove and replace malfunctioning security plumbing fixtures. Retest as specified above after repairs or replacements are made.

3.5 ADJUSTING

- A. Operate and adjust water-supply flushometers and flow-control valves on security plumbing fixtures.

3.6 CLEANING

- A. Clean security plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall spouts and strainers.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed security plumbing fixtures and fittings.
- B. Do not allow use of security plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 15413

**NEW PASSENGER TERMINAL
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**SECTION 15426 - DRINKING
FOUNTAINS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes drinking fountains and related components.
- B. Related Sections:
 - 1. Division 15 Section 15051 "Basic Plumbing Materials and Methods"
 - 2. Division 15 Section 15410 "Plumbing Fixtures"
 - 3. Division 15 Section 15430 "Plumbing Specialties"

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of drinking fountain.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include operating characteristics, and furnished specialties and accessories.
- B. LEED Submittals:
 - 1. Product Data for Prerequisite WE 1, Credit WE 2, and Credit WE 3: Documentation indicating flow and water consumption requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For drinking fountains to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

- A. Drinking Fountains: Two-level, wall mounted.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Elkay Manufacturing Co.
 - b. Halsey Taylor.
 - c. Haws Corporation.
 - 2. Standards:
 - a. Comply with ASME A112.19.3/CSA B45.4.
 - b. Comply with NSF 61.
 - c. Comply with United States Access Board "Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines" July 23, 2004 Edition.
 - 3. Type Receptor: Stainless Steel Slab.
 - 4. Receptor Shape: Rounded.
 - 5. Back Panel: Stainless-steel wall plate behind drinking fountain.
 - 6. Bubblers: Two, with adjustable stream regulator, located on deck.
 - 7. Control: Push button or Push bar, vandal-resistant.
 - 8. Drain: Grid type with NPS 1-1/4 tailpiece.
 - 9. Supply: NPS 3/8 with shutoff valve.
 - 10. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 chrome-plated brass P-trap and waste.
 - 11. Support: ASME A112.6.1M, Type III lavatory carrier.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 15110 "Plumbing Valves."
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07920 "Joint Sealants."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Install ball, gate, or globe shutoff valve on water supply to each fixture.

3.4 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.

3.5 CLEANING

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures and do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 15426

**NEW PASSENGER TERMINAL
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SECTION 15430 - PLUMBING - SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following plumbing specialties:

1. Backflow preventers.
2. Water regulators.
3. Balancing valves.
4. Thermostatic water mixing valves.
5. Strainers.
6. Key-operation hydrants.
7. Wheel-handle wall hydrants.
8. Trap seal primer valves.
9. Drain valves.
10. Miscellaneous piping specialties.
11. Sleeve penetration systems.
12. Flashing materials.
13. Cleanouts.
14. Floor drains.
15. Trench drains.
16. Roof drains.
17. Solids interceptors.

B. Related Sections include the following:

1. Division 15 Section "Plumbing - Meters and Gages" for water meters, thermometers, and pressure gages.

1.3 DEFINITIONS

A. The following are industry abbreviations for plastic piping materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. PE: Polyethylene plastic.
3. PUR: Polyurethane plastic.
4. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:

1. Domestic Water Piping: 125 psig (860 kPa).
2. Sanitary Waste and Vent Piping: 10-foot head of water (30 kPa).
3. Storm Drainage Piping: 10-foot head of water (30 kPa).
4. Force-Main Piping: 100 psig (690 kPa).

1.5 SUBMITTALS

A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:

1. Backflow preventers and water regulators.
2. Balancing valves, water filters, and strainers.
3. Thermostatic water mixing valves and water tempering valves.
4. Water hammer arresters, air vents, and trap seal primer valves and systems.
5. Drain valves, hose bibbs, hydrants, and hose stations.
6. Outlet boxes and washer-supply outlets.
7. cleanouts, floor drains, open receptors, trench drains, and roof drains..

- 8. solids interceptors.
- 9. Sleeve penetration systems.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field test reports.
- D. Maintenance Data: For plumbing specialties to include in maintenance manuals. Include the following:
 - 1. Backflow preventers and water regulators.
 - 2. Thermostatic water mixing valves and water tempering valves.
 - 3. Trap seal primer valves and systems.
 - 4. Hose stations and hydrants.
 - 5. solids interceptors.

1.6 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of plumbing specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.
- E. NSF Compliance:
 - 1. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents..
 - 1. Operating Key Handles: Equal to 100 percent of amount installed for each key-operated hose bibb and hydrant installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.

2.2 BACKFLOW PREVENTERS

- A. Manufacturers:
 - 1. Ames Co., Inc.
 - 2. Cla-Val Co.
 - 3. CMB Industries, Inc.; Febco Backflow Preventers.
 - 4. Mueller Co.; Hersey Meters Div.
 - 5. Watts Industries, Inc.; Water Products Div.
 - 6. Zurn Industries, Inc.; Wilkins Div.
- B. General: ASSE standard, backflow preventers.
 - 1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
 - 2. NPS 2-1/2 (DN 65) and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
 - (a) Interior Lining: AWWA C550 or FDA-approved, epoxy coating for backflow preventers having cast-iron or steel body.
 - 3. Interior Components: Corrosion-resistant materials.
 - 4. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.
 - 5. Strainer: On inlet.
- C. Pipe-Applied, Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.
- D. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7, garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.

- E. Intermediate Atmospheric-Vent Backflow Preventers: ASSE 1012, suitable for continuous pressure application. Include inlet screen and two independent check valves with intermediate atmospheric vent.
- F. Reduced-Pressure-Principle Backflow Preventers: ASSE 1013, suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between two positive-seating check valves.
 - 1. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
- G. Double-Check Backflow Prevention Assemblies: ASSE 1015, suitable for continuous pressure application. Include shutoff valves on inlet and outlet, and strainer on inlet; test cocks; and two positive-seating check valves.
 - 1. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
- H. Antisiphon-Pressure-Type Vacuum Breakers: ASSE 1020, suitable for continuous pressure application. Include shutoff valves, spring-loaded check valve, spring-loaded floating disc, test cocks, and atmospheric vent.
 - 1. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
- I. Dual-Check-Valve-Type Backflow Preventers: ASSE 1024, suitable for continuous pressure application. Include union inlet and two independent check valves.
- J. Dual-Check-Valve-Type Backflow Preventers: ASSE 1032, suitable for continuous pressure application for carbonated beverage dispensers. Include stainless-steel body; primary and secondary checks; ball check; intermediate atmospheric-vent port for relieving carbon dioxide; and threaded ends, NPS 3/8 (DN 10).
- K. Reduced-Pressure Detector Assembly Backflow Preventers: ASSE 1047, FM approved or UL listed, and suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet. Include test cocks; pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between two positive-seating check valves; and bypass with displacement-type water meter, valves, and reduced-pressure backflow preventer.
 - 1. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
- L. Double-Check Detector Assembly Backflow Preventers: ASSE 1048, FM approved or UL listed, and suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet. Include test cocks; two positive-seating check valves; and bypass with displacement-type water meter, valves, and double-check backflow preventer.
 - 1. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.

- M. Hose-Connection Backflow Preventers: ASSE 1052, suitable for at least 3-gpm (0.19-L/s) flow and applications with up to 10-foot head of water (30-kPa) back pressure. Include two check valves; intermediate atmospheric vent; and nonremovable, ASME B1.20.7, garden-hose threads on outlet.
- N. Back-Siphonage Backflow Vacuum Breakers: ASSE 1056, suitable for continuous pressure and backflow applications. Include shutoff valves, check valve, test cocks, and vacuum vent.

2.3 WATER REGULATORS

- A. Manufacturers:
 - 1. Cla-Val Co..
 - 2. Watts Industries, Inc.; Water Products Div.
 - 3. Zurn Industries, Inc.; Wilkins Div.
- B. General: ASSE 1003, water regulators, rated for initial working pressure of 150 psig (1035 kPa) minimum. Include integral factory-installed or separate field-installed, Y-pattern strainer.
 - 1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
 - (a) General-Duty Service: Single-seated, direct operated, unless otherwise indicated.
 - (b) Booster Heater Water Supply: Single-seated, direct operated with integral bypass.
 - 2. NPS 2-1/2 (DN 65) and Larger: Bronze or cast-iron body with flanged ends. Include AWWA C550 or FDA-approved, interior epoxy coating for regulators with cast-iron body.
 - (a) Type: Pilot-operated, single- or double-seated, cast-iron-body main valve, with bronze-body pilot valve.
 - 3. Interior Components: Corrosion-resistant materials.
 - 4. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.
 - 5. Strainer on inlet.

2.4 BALANCING VALVES

- A. Balancing Valves: Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.

1. Manufacturers:
 - (a) Amtrol, Inc.
 - (b) Armstrong Pumps, Inc.
 - (c) Armstrong-Yoshitake, Inc..
 - (d) ITT Industries; Bell & Gossett Div.
 - (e) Taco, Inc.
 - (f) Watts Industries, Inc.; Water Products Div.
2. NPS 2 (DN 50) and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends..

2.5 THERMOSTATIC WATER MIXING VALVES 60° - 85°

- A. Manufacturers:
 1. Lawler Manufacturing Company, Inc.
 2. Leonard Valve Company.
 3. Mark Controls Corp.; Powers Process Controls.
 4. Symmons Industries, Inc.
- B. General: ASSE 1017, manually adjustable, thermostatic water mixing valve with bronze body. Include check stop and union on hot- and cold-water-supply inlets, adjustable temperature setting, and thermometer.
 1. Type: Bimetal thermostat, operation and pressure rating 125 psig (860 kPa) minimum.
 2. Type: Liquid-filled motor, operation and pressure rating 100 psig (690 kPa) minimum.

2.6 STRAINERS

- A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch (1.2-mm) round perforations, unless otherwise indicated.
 1. Pressure Rating: 125-psig (860-kPa) minimum steam working pressure, unless otherwise indicated.
 2. NPS 2 (DN 50) and Smaller: Bronze body, with female threaded ends.

3. NPS 2-1/2 (DN 65) and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.
4. Y-Pattern Strainers: Screwed screen retainer with centered blowdown.
 - (a) Drain: Factory- or field-installed, hose-end drain valve.
5. Basket Strainers: Bolted flange or clamp cover, and basket with lift-out handle.
 - (a) Type: Simplex with one basket.
 - (b) Drain: Factory- or field-installed, hose-end drain valve.

2.7 KEY-OPERATION HYDRANTS

- A. Manufacturers:
 1. Josam Co.
 2. Murdock, Inc.
 3. Simmons Manufacturing Co.
 4. Smith, Jay R. Mfg. Co.
 5. Tyler Pipe; Wade Div.
 6. Watts Industries, Inc.; Drainage Products Div.
 7. Woodford Manufacturing Co.
 8. Zurn Industries, Inc.; Jonespec Div.
 9. Zurn Industries, Inc.; Specification Drainage Operation.
- B. General: ASME A112.21.3M, key-operation hydrant with pressure rating of 125 psig (860 kPa).
 1. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25) threaded or solder joint.
 2. Outlet: ASME B1.20.7, garden-hose threads.
 3. Operating Keys: Two with each key-operation hydrant.
- C. Nonfreeze Exposed-Outlet Wall Hydrants: ASSE 1019, self-drainable with integral nonremovable hose-connection vacuum breaker, casing and operating rod to match wall thickness, projecting outlet, and wall clamp.

1. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
 2. Nozzle and Wall Plate Finish: Polished Chrome plated bronze.
- D. Nonfreeze Concealed-Outlet Wall Hydrants: ASSE 1019, self-drainable with flush-mounting box with cover, integral nonremovable hose-connection vacuum breaker or backflow preventer, casing and operating rod to match wall thickness, concealed outlet, and wall clamp.
1. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
 2. Box and Cover Finish: Polished Chrome plated bronze.

2.8 TRAP SEAL PRIMER VALVES

- A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:
1. Manufacturers:
 - (a) Josam Co.
 - (b) MIFAB Manufacturing, Inc.
 - (c) Precision Plumbing Products, Inc.
 - (d) Smith, Jay R. Mfg. Co.
 - (e) Tyler Pipe; Wade Div.
 - (f) Watts Industries, Inc.; Drainage Products Div.
 - (g) Watts Industries, Inc.; Water Products Div.
 - (h) Zurn Industries, Inc.; Jonespec Div.
 - (i) Zurn Industries, Inc.; Specification Drainage Operation.
 2. 125-psig (860-kPa) minimum working pressure.
 3. Bronze body with atmospheric-vented drain chamber.
 4. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
 5. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.

6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.9 DRAIN VALVES

- A. Hose-End Drain Valves: MSS SP-110, NPS 3/4 (DN 20) ball valve, rated for 400-psig (2760-kPa) minimum CWP. Include two-piece, copper-alloy body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, and vinyl-covered steel handle.
 1. Inlet: Threaded or solder joint.
 2. Outlet: Short-threaded nipple with ASME B1.20.7, garden-hose threads and cap.
- B. Hose-End Drain Valve: MSS SP-80, gate valve, Class 125, ASTM B 62 bronze body, with NPS 3/4 (DN 20) threaded or solder-joint inlet and ASME B1.20.7, garden-hose threads on outlet and cap. Hose bibbs are prohibited for this application.
- C. Stop-and-Waste Drain Valves: MSS SP-110, ball valve, rated for 200-psig (1380-kPa) minimum CWP or MSS SP-80, Class 125, gate valve; ASTM B 62 bronze body, with NPS 1/8 (DN 6) side drain outlet and cap.

2.10 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, piston type with pressurized metal-tube cushioning chamber. Sizes indicated are based on ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.
 1. Available Manufacturers:
 - (a) Amtrol, Inc.
 - (b) Josam Co.
 - (c) Precision Plumbing Products, Inc.
 - (d) Sioux Chief Manufacturing Co., Inc.
 - (e) Watts Industries, Inc.; Drainage Products Div.
 - (f) Watts Industries, Inc.; Water Products Div.
 - (g) Zurn Industries, Inc.; Wilkins Div.
- B. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet, of design suitable for pressure of at least 125 psig (860 kPa); integral [or field-installed,] nonremovable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.

1. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
 2. Finish for Service Areas: Chrome or nickel plated.
 3. Finish for Finished Rooms: Chrome or nickel plated.
 4. Operation for Equipment Rooms: Wheel handle or operating key.
 5. Operation for Service Areas: Wheel handle.
 6. Operation for Finished Rooms: Operating key.
 7. Include operating key with each operating-key hose bibb.
 8. Include integral wall flange with each chrome- or nickel-plated hose bibb..
- C. Roof Flashing Assemblies: Manufactured assembly made of 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch- (2.4-mm-) thick, lead flashing collar and skirt extending at least 10 inches (250 mm) from pipe with galvanized steel boot reinforcement, and counterflashing fitting.
1. Manufacturer:
 - (a) Acorn Engineering Company; Elmdor/Stoneman Div
 2. Extended Vent Cap: With field-installed, vandal-proof vent cap.
- D. Open Drains: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting, joined with ASTM C 564, rubber gaskets.
- E. Deep-Seal Traps: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap seal primer valve connection.
1. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
 2. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.
- F. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
- G. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semiopen top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.
- H. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.

- I. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
- J. Vent Terminals: Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.
- K. Downspout Boots: ASTM A 48 (ASTM A 48M), gray-iron casting, with NPS 4 (DN 100) outlet; shop-applied bituminous coating; and inlet size to match downspout.
- L. Downspout Boots: ASTM A 74, Service class, hub-and-spigot, cast-iron soil pipe.

2.11 SLEEVE PENETRATION SYSTEMS

- A. Manufacturer:
 - 1. ProSet Systems, Inc.
- B. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
 - 1. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 2. Stack Fitting: ASTM A 48 (ASTM A 48M), gray-iron, hubless-pattern, wye-branch stack fitting with neoprene O-ring at base and gray-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.
 - (a) Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

2.12 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 - 2. Vent Pipe Flashing: 3-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 - 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Copper Sheet: ASTM B 152 (ASTM B 152M), of the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Applications: 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).
 - 2. Vent Pipe Flashing: 8 oz./sq. ft. (2.5 kg/sq. m or 0.27-mm thickness).

- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.
- G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.13 CLEANOUTS

- A. Cleanouts: Comply with ASME A112.36.2M and ASME A112.3.1.
 - 1. Application: Floor cleanout, wall cleanout and for installation in exposed piping.
 - 2. Manufacturers:
 - (a) Josam Co.;
 - (b) Josam Co., Blucher-Josam Div.
 - (c) Smith, Jay R. Mfg. Co.;
 - (d) Tyler Pipe, Wade Div.;
 - (e) Watts Industries, Inc., Drainage Products Div.;
 - (f) Zurn Industries, Inc., Jonespec Div.;
 - (g) Zurn Industries, Inc., Specification Drainage Operation;
 - 3. Body or Ferrule Material: Cast iron.
 - 4. Clamping Device: As required.
 - 5. Outlet Connection: Threaded, inside calk or spigot.
 - 6. Closure: Brass plug with straight threads and gasket.
 - 7. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
 - 8. Frame and Cover Material and Finish: Nickel-bronze, copper, polished bronze or stainless steel.
 - 9. Frame and Cover Shape: Round.

10. Top Loading Classification: Light Duty, medium Duty, heavy Duty, extra Heavy-Duty or special Duty.

2.14 FLOOR, ROOF, TRENCH, DRAINS (SEE SCHEDULE ON DRAWINGS)

- A. Floor, Roof, Trench, Drains: Comply with ASME A112.21.1M and ASME A112.21.1M with ASME A112.14.1, backwater valve, ASME A112.3.1.

1. Application: Area drain, Floor drain, Funnel floor drain, etc.
2. Manufacturers:
 - (a) Josam Co., Blucher-Josam Div.;
 - (b) Smith, Jay R. Mfg. Co.;
 - (c) Tyler Pipe, Wade Div.;
 - (d) Watts Industries, Inc., Drainage Products Div.;
 - (e) Zurn Industries, Inc., Jonespec Div.;
 - (f) Zurn Industries, Inc., Specification Drainage Operation;

2.15 GREASE INTERCEPTORS (SEE DESCRIPTION ON DRAWINGS)

2.16 SOLIDS INTERCEPTORS

- A. Solids Interceptors:
 1. Manufacturers:
 - (a) Josam Co.;
 - (b) MIFAB Manufacturing, Inc.;
 - (c) Rockford Sanitary Systems, Inc.;
 - (d) Schier Products Co.;
 - (e) Smith, Jay R. Mfg. Co.;
 - (f) Town & Country Plastics, Inc.;
 - (g) Tyler Pipe, Wade Div.;
 - (h) Watts Industries, Inc., Drainage Products Div.;
 - (i) Zurn Industries, Inc., Specification Drainage Operation;

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 15 Section 15051 "Basic Plumbing Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- C. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
- D. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve..
- E. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- F. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet (15 m).
 - 4. Locate at base of each vertical soil and waste stack.
- G. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- H. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- I. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.

- J. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- K. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- L. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 - 3. Set with grates depressed according to the following drainage area radii:
 - (a) Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - (b) Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - (c) Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 - 4. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- M. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 - 1. Install roof-drain flashing collar or flange so no leakage occurs between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Position roof drains for easy access and maintenance.
- N. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- O. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- P. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.

- Q. Install individual shutoff valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 15 Section "Plumbing - Valves" for general-duty ball, butterfly, check, gate, and globe valves.
- R. Install air vents at piping high points. Include ball, gate, or globe valve in inlet and drain piping from outlet to floor drain.
- S. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- T. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect plumbing specialties to piping specified in other Division 15 Sections.
- D. Ground equipment.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- F. Connect plumbing specialties and devices that require power according to Division 16 Sections.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.

2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
 - D. Secure flashing into sleeve and specialty clamping ring or device.
 - E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 7 Section "Sheet Metal Flashing and Trim."
 - F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
 - G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each piece of equipment.
 1. Text: Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
 2. Refer to Division 15 Sections "Basic Plumbing Materials and Methods" and "Plumbing - Identification" for nameplates and signs.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled grease recovery units and their installation, including piping and electrical connections. Report results in writing.
 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain each piece of equipment. Refer to Division 1 Sections "Closeout Procedures" and/or "Demonstration and Training."

END OF SECTION 15430

**NEW PASSENGER TERMINAL
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 16050 - BASIC ELECTRICAL
MATERIALS AND METHODS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 16.

1.2 SUMMARY

- A. This Section includes general requirements for electrical installations. These requirements are applicable to all Division 16 work. The following requirements are included in this Section to expand the requirements specified in Division 1:
 - 1. Submittals.
 - 2. Coordination drawings.
 - 3. Record documents.
 - 4. Maintenance manuals.
 - 5. Rough-ins.
 - 6. Electrical installations.
 - 7. Cutting and patching.
 - 8. Codes, Permits and Inspections.
 - 9. Separation of Work Between Trades.
 - 10. Definitions and Interpretations.
 - 11. Energy Conservation Rebate Programs.

1.3 SUSTAINABLE DESIGN

- A. Sustainable Design Intent: Comply with project requirements intended to achieve a Certified Rating, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council.
- B. LEED Certification Documentation: Submit documentation from the manufacturer highlighting LEED requirements for materials and products of this Section.

- C. Comply with the requirements of Division 1 Section "LEED REQUIREMENTS".
- D. Construction Waste Management: Comply with the requirements of Division 1, Section "Construction Waste Management", for removal and disposal of construction debris and waste.

1.4 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Section "SUBMITTALS."
- B. Additional copies may be required by individual sections of these Specifications.

1.5 COORDINATION DRAWINGS

- A. Prepare coordination drawings in accordance with Division 1 to a scale of 1/4"=1'-0" (1:50) or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components in all electric rooms including 1st floor main electrical room, 2nd floor electrical room and 3rd floor electrical room. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
 - 1. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:
 - (a) Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
 - (b) Exterior wall and foundation penetrations.
 - (c) Fire-rated wall and floor penetrations.
 - (d) Equipment connections and support details.
 - (e) Sizes and location of required concrete pads and bases.
 - 2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 - 3. Prepare floor plans, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

B. Project Coordination Drawings

1. This Trade shall add to Coordination Drawings prepared by the HVAC Contractor showing all of the electrical work (equipment, conduit, etc.) to be installed as part of the work of this section of the specifications.
2. Requirements for vibration isolation and seismic restraints shall be shown on the coordination drawings by each trade.
3. This Trade after showing all of the electrical work shall forward the completed electronic AutoCAD files to the General Contractor/Construction Manager.
4. The Electrical Contractor shall attend a series of meetings arranged by the General Contractor/Construction Manager to resolve any real or apparent interferences or conflicts with the work of the other Contractors.
5. The Electrical Contractor shall then make adjustments to his work on the Coordination Drawings to resolve any real or apparent interferences or conflicts.
6. After any real or apparent interferences and conflicts have been incorporated into the Coordination Drawings, the Electrical Contractor shall "sign-off" the final Coordination Drawings.
7. The Electrical Contractor shall not install any of this work prior to "sign-off" of final Coordination Drawings. If the electrical work proceeds prior to sign-off of Coordination Drawings, any change to the electrical work to correct the interferences and conflicts which result will be made by the Electrical Contractor at no additional cost to the project.

1.6 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1. In addition to the requirements specified in Division 1, comply with the following:
1. A complete set of "as-built" or record electric drawings shall be made up and delivered to the Architect.
 2. The drawings shall show:-
 - (a) All electric work installed exactly in accordance with the original design.
 - (b) All electric work installed as a modification or addition to the original design.

- (c) The dimensional information necessary to delineate the exact location of all circuitry and wiring runs (other than lighting and appliance branch circuitry and small control, signal and communications runs) which are so buried or concealed as to be untraceable by inspection through the regular means of access established for inspection and maintenance.
 - (d) The numbering information necessary to correlate all electrical energy consuming items (or outlets for same) to the panel or switchboard circuits from which they are supplied.
- 3. The drawings shall be produced using AutoCAD software. The design drawing files will be made available should it be determined that such files would serve as suitable backgrounds for the "as-built" drawings. These documents remain the property of Cosentini Associates and may be used for no other purpose without expressed, written consent. The contractor shall assume all liabilities resulting from unauthorized use or modifications to the drawings.
- 4. "As-built" information shall be submitted as follows:
 - (a) CADD drawing files on CD-R in AutoCAD format.
 - (b) One (1) set of reproducible drawings.
 - (c) Two (2) sets of blueprints.
- 5. The quantity of design drawings which are made available shall in no way be interpreted as setting a limit to the number of drawings necessary to show the required "as-built" information.
- 6. Progress prints of record drawings shall be submitted monthly during the construction period for Architect's approval.

1.7 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1. In addition to the requirements specified in Division 1, include the following information for major equipment items such as engine generator set(s), UPS equipment, alarm system(s), communications systems, transformers, busways, switchgear, switchboards, panelboards, automatic transfer switches, lighting fixtures, and other items as specified elsewhere.
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.9 CODES, PERMITS AND INSPECTIONS

- A. All work shall meet or exceed the latest requirements of all national, state, county, municipal, and other authorities exercising jurisdiction over electrical construction work and the project.
- B. All required permits and inspection certificates shall be obtained, paid for, and made available at the completion of the work.
- C. Any portion of the work which is not subject to the requirements of an electric code published by a specific authority having jurisdiction shall be governed by the National Electrical Code and other applicable sections of the National Fire Code, as published by the National Fire Protection Association.
- D. Equipment, material, layout and installation provided as part of the electrical work shall conform to the requirements of all agencies having jurisdiction. Include as part of the electrical work all required filings and submissions for approval. Equipment furnished separate from - but installed as part of - the electrical work, which does not have all necessary approvals, shall not be installed until approvals are obtained by the parties furnishing the equipment.
- E. Installation procedures, methods and conditions shall comply with the latest requirements of the Federal Occupational Safety and Health Administration (OSHA).
- F. All equipment furnished as part of the electrical work shall comply with the latest editions of all applicable state and municipal "energy codes." Provide certification from the equipment suppliers for all energy-consuming equipment that the equipment fully complies with these codes. Equipment submissions will not be accepted for review unless accompanied by such certification in writing.

1.10 GUARANTEES AND CERTIFICATIONS

- A. All work shall be guaranteed to be free from defects. Any defective materials or workmanship as well as damage to the work of all trades resulting from same shall be replaced or repaired as directed for the duration of stipulated guaranteed periods.
- B. The duration of guarantee periods following the date of beneficial use of the system shall be one year. Beneficial use is defined as operation of the system to obtain its intended use.
- C. The date of acceptance shall be the date of the final payment for the work or the date of a formal notice of acceptance, whichever is earlier.
- D. Non-durable items such as electric lamps, shall be replaced up to the date of acceptance, such that they shall have had no more than 100 hours use prior to this date.
- E. Certification shall be submitted attesting to the fact that specified performance criteria are met by all items of electrical equipment for which such certifications is required.

1.11 SEPARATION OF WORK BETWEEN TRADES

- A. The specifications for the overall construction delineate various items of work under separate trade headings. The list below sets forth this delineation to the extent that it affects the electric work.
- B. In the absence of more detailed information, the list shall be taken as a specific instruction to the electrical trade to include the work assigned to it.
- C. Indications that any trade is to perform an item of work means that it is to perform the work for its own accommodation only, except as specifically noted otherwise.

Oth	=	Other than electrical or mechanical.
Plb	=	Plumbing
FP	=	Fire Protection
Htg	=	Heating, Ventilating & Air Conditioning
Elec	=	Electrical.
f	=	Furnished.
i	=	Installed.
p	=	Provided (furnished and installed).

Item	Oth	Plb	FP	Htg	Elec	Note
Motors for mechanical equipment.		p	p	p		
Motor controllers for: Htg Plb FP		f	f	f	i i	Specifications and drawings delineate exceptions. Includes motor control centers if applicable.
Motor control devices for: Htg Plb FP		p	p	p		Specifications and drawings delineate exceptions. Control devices for mounting within controller are provided integral with controller.
Power wiring for motors: Htg Plb FP					p p	
Control wiring for motor controllers: Htg Plb FP				p	p p	Specifications and drawings delineate exceptions.
Temporary light and power.	p					See General conditions specifications. To accommodate all trades.
Temporary water.	p					
Temporary heat.	p					
Temporary toilets.	p					
Hoisting.					p	

Item	Oth	Plb	FP	Htg	Elec	Note
Rigging.					p	
Bracing and dunnage for safe rigging.					p	
Cutting, chasing and patching.	p					Cost where due to late installation or improper coordination of work is the responsibility of the electric.
Framed slots and openings in walls, decks and slabs.	p					Coordination drawings are required from the electric.
Sleeves through non-waterproof slabs, decks and walls.					p	Includes drilling of holes when required.
Sleeves through waterproof slabs, decks and walls.					p	Includes drilling of holes for other than field poured concrete.
Waterproof sealing of sleeves through waterproof slabs, decks and walls.					p	
Fireproof sealing (fire-stopping) excess opening spaces in slabs, decks and fire-rated walls.					p	
Excavation and backfill inside buildings.	p					
Excavation and backfill outside buildings.					p	
Concrete encasement of conduits.					p	Red coloring for concrete encasing primary voltage runs included in electric.
Electric manholes and handholes.					p	Furnishing of covers, associated frames and other hardware included in electric.
Fastenings.					p	
Supports.					p	

Item	Oth	Plb	FP	Htg	Elec	Note
Flashing of electric conduits through roof (pitch pockets).	p					
Concrete foundations, pads and bases inside buildings.	p					Furnishing of anchors and vibration mounts included in the electric.
Concrete foundations, pads and bases outside buildings.					p	Furnishing of anchors and vibration mounts included in the electric.
Concrete lined trenches in building foundation.	p					
Field touch-up painting of damaged shop coats.					p	
Field rustproof painting of supporting steel members, frames and racks.					p	
Finish painting of exposed work.	p					Red coloring of exposed fire protection alarm systems circuitry included in electric. Red and white striping of exposed primary voltage runs included in electric.
Finished wall and ceiling access doors, panels and supporting frames.	i				f	Supplying list of locations where required included in electric.
Permanent catwalks to equipment.	p					Supplying list of locations where required included in electric.
Permanent ladders to equipment.	p					Supplying list of locations where required included in electric.
Opening frames for ceiling recessed lighting fixtures and other electrical items.					p	
Luminous ceilings.	p					Lamp strips and lamps included in electric.

Item	Oth	Plb	FP	Htg	Elec	Note
Electric duct heaters (heaters installed in air ducts).				p		Line and control connections included in electric.
Electric heaters with integral fans, (unit heaters, cabinet heaters, fan coil units and the like.)				p		Line and control connections included in electric.
Electric radiators (baseboard, sill line and convector type heaters).					p	
Electric water heaters.		p				Line and control connections included in electric.
Electric boilers.				p		Line and control connections included in electric.
Through wall sleeve type air conditioning and electric heating units.					p	
Electric heater cables for radiant space heating.					p	
Electric heater cables for snow melting.					p	
Electric heater cables for mechanical system pipe tracing.					p	
Electric power consuming items and controls for same not referred to above.	p	p	p	p		Line and control connections to equipment included in electric.
Rubbish removal.					p	Removal of the shipping and packing materials of electrical items is included in the electric regardless by whom the items are furnished.

Item	Oth	Plb	FP	Htg	Elec	Note
Special tools for maintenance of equipment furnished as part of electric work.					f	

- D. Include in the electrical work all necessary supervision and the issuing of all coordination information to any other trades who are supplying work to accommodate the electrical installations.
- E. For items of equipment which are to be installed but not purchased as part of the electrical work, the electrical work shall include:
1. The coordination of their delivery.
 2. Their unloading from delivery trucks driven in to any point on the property line at grade level.
 3. Their safe handling and field storage up to the time of permanent placement in the project.
 4. The correction of any damage, defacement or corrosion to which they may have been subjected.
 5. Their field make-up and internal wiring as may be necessary for their proper operation.
 6. Their mounting in place including the purchase and installation of all dunnage, supporting members, and fastenings necessary to adapt them to architectural and structural conditions.
 7. Their connection to building wiring including the purchase and installation of all "crown boxes" or other type of termination junction boxes necessary to adapt and connect them to this wiring. Included also shall be the purchase and installation of any substitute lugs or other wiring terminations as may be necessary to adapt their terminals to the building wiring as called for and to the connection methods set forth in these specifications.
- F. Items of equipment which are installed but not purchased as part of the electrical work shall be carefully examined upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of the electric work will be considered only if presented in writing within one week of the date of delivery to the project of the items in question. The electric work includes all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

1.12 DEFINITIONS AND INTERPRETATIONS

- A. As used in the drawings and specifications for electrical work, certain non-technical words shall be understood to have specific meanings as follows regardless of indications to the contrary in the General Conditions or other documents governing the electric work.

"Furnish" -- Purchase and deliver to the project site complete with every necessary appurtenance and support, all as part of the electrical work. Purchasing shall include payment of all sales taxes and other surcharges as may be required to assure that purchased items are free of all liens, claims or encumbrances. Payment of sales taxes is, however, specifically excluded.

"Install" -- Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project, all as part of the electrical work.

"Provide" -- "Furnish" and "install."

"New" -- Manufactured within the past two years and never before used.

Regardless of their usage in codes or other industry standards, certain words as used in the drawings or specifications for the electrical work, shall be understood to have the specific meanings ascribed to them in the following list:-

"Circuitry" -- Any electric work (not limited to light and power distribution) which consists of wires, cables, raceways, and/or specialty wiring method assemblies taken all together complete with associated junction boxes, pull boxes, outlet boxes, joints, couplings, splices and connections except where limited to a lesser meaning by specific description.

"Wiring" -- Same as Circuitry.

"Circuit" -- Any specific run of circuitry.

"Branch Circuit" -- Any light and power distribution system circuit which, at its load end, is directly connected to one or more electrical energy consuming items with no overcurrent protection devices interposed, other than (where required) those protecting the energy consuming items from overloading or overheating.

"Appliance Panel" -- Any panel, used in a light and power distribution system, containing single pole and/or multipole branches rated in various sizes.

"Lighting Panel" -- Any panel used in a light and power distribution system, having all (or the majority) of its branches single pole and rated the same.

"Lighting and Appliance Branch Circuitry" -- All or any portion of branch circuits outgoing from a lighting or appliance panel.

"Feeder" -- Any item of light and power circuitry used in a distribution system which is not lighting and appliance branch circuitry.

"Main Feeder" -- Any feeder which, at its supply end, is connected through its own overcurrent protection (and switching) device, and none other, directly to a main service or a main service overcurrent protection (and switching) device.

"Branch Feeder" -- A feeder, other than a main feeder, which complies with the definition of a branch circuit.

"Submain Feeder" -- Any feeder which is neither a main feeder nor a branch feeder.

"Distribution Panel" -- Any panel, used in a light and power distribution system, containing only multi-pole branches and with all (or the majority) of its branches used for feeders supplying other panels.

"Power Panel" -- Same as distribution panel, except with all (or the majority) of its branches used for feeders which do not supply other panels.

"Motor Power Circuit" -- Any circuit which operates nominally at 100 volts or more, and which carries electrical input energy to a motor.

"Motor Control Circuit" (used in conjunction with a motor for which a magnetic starter is supplied) -- Any circuit (other than a motor power circuit), which operates nominally at 100 volts or more, and which carries current intended for directing or indicating the performance of a motor starter.

"Motor Control Circuit" (used in conjunction with a motor for which a manual starter is supplied) -- Any circuit containing an extension of power circuit wires, other than those constituting the direct connection between source of supply, starter and motor.

"Motor Control Actuating Device" -- Any device which performs a switching function in a motor control circuit (pushbuttons, automatic contacting devices, etc.).

"Motor Control Actuated Device" -- Any device which functions in response to voltage received from a motor control circuit (pilot lights, solenoids, etc.)

"Package Unit" -- An item of equipment having one or more motors or other electric energy consuming elements integrally factory mounted on a single base, complete with all associated control devices and interconnecting wiring.

"Low Voltage" -- Below 50 volts.

"Process Control System" -- An overall control and/or logging system of a low voltage, electronic or pneumatic type available as a fully installed "package" from specialty manufacturers (commonly referred to as a "Temperature Control System" or an "Automatic Control System" or a "Building Management System" where used in conjunction with air conditioning).

"Grade Slab" -- A building floor slab which is in contact with or directly over grade (earth).

"Building Confines" -- The extent of a building, as defined by the outside surfaces of its peripheral walls, the top surface of its roof, and the underside surface of its grade slab.

"Distribution Switch" -- Any switch used in a light and power system other than a tumbler, toggle or specialty switch in the "wiring device" category.

"Normal Electric Work Conditions" -- Locations within building confines which are neither damp, wet nor hazardous and which are not used for air handling.

"Underground" -- Subsurface and exterior to building foundations.

"At Underside of Grade Slab" -- Under a grade slab and integrated into it.

"Below Grade Slab" -- Under a grade slab but not integrated into it.

"Standard" (as applied to wiring devices) -- Not of a separately designated individual type.

"Raceway" -- Any pipe, duct, extended enclosure, or conduit (as specified for a particular system) which is used to contain wires, and which is of such nature as to require that the wires be installed by a "pulling in" procedure.

"Specialty Cast-in-Floor Raceway" -- Underfloor duct, cellular deck and the like.

"Concealed" (as applied to circuitry) -- Covered completely by building materials, except for penetrations (by boxes and fittings) to a level flush with the surface as necessitated by functional or specified accessibility requirements.

"Exposed" (as applied to circuitry) -- Not covered in any way by building materials.

"Subject to Mechanical Damage" -- Exposed within seven feet of the floor in mechanical rooms, vehicular spaces, or other spaces where heavy items (over 100 pounds) are moved around or rigged as a common practice or as required for replacement purposes.

"Primary" (as applied to light and power distribution) -- Over 600 volts.

"Secondary" (as applied to light and power distribution) -- Under 600 volts.

"Assembly" -- A defined set of elements of electric work.

- B. The following shall be treated as damp or wet locations within building confines, regardless of whether or not a high ambient moisture level is found to exist:-
 - 1. Spaces where any designations indicating weatherproof (WP) or vapor-proof (VP) appear on the drawings.
 - 2. Cooling tower areas.
 - 3. Below waterproofing in slabs applied directly on grade.
 - 4. Kitchens up to a height of 18" above finished floor.
 - 5. Outside of waterproofing in foundation walls in contact with grade.
 - 6. Above waterproofing in slabs having no building above.
 - 7. Above waterproofing in fill on slabs having no building above.
 - 8. Spaces containing equipment owned and/or maintained by the electric utility company.
- C. Electric work in slabs, walls or suspended ceilings which bound on a space defined as a damp or wet location shall meet the damp or wet location requirements if it enters into, or opens into the damp or wet location in any way.
- D. Where the word "conduit" is used without specific reference to type, it shall be understood to mean "raceway".
- E. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any electrical item in the drawings and specifications for electrical work carries with it the instruction to furnish, install and connect the item as part of the electrical work regardless of whether or not this instruction is explicitly stated.
- F. It shall be understood that the specifications and drawings are complementary and are to be taken together for a complete interpretation of the work. Where there are conflicts between the drawings and specifications or within the specifications or drawings themselves, the items of higher standard shall govern.
- G. To the extent that they govern the basic work, the specifications also govern change order work if any.
- H. No exclusion from or limitation in, the symbolism used on the drawings for electrical

work or the language used in the specifications for electrical work shall be interpreted as a reason for omitting the appurtenances or accessories necessary to complete any required system or item of equipment.

- I. The drawings for electrical work utilize symbols and schematic diagrams which have no dimensional significance. The work shall, therefore, be installed to fulfill the diagrammatic intent expressed on the electrical drawings, but in conformity with the dimensions indicated on the final working drawings, field layouts and shop drawings of all trades. In particular, information as to the exact size, location and electrical connection points for mechanical equipment shall be derived by reference to HVAC and Plumbing documents.
- J. Certain details appear on the drawings for electrical work which are specific with regard to the dimensioning and positioning of the work. These are intended only for general information purposes. They do not obviate field coordination for individual items of the indicated work.
- K. Information as to general construction and architectural general construction and architectural features and finishes shall be derived from structural and architectural drawings and specifications only.
- L. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred to.
- M. Ratings of devices, materials and equipment specified without reference to specific performance criteria shall be understood to be nominal or nameplate ratings established by means of industry standard procedures.
- N. The restriction of conductors in wires to copper, as specified elsewhere, shall be understood to also apply to all conductors (wire, cable or bus as applicable), including those provided as part of factory assembled components such as transformers, switchboards, panelboards, switchgear, overcurrent protection and switching devices. This restriction shall apply equally to all such equipment regardless of indications (or lack thereof) elsewhere to the contrary. Aluminum will not be acceptable.

PART 2 - PRODUCTS

2.1 TOUCH UP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

2.2 ACCESS DOORS IN FINISHED CONSTRUCTION

- A. Access doors as required for operation and maintenance of concealed equipment, valves, controls, etc. will be coordinated by general contractor.
1. Access doors shall be of ample size, minimum of 16 inches x 16 inches (40 cm. x 40 cm.).
- B. Furnish (confirm with GC) access doors as required for operation and maintenance of concealed equipment, valves, controls, etc., and coordinate their delivery with the installing Trade.
1. Coordinate and prepare a location, size, and function schedule of access required and deliver to a representative of the installing Trade.
 2. Doors shall be minimum size 16 inches x 16 inches (40 cm. x 40 cm.) as manufactured by Karp Associates, Inland Steel Products "Milcor", "MIFAB" or other approved in accordance with the following schedule:

Location	Type	Catalog Number
Plaster Ceiling	Recessed Door Panel	Karp DSC-210-PL Milcor Style AP MIFAB-CAD-PL
Acoustic Tile Ceiling	Recessed Door Panel for Tile	Karp DSC-210 Milcor Style AT MIFAB-CAD
Plaster Wall	Flush Door Panel	Karp DSC-214-PL Milcor Style K MIFAB-CAD-PL-PL
Drywall	Flush Door Panel	Karp DSC-214-M Milcor Style DW MIFAB-MDW
Drywall	Recessed Door Panel	Karp-RDW-210 MIFAB-CAD-FL
Ceramic Tile Walls	Flush Door Panel	Karp DSC-214-M Milcor Style M MIFAB-UA
Masonry Wall	Flush Door Panel	Karp DSC-214-M Milcor Style M MIFAB-UA
3-Hour Rated Masonry Shaft	Flush Door Panel	Karp DSC-211-FRT MIFAB-MPFR-SD

Location	Type	Catalog Number
1-1/2 Hour Rated Shaft	Flush Door Panel	Karp KRP-150-FR Milcor Fire Door Rated Access Door Panel MIFAB-MPFR

3. Doors and frames shall be given a factory prime coat of corrosion resistant paint.
4. Type shall be as approved by Architect.
5. Frames shall be welded minimum 14 gauge steel, mitered corners ground smooth with anchors.
6. Finish shall be as selected and approved by Architect.
7. Doors shall be minimum 14 gauge steel, heavy hinges flush with frame, invisible when closed.

PART 3 - EXECUTION

3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.2 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
 1. Coordinate electrical systems, equipment, and materials installation with other building components.
 2. Verify all dimensions by field measurements.
 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 7. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
 8. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 9. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
 10. Coordinate location of access panels or doors where outlet boxes, junction boxes, or equipment are concealed behind finished surfaces.
 11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
- B. Coordinate electrical service connections to components furnished by utility companies.
1. Coordinate installation and connection of exterior underground and overhead utilities and services.
 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- C. Locations of all devices, fixtures, and other visible components shall be as indicated on the architectural drawings. Mounting heights shall be as specified in Division 16 Section "Raceways and Boxes".
- D. Each piece of mechanical equipment located outside the building or on the roof shall be within 25 feet (7 m) of a duplex outlet. Where necessary to meet this criteria, provide duplex outlets in addition to those devices shown on the drawings. Each shall be complete with waterproof cover and integral GFI protection, and 20 ampere circuitry to the nearest 120 volt panel on the proper electric meter.

3.3 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Firestopping."

3.4 FOUNDATIONS

A. General

1. All equipment, including but not limited to Switchgear, Switchboards, Motor control centers, Generators, Uninterruptible power supplies and battery racks, Automatic transfer switches, transformers shall be provided with foundations.
2. Furnish shop drawings showing adequate concrete reinforcing steel details and templates for all concrete foundations and supports, and all required anchor bolts and other appurtenances necessary for the proper installation of this equipment. All concrete work shall be shown in detail on the shop drawings, prepared by this trade.
3. Each piece of equipment shall be set on a concrete base minimum 4 inches (10 cm.) high and extending 3 inches (8 cm.) beyond the equipment in all directions. Bases shall be integrally keyed to structural slab.

3.5 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1 Section "Cutting and Patching." In addition to the requirements specified in Division 1, the following requirements apply:

1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - (a) Uncover Work to provide for installation of ill-timed Work.
 - (b) Remove and replace defective Work.
 - (c) Remove and replace Work not conforming to requirements of the Contract Documents.
 - (d) Upon written instructions from the Architect, uncover and restore Work to provide for Architect observation of concealed Work.

2. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
 3. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers.
- B. Identify for future use with a tag at each unterminated end all low voltage (audio, data, Class 2, Class 3, PLTC, fire alarm, optical fiber, communications, coaxial, and network) cables.

3.6 REFINISHING AND TOUCH UP PAINTING

- A. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
- B. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
- C. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
- D. Repair damage to PVC or paint finishes with matching touch up coating recommended by manufacturer.

3.7 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 1. Cutting and patching for electrical construction.
 2. Touch up painting.

3.8 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 16050

**NEW PASSENGER TERMINAL
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

SECTION 16060 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.
- B. Related sections include the following:
 - 1. Division 16 Section "Conductors and Cables."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Ground rods, connectors, exothermic welds, ground bars, grounding conductors and other components of system.
- B. Field Test Reports: Written reports specified in Part 3.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by Underwriters Laboratories, Inc.
- B. Comply with UL 467.
- C. Comply with NFPA 70, as amended by state and local codes.
- D. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.
- E. Comply with applicable BICSI standards.
- F. Comply with ANSI/IEEE 142

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. Erico Products, Inc.
 2. Ideal Industries, Inc.
 3. Kearney.
 4. O-Z/Gedney Co.
 5. Racco, Inc.
 6. Thomas & Betts, Electrical

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."
- B. Material: Copper
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape - alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- E. Grounding Electrode Conductors: Stranded cable.
- F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- G. Bare Copper Conductors: Comply with the following:
1. Solid Conductors: ASTM B 3.
 2. Assembly of Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
- H. Copper Bonding Conductors: As follows (except where otherwise indicated):
1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 0.25-inch (6.4 mm) in diameter.
 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.

3. Bonding Jumper: Bare copper tape, braided bare copper No. 30 AWG conductors, terminated with copper ferrules; 1.625 inch (42 mm) wide and 1/16 inch (1.5 mm) thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper No. 30 AWG conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
- I. Grounding Bus: Bare, annealed copper bars of rectangular cross section, 1/4 by 2 inches (6 by 50 mm) in cross section, unless otherwise indicated; with mounting insulators.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Connectors: Bolted-pressure-type connectors, or compression type.
- C. Bolted Clamps: Heavy-duty type.
- D. Pressure Connectors: High-conductivity-plated units.
- E. Main Grounding System - Welded Connections: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions for the specific types, sizes, and combinations of conductors and other items to be connected.

1. **Manufacturer: Erico "Cadweld" system.**

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.
 1. Size: 3/4 inch by 10 feet (19 by 3000 mm).

PART 3 - EXECUTION

3.1 APPLICATION

- A. Equipment Grounding Conductor Application: Comply with NFPA 70, as amended by state and local codes, for sizes and quantities of equipment grounding conductors except where specific types, larger sizes or more conductors are indicated.
 1. Provide equipment grounding conductors with circuit conductors for all feeders and branch circuits.
- B. Signal and Communications: For telephone, alarm, voice and data and other communication systems, provide a #4 AWG minimum green insulated copper conductor in raceway from the grounding electrode system to each service location, antenna, terminal cabinet, wiring closet and central equipment location.

- C. The ground bus of switchboards and switchgear shall be connected to the main grounding electrode by means of insulated grounding electrode conductors run in intermediate metallic conduit and sized as per Code.
- D. The neutral bar of each individually enclosed service switch shall be bonded to its enclosure on the line side of a removable link (included therein), and connected to the main grounding electrode by means of insulated grounding electrode conductors run in intermediate metallic conduit and sized as per Code.
- E. The emergency generator system neutral shall be grounded by means of a connection from the [neutral bar in the generator main circuit breaker enclosure to the main grounding electrode by means of an insulated grounding electrode conductor run in intermediate conduit and sized as per Code. Include a bonding connection from the neutral to the equipment enclosure.
- F. The Uninterruptible Power Source (UPS) system neutral shall be grounded by means of a connection from the neutral bar in the UPS main circuit breaker enclosure to the main grounding electrode by means of an insulated grounding electrode conductor run in intermediate conduit and sized as per Code. Include a bonding connection from the neutral to the equipment enclosure.
- G. The main grounding electrode shall be an accessible point on the nearest metallic main water service pipe. Connection shall be made on the street side of the main valve utilizing a ground clamp of a type specifically manufactured for the purpose. Bonding jumpers shall be provided around the water meters (if provided) and around insulating joints and/or sections, utilizing conductors sized as per Code and run in IMC. Bond the structural steel to the grounding electrode system.
- H. The water pipe ground shall be supplemented by an additional "made" electrode consisting of buried ground rods, and provided in sufficient quantity so as to have a measured resistance to ground of not more than 5 ohms. Establish a bonding connection from the "made" electrode consisting of green insulated conductors run in IMC and sized as per Code.
- I. Bond the reinforcing bars in concrete to the nearest grounding electrode. Where reinforcing bars are installed in building foundations and footings protect the bonding conductor during construction. Arrange for inspection by the authority having jurisdiction prior to placement of concrete.
- J. The neutral of secondary winding of each low voltage (i.e., less than 600 volts) transformer shall be grounded to the grounding electrode as specified hereinafter by means of an insulated grounding conductor sized as per Code and run in IMC. The neutral of each transformer shall be bonded to the transformer enclosure by means of an insulated conductor sized as per code. If not factory installed the jumper shall be field installed within the transformer enclosure.
- K. At each secondary voltage to secondary voltage transformer, bond the metallic water piping system to the transformer neutral at the nearest available location utilizing conductors sized equal to the grounding electrode conductor and run in conduit.

- L. The grounding electrode for each low voltage (both windings 600 volts or less) transformer shall be the main water service pipe entering the building taken at a point on the street side of its main valve. Utilize a common ground clamp on the main water pipe, with means for connecting the multiple separate grounding conductors from the various transformers. In lieu of multiple separate grounding conductors, multiple connection to a "ground bus cable" may be utilized. The ground bus cable shall consist of a 500 MCM green coded insulated copper conductor run in 1-1/2 inch (DN 41) threaded steel conduit from the street side of the main water service valve, throughout the building to all dry type transformer locations requiring grounding. The ground bus cable shall be connected to the main water pipe by means of a ground clamp of a type specifically manufactured for the purpose. At each transformer location, establish a "grounding electrode" connection point by arranging a break in the "ground bus cable" conduit exposing the cable for not more than a twelve inch length. Ends of conduit at the break shall be equipped with bushings. The connection shall be made by means of an irreversible compression connector listed for the purpose or an exothermic weld.
- M. Include a properly sized green insulated grounding conductor within the conduit for each feeder supplying a panel containing an isolated ground bus (i.e., insulated from ground). Increase indicated conduit size if necessary to accommodate this conductor. Connect to the neutral grounding facility for feeders originating at the service entry point or at 480-120/208 volt stepdown transformers as applicable.
- N. Bond metallic conduits containing grounding electrode conductors and main bonding conductors to the ground bus service enclosure and/or grounding electrode at both ends of each run utilizing grounding bushings and jumpers. Bonding jumpers shall be sized equal to the grounding electrode conductors.
- O. Provide grounding bonds for all metallic conduits of the light and power system which terminate at (or in pits below) distribution equipment for which a ground bus is specified. Accomplish this by equipping the conduits with bushings of the grounding type connected individually to the ground bus.
- P. Provide supplementary ground bonding to maintain continuity of the equipment and raceway grounding system as follows:
 - 1. Bonding jumpers shall be applied where wiring devices (receptacles and switches) are not equipped with approved self-grounding features. Include any necessary field modifications for termination of the bonding jumpers so as to insure grounding continuity.
 - 2. Bonding jumpers shall be applied to insure that grounding continuity does not depend solely on the supporting screws fastening metallic enclosures together.
 - 3. Include any necessary field modifications for termination of the bonding jumpers so as to insure grounding continuity.

- Q. Provide grounding of raised metallic floors used to contain wiring to computers and/or other equipment. Where the floor system is of a type that is specifically designed by the manufacturer to maintain ground continuity through its metallic structural support system, the grounding may be accomplished by means of no fewer than (8) bonding connections spaced equally about the perimeter but in no case more than 100 feet (30 m) apart. Utilize #8 AWG green insulated copper conductors for the connection of the bonding locations to the ground bus in the panel serving the equipment and the service ground point. If the raised floor is to be used as an air handling plenum, the insulation shall be of a fluoropolymer type suitable for use in plenums without raceway. If the floor system is not designed to maintain ground continuity through the metallic structural support system, alternating support pedestals in each direction must be connected to the bonding conductors.
- R. Provide a ground connection for each 100 feet (30 m) of run of cable tray, and for each isolated run of less than 100 feet (30 m), by means of a #6 AWG green coded insulated copper conductor run in 3/4 inch (DN 21) conduit. The grounding electrode for each run of cable tray requiring same shall consist of a cadweld connection to adjacent structural steel at a point where only fireproofing and not structural concrete is applied to it or the nearest cold water pipe if steel is not available. Utilize ground clamps of a type specifically manufactured for the purpose.
- S. Provide supplementary ground bonding for each motor control center (MCC) as follows:
1. Provide equipment grounding conductors as required to insure that all sections (including attached integral or field installed pullboxes) are bonded together by means of these conductors and by means of the MCC ground bus (if a ground bus is included in the MCC).
 2. Provide grounding bushings and jumpers as required to insure that all conduits and any contained equipment grounding conductors are bonded to the enclosure grounding conductors (or ground bus).
- T. Where specifically noted on the drawings, or described hereinbefore in this Section, include insulated equipment and raceway grounding conductors run within the raceways. Where insulated equipment grounding conductors required for feeders have not been included in the quantities of conductors indicated on the drawings, incorporate such conductors in accordance with the electrical code. Adjust conduit sizing if required.
- U. Common Ground Bonding With Lightning Protection System: Bond electric power system ground directly to lightning protection system grounding conductor at closest point to electric service grounding electrode. Use bonding conductor sized same as system ground conductor and installed in conduit.
- V. Grounding Underground Distribution System Components complies with IEEE C2 grounding requirements and the following. Provide additional grounding if required to comply with Utility Company standards.

1. **Grounding Manholes and Handholes:** Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, non-shrink grout.
2. **Grounding Connections to Manhole Components:** Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
3. **Pad-Mounted Transformers and Switches:** Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with pad mounted equipment by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.2 INSTALLATION

- A. **General:** Ground electrical systems and equipment according to NFPA 70, as amended by state and local codes, except where Drawings or Specifications exceed such requirements.
- B. **Grounding Rods:** Locate a minimum of 1-rod length from each other and at least the same distance from any other grounding electrode.
 1. Drive until tops are 2 inches (50 mm) below finished floor or final grade, except as otherwise indicated.
 2. Interconnect with grounding-electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make these connections without damaging copper coating or exposing steel.
- C. **Grounding Conductors:** Route along the shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- D. **Underground Grounding Conductors:** Use bare copper wire. Bury at least 24 inches (600 mm) below grade.

- E. Metal Water Service Pipe: Provide insulated copper grounding conductors, sized as indicated, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding-clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Provide a grounding jumper with the same size conductor across dielectric fittings. Bond grounding-conductor conduit to conductor at each end.
- F. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding-clamp connectors.
- G. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

3.3 CONNECTIONS

- A. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding-Wire Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: Where metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.
- E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.
- F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

- G. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage an independent electrical testing organization to perform tests described below.
- B. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal.. Measure ground resistance not less than 2 full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the fall-of-potential method according to IEEE 81.
- C. Maximum grounding resistance shall be less than or equal to 5 ohms.
- D. Excessive Ground Resistance: Where resistance to ground exceeds specified values, provide additional grounding to achieve required results.
- E. Report: Prepare test reports, certified by the testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results.
- F. Field Test Reports: Submit written test reports to include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

END OF SECTION 16060

**NEW PASSENGER TERMINAL
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SECTION 16075 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70 - as amended by state and local codes, OSHA standards, and the requirements of the authorities having jurisdiction. All power distribution equipment shall be labeled.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70, as amended by state and local codes.
- B. Comply with ANSI A13.1 and NFPA 70 for color-coding.
- C. Comply with ANSI Z535-2, Z535-4, and NFPA 70E.
- D. Comply with ANSI C2.
- E. Comply with 29 CFR 1910.145

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY AND CABLE LABELS

- A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
 - 1. Color: Black letters on orange field.
 - 2. Legend: Indicates voltage and service.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, **2 inches (50 mm)** long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; **2 inches (50 mm)** wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than **3 mils (0.08 mm)** thick by **1 to 2 inches (25 to 50 mm)** wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- C. Aluminum Wraparound Marker Labels: Cut from **0.014-inch- (0.35-mm-)** thick aluminum sheet, with stamped, or embossed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.
- D. Metal Tags: Brass or aluminum, **2 by 2 by 0.05 inch (50 by 50 by 1.3 mm)**, with stamped legend, punched for use with self-locking nylon tie fastener.
- E. Write-On Tags: Polyester tag, **0.015 inch (0.38 mm)** thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 1. Not less than **6 inches (150 mm)** wide by **4 mils (0.102 mm)** thick.
 2. Compounded for permanent direct-burial service.
 3. Embedded continuous metallic strip or core.
 4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS, NAMEPLATES AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Engraved Plastic Warning Labels, 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.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
- C. Baked-Enamel Warning Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. **1/4-inch (6.4-mm)** grommets in corners for mounting. Nominal size, **7 by 10 inches (180 by 250 mm)**.
- D. Exterior, Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with **0.0396-inch (1-mm)** galvanized-steel backing; and with colors, legend, and size required for application. **1/4-inch (6.4-mm)** grommets in corners for mounting. Nominal size, **10 by 14 inches (250 by 360 mm)**.
- E. Warning label and sign shall include, but are not limited to, the following legends:
 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR **48 INCHES (1200 MM)**.". Adjust clearance dimensions as required for system voltage and equipment configuration.
 3. Arc Flash Warning: "POTENTIAL ARC FLASH HAZARD - APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT AND TOOLS REQUIRED WHEN WORKING ON THIS EQUIPMENT."

- F. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength: 50 lb (22.3 kg) minimum.
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: Black, except where used for color-coding.
- B. Paint: Formulated for the type of surface and intended use.
1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
 2. Primer for Concrete Masonry Units: Heavy-duty concrete masonry unit block filler.
 3. Primer for Concrete: Exterior concrete and masonry primer.
 4. Enamel: Exterior semigloss acrylic enamel.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands or with snap-around, color-coding bands:
1. Fire Alarm System: Red.
 2. Telecommunication System: Green and yellow.
 3. Control Wiring: Green and red.
- B. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use aluminum wraparound marker labels or non-ferrous metal tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use aluminum wraparound marker labels. Identify each ungrounded conductor according to source and circuit number.

- D. Ground fault interrupter outlets: Identify receptacles supplied by ground fault interrupter circuit breakers or by upstream ground fault interrupter receptacles. Use engraved letters on device plate.
- E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- H. Warning Labels for Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - (a) Power transfer switches.
 - (b) Controls with external control power connections.
 - 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
 - 3. Switchboards, Panelboards, Equipment Control Panels, Meter Socket Enclosures, and Motor Control Centers: Labeled to warn of potential electric arc flash hazards. The label shall be located so as to be clearly visible before examination, adjustment, servicing, or maintenance of the equipment.
- I. Instruction Signs:
 - 1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum **3/8-inch- (10-mm-)** high letters for emergency instructions at equipment used for power transfer or for load shedding.
- J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - (a) Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with **1/2-inch- (13-mm-)** high letters on **1-1/2-inch- (38-mm-)** high label; where 2 lines of text are required, use labels **2 inches (50 mm)** high.
 - (b) Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 2. Equipment to Be Labeled:
 - (a) Panelboards, electrical cabinets, and enclosures.
 - (b) Access doors and panels for concealed electrical items.
 - (c) Electrical switchgear and switchboards.
 - (d) Transformers.
 - (e) Emergency system boxes and enclosures.
 - (f) Motor-control centers.
 - (g) Disconnect switches.
 - (h) Enclosed circuit breakers.
 - (i) Motor starters.
 - (j) Push-button stations.
 - (k) Power transfer equipment.
 - (l) Contactors.
 - (m) Remote-controlled switches, dimmer modules, and control devices.
 - (n) Battery racks.

- (o) Power-generating units.
- (p) Voice and data cable terminal equipment.
- (q) Master clock and program equipment.
- (r) Intercommunication and call system stations.
- (s) Television/audio components, racks, and controls.
- (t) Fire-alarm control panel and annunciators.
- (u) Monitoring and control equipment.
- (v) Uninterruptible power supply equipment.
- (w) Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Attach signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- E. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied the entire length of conductors, except the following field-applied color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
 - (a) Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch- (25-mm-) wide tape in colors specified. Locate tape bands to avoid obscuring cable identification markings.

- (b) Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting **3 inches (76 mm)** from the terminal and spaced **3 inches (76 mm)** apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length. Locate bands to avoid obscuring cable identification markings.
- 2. Colors for 208/120-V Circuits:
 - (a) Phase A: Black.
 - (b) Phase B: Red.
 - (c) Phase C: Blue.
- 3. Colors for 480/277-V Circuits:
 - (a) Phase A: Brown.
 - (b) Phase B: Orange.
 - (c) Phase C: Yellow.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at **6 to 8 inches (150 to 200 mm)** below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds **16 inches (400 mm)** overall.
- I. Painted Identification: Install painted identification according to manufacturer's written instructions and as follows:
 - 1. Clean surfaces of dust, loose material, and oily films before painting.
 - 2. Prime surfaces using type of primer specified for surface.

END OF SECTION 16075

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SECTION 16080 - ELECTRICAL TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes general requirements for electrical field testing and inspecting. Detailed requirements are specified in each Section containing components that require testing. General requirements include the following:
 - 1. Coordination requirements for testing and inspecting
 - 2. Reporting requirements for testing and inspecting.

1.3 QUALITY ASSURANCE

- A. As specified in each Section containing electrical testing requirements.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 GENERAL TESTS AND INSPECTIONS

- A. Where no specific requirements are given, provide testing in accordance with the latest version of the InterNational Testing Association (NETA) Acceptance Testing Specification for Electric Power Distribution Equipment and Systems.
- B. Where tests are specified to be performed by an independent testing agency, prepare systems, equipment, and components for tests and inspections, and perform preliminary tests to ensure that systems, equipment, and components are ready for independent agency testing. Include the following minimum preparations as appropriate:
 - 1. Perform insulation-resistance tests.
 - 2. Perform continuity tests.
 - 3. Perform rotation test (for motors to be tested).

4. Provide a stable source of single-phase, 208/120-V electrical power for test instrumentation at each test location.
- C. Test and Inspection Reports: In addition to requirements specified elsewhere, report the following:
1. Manufacturer's written testing and inspecting instructions.
 2. Calibration and adjustment settings of adjustable and interchangeable devices involved in tests.
 3. Tabulation of expected measurement results made before measurements.
 4. Tabulation of "as-found" and "as-left" measurement and observation results.

3.2 COMMISSIONING

- A. Provide manpower as required to assist the commissioning agent, as required in Division 1 Section "GENERAL COMMISSIONING REQUIREMENTS" and Division 1 Section "HVAC COMMISSIONING REQUIREMENTS".

END OF SECTION 16080

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SECTION 16120 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes building wires and cables and associated splices, connectors, and terminations for wiring systems rated 600 volts and less.

1.3 SUBMITTALS

- A. Product Data: for each type of product indicated.
- B. Field Quality Control Test Reports.

1.4 QUALITY ASSURANCE

- A. Listing and Labeling: Provide products specified in this Section that are Underwriters Laboratories listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
- B. Comply with NFPA 70, as amended by state and local codes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 CONDUCTORS AND CABLES

- A. Available Manufacturers:
 - 1. American Insulated Wire Corp.; a Leviton Company.

2. General Cable Corporation.
 3. Senator Wire & Cable Company.
 4. Southwire Company.
 5. Belden, Division Cooper Industries.
 6. Cable & Wire Division, AT&T.
 7. Pyrotenax.
- B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
1. Conductor Material: Copper, complying with NEMA WC 5 or 7; solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.
 2. Conductor Insulation Types: Type THHN, THWN, XHHW complying with NEMA WC 5 or 7.
- C. Electrical Circuit Protective System Cable: Where required by code, or where indicated on the drawings, feeders and circuitry are a fire rated cable system, except where enclosed within equivalent fire rated construction indicated on the architectural drawings. Mineral-insulated, metal-sheathed cable, Type MI.

2.3 CONNECTORS AND SPLICES

- A. Available Manufacturers:
1. AFC Cable Systems, Inc.
 2. AMP Incorporated/Tyco International.
 3. Hubbell/Anderson.
 4. O-Z/Gedney; EGS Electrical Group LLC.
 5. 3M Company; Electrical Products Division.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 WIRE AND INSULATION APPLICATIONS

- A. Utilize copper conductors with THWN, THHN or XHHW insulation, except provide THHW-2, THWN-2 or XHHW-2 insulation for conductors 1/0 and larger in "wet" locations. Conductors utilized in underground installations are UL Listed for use in wet locations. Conductors are run in raceways as described in Section 16 "Raceways and Boxes". Type THHW and THHW-2 are not utilized where excluded by conduit sizing. Type THWN are not utilized for connection to 100 percent rated overcurrent devices.
- B. Electrical circuit protective system cable is utilized for feeders and circuitry which is required to be fire rated and which is not enclosed within equivalent fire rated construction indicated on the architectural drawings.
 - 1. A one-hour rating is required for:
 - (a) Feeders for Emergency Systems except where run within space directly protected by sprinklers.
 - (b) Normal and emergency feeders to fire pump.
- C. In general, cable ampacities are based on a 60 degree C rating for cables #1 AWG and smaller and on a 75 degree C rating for larger cables. In conjunction with this, note the following:
 - 1. 75 degree C ratings may be utilized for cables #1 AWG and smaller where overcurrent protection and switching devices (OCD's), wiring devices and solidly connected equipment connected to such cables are listed and identified for use with 75 degree C rated conductors. (Note that these specifications require all OCD's - regardless of ampere rating to be suitable for use with 75 degree C rated conductors).
 - 2. Increase indicated cable (and raceway) sizing as required for circuitry where conductors #1 AWG and smaller will connect directly to solidly connected utilization equipment whose load current will exceed the 60 degree C rating of the cable, and for which manufacturer's approval for cable terminations is less than 75 degrees C, or to receptacles whose ampere rating exceeds the 60 degree C rating of the connected cables unless such receptacles are listed for use with 75 degree C rated conductors. Note that accessible intermediate tap boxes may be utilized adjacent to 60 degree C rated terminations to allow conductor "upsizing" locally so as to comply with such termination requirements.
- D. For low voltage systems where circuits are power limited in accordance with Class 2 or Class 3 requirements (as defined in Article 725 of the National Electrical Code) utilize cables having characteristics as follows:

1. Cables are of a fluoropolymer type having adequate fire-resistant and low-smoke producing characteristics and are U.L. listed for plenum use (Type CL2P for Class 2 circuits, type CL3P or CMP for Class 3 circuits), except that where run in conduit, they may be U.L. type CL3, or where run in cable trays they are U.L. type CMP.
- E. For low voltage systems whose circuits are not power limited Class 2 or Class 3 (in accordance with the requirements of Article 725 of the National Electrical Code), and which are not telecommunications circuitry (in accordance with Article 800 thereof), utilize copper conductors having TFN insulation for sizes #16 AWG and smaller, and type THHN or THWN for sizes #14 AWG and larger. Wires are run in electric metallic tubing.
- F. Low voltage circuits intended for the distribution of voice or data utilize communications cables (complying with requirements of Article 800 of the National Electrical Code) having characteristics as follows:
1. Cables are of a fluoropolymer type having adequate fire-resistant and low-smoke producing characteristics and are U.L. listed for plenum use (Type CMP), except that where run in conduit, they may be U.L. type CM.
 2. Refer to Division 16, Section "Fire Protective Alarm System" for fire alarm system wiring.

3.2 INSTALLATION

- A. Conceal cables in finished walls, ceilings and floors unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- E. Support cables according to Division 16 Section "Basic Electrical Materials and Methods."
- F. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."
- G. Identify wires and cables according to Division 16 Section "Electrical Identification" and Division 16 Section "Supporting Devices".

3.3 CONNECTIONS:

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Maintain all splices and joints in removable cover boxes or cabinets where they may be easily inspected.
- D. Locate each completed conductor splice or joint in the outlet box, junction box, or pull box containing it, so that it is accessible from the removal cover side of the box.
- E. Join solid conductors #8 AWG and smaller by securely twisting them together and soldering, or by using insulated coiled steel spring "wire nut" type connectors. Exclude "wire nuts" employing non-expandable springs. Terminate conductors #8 AWG and smaller by means of a neat and fast holding application of the conductors directly to the binding screws or terminals of the equipment or devices to be connected. Terminals and connectors are U.L. approved specifically for the application.
- F. Join, tap and terminate stranded conductors #6 AWG and larger by means of solder sleeves, taps and lugs with applied solder or by means of pressure indent type connectors, or mechanical connectors utilizing ball tipped set screws. Apply pressure indent type connectors, utilizing tools manufactured specifically for the purpose and having features preventing their release until the full pressure has been exerted on the lug or connector. Factory installed equipment or device terminals are of types UL approved specifically for the application.
- G. Except where wire nuts are used, build up insulation over conductor joints to a value equal both in thickness and dielectric strength to that of the factory applied conductor insulation. Insulation of conductor taps and joints are by means of half-lapped layers of rubber tape, with an outer layer of friction tape; by means of half-lapped layers of approved plastic electric insulating tape; or by means of split insulating casings manufactured specifically to insulate the particular connector and conductor, and fastened with stainless steel or non-metallic snaps or clips.
- H. Exclude splicing procedures for neutral conductors in lighting and appliance branch circuitry which utilize device terminals as the splicing points.
- I. Exclude joints or terminations utilizing solder in any conductors used for grounding or bonding purposes.
- J. Exclude all but solder or pressure indent type joints in conductors used for signaling or communications purposes.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both wall surfaces.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 7 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 7 Section "Through-Penetration Firestop Systems."
- K. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.5 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.6 FIREPROOFING WIRES AND CABLES:

- A. Beyond the termination of raceways, apply fireproofing over the unprotected insulation and/or splices of the following:-
 - 1. All service feeder cables ahead of main service overcurrent protection devices within all the pits, cable chambers or pull boxes they pass through and elsewhere where they are not enclosed in raceways.
 - 2. Fire pump feeder cables wherever they extend beyond the termination of raceways.
 - 3. All feeder wires and cables emanating from different secondary service connections or both normal and emergency supplies which, due to indications on the drawings or unavoidable field conditions are forced to enter the same unbarriered compartment of a cable chamber, cable pit, pull box or junction box.
- B. Fireproofing of wires and cables is by means of a half-lapped layer of Scotch 77 fire and arc-proofing tape. The wrapped tape is secured by a band consisting of two layers of glass cloth electrical tape. Fireproofing is extended up into raceways. Fireproofing is applied in an overall manner to raceway groupings of conductors.

3.7 INSTALLATION OF CIRCUITRY FOR MISCELLANEOUS LOW VOLTAGE SYSTEMS:

- A. Comply with requirements described in applicable subsections of this Section. In particular, note the following circuitry requirements for low voltage systems:
 - 1. Wiring for miscellaneous low voltage systems may be run without conduit - subject to the approval of the local authorities - except where prohibited by other sections of these specifications or by indications on the drawings.
 - 2. Where conduit is required, it is steel electric metallic tubing (EMT), except that it is galvanized intermediate steel conduit where located within 8 feet (2.4 m) of the floor in mechanical spaces (or is otherwise exposed to mechanical damage), or is intended for embedment in concrete.
 - 3. Wires and cables have characteristics - in compliance with Articles 725 and/or 800 (as applicable) of the National Electrical Code - as described elsewhere in the specifications or drawings for this project, and are U.L. listed in accordance therewith.
 - 4. Where wires and cables are permitted to be run without conduit, they are independently supported from the building structure or ceiling suspension systems at intervals not exceeding four feet on center, utilizing cable supports specifically approved for the purpose. Wires and cables do not rest on or depend on support from suspended ceiling media (tiles, lath, plaster, as well as splines, runners or bars in the plane of the ceiling), nor are they supported from pipes, ducts or conduits. Where cables are bundled together, separate bundles are provided separately for each type of cabling and separately for each independent system. Bundling and/or supporting ties are of a type suitable for use in a ceiling air handling plenum regardless of whether or not installed in a plenum.

5. Cables are tagged or labeled at each termination point and in each intermediate junction box, pull box or cabinet through which they pass.
6. Comply with applicable requirements for locating and routing circuitry, for installing circuitry, and for fire-stopping as described in other sub-section of this Section.

3.8 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 2 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 3. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test Reports: Prepare a written report to record the following:
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 16120

**NEW PASSENGER TERMINAL
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 16231 - PACKAGED ENGINE
GENERATORS**

SECTION 16231 - PACKAGED ENGINE GENERATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section includes the following basic electrical materials and methods to complement other Division 16 Sections.
- B. This Section includes packaged engine generator set(s) with the following features and accessories:
 - 1. Engine generator set.
 - 2. Fuel tank.
 - 3. Starting battery.
 - 4. Battery charger.
 - 5. Remote stop switch.
 - 6. Muffler.
 - 7. Outdoor enclosure.
 - 8. Remote annunciator.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Related Section: The following Sections contain requirements that relate to this Section:
 - 1. Section 16050 "Basic Electrical Materials and Methods".
 - 2. This section is a part of each Division 16 section.

1.3 DEFINITIONS

- A. Standby Rating: Power output rating equal to the power the generator set delivers continuously under normally varying load factors for the duration of a power outage.
- B. Operational Bandwidth: The total variation from the lowest to the highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- C. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hz or cycles per second.

1.4 SUBMITTALS

- A. Product Data: Include data on features, components, ratings, and performance. Include the following:
 - 1. Dimensioned outline plan and elevation drawings of engine generator set and other components specified.
 - 2. Thermal damage curve for generator.
 - 3. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Indicate fabrication details, dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
 - 2. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 - 3. Wiring Diagrams: Detail wiring for power and control connections and differentiate between factory-installed and field-installed wiring.
- C. Qualification Data: For firms specified in "Quality Assurance" Article.
- D. Field Test and Observation Reports: Indicate and interpret test results and inspection records relative to compliance with performance requirements.
- E. Certified Summary of Performance Tests: Demonstrate compliance with specified requirement to meet performance criteria for sensitive loads.
- F. Factory Test Reports: For units to be shipped for this Project, showing evidence of compliance with specified requirements.
- G. Exhaust Emissions Test Report: To show compliance with applicable regulations.

- H. Sound Measurement Test Report: To show compliance with applicable regulations.
- I. Certification of Torsional Vibration Compatibility: Comply with NFPA 110.
- J. Field test report of tests specified in Part 3.
- K. Maintenance Data: For each packaged engine generator and accessories to include in maintenance manuals specified in Division 1. Include the following:
 - 1. Detail operating instructions for both normal and abnormal conditions.
 - 2. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - (a) The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of emergency maintenance and repairs at the Project site with 8 hours maximum response time.
- B. Source Limitations: Obtain engine generator set and auxiliary components specified in this Section through one source from a single manufacturer with the responsibility for the entire system.
- C. Electrical Components, Devices and Accessories: Underwriters Laboratories listed or labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- D. Comply with NFPA 70, as amended by state and local codes.
- E. Comply with NFPA 110 requirements for a Level 1 emergency power supply system.
- F. Comply with UL 2200, listed and labeled.
- G. Engine Exhaust Emissions: Comply with applicable federal, state and local government requirements, including published requirements which will be in effect at the date of system commissioning.
- H. Noise Emission: Comply with applicable federal, state and local government requirements due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.
- I. Comply with UL 142.
- J. Comply with EPA emissions Tier 2.

J. DELIVERY, STORAGE, AND HANDLING

- J. Deliver engine generator set and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is safe from such hazards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Caterpillar, Inc.; Engine Division.
 - 2. Detroit Diesel.
 - 3. Cummins Power Generation.

2.2 ENGINE GENERATOR SET

- A. Furnish a coordinated assembly of compatible components.
- B. Ratings: Voltage and power output ratings of system shall be as indicated. Frequency shall match utility service frequency unless otherwise indicated. Unit shall supply its indicated KW power load at power factors down to 80 percent.
- C. Output Connections: 3 phase, 4 wire.
- D. Safety Standard: Comply with ASME B15.1.
- E. Nameplates: Each major system component shall be equipped with a conspicuous nameplate of component manufacturer. Nameplate shall identify manufacturer of origin and address, and model and serial number of item.
- F. Limiting dimensions indicated for system components shall not be exceeded.
- G. Power Output Rating: Nominal ratings shall be as indicated, with capacity as required to operate as a unit as evidenced by records of factory testing.
- H. Emissions and Noise: Emissions and Noise shall be in compliance with all applicable criteria regarding environmental pollution of all agencies having jurisdiction
- I. Skid: Adequate strength and rigidity to maintain alignment of mounted components without dependence on a concrete foundation. Skid shall be free from sharp edges and corners. Lifting attachments shall be arranged to facilitate lifting with slings without damaging any components.

- J. The engine-generator set(s), including radiator, shall be provided with a structural steel base. The base shall have sufficient rigidity for spring type isolators in quantities as required between enclosure floor and generator. Mounting shall incorporate a leveling device, vertical stops and three layers of neoprene acoustical pad, with each layer separated by a steel plate. The mountings shall be installed directly under the structural steel base and positioned to accept the weight and weight distribution for uniform mounting deflection. Spring isolators shall provide a minimum static deflection of 2 inches (5 cm) and shall be similar to Mason Industries, Inc., Type SLR or as approved. Neoprene pads shall be similar to Mason Industries Type W, or as approved.

2.3 GENERATOR-SET PERFORMANCE, NOMINAL

- A. The emergency generator set and associated controls and appurtenances shall be suitable for use where up to 33 percent of the total load to be supplied are non-linear loads .
- B. Steady-State Voltage Operational Bandwidth: 4 percent of rated output voltage from no load to full load.
- C. Steady-State Voltage Modulation Frequency: Less than one Hz.
- D. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover to remain within the steady-state operating band within 2 seconds. Unit shall accept a one-step application of 100 percent of specified load rating without causing the engine to stall.
- E. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
- F. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
- G. Transient Frequency Performance: Less than 2-Hz variation for a 50 percent step-load increase or decrease. Frequency shall recover to remain within the steady-state operating band within 3 seconds.
- H. Output Waveform: At no load, harmonic content measured line-to-line or line-to-neutral shall not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.
- I. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at the system output terminals, the system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to any generator system component.
- J. Temperature Rise of Generator: Not more than 115 deg C over a 40 deg C ambient, as measured by resistance, NEMA MG 1 when operating continuously at full-rated load.

- K. Starting Time: Maximum total time period for a cold start, with ambient temperature at the low end of the specified range, shall be 8 seconds. Time period shall include output voltage and frequency settlement within specified steady-state bands.]

2.4 SERVICE CONDITIONS

- A. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 35 deg C to plus 50 deg C
 - 2. Altitude: Sea level to 1485 feet (453m).

2.5 ENGINE

- A. Comply with NFPA 37.
- B. Fuel: Diesel fuel oil grade DF-2.
- C. Maximum Engine Speed: 1800 rpm.
- D. Maximum Piston Speed for 2-Cycle Engines: 1725 fpm (880 cm/s).
- E. Maximum Piston Speed for 4-Cycle Engines: 2250 fpm (1140 cm/s).
- F. Lubrication System: Pressurized by a positive-displacement pump driven from engine crankshaft. The following items shall be mounted on the engine or skid:
 - 1. Filter and Strainer: Rated to remove 90 percent of particles 5 microns and smaller while passing full flow.
 - 2. Oil Cooler: Maintains lubricating oil at manufacturer's recommended optimum temperature.
 - 3. Thermostatic Control Valve: Controls flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and shall be designed to be fail-safe.
 - 4. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without the use of pumps or siphons or special tools or appliances.
- G. Engine Fuel System: Comply with NFPA 37. System includes the following:
 - 1. Integral Injection Pumps: Driven by engine camshaft. Pumps shall be adjustable for timing and cylinder pressure balancing.
 - 2. Main Fuel Pump: Mounted on engine. Pump shall ensure adequate primary fuel flow under starting and load conditions.
 - 3. Fuel Oil Filters: Primary and secondary. Primary filter shall include water separator.

4. Relief/Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
 5. Integrally mounted, electric motor driven, air cooled fuel oil cooler, complete with electric supply tapped from generator control panel. Radiator cooled unit will not be acceptable unless manufacturer certifies that radiator has been sized to accommodate this additional load. Cooler shall limit maximum engine fuel inlet temperature with engine running continuously at full load as required by engine manufacturer.
- H. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

2.6 GOVERNOR

- A. Type: Adjustable electronic isochronous type, with speed droop provisions.

2.7 ENGINE COOLING SYSTEM

- A. Description: Closed loop, liquid cooled, with radiator factory mounted on engine generator-set skid and integral engine-driven coolant pumping.
- B. Radiator: Rated for specified coolant. Airflow shall be less than 100 CFM (170 cubic meters per hour) per kilowatt of certified load.
1. Radiator Core Tubes: Nonferrous-metal construction other than aluminum.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 3. Fan: Driven by multiple belts from engine shaft. Unit shall be sized to deliver required air flow with at least 1/2 inch water column (.12 kPa) static pressure plus drop within radiator [plus drop within in-line load bank.
- C. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anti-corrosion additives as recommended by engine manufacturer.
- D. Temperature Control: Self-contained, thermostatic-control valve shall modulate coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
- E. Coolant Hose: Flexible assembly with nonporous rubber inside surface and aging, ultraviolet, and abrasion-resistant fabric outer covering.
1. Rating: 50-psig (345-kPa) maximum working pressure with 180 deg F (82 deg C) coolant, and noncollapsible under vacuum.
 2. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

2.8 FUEL SUPPLY SYSTEM

- A. Comply with NFPA 30 and NFPA 37.
- B. Base-Mounted Fuel Oil Tank: Factory-installed and -piped, listed and labeled fuel oil tank. Features shall include the following:
 - 1. Double walled tank with integral leak detection with dry contact closure for connection to BMS.
 - 2. Tank level indicator.
 - 3. Capacity: Fuel for 24 hours of continuous operation at 100 percent rated power output.
 - 4. Vandal-resistant fill cap.
 - 5. Tank shall be vented to the outside of the enclosure with a minimum of a two inch pipe with appropriate ball plunger type apparatus which will only allow fumes to be released to the atmosphere and not liquids.
- C. Interior Fuel Oil Piping: Include required field installed piping between the fuel tank and the engine. Refer to Division 15 specifications for materials and installation.

2.9 ENGINE EXHAUST SYSTEM

- A. Muffler: Critical type, sized as recommended by engine manufacturer. Measured sound level at a distance of 10 feet (3 m) from the exhaust discharge, shall be 85 dBA or less. Muffler shall be sized so that engine will be capable of delivering its rated output with a friction head back pressure of up to 3/4 inches of mercury (2.5 kPa) in the exhaust pipe extension from the output side of the muffler (i.e., excluding the drop in the muffler).
- B. Connections from Engine to Exhaust System: Flexible section of corrugated stainless-steel pipe.
- C. Supports of Muffler and Exhaust Piping: Spring hangers and all-thread rods as specified in Division 15 Section "Vibration Control"; attached to generator housing.
- D. Exhaust Piping External to Engine: Welded joints and fittings.
- E. Thimbles for Exhaust Piping: Comply with NFPA 211.

2.10 AIR INTAKE AND EXHAUST SYSTEM

- A. All required material and appurtenances.

2.11 STARTING SYSTEM

- A. Description: 24-V electric, with negative ground and including the following items:
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Environmental Conditions" Paragraph above.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for Level 1 systems.
 4. Battery : Adequate capacity within ambient temperature range specified in "Service Conditions" Paragraph above to provide specified cranking cycle at least twice without recharging.
 5. Battery Cable: Size as recommended by generator set manufacturer for cable length. Include required interconnecting conductors and connection accessories.
 6. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage-regulation and 35-A minimum continuous rating.
 7. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 508 and shall include the following features:
 - (a) Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then automatically switch to a lower float-charging mode and continue operating in that mode until battery is discharged again.
 - (b) Automatic Temperature Compensation: Adjusts float and equalizes voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - (c) Automatic Voltage Regulation: Maintains output voltage constant regardless of input voltage variations up to plus or minus 10 percent.
 - (d) Ammeter and Voltmeter: Flush mounted in charger enclosure. Meters shall indicate charging rates.

- (e) Safety Functions: Include sensing of abnormally low battery voltage arranged to close contacts providing low battery voltage indication on control and monitoring panel. Also include sensing of high battery voltage and loss of AC input or DC output of battery charger. Either of these conditions shall close a set of dry contacts that provide a battery charger malfunction indication at system control and monitoring panel and a dry contact closure for connection to BMS.
- (f) Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.12 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches shall initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set shall start. The off position of same switch shall initiate generator-set shutdown. When generator set is running, specified system or equipment failures or derangements shall automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch shall also shut down generator set.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position shall start generator set. The off position of same switch shall initiate generator-set shutdown. When generator set is running, specified system or equipment failures or derangements shall automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch shall also shut down generator set.
- C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped on a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
 - (a) Current and potential transformers: Instrument accuracy class.
- D. Indicating and Protective Devices, and Controls: Include those required by NFPA 110 for a Level 1 system, plus the following:
 - 1. Ac voltmeter.
 - 2. Ac ammeter.
 - 3. Ac frequency meter.
 - 4. Dc voltmeter (alternator battery charging).
 - 5. Engine-coolant temperature gage.
 - 6. Engine lubricating-oil pressure gage.

7. Running-time meter.
 8. Ammeter-voltmeter, phase-selector switch or switches.
 9. Generator-voltage adjusting rheostat.
- E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices, and wiring required to support specified items. Locate sensors and other supporting items on engine, generator, or elsewhere to suit manufacturer's standard.
- F. Connection to Data Link: A Mod-Bus compatible interface for all monitoring and alarm functions. Also provide a separate terminal block, factory wired to Form "C" dry contacts, for each alarm and status indication for connections for data link transmission of indications to remote data terminals.
- G. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel for connection to BMS.
1. Engine high-temperature shutdown.
 2. Lube-oil low-pressure shutdown.
 3. Overspeed shutdown.
 4. Remote emergency-stop shutdown.
 5. Engine high-temperature prealarm.
 6. Lube-oil low-pressure prealarm.
 7. Fuel tank low level.
 8. Overcrank shutdown.
 9. Coolant low-temperature alarm.
 10. Control switch not in auto position.
 11. Battery-charger malfunction alarm.
 12. Battery low-voltage alarm.

- H. Remote Alarm Annunciator / Control: An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing initiating condition will reactivate alarm until silencing switch is reset. Include manual Hand-Off-Auto control switch to control operation of generator. Cabinet and faceplate shall be surface- or flush-mounting type to suit mounting conditions indicated. Install at fire command center or location as directed, complete with all required circuitry.
- I. Remote Emergency-Stop Switch: Multipole emergency generator break-glass switch, in NEMA 3R enclosure located at the exterior of the generator enclosure at strike side of the main door. Provide nameplate to read "Emergency Generator Emergency Shutdown and Stop of Fuel Oil Flow". Activation of break-glass switch to shut down fuel supply to the engine with spare dry contact for connection to BMS. Install complete with circuitry.

2.13 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Overcurrent protective devices: Generator overcurrent devices and other indicated components shall be grouped in a separately mounted generator power panel. Devices serving Elevators and "Emergency" System and "Legally Required Standby System" loads other than fire pumps shall be fully coordinated with downstream devices, and shall be switch and fuse type if required in order to achieve this coordination. Other devices shall be circuit breaker type. Panel features shall include:
 - 1. Switchboard type construction, with the devices serving emergency, legally required, and optional loads mounted in separate vertical sections.
 - 2. Generator Circuit Breakers: Molded case or insulated case type conforming to Division 16 Section "Selection of Overcurrent Devices" with suitable interrupting capacity.
 - (a) Feeder Overcurrent Devices: with ratings as indicated on drawings. Instantaneous trip settings shall be adjustable.
 - 3. Generator Switch and Fuse Devices: Fusible switching devices conforming to Division 16 Section "Selection of Overcurrent Devices" with suitable interrupting capacity.
 - (a) Feeder Overcurrent Devices: with ratings as indicated on drawings.
 - 4. Ground Fault: Sensors plus alarm relay. Automatic tripping shall not be provided. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.14 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1 and specified performance requirements.

- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction prevents mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 100 percent of rated capacity.
- F. Excitation shall use no slip or collector rings, or brushes, and shall be arranged to sustain generator output under short-circuit conditions as specified.
- G. Enclosure: Dripproof.
- H. The generator together with its associated voltage regulator, exciter, instrumentation and controls shall be of a type which shall be suitable for applications where the load to be supplied consists of substantial amounts of non-linear (i.e., harmonic producing) equipment. Isolation transformers, complete with filtering equipment, shall be provided to minimize the effect of distortion on the voltage regulator power supply and sensing circuits, on governor control and supply circuits, on instrumentation and relaying and on other voltage sensing components. Voltage and current sensing devices shall sense true RMS values, and frequency sensing devices shall sense zero crossover.
- I. Excitation System: Generator shall be equipped with a permanent magnet generator excitation system. The output of the PMG shall be used to supply power to the voltage regulator and to effectively isolate the regulator power circuits from the distortion that occurs when the generator supplies large non-linear loads. Under short circuit conditions, system shall be capable of sustaining 300 percent of rated current for 10 seconds. Rotating rectifier shall use a three phase full wave rectifier assembly with hermetically sealed silicon diodes protected against abnormal transient conditions by a surge protector.
- J. Voltage Regulator: Completely solid state with electronic components encapsulated for protection against vibration and atmospheric deterioration. The regulator includes three phase RMS sensing, true volts per hertz operation with adjustable cut in, and provisions for parallel operation.
 - 1. A voltage adjusting rheostat shall be provided on the control panel to permit a ± 10 percent adjustment in generator voltage.
 - 2. The voltage regulator also includes circuits that provide loss of sensing voltage shutdown and overexcitation shutdown with inverse time characteristic to protect the generator and the connected load from abnormal voltages. Loss of sensing shutdown does not activate if a short circuit condition were to occur.
- K. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

- L. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- 2.15 OUTDOOR GENERATOR SET ENCLOSURE WRAP-AROUND (I.E., NON WALK-IN) TYPE
- A. Description: Weatherproof non-walk-in type sound attenuating enclosure, mated and matched to the unit enclosed so as to permit proper cooling and to afford ready access to all control, inspection and servicing points. Enclosure limits the sound as required to comply with applicable sound restrictions, but in any case to no more than 85 dBA as measured at 3 feet (90 cm) from any side, top or bottom, under all operating conditions. Appropriate sound baffling and insulation shall be applied to achieve this designated sound level.
- B. Construction: Rust-resistant, complying with the following:
1. Enclosure and other items shall be designed and built by the engine manufacturer as an integral part of the engine generator set and shall be designed to perform without overheating in the ambient temperature specified.
 2. Enclosure shall be constructed of 14-gauge and 16-gauge sheet metal, suitably reinforced to be vibration free in the operating mode.
 3. Doors provide access for service. Each door shall have at least one latch-bearing point.
 4. If generator is not on grade, provide stairs complete with platforms, railings, and handrails as required to provide full access to each service access door. They shall be steel, hot-dipped galvanized after fabrication, and shall comply with the requirements of Division 5, Miscellaneous Metals. They shall comply with the applicable building codes, OSHA standards, State Occupational Safety and Health Plan requirements, and other applicable regulations.
 5. Side and rear panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools.
 6. Roof shall be peaked to allow drainage of rain water.
 7. Finish shall be baked enamel with primer and finish coat painted before assembly. Fasteners shall be rust resistant.
 8. Unit shall have sufficient guards to prevent entrance by small animals.
 9. Batteries shall fit inside enclosure and alongside the engine.
 10. Unit shall have coolant and oil drains outside the unit to facilitate maintenance. Each drain line shall have a high quality valve located near the fluid source.

11. Fuel filter shall be inside the base perimeter and located so spilled fuel cannot fall on hot parts of engine or generator. A cleanable primary fuel strainer shall be provided to collect water and sediment between tank and main engine fuel filter.
12. Crankcase fumes disposal shall terminate in front of the radiator to prevent oil from collecting on the radiator core and reducing cooling capacity.
13. Enclosure shall house batteries, fuel tank, fuel pump, lighting, lighting switch, heaters, battery charger and accessories to provide a self-contained operating unit. Note fuel tank and associated components may need to be located in separate sub-base weatherproof enclosure if tank does not fit within generator enclosure. Contractor shall consult manufacturer for requirements.
14. Enclosure shall include two (2) space heaters complete with thermostat, sized as required to maintain a minimum housing interior temperature of 40 deg F (5 deg C).
15. Enclosure shall include air scoops internally in the intakes of the doors.
16. The muffler shall be contained within the housing. Exhaust pipe shall extend through the housing and shall be fitted with a rain cap. Include supports as required.

2.16 FINISHES

- A. Indoor Enclosures and Components: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.
- B. Outdoor Enclosures: Polyurethane enamel over corrosion-resistant pretreatment and manufacturer's compatible standard primer.

2.17 SOURCE QUALITY CONTROL

- A. Factory Tests: Include Project-specific equipment testing (testing of equipment manufactured specifically for this Project).
- B. Project-Specific Equipment Tests: Factory test engine generator set and other system components and accessories before shipment. Test items individually and assembled and connected as a complete system the same as specified in "Field Quality Control" Article below. Record and report test data. Conform to the following:
 1. Test Equipment: Use instruments calibrated within the previous 12 months and with accuracy directly traceable to the National Institute of Standards and Technology.
 2. Hydrostatic Test: Perform on radiator, heat exchanger, and engine water jacket.
 3. Generator Tests: Comply with IEEE 115.

4. Complete-System, Continuous-Operation Test: Include nonstop operation for a minimum of 8 hours, including at least 2 hours each at one-half, three-fourths, and full load. If unit stops during the 8-hour test, repeat the complete test. Record the following minimum data at start and end of each load run, at 15-minute intervals between those times, and at 15-minute intervals during balance of test:
 - (a) Fuel consumption.
 - (b) Exhaust temperature.
 - (c) Jacket water temperature.
 - (d) Lubricating oil temperature and pressure.
 - (e) Generator load current and voltage, each phase.
 - (f) Generator system gross and net output kW.
5. Complete-System Performance Tests: Include the following to demonstrate conformance to specified performance requirements:
 - (a) Single-step load pickup.
 - (b) Transient and steady-state governing.
 - (c) Transient and steady-state voltage performance.
 - (d) Safety shutdown devices.
6. Observation of Test: Provide 14 days' advance notice of tests and opportunity for observation of test by Owner's representatives.
7. Report test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install generator set(s), and other components as indicated, in accordance with equipment manufacturers written instructions, and with recognized industry practices, to ensure proper performance in accordance with the specifications. Comply with applicable NEMA standards pertaining to installation of engine-generator sets and accessories and with NFPA110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Coordinate with the work of other trades including fuel tanks, pumps, piping, ductwork and accessories as necessary to provide a complete operational system.
- D. Include the installation of control and monitoring panels, battery charger(s), remote annunciator panel, batteries and racks and other appurtenances to the extent that such appurtenances are not factory installed and wired. Piping between engine and fuel tank complies with Division 15 Section.
- E. Include field interwiring and power supply and control connections for batteries, battery chargers, pumps, heaters, solenoid valves, damper operators and other miscellaneous items as required in accordance with manufacturers wiring diagrams. Such wiring includes (but is not be limited to):
 - 1. Wiring between battery and engine control panel(s) and battery charger(s).
 - 2. Power supply wiring from an appliance panel to battery charger.
 - 3. Power supply wiring from an appliance panel and control wiring for engine jacket water heater(s).
 - 4. Power supply wiring for fuel pumps and fuel management control panel.
 - 5. Control wiring for fuel pumps, fuel tanks, day tanks, float switches, valves, leak detection system, and other fuel supply system components.
 - 6. Power supply and control wiring for automatic louver damper operators.
 - 7. Emergency stop break glass switch and control wiring run to engine control panel.
 - 8. "Manual start" switch and control wiring to engine control panel.
 - 9. Remote annunciator panel mounted where indicated or where directed, complete with power supply and alarm interwiring to engine control panel.
- F. Ground equipment in accordance with Division 16 Section "Grounding and Bonding." .

- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

- A. Identify system components according to Division 16 Section "Electrical Identification."

3.4 FIELD QUALITY CONTROL

- A. Testing: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Tests: Include the following:
 - 1. Tests recommended by manufacturer.
 - 2. InterNational Electrical Testing Association Tests: Perform each visual and mechanical inspection and electrical and mechanical test stated in InterNational Electrical Testing Association's NETA ATS for emergency engine generator tests. Certify compliance with test parameters.
 - 3. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified herein, including, but not limited to a single step full load pickup test.
 - 4. Testing Load Bank: Building loads may be used for generator testing. Supplement building loads with a resistive load bank as required to load generator to its full rated load for testing. Provide temporary interconnecting cables and connections.
 - 5. Battery Tests: Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions. Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery. Verify acceptance of charge for each element of battery after discharge. Verify measurements are within manufacturer's specifications.
 - 6. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 - 7. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.

8. Exhaust System Back-Pressure Test: Use a manometer with a scale exceeding 40 inches water gauge (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 9. Exhaust Emissions Test: Conform with applicable government test criteria.
 10. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases and verify that performance is as specified.
 11. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
- C. Coordinate tests for transfer switches and run them concurrently.
- D. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- E. Report results of tests in writing. Record adjustable settings, time delays and other valves and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- F. Test instruments shall be calibrated to National Institute of Standards and Technology (NIST) Standards.
- G. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 CLEANING

- A. Upon completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.6 DEMONSTRATION

- A. Training: Engage a factory-authorized service representative to demonstrate adjustment, operation, and maintenance of system and to train Owner's maintenance personnel as specified below.
 - 1. Conduct a minimum of 8 hours of training as specified in Division 1 Section "Contract Closeout."
 - 2. Schedule training with at least 7 days advance notice.

END OF SECTION 16231

**NEW PASSENGER TERMINAL
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**SECTION 16714 - COMMUNICATIONS
EQUIPMENT ROOM FITTINGS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Telecommunications mounting elements.
 - 2. Backboards.
 - 3. Telecommunications equipment racks and cabinets.
 - 4. Telecommunications service entrance pathways.
 - 5. Grounding.
- B. Related Sections:
 - 1. Division 16 Section 16710 "Premise Distribution System."
 - 2. Division 16 Section 16716 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
 - 3. Division 16 Section 16717 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- C. LAN: Local area network.
- D. RCDD: Registered Communications Distribution Designer.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

- 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.
- C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
- 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- D. Grounding: Comply with ANSI-J-STD-607-A.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.7 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
- 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute them to other participants.
 - 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
 - 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

- B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.
 - 1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
 - 2. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 3. Lacing bars, spools, J-hooks, and D-rings.
 - 4. Straps and other devices.
- C. Cable Trays:
 - 1. Refer to Section 16127 "Cable Trays" for specification information.
- D. Conduit and Boxes: Comply with requirements in Division 16 Section "Raceways and Boxes." Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Division 6 Section "Rough Carpentry."
- B. Provide prefabricated backboard as indicated on the drawings.

2.3 EQUIPMENT FRAMES

- A. Manufacturers: Subject to compliance with requirements of paragraph 1.2 C of Section 16710, provide products by one of the following:
 - 1. ADC.
 - 2. Aim Electronics; a brand of Emerson Electric Co.
 - 3. AMP; a Tyco International Ltd. company.
 - 4. Cooper B-Line, Inc.
 - 5. Hubbell Premise Wiring.
 - 6. KRONE Incorporated.
 - 7. Leviton Voice & Data Division.
 - 8. Middle Atlantic Products, Inc.
 - 9. Nordex/CDT; a subsidiary of Cable Design Technologies.
 - 10. Ortronics, Inc.
 - 11. Panduit Corp.
 - 12. Siemon Co. (The).
- B. General Frame Requirements:

1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 2. Module Dimension: Width compatible with EIA 310 standard, 19-inch (480-mm) panel mounting.
 3. Finish: Manufacturer's standard, baked-polyester powder coat.
- C. Floor-Mounted Racks: Modular-type, steel or aluminum construction.
1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
 2. Baked-polyester powder coat finish.
- D. Modular Freestanding Cabinets:
1. Removable and lockable side panels.
 2. Hinged and lockable front and rear doors.
 3. Adjustable feet for leveling.
 4. Screened ventilation openings in the roof and rear door.
 5. Cable access provisions in the roof and base.
 6. Grounding bus bar.
 7. Rack-mounted, 550-cfm (260-L/s) fan with filter.
 8. Power strip.
 9. Baked-polyester powder coat finish.
 10. All cabinets keyed alike.
- E. Modular Wall Cabinets:
1. Wall mounting.
 2. Steel or aluminum construction.
 3. Treated to resist corrosion.
 4. Lockable front and rear doors.
 5. Louvered side panels.
 6. Cable access provisions top and bottom.
 7. Grounding lug.
 8. Rack-mounted, 250-cfm (118-L/s) fan.
 9. Power strip.
 10. All cabinets keyed alike.
- F. Cable Management for Equipment Frames:
1. Metal, with integral wire retaining fingers.
 2. Baked-polyester powder coat finish.
 3. Vertical cable management panels shall have front and rear channels, with covers.
 4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.4 POWER STRIPS

- A. Power Strips: Comply with UL 1363.
1. Rack mounting.
 2. Six 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
 3. LED indicator lights for power and protection status.
 4. LED indicator lights for reverse polarity and open outlet ground.
 5. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.

- 6. Close-coupled, direct plug-in line cord.
- 7. Rocker-type on-off switch, illuminated when in on position.

2.5 GROUNDING

- A. Comply with requirements in Division 16 Section "Grounding and Bonding" for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
 - 1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
 - 2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
 - 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with ANSI-J-STD-607-A.

2.6 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and housing when so directed by service provider.
- B. Install underground pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.
 - 1. Install underground entrance pathway complying with applicable Division 16 Sections.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Cable Trays: Comply with Specification Section 16127 and TIA/EIA-569-A-7.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 FIRESTOPPING

- A. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.4 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 16 Section "Electrical Identification."
- B. Comply with requirements in Division 9 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 3 level of administration including optional identification requirements of this standard.
- D. Labels shall be preprinted or computer-printed type.

END OF SECTION 16714

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**SECTION 16715 – COMMUNICATIONS
NETWORK EQUIPMENT**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Local Area Network Hardware.
 - 2. Wireless Network.
 - 3. Network Management.
 - 4. Configuration.
 - 5. Device and Cable Identification
 - 6. System Warranty

1.3 FUNCTIONS AND PERFORMANCE REQUIREMENTS

- A. Firewall: The new network design shall incorporate a firewall between the airport and the outside world. VPN access shall be created for remote access by the Owner and Integrator for testing and maintenance.
- B. Pre-Configuration: Provide pre-configuration of all equipment before deploying it in the field.
- C. Field Configuration: Provide addition field configuration of the network to provide optimized network services for all users.
- D. Network Monitoring: A comprehensive on-site network monitoring system shall be put in place, which will ensure that all key services are functional. Further refinements shall track service degradation in other areas, provide enhanced alerting, and allow for long-term tracking of resource allocation. The network monitoring system shall monitor and manage the following critical systems:
 - 1. UPS system.
 - 2. Access Control Hardware.
 - 3. CCTV Hardware.
 - 4. Wireless Devices.
 - 5. Temperature Sensors.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated on the drawings and specifications.
- B. Shop Drawings: Provide complete shop drawings which include the following:
 - 1. Indicate all system device locations on scaled plans.

2. Include full schematic wiring information on these drawings for all devices. Wiring information shall include cable type, conductor routings, quantities, and connection details at device.
 3. Include a complete one-line, block diagram.
 4. Include a statement of the system sequence of operation of each device and overall system performance.
- C. Qualification Data: For Project Manager and network implementation engineers.
- D. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
 2. Device address list.
 3. Printout of software application and graphic screens.
- E. Wireless Network Report
- F. Project Close-out Submittal:
1. Provide three sets of hard copy manuals and three sets electronic format manuals including operating instructions, maintenance recommendations and parts list including wiring and connection diagrams modified to reflect as-built conditions.
 2. Final copies of the manuals shall be delivered within 30 days after completing the installation test. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of the contractor responsible for the installation and maintenance of the system and the factory representatives for each item of equipment for each system. The manuals shall have a table of contents and labeled sections. The final copies delivered after completion of the installation test shall include all modifications made during installation, checkout, and acceptance testing. The manuals shall consist of the following
 - a. Functional Design Manual: The functional design manual shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included.
 - b. Hardware Manual: The manual shall describe all equipment furnished including:
 - 1) General description and specifications
 - 2) Installation and check out procedures
 - 3) Equipment layout and electrical schematics to the component level
 - 4) System layout drawings and schematics
 - 5) Alignment and calibration procedures
 - 6) Manufacturers repair parts list indicating sources of supply
 - c. Software Manual: The software manual shall describe the functions of all software and shall include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
 - 1) Definition of terms and functions
 - 2) System use and application software
 - 3) Initialization, start up, and shut down
 - 4) Reports generation
 - 5) Details on customization and field parameters

- d. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
- 3. As-Built Drawings: During system installation, the Contractor shall maintain a separate hard copy set of drawings, elementary diagrams, and wiring diagrams of the network to be used for record drawings. This set shall be accurately kept up to date by the Contractor with all changes and additions to the network. Copies of the final as-built drawings shall be provided to the end user in PDF format.

1.5 QUALITY ASSURANCE

- A. The system contractor / integrator responsible for providing the network shall have at least ten (10) years experience in furnishing and installation of such systems.
- B. The system contractor's project manager and on-site superintendent shall have a minimum of fifteen (15) years experience and shall have worked on the projects in similar capacity.
- C. Manufacturer Qualifications
 - 1. Manufacturer of the network hardware shall be an established organization with referenced and documented experience delivering and maintaining network system of equal or higher sophistication and complexity as compared to the system detailed in this specification.
 - 2. Manufacturer's manufacturing facilities shall be certified ISO-9000:2000 operations, utilize ISO-9000:2000 manufacturing procedures and maintain their ISO certifications.
 - 3. Manufacturer shall employ at a minimum the following methods for QA of component and assembly devices.
 - a. Visual inspection of devices shall be performed to verify assembly according to defined procedures. End of line operational tests shall be performed to ensure product functionality has been correctly configured. A system burn-in period shall be utilized to screen for early life failures of electronic components.
 - 4. Individual functionality and system level regression testing shall be performed to ensure compliance with product specifications. Single and multiple unit system tests shall be performed to mimic end-user installation configurations. Automated hardware and software testing shall be utilized to evaluate system performance under published operational loads and shall be compared to published system capabilities.
- D. Network installer experience: The network system integrator / contractor shall have factory trained personnel from the approved manufacturer with a minimum of five (5) years experience in system integration and a minimum of two (2) years experience in the proposed network systems for this project. Submit names of the qualified personnel.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Test equipment upon receipt at Project site. Store and handle as required by manufacturer's instructions.

1.7 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. One network switch, mesh node and antenna of each type complete to allow easy swapping of a defective switch without requirement of new software or firmware.

PART 2 - PRODUCTS

2.1 LOCAL AREA NETWORK (LAN)

- A. Provide network switches and other network components as indicated on the drawings.
- B. LAN hardware shall be Cisco or approved equal.

2.2 WIRELESS NETWORK (WIFI)

- A. Conduct a site survey prior to network design submission and submit results with the design.
- B. Use a wireless overlay to provide in-building roaming network connectivity. All access points shall provide 802.11 compatibility will full 54 Mbps connectivity available in 100% of all airport spaces.
- C. WEP, SSID and LEAP configuration information shall be coordinated with Owner & A/E prior to final configuration.
- D. Access Point Naming Conventions: AP Number-IDF # to which AP connects-Patch Panel Port #.

2.3 NETWORK CONFIGURATION AND TECHNOLOGY IMPLEMENTATION

- A. Develop and provide complete and secure network configuration for all network users and devices as indicated on drawings.
- B. The approved IT professional shall provide following services to provide an efficient secured and highly manageable network system:

1. Develop planning and implementation strategy, working with the owner, A/E and other network users, for the implementation of the network.
2. Develop LAN configuration including Quality of Service, Layer Switching and Forwarding, Multicast, Port Monitoring, Spanning Tree Protocol, VLAN Trunking Protocol and other techniques.
3. Develop Monitoring and Management procedures. Network monitoring system shall be configured to notify administrator of system modifications and provide a management policy for tracking and notification.
4. Develop Network Optimization scheme to prevent larger users of the network resources (e.g. CCTV system) from reducing network availability and efficiency. Develop QoS priorities and coordinate optimization with all systems connected to the network. Integrator shall notify A/E of any priority issues that cannot be resolved with network configurations.

2.4 IP ADDRESSING

- A. IP addressing ranges shall be coordinated with Owner and A/E prior to implementation.

PART 3 - EXECUTION

3.1 IMPLEMENTATION

- A. Provide a detailed implementation schedule, coordinated with all network users and devices, for review and approval.
- B. Provide network services as required to meet phasing, sequencing and completion on schedule.

3.2 DELIVERABLES:

- A. All deliverables shall be provided electronically and in hard copy.
 1. Electronic deliverables will be sent to the Airport Network Administrator and A/E.
 2. Hard copy deliverables shall be placed in a heavy duty plastic pouch ring binder (preferred) or laminated.
 3. Specific deliverables are dependent upon scope of work; however, an asset tracking spreadsheet shall be required.

3.3 ACCEPTANCE CRITERIA

- A. All electronic deliverables have been received.
- B. Successfully demonstrate network management and monitoring system.
- C. Output of show interfaces command indicates that end user devices are communicating properly with network electronics. Obviously incrementing errors on an interface shall be resolved prior to acceptance.
- D. Onsite inspection is conducted.
 1. Packing material has been removed from all devices.
 2. All equipment is properly secured and mounted.

3. Velcro has been used to secure power cords and patch cables.
4. Patch cables of proper color are neatly and properly contained in wire managers or properly dressed with Velcro if wire managers are not installed.
5. Power cords from hardware to power outlets are neatly attached.
6. Hard copy deliverables are in place.
7. Check of labeling configuration indicates accuracy of documentation.
8. Outdoor penetrations and cable connections are properly weather proofed.
9. Viewing reports of network monitoring systems.

3.4 MAINTENANCE SERVICES (WARRANTY)

- A. The Contractor shall provide "on-call" warranty maintenance service for all equipment supplied under this Contract for two (2) years after acceptance of the entire NETWORK EQUIPMENT (hardware and software) by Owner. The "On Call" services shall be provided by the qualified contractor and shall include combination of periodic (once every 4 months for a minimum of two days) onsite and additional 24/7 support by remote (telephone and remote log-in) access. Include additional two (2) days per year for emergency services.

END OF SECTION 16715

**NEW PASSENGER TERMINAL
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**SECTION 16722
INTERCOMMUNICATIONS SYSTEMS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Networked voice over internet protocol intercommunication system with the following components:
 - 1. IP master stations.
 - 2. IP sub-station
 - 3. Intercom server
 - 4. Duress alarm.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For intercommunications and program systems. Include outline drawings, schematic connection diagrams, and detailed field wiring diagrams.
 - 1. Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location and type of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - a. Identify terminals to facilitate installation, operation, and maintenance.
 - b. Single-line diagram showing interconnection of components.
 - c. Cabling diagram showing cable routing.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, showing the installation and mounting of case work mounted equipment.
- B. Qualification Data: For qualified installer provide certifications and experience profile.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For intercommunications and program systems to include in operation and maintenance manuals. In addition to items specified in Section 01782 "Operation and Maintenance Data," include the following:
 - 1. A record of Owner's equipment-programming option decisions on optical disk.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is factory trained and approved for installation of units required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a NRTL, and marked for intended location and application.
- C. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate layout and installation of substations and controls with casework installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Communications / Golmar
 - 2. Commend Security and Communications
 - 3. Jeron Electronic Systems, Inc.
 - 4. Zenitel USA; the home of STENTOFON brand products.

2.2 FUNCTIONAL DESCRIPTION OF MICROPROCESSOR-SWITCHED SYSTEMS

- A. Master Station:
 - 1. Communicating selectively with other master and speaker-microphone stations by dialing station's number on a 12-digit keypad.
 - 2. Communicating simultaneously with all other stations by dialing a designated number on a 12-digit keypad.
 - 3. Communicating with individual stations in privacy.
 - 4. Including other master-station connections in a multiple-station conference call.
 - 5. Accessing separate paging speakers or groups of paging speakers by dialing designated numbers on a 12-digit keypad.
 - 6. Overriding any conversation by a designated master station.

- 7. Displaying selected station.
- 8. Speed dial to designated house telephone.
- B. Speaker-Microphone Station:
 - 1. Having privacy from remote monitoring without a warning tone signal at monitored station. Designated speaker-microphone stations privacy to prevent another station from listening and to permit incoming calls shall be programmable.
 - 2. Communicating hands free.
 - 3. Calling master station by actuating duress call switch lighting alarm light at master and allowing master to listen. Duress call button shall be separately identified.
 - 4. Returning a busy signal to indicate that station is already in use.
 - 5. Being free of noise and distortion during operation and when in standby mode.
- C. Speakers: Free of noise and distortion during operation and when in standby mode.

2.3 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

- A. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.
- B. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.
- C. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

2.4 MASTER STATION FOR MICROPROCESSOR-SWITCHED SYSTEMS

- A. 12-Digit Keypad Selector: Transmits calls to other stations and initiates commands for programming and operation.
- B. Volume Control: Regulates incoming-call volume.
- C. LED Annunciation: Identifies calling stations and stations in use. LED remains on until call is answered.
- D. Tone Annunciation: Momentary audible tone signal announces incoming calls.
- E. Handset with Hook Switch: Telephone type with 18-inch- long, permanently coiled cord. Arrange to disconnect speaker when handset is lifted.
- F. Reset Control: Cancels call and resets system for next call.

- G. Equipment Cabinet: Comply with TIA/EIA-310-D. Remote rack-mounted, ventilated metal cabinet houses terminal strips, power supplies, amplifiers, system volume control, and other switching and control devices required for conversation channels and control functions.

2.5 SPEAKER-MICROPHONE STATIONS

- A. Mounting: Flush unless otherwise indicated, and suitable for mounting conditions indicated.
- B. Faceplate: Stainless steel or anodized aluminum with tamperproof mounting screws.
- C. Back Box: Two-gang galvanized steel with 2-1/2-inch minimum depth.
- D. Speaker: 3 inches minimum; permanent magnet.
- E. Tone Annunciation: Recurring momentary tone indicates incoming calls.
- F. Call Switch: Mount on faceplate. Permits calls to master station.
- G. Privacy function: Programmable function.
- H. Handset with Hook Switch: Telephone type with 18-inch- long, permanently coiled cord. Arrange to disconnect speaker when handset is lifted.

2.6 CALL-SWITCH UNIT

- A. Enclosure: Detention-grade single-gang box with stainless-steel faceplate.
- B. Call Switch: Momentary contact signals system that a call has been placed.
- C. Volume Control: Operated by screwdriver blade through a hole in faceplate to adjust output level of associated speaker.

2.7 ALL-CALL AMPLIFIER

- A. Output Power: 70-V balanced line. 80 percent of the sum of wattage settings of connected for each station and speaker connected in all-call mode of operation, plus an allowance for future stations.
- B. Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to quantity of stations connected in all-call mode of operation.
- C. Minimum Signal-to-Noise Ratio: 45 dB, at rated output.
- D. Frequency Response: Within plus or minus 3 dB from 70 to 12,000 Hz.
- E. Output Regulation: Maintains output level within 2 dB from full to no load.

- F. Input Sensitivity: Compatible with master stations and central equipment so amplifier delivers full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on master stations, speaker microphones, or handset transmitters.
- G. Amplifier Protection: Prevents damage from shorted or open output.

2.8 INTERCOMMUNICATION AMPLIFIER

- A. Minimum Output Power: 2 W; adequate for all functions.
- B. Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to one station connected to output terminals.
- C. Minimum Signal-to-Noise Ratio: 45 dB, at rated output.
- D. Frequency Response: Within plus or minus 3 dB from 70 to 10,000 Hz.
- E. Output Regulation: Maintains output level within 2 dB from full to no load.
- F. Input Sensitivity: Matched to input circuit and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on master stations, speaker microphones, or handset transmitters.
- G. Amplifier Protection: Prevents damage from shorted or open output.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Section 16130 "Raceways and Boxes."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF RACEWAYS

- A. Comply with requirements in Section 16130 "Raceways and Boxes" for installation of conduits and wireways.

- B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements:
 1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
 2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
 3. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
 5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 6. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used.
- C. Open-Cable Installation:
 1. Install cabling with horizontal and vertical cable guides in telecommunication spaces with terminating hardware and interconnection equipment.
 2. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
- D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches (300 mm) apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

3.4 INSTALLATION

- A. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- B. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.
- C. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.

- D. Speaker-Line Matching Transformer Connections: Make initial connections using tap settings indicated on Drawings.
- E. Connect wiring according to Section 16120 "Conductors and Cables."

3.5 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes as specified in Section 16450 "Grounding and Bonding."

3.6 SYSTEM PROGRAMMING

- A. Programming: Fully brief Owner on available programming options. Record Owner's decisions and set up initial system program. Prepare a written record of decisions, implementation methodology, and final results.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Schedule tests with at least seven days' advance notice of test performance.
 - 2. After installing intercommunications and program systems and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: Test originating station-to-station, and all-call messages at each intercommunication station. Verify proper routing and volume levels and that system is free of noise and distortion. Test each available message path from each station on system.
 - 4. Frequency Response Test: Determine frequency response of two transmission paths, including all-call by transmitting and recording audio tones. Minimum acceptable performance is within 3 dB from 150 to 2500 Hz.
 - 5. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
 - a. Disconnect speaker microphone and replace it in the circuit with a signal generator using a 1000-Hz signal. Measure signal-to-noise ratio at speakers.

- b. Repeat test for four speaker microphones].
 - c. Minimum acceptable ratio is 35 dB.
- 6. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 150, 200, 400, 1000, and 2500 Hz into a minimum of two selected intercommunication amplifiers. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 5 percent total harmonics.
- 7. Signal Ground Test: Measure and report ground resistance at system signal ground. Comply with testing requirements in Section 16450 "Grounding and Bonding."
- C. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.
- D. Intercommunications and program systems will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.8 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
 - 2. Complete installation and startup checks according to manufacturer's written instructions.

3.9 ADJUSTING

- A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain the intercommunications and program systems.
 - 1. Train Owner's maintenance personnel on programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining the system and equipment.

END OF SECTION 16722

**NEW PASSENGER TERMINAL
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 16726 – INTEGRATED PAGING
SYSTEMS AND EQUIPMENT**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. The Owner's General Conditions shall be considered part of this Specification. Unless this Section contains statements, which are more definitive or more restrictive than those contained in the Owner's General Conditions, this Specification shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions.

1.2 SUMMARY

- A. Location
 - 1. This specification section applies to the paging system to be installed in the New Terminal of the Duluth International Airport in Duluth, MN.
- B. Description
 - 1. The Duluth Airport Authority has commissioned a new passenger terminal building to support four airline carriers.
 - 2. The three story building features large expansive spaces, contemporary architectural design and high quality finishes to clearly establishing the terminal as a world class facility.
 - 3. The facility will feature four gates; Gate 1 can be configured to receive international flights on an "as needed" basis.
 - 4. The architectural team has programmed public space such as Check-in Lobby, Circulation, Passenger Waiting, TSA Checkpoints Gates, International processing and Baggage Claim.
 - 5. Support spaces include offices for Administrative Staff, Maintenance workers, TSA staff, and Security staff.
 - 6. A bar and servery space will provide food and vending for travelers and will feature independent AV systems designed by others.
 - 7. The third floor of the building provides a large meeting and conference space. This area is multipurpose in nature and will facilitate community events, meetings, presentations, and emergency operations.

8. It should be noted that the Meeting and Conference Rooms, Bar and Multipurpose room independent AV systems are not included in this scope of work. However, the audio output from these systems should be routed to the Paging System and should be capable of accepting a signal from the paging that will 'duck' the local room audio source and amplify the paging system over each particular rooms amplification system. This arrangement will allow the ability to override the local systems with higher priority announcements.
- C. The "Paging system" references the systems specifically identified for this project. These systems are identified as:
1. Paging Systems
 - a. Including but not limited to:
 - 1) Paging Stations
 - 2) Ambient Noise Microphones
 - 3) Ambient Noise Compensation Devices
 - 4) PoE Network Switches
 - 5) 70V speakers (wall and ceiling type)
 - 6) BGM source (by others)
 - 7) Bar source (by others)
 - 8) Conference room source (by others)
 - 9) Sound Masking Generator/EQ
 - 10) Feed from Fire/Life Safety System (by others)
 - 11) 70V amplifiers with backup capability
 - 12) Audio input and output expansion devices
 - 13) Message Server
 - 14) Rackmount PC
 - 15) Rackmount KVM
 2. Miscellaneous
 - a. Including but not limited to:
 - 1) Equipment Racks
 - 2) Technical and Rack panels
 - 3) Power distribution and conditioning
- D. General requirements
1. The paging system (PS) shall be based on IEEE 802.3af PoE Ethernet Network Infrastructure. All cabling, conventions, and equipment shall be consistent with this IEEE standard.

2. The PS shall use a VLAN (detailed below) for transport of all digital audio data, including all recorded and live voice messages, preambles, background music, and other audible signals. This same Network shall carry monitoring and control data to and from each PS device. This audio data traffic shall be standard Cobranet at a sample rate of 48 kHz.
3. All PS components shall be continuously monitors for presence, proper function, and faults. Each and every fault must be logged and be able to be viewed and copied the attached Monitoring Computer (detailed below) running software supplied by the Manufacturer.
4. All PS components shall be addressable on the Cobranet LAN (or vLAN).
5. All PS preambles, voice prompts, and recorded announcements shall be in a common audio format. The PS shall be capable of importing custom preambles, prompts, and announcements through software running on the attached Monitor Computer.
6. Each PS device shall have sufficient on-board memory to retain its configuration and settings in the event of a power loss.

1.3 RELATED WORK

- A. Paging systems contractor shall coordinate with the General/Electrical Contractor on raceway/junction box location for paging systems equipment and routing of audio, control and power cables/raceway from equipment terminal, and pull boxes to system equipment racks as necessary.
- B. Equipment and materials provided and installed by others shall include but are not limited to (unless otherwise shown).
 1. Telecommunications items for accessing building LAN.

1.4 DEFINITIONS

- E. The following shall serve as general identifiers as specified herein.
 1. Owner – Duluth Airport Authority
 2. Paging Systems Consultant – Shen Milsom & Wilke, LLC
 3. Contractor – The Contractor is the firm submitting a proposal to furnish and install the Work as defined within this Specification. Note: Paging Systems Contractor is to be a subcontractor to the General Contractor for this project.
 4. Project – The Project is the Duluth International Airport New Terminal Design.
 5. Work – The term “Work” means all construction and services specified within this document. The Work includes all related

labor, materials, equipment, and services provided, or to be provided, by the Systems Contractor to fulfill the proposal's obligations.

6. Drawings – The term “Drawings” means all Paging Systems Drawings and associated sketches, details, riser diagrams, etc.
7. As used in the Drawings and Specifications for the Work, certain non-technical words and phrases shall be understood to have specific meanings as follows, regardless of indications to the contrary in the General Conditions or other documents governing the Work.
 - a. “Furnish” – Purchase and deliver to the project site complete with every necessary appurtenance and support, all as part of the Paging Systems Work. Purchasing shall include payment of all sales taxes and other surcharges as may be required to assure that purchased items are free of all liens, claims, or encumbrances.
 - b. “Install” – Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project, all as part of the Work.
 - c. “New” – Manufactured within the past year and never before used.
 - d. “Provide” – Furnish and Install.
8. Regardless of their usage in codes or other industry standards, certain words or phrases as used in the Drawings or Specifications for the Work, shall be understood to have the specific meanings as ascribed to them in the following list:
 - a. “Circuit” – Any specific run of circuitry
 - b. “Circuitry” – Any Work which consists of wires, cables, raceways, and/or specialty wiring method assemblies complete with associated junction boxes, pull boxes, outlet boxes, joints, couplings, splices, and connections except where limited to a lesser meaning by specific description.
 - c. “Concealed” (as applied to circuitry) – Covered completely by building materials, except for penetrations (by boxes and fittings) to a level flush with the surface as necessitated by functional or specified accessibility requirements.
 - d. “Exposed” (as applied to circuitry) – Not covered in any way by building materials.
 - e. “Normal Work Conditions” – Locations within building confines that are not damp, wet, or hazardous and that are not used for air handling.

- f. "Patch Panel" – A System of terminal blocks, patch cords, and backboards that facilitate administration of cross-connecting cables.
 - g. "Raceway" – Any pipe, duct, extended enclosure, or conduit (as specified for a particular System) which is used to contain wires and which is of such nature as to require that the wires be installed by a "pulling in" procedure.
 - h. "Riser" – Shall refer to the portion of the installation that transmits between building floors (or between Paging Systems rooms), also referred to as "Backbone Cabling."
 - i. "Paging System Closet" – The enclosed area or room specifically designated for the routing, termination, and/or cross connecting of Paging Systems cable (i.e. riser cable) to other Paging Systems cable and/or equipment.
 - j. "Paging Systems Control Room" and/or "Paging Systems Headend" – The enclosed area or room specifically designated for the routing, termination, and/or cross connecting of Paging System cable (i.e. riser cable) to other Paging System cable, and/or equipment and racks.
 - k. "PAGING System(s)" – Paging System(s), includes all components contained herein that work in conjunction to create and completely integrated and fully functioning system as described within the Drawings and Specifications
 - l. "Paging Systems Wiring" – see "Circuitry"
 - m. "Paging Systems Work" – See "Work"
 - n. "Standard" (as applied to wiring devices) – Not of a separately designated individual type.
 - o. "Subject to Mechanical Damage" – Exposed within 6 feet of the floor in mechanical rooms, manufacturing spaces, vehicular spaces, or other spaces where Paging items are moved around or rigged as a common practice or as required for replacement purposes.
 - p. "System" – See "PAGING Systems"
 - q. "Wiring" – see "Circuitry"
 - r. "PGC" – Paging Systems Contractor
 - s. "EMS" – Energy Management System
 - t. "DCS" – Distributed Control System
9. Where the word "conduit" is used without specific reference to type, it shall be understood to mean "raceway."
10. Reference to "U.L. (Materials Construction) Standards" shall mean the "Standards for Safety" published by Underwriters Laboratories, Inc.

1.5 SCOPE OF WORK

A. General:

1. Provide Paging systems design, engineering, and installation within all phases and spaces of the Project. Systems are to include all devices, equipment, installation, programming and commissioning in accordance with requirements of the contract documents and drawings.
2. The Work detailed within the Contract Documents has been specified to meet certain requirements for performance, appearance, and costs. It shall be the responsibility of the Contractor to implement the guidelines and requirements contained in the Contract Documents and translate them into a complete design package containing all elements necessary for a complete, operational, and functionally integrated Paging System(s).
3. Provide all work as detailed in the Contract Documents as a turnkey installation including all material, labor, engineering, warranties, taxes, freight, and permits. Only items and requirements specifically stated to be provided by others shall not be a requirement for this Section of the Work.

B. Work Included:

1. Refer to Sections contained in PART 2, 16 7 26 for Scope requirement and System descriptions. See attached Appendix for the Master Recap form that must be completed as part of the bidding process. This is provided for the post bidding evaluation process.

C. Work Specified Elsewhere

1. Installation of raceway, pull-boxes, plywood backboards, and floor-boxes (provided under electrical Work). Coordination is required within the design to verify the appropriate raceways are in place.
2. Installation of Cable Tray.
3. Installation and termination of Data and Communication Structured Cabling and RF distribution systems for items that access building LAN.
4. Cutting, patching, and painting of walls, unless damaged performing the work described herein.
5. Lighting Control systems.

D. Coordinated Work

1. Coordinate with related trades to schedule the Work and ensure a complete installation in accordance with the schedule outlined by the Owner.
2. Coordinate all IP device requirements with the Data vendor, Owner, and Contractor.
3. Coordinate all network connectivity requirements with the low voltage cabling contractor and Owner for items that access building LAN.

1.6 GENERAL CONDITIONS

A. Work Experience Coordination and Compliance

1. The Contractor represents that they are familiar with, and have expertise in the Work of this nature and scope. The Contractor further agrees that they shall provide all Work as may be required to make a complete job of that which may not be fully defined in the Programmatic Documents.
2. The Contractor shall comply with all of the regulations, including safety regulations of national, city, local and other government agencies having jurisdiction concerning the work of the Contractor. The Contractor shall give all notices and comply with all laws, ordinances, codes, rules, and regulations bearing on the conduct of the Work. If the Contractor performs any work, which is contrary to such laws, ordinances, codes, rules and regulations, they shall make all changes for compliance and bear all associated costs.
3. The Contractor warrants that both they and their subcontractors are licensed as required by the authorities having jurisdiction and as required by local ordinances.
4. The Contractor must state if they intend to utilize a subcontractor, and provide said subcontractor's name and address. The subcontractor shall comply with all the same rules, regulations, laws and codes, licenses, etc. as required by the Contractor and as specified herein. The Owner reserves the right to approve or disapprove any subcontractor proposed by Contractor.
5. All of the Contractor's work shall be tested and inspected by all authorities having jurisdiction and in accordance with all Specifications. The Contractor shall coordinate and cooperate fully and shall provide at no additional cost to the Owner, manpower, blueprints, facilities, scaffolds, etc. to reasonably assist the inspectors.
6. All permits required for any part of the Contractor's work shall be procured and paid for by the Contractor. The Contractor shall determine all permits required and transmit this information to the Owner.

7. The Work called for under this Contract shall be carried on simultaneously with the Work of other trades and Owner functions in such a manner as to not delay the overall progress of the construction project. The Contractor is responsible for all coordination of the Work with other trades.
8. Include in the Work all necessary supervision and issuing of all coordination information to any other trades who are supplying work to accommodate the Paging Systems installation.

B. Quality of Workmanship

1. The Contractor, upon receiving notice from Owner that the Contractor has furnished inferior, improper or unsound work or materials (including equipment), or work or materials at variance with that which is specified, will, within 24 hours, proceed to remove such work or materials and make good all other work or materials damaged thereby, and, at the option of the Owner, the Contractor shall immediately replace such work or materials with work or materials as specified. The removal, replacement, and repair shall be performed at such times and with manpower sufficient, in the judgment of the Owner, so as to avoid disturbance to occupants, or other ongoing work for the Project.
2. If the Contractor does not remove such unsound Work within a reasonable time, the Owner may remove it and may store the material at the expense of the Contractor. If the Contractor does not pay the expenses of such removal within ten (10) days time thereafter, the Owner may, upon written notice, sell such materials at auction or at private sale and shall account for the net proceeds thereof, after deducting all the costs and expenses that should have been borne by the Contractor and all expenses of the sale.
3. The Owner shall have the authority at all times, until final completion and acceptance of the Work, to inspect and reject work and materials which in its judgment are not in conformity with the Drawings and Details, Room Data Sheets and Specifications, and its decision in regard to character and value of Work shall be final and conclusive on both contracting parties. If the Owner permits said Work or materials to remain, the Owner shall be allowed the difference in value or shall at its election have the right to have said Work or materials repaired or replaced, as well as the damage caused thereby, at the expense of the Contractor, at any time within one (1) year after the completion of the entire project, or within such longer period as may be covered by any guaranty; and neither payments made to the Contractor, nor any other acts of the Owner, shall be construed as evidence of acceptance, waiver, or estoppels.
4. Any expense incurred by the Owner in connection with the foregoing, shall be borne by the Contractor, and the Owner may withhold money due to the Contractor or recover money already paid to the Contractor, to the extent of such expense.

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C. On-Site Storage

1. The Contractor shall be responsible coordinate and maintain a storage space.
2. If this storage space is required to be on-site it shall be the Contractor's responsibility to coordinate the size and spatial requirements with the Owner.
3. The Contractor shall assume full responsibility for the storage space and all contents, unless otherwise indicated by the Owner.
4. The Contractor shall examine the site and the Programmatic Documents and review with the Owner the designated areas of access, delivery, and storage for the Contractor's use. The Contractor agrees that such areas are satisfactory and sufficient for their needs in the completion of their work and in conformance with the terms of this Contract.

D. Protection from Damage

1. The Contractor shall provide all protection necessary to safeguard their work from damage by their operations and the operations of others. Unless the Contractor proves to the Owner's satisfaction that the Work has been damaged by others, the Contractor shall promptly repair, adjust, and clean all defective installations and bear all associated costs.

E. Owner Furnished Equipment

1. The Owner reserves the right to furnish any materials necessary for the Project.
2. For items of equipment which are to be installed but not purchased as part of the Work, the Work shall include:
 - a. Coordination of delivery
 - b. Unloading from delivery trucks
 - c. Safe handling and field storage up to the time of permanent placement in the project
 - d. Correction of any damage to the item(s)
 - e. Mounting in place and connection(s) as specified
3. Items which are to be installed, but not purchased as part of the Work shall be carefully examined upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of the Work will be considered only if presented in writing within one (1) week of the date of delivery to the project of the items in question. The Work includes all procedures necessary to put in satisfactory operation all items for which no claims have been submitted as outlined above.

F. Design Intent

1. The project documentation is, in general, diagrammatic and/or developed to communicate design intent. The Contractor shall coordinate the installation of all devices and/or equipment with the Owner prior to installation based on the existing field conditions.
2. It shall be understood that the Specifications and Drawings are complementary. Where there are conflicts within the documents, the overall design intent shall govern.
3. To the extent that they govern the Work, the Program documents, Specifications and Drawings also govern change order Work, if any.
4. The Drawings for the Work utilize symbols and schematic diagrams that have no dimensional significance. The Work shall be installed to fulfill the diagrammatic intent expressed on the Drawings, field layouts, and shop drawings of all trades.
5. Certain details appear on the Drawings for the Work that are specified with regard to the dimensioning and positioning of the Work. These are intended only for general information purposes. They do not obviate field coordination for individual items of the indicated Work.
6. Information as to general construction and architectural general construction and architectural features and finishes shall be derived from the structural and architectural drawings and specifications, are may require ongoing coordination with the Architect.
7. Ratings of devices, materials, and equipment specified without reference to specific performance criteria shall be understood to be nominal or nameplate ratings established by means of industry standard procedures.
8. It is the intent of the Drawings and Specifications to provide complete operating Paging Systems. All Work necessary to provide such a System shall be performed. Any discrepancies shall be brought to the Consultant's attention.

1.7 PROJECT MANAGEMENT

A. Project Manager

1. The Contractor shall provide a Project Manager to oversee and coordinate all activities on the Project
2. Project Manager's Duties and Responsibilities:
 - a. The Contractor shall provide to the Owner, as a part of the prefabrication submittal, the name of the Project Manager that will provide all duties and responsibilities as specified herein, during the term of the project.

- b. The Project Manager shall maintain the ability of making all managerial decisions on behalf of the Contractor on a day-to-day basis, and shall retain the authority of accepting notices of deduction, inspection reports, payment schedules and any other project related correspondence on behalf of the owner.
 - c. The Project Manager shall schedule and attend project management meetings, during which time all System related issues are discussed, scheduled, confirmed, and/or resolved.
 - d. The Project Manager shall be available during normal business hours during the term of the project.
 - e. After normal business hours, the Project Manager shall be available within four (4) hours by telephone during the term of the project.
 - 1) In the event that the Project Manager is not available within the allotted time frame, the Contractor may designate another employee to temporarily act as the Project Manager in all correspondence with the Owner.
 - 2) The Contractor shall ensure that any individual temporarily assuming the duties of the Project Manager is at equal or higher level in the Contractor's managerial chain of command.
3. Upon notification by the Owner, of any project related installation issue, or issue that may contradict the Specifications as stated herein, the Project Manager shall respond to such issue, verbally and/or in writing within an eight (8) hour period.
- a. Responses to such issues as stated above shall include a clear understanding of the issue, along with a tentative plan of action, reflecting milestones and/or deadlines to resolve the issue.
 - b. Where appropriate, based on the overall importance of the project issue, the Project Manager shall follow-up their initial response with a written response to the issue within 24 hours of identification of the issue.
4. Prior to the initiation of the Work, the Project Manager shall submit a schedule reflecting key milestones of the Work, including but not limited to the following:
- a. Bid award
 - b. Kick-off meeting
 - c. Master Plan submittal
 - d. Prefabrication submittal
 - e. Ordering, delivery, and installation of head-end System equipment

- f. Field equipment delivery
 - g. Project management schedule
 - h. Payment schedule
 - i. Installation completion date
 - j. System training
 - k. Delivery of As-Built documentation
 - l. Delivery of Operations & Maintenance Manuals
 - m. Final System test
 - n. Acceptance of System
- 5. The Project Manager shall update the schedule on a weekly basis to reflect the status of each key milestone as the Work progresses.
 - 6. As the System installation progresses, the Project Manager shall be capable of discussing any/or all of the above mentioned items at the request of the Owner, and shall address each item, as it relates to the current status of the Work.

1.8 REFERENCES

- A. The Paging Systems shall be installed in accordance with the latest applicable revisions pertaining to all applicable national, state, and local codes and standards including, but not limited to the following:
 - 1. National Electrical Code (NEC), current state recognized edition.
 - 2. Uniform Building Code (UBC), current state recognized edition.
 - 3. Local Governing Authorities Having Jurisdiction
 - 4. Telecommunications Industry Association (TIA).

1.9 SUBMITTALS

- A. Sequence
 - 1. Shop Drawings - Upon award of Contract, submittals shall be prepared and submitted for review by the Owner, Architect, and Paging Consultant prior to commencement of any work.
 - 2. Record Documents - Upon completion of systems and Contractor System Check Out, Record Documents to be created and submitted for review prior to system final acceptance.
 - 3. Operation and Maintenance Manuals– Shall be produced for review prior to Owner Training.

- B. Furnish submittals in accordance with general requirements specified in Division 1, SUBMITTALS.
- C. Prefabrication Submittals
 - 1. NOTE: ELECTRONIC SUBMISSION OF SUBMITTALS IS ACCEPTABLE IF ACCEPTABLE BY OWNER.
 - 2. Submit pre-fabrication submittals in accordance with the Owner's construction schedule.
 - 3. Pre-fabrication submittals shall consist of product data, shop drawings, samples, and a detailed completion schedule. Partial submittals will not be accepted without prior written approval from the Architect.
 - 4. Pre-fabrication submittals shall be furnished in electronic formats as defined by the General Conditions under Part 1 of the Project Specifications.
 - 5. No portion of the Work shall commence nor shall any equipment be procured until the Architect has approved the pre-fabrication submittals in writing.
 - 6. A letter of transmittal identifying the name of the Project, Contractor's name, date submitted for review, shall accompany pre-fabrication submittals and a list of items transmitted.
 - 7. Product data required as part of the pre-fabrication submittal shall include the following:
 - a. Product Submittals
 - 1) Equipment schedules listing all System components, manufacturer, model number and the quantity of each
 - 2) Submit manufacturer's product data sheets for all materials and equipment proposed for use on the project sorted by room and indexed.
 - 3) Mark each product data sheet to show applicable choices and options (sheets containing more than one device or component model number shall be clearly marked to delineate items included in the Work)
 - b. Submit manufacturer's product data sheets for all fire stopping materials proposed for use on the project.
 - c. A complete list of finishes and sample graphics, including custom art work and custom graphics (if applicable)
 - d. DSP Program Matrix drawings or program print out.
 - e. Project Calculations

- f. Cable run sheets denoting cable type, signal type, termination type, cable number designation, start point and end point.
- g. Shop Drawings
 - 1) Detailed plan views and elevations of Paging Control and/or Headend rooms (in addition to relevant telecommunications rooms) showing raceway, sleeves, cable tray, cable paths, equipment racks, equipment cabinets, termination blocks, power receptacles and grounding bus bars.
 - 2) Cable termination schedules showing cable transmission and device location. This can be shown on the drawings or in a separate spreadsheet.
 - 3) Floor plan drawings indicating device locations with device legends
 - 4) System riser diagram with all devices, wire runs, and wire designations
 - 5) Schematic block diagrams for each System showing all equipment, interconnects, data flow, etc.
 - 6) Fabrication shop drawings for all custom equipment (if applicable)
 - 7) Plans and elevations of the Paging equipment racks and/or custom furniture (including consoles, desks, and lecterns) quantifying all equipment to be mounted therein
 - 8) It is the responsibility of the Contractor to confirm all dimensions, quantities, and the coordination of materials and products supplied by the Contractor with other trades. Approval of shop drawings containing errors does not relieve the Contractor from making corrections at their expense.

D. Samples

- 1. The Contractor shall submit samples of any equipment components upon request of the Owner.
- 2. Samples submitted shall be the latest version of equipment.

E. Record Documentation

- 1. NOTE: ELECTRONIC SUBMISSION OF SUBMITTALS IS ACCEPTABLE IF ACCEPTABLE BY OWNER.
- 2. Shall include all information required in the Pre-fabrication Submittals but revised to reflect "as installed" conditions.

3. General Description and Requirements

- a. Submit Record Documentation in accordance with the Architect's construction schedule.
- b. Provide a letter of transmittal with Record Documentation identifying the name of the Project, Contractor's name, date submitted for review, and a list of items transmitted.
- c. Prior to the final acceptance of the Work, submit two draft sets of the Record Drawings portion of Record Documentation to the Architect. The draft copy shall be used during the final acceptance testing by the Architect.
- d. Update all record documentation to reflect changes or modifications made during final acceptance testing as required and submit three blue/black lines and one reproducible set.
- e. Provide cable test results for all cables installed under this Work, tested, and documented as described herein.
- f. Provide Owner with all systems programming on electronic media. The Owner is granted the rights to use and modify the code for the systems specified within this scope of work.

4. Record Drawings

- a. Produce all Record "as-built" Drawings using the latest version of AutoCAD and in PDF format. Record drawings shall, at a minimum, include the following:
 - 1) Floor plan drawings indicating device locations, with device legends indicating manufacturers and model numbers for each device
 - 2) Floor plan drawings indicating wire routing, wire routing shall be delineated in straight line runs and be tagged with cable identification and terminal strip numbers to coincide with the installation
 - 3) Mounting details for all equipment and hardware
 - 4) Functional block diagrams for each subsystem
 - 5) Wiring details showing rack elevations, equipment wiring and terminations, and inter-rack wiring
 - 6) Wiring diagrams for all custom circuitry including interfaces to various control output controlled devices, lighting control interfaces, projections screens, operable window treatments, motorized doors/partitions, etc.
 - 7) Wiring diagrams for each System, including a copy laminated and located within each equipment rack.

- 8) Typical point-to-point wiring diagrams for each piece of equipment and groups of equipment within the System
 - 9) Layout details for each riser location, including Paging panels, power supplies, junction boxes, conduit, and any other Paging related equipment
5. Operation and Maintenance Manuals
- a. Operation and Maintenance Manuals shall apply to all Paging related devices, equipment, and software modules.
 - b. Operation and Maintenance Manuals shall be formatted as follows:
 - 1) Bind each manual in a hard-back loose-leaf binder.
 - 2) Identify each manual's contents on the cover.
 - 3) Provide a table of contents and tabulated sheets for each manual. Place tab sheets at the beginning of each chapter or section and at the beginning of each appendix if applicable.
 - 4) Any hardware manual demonstrating more than one model number of device on any one page shall be clearly marked as to delineate which model has been implemented in the Work.
 - c. Operation and Maintenance Manuals shall include, at a minimum, the following:
 - 1) Operational description of each subsystem
 - 2) Detailed programming descriptions for each subsystem
 - 3) Explanations of subsystem interrelationships
 - 4) Electrical schematics for each piece of equipment specified
 - 5) Power-up and power-down procedures for each subsystem
 - 6) Description of all diagnostic procedures
 - 7) A menu tree for each subsystem
 - 8) Setup procedures for each component of the subsystems
 - 9) A list of manufacturers, their local representatives, and subcontractors that have performed Work on the Project
 - 10) Installation and service manuals for each piece of equipment
 - 11) Maintenance schedules for all installed components

- d. Operation and Maintenance Manuals shall include a separate section for each software program incorporated into the Project. The software section shall include, at a minimum, the following information:
 - 1) Definitions of all software related terms and functions
 - 2) Description of required sequences
 - 3) Directory of all disk files
 - 4) Description of all communications protocols, including data formats, command characters, and a sample of each type of data transfer
 - 5) Instructions for manufacturer supplied report generation
 - 6) Instructions for custom report generation
 - 7) Database format and data entry requirements
 - 8) Procedure for Resubmitting
 - e. Make corrections or changes in O & M and/or Record Drawings as required by the Architect and resubmit when the Architect's stamp requires re-submittal.
 - f. Clearly identify changes made other than those specifically requested by the Architect when resubmitting Record Drawings. Changes shall be clouded or similarly highlighted as coordinated with the Architect. Only changes that have been specifically requested by the Architect or have been clouded by the Contractor will be reviewed on resubmittals.
 - g. Any drawing sheets added to the resubmittal shall be clearly identified and clouded, and shall not change the sheet numbering scheme for previously issued Record Drawings.
 - h. The Contractor shall be responsible for any delays caused by the re-submittal process.
6. Re-submittal Review Fees
- a. If the Architect rejects the Contractor's Record Submittal (Rejected, Revise, and Resubmit) more than two times, the Architect will be compensated for all subsequent reviews, whether partial or comprehensive. The amount of such compensation will be incorporated by Change Order and withheld from the Contractor's Application for Payment.

1.10 QUALITY ASSURANCE

A. Contractor Qualifications

1. Work specified herein shall be the responsibility of a single Paging Systems Contractor. Bid submission shall document a minimum of five (5) years experience in the fabrication, assembly, and installation of Systems of similar complexity as specified herein. The documentation shall include the names, locations, and points of contact for at least three (3) installations of the type and complexity specified herein.
2. Installer Training Process: – Contractor's labor force shall have certified installers who attended training programs of the proposed system preparing them to perform the work.
3. The Installer for this Project is to be certified by all manufacturers of the installed equipment that the Contractor proposes.
4. Registered and Certified supervisors- Contractor must have all supervisory personnel certified for the type of work they are overseeing (installation and design) from InfoComm International.
5. Quality assurances for Paging systems includes a multi-step program consisting of pre-qualification procedure for manufacturers and installation specialists; products phase; installation; operating instruction and training; and the submission of maintenance and operating manuals.
6. The Contractor shall have local in-house engineering and project management capabilities consistent with the requirements of the Work.
7. By submitting a bid, the Contractor thereby certifies that it is qualified in all areas pertaining to, directly or indirectly, the Work. In the event the Contractor becomes unable to complete the Work in accordance with the Contract Documents, or the satisfaction of the Owner, it shall be the responsibility of the Contractor to retain the services of applicable manufacturers' representatives to expeditiously complete the Work in accordance with the Owner's construction schedule with no additional cost to the Owner.
8. The Contractor shall maintain, or establish and maintain, a fully staffed office including a service center capable of providing maintenance and service to the Project. The Contractor shall staff the service center with factory trained technicians and adequately equip the office to provide emergency service within seventy-two (72) hours after being called, 24 hours per day.
9. The Contractor shall provide factory-certified technicians to install, commission, and maintain the Work. All installing personnel shall be licensed as required by local and/or state jurisdictions.
10. The Contractor shall ensure compliance with, and have a thorough understanding of, all local codes and contract conditions pertaining to this Project.

11. The Contractor shall maintain an inventory of spare parts and other items critical to System operation and as necessary to meet the emergency service requirements of this Project within the local service center.

B. Product Standards

1. All equipment and materials for contained herein shall be the products of recognized manufacturers and shall be new.
2. New equipment and materials shall:
 - a. Be Underwriters Laboratories, Inc. (U.L.) listed and approved where specifically called for; or where normally subject to such U.L. labeling and/or listing services.
 - b. Be without blemish or defect.
 - c. Be products that meet with the acceptance of the agency inspecting the Paging Systems work.
3. It is the intent of these specifications that wherever a manufacturer of a product is specified, and the terms "other approved" or "approved equal" are used, the substituted item must conform in all respects to the specified item. Consideration will not be given to claims that the substituted item meets the performance requirements with lesser construction. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.
4. Substituted equipment or optional equipment, where permitted and approved, must conform to space requirements. Any substituted equipment that cannot meet space requirements, whether approved or not, shall be replaced at the Contractor's expense. Any modifications of related Systems as a result of substitutions shall be made at the Contractor's expense.
5. The approval of shop drawings, or other information submitted in accordance with the requirements hereinbefore specified, does not ensure that the Paging Consultant, Architect, or the Owner attests to the dimensional accuracy, dimensional suitability of the material, or mechanical performance of equipment. Approval of shop drawings does not invalidate the Drawings and Specifications.
6. Substitutions of equipment shown on the schedules or designated by model number in the specifications will not be considered if the item is not a regular catalogued item carried by the manufacturer.
7. Within the Specifications, certain manufacturers have been listed. These manufacturers are listed for example purposes (unless followed by "No Exceptions"). The Contractor may substitute manufacturers and models that may be more cost effective or readily available than that specified. However, all substitutions shall meet or exceed the specified functional and technical

requirements. Acceptance of such substitutions is at the discretion of the Consultant and/or Owner.

C. Alternate Equipment Submittal Requirements

1. All bids shall be submitted on the basis of the systems and equipment used as the basis of design in the attached specification. The Bidder may propose alternate equipment. However, all such proposals shall be submitted separately and will be identified as "alternates" with equipment costs shown separate and apart from the costs of the equipment "as specified." Additionally, systems incorporating alternate equipment are anticipated to require modification of the design of the attached specification and will require the bidder to provide revised design drawings as part of an alternate submittal, that detail the bidders intent to integrate alternate systems and equipment without modifying the design intent of the bid.
2. Proposals for alternate equipment will receive careful and equitable consideration if the differences do not depart from the overall intent of the design and operation of the system, are in the best interests of the Owner, and are equal to, or greater in functionality, durability, and usability.
3. All such proposals for alternate equipment shall be accompanied by full technical information, design drawings, cut sheets, and specifications for the equipment so proposed. The Bidder shall identify the substantive differences between the alternate and the specified equipment for consideration.
4. Submittals for alternate equipment/design will be required to include the following information at time of submittal, and as part of the bid response:
 - a. Proposal response as provided in the bid specification, using bid forms as provided.
 - b. Alternate proposal shall be submitted separately
 - c. Alternate proposal must be separated from the base bid and identified as "alternate" with equipment costs shown separate and apart from the costs of the equipment "as specified."
 - d. Revised design drawings that detail the bidders intent to integrate alternate systems and equipment without modifying the design intent of the bid. Original design drawings that are part of this bid package will not be provided electronically to bidders until award of bid.
 - e. Full technical information to include:
 - 1) Design drawings
 - 2) Cut sheets for proposed alternate equipment

- 3) Specifications for the proposed alternate equipment.
- 4) The Bidder shall identify the substantive differences between the alternate and the specified equipment for consideration.

1.11 WARRANTY AND MAINTENANCE

- A. Systems Contractor shall provide a one (1) year warranty for the Work. The warranty shall cover all Work, Systems, and subsystems against defects in materials and workmanship. The Work as specified herein, including all materials and labor, but excepting any existing devices and equipment which are incorporated in the completed Work, shall be warranted to be free from defects in design, workmanship, and materials. Further, the Contractor shall warrant that the completed Systems, including all components (except those, which are existing or provided by others), are of sufficient size and capacity to fulfill the requirements of the Specifications.
- B. The warranty shall be valid for a period of one (1) year following the date of System acceptance by the Owner. System acceptance shall commence when all parts, components, sub-Systems, and Systems have been tested, shown to be working in accordance with the Specification, and approved by the Owner
- C. In cases where the manufacturer's warranty period is greater than twelve months, the contractor must be prepared to honor that warranty for the full extent of the manufacturer's warranty period. This shall exclude any labor costs incurred by the contractor removing and re-installing the defective items.
- D. In cases where the manufacturer's warranty period is less than 12 months, the contractor is liable for defects in the item up to-but not exceeding-the first twelve-month period on any contractor provided items.
- E. To maintain certain manufacturer's warranties, said equipment must be installed, aligned, and serviced by those installers authorized by said manufacturer to perform those duties. If the contractor is not authorized, by said manufacturer, it is his sole responsibility to make the appropriate arrangements and bear all cost and consequences thereof.
- F. All manufacturers' equipment warranties shall be activated in the Owner's name and shall commence on the date of system acceptance. In the case of Contractor-modified equipment, the manufacturer's warranty is normally voided. In such cases, the Contractor shall provide the Owner with a warranty equivalent to that of the original manufacturer.

G. Warranty Service:

1. In the event that defects in the materials and/or workmanship are identified during the warranty period, the Contractor shall provide all labor and materials as may be required for prompt correction of the defect.
2. Provide written notice to the Owner documenting any Work performed during the warranty period, including any preventative maintenance Work performed.
3. Provide loaner equipment that is fully compatible with the Paging Systems for any equipment not field repairable.
4. Loaner equipment for components that must be shipped to/from the manufacturer or distributor shall be on site and operational within 48 hours of the component failure. Furnish lists of equipment that will require shipment from the manufacturer or distributor and lead times associated with that equipment.

H. See attached Appendix for the Warranty costs form that must be completed as part of the bidding process. This is provided for the post bidding evaluation process.

PART 2 - PRODUCTS

2.1 PAGING SYSTEMS

- A. All network based equipment will utilize PoE network switches furnished by others. Coordinate VLAN requirements with Owner and Network Contractor as required. Switches require the following:
1. Switches shall be managed-type with VLAN capabilities and Power-Over-Ethernet (PoE). Care should be taken to ensure that each Switch be able to supply adequate PoE power to the endpoint devices it serves. Uplink ports for each switch shall be via Optical Fiber. Either Multimode or Single-mode fiber may be used, as determined by the length of the required uplink runs. Each port on each Switch shall be capable of sustained 100MBit data rates.
 2. One consistent VLAN (Virtual Local Area Network) shall be established across each managed Switch, with enough ports to accommodate the PS devices attached to it, plus 25% for future expansion.
- B. Provide and integrate one (1) rackmount computer with rackmount keyboard, mouse, and monitor.
1. Computer shall meet the following minimum specifications
 - a. Microsoft Windows 7 operating system, or XP-Professional

- b. Intel Pentium Dual Core processors, 2.6 GHz.
 - c. 2 GB RAM
 - d. 160 GB SATA hard drive
 - e. Integrated video adapter, minimum 1280 x 1024 native output at 32-bit color
 - f. Dual integrated gigabit Ethernet ports
 - g. CPU shall be Lenovo ThinkCentre 158 or equivalent
- C. Provide and integrate audio amplifiers, including all required amplifier module cards as required.
 - 1. Amplifiers shall allow a total of eight amplifier modules per amplifier chassis. Seven channels shall be active, and one shall be a backup. Amplifier will automatically switch over to backup channel in the event of a module failure.
 - 2. All amplifiers modules shall be 70V and shall be sized properly for their respective loads.
 - 3. DSP shall be available at each module.
- D. Provide and integrate ambient noise microphones as required.
- E. Provide and integrate ambient noise compensators (ANC) as required.
 - 1. Each ANC shall be PoE and wired to the Cobranet VLAN.
 - 2. Each ANC shall be housed in a small surface-mountable enclosure.
 - 3. Each ANC shall respond to its associated amplifier channel module, advising that channel of changes in ambient noise level.
 - 4. Each ANC shall have two microphone inputs, both with 48V phantom power.
- F. Provide and integrate audio input expansion devices as required.
 - 1. PoE and wired to the Cobranet LAN
 - 2. Ability to output a Multicast Bundle of 6 mono signals to the Cobranet VLAN.
 - 3. Four pairs of unbalanced RCA inputs plus four balanced inputs.
 - 4. DSP available for each channel
 - 5. Four control inputs
 - 6. Reporting and logging of any and all failure conditions.
- G. Provide and integrate audio output expansion devices as required.
 - 1. PoE and wired to the Cobranet LAN

2. Four balanced analog audio outputs.
 3. DSP available for each channel
 4. Four control inputs
 5. Four Form-C contact outputs
 6. Reporting and logging of any and all failure conditions.
- H. Provide and integrate 4-button desktop paging stations as required.
1. PoE and wired to the Cobranet LAN
 2. Four buttons, each assignable to a specific paging task, plus push-to-talk button and LEDs.
 3. Cardioid gooseneck microphone.
 4. Integrated DSP.
 5. Internal page storage.
 6. Backlit LCD display.
 7. Reporting and logging of any and all failure conditions.
- I. Provide and integrate 4-button wall/millwork-mounted paging stations as required.
1. PoE and wired to the Cobranet LAN
 2. Four buttons, each assignable to a specific paging task, plus push-to-talk button and LEDs.
 3. Dynamic noise-canceling close-talking microphone with push-to-talk button on heavy duty coiled cord. Microphone shall be replaceable in field.
 4. Integrated DSP.
 5. Internal page storage.
 6. Backlit LCD display.
 7. Reporting and logging of any and all failure conditions.
- J. Provide and integrate one (1) Message Server (MS).
1. MS shall be a single space rack mounted Linux Server
 2. MS wired to Cobranet VLAN and VoIP VLAN.
 - a. Note: If phone system is not VoIP, additional equipment will be required to convert analog phone line into VoIP. It is the Paging Contractors' responsibility, in coordination with the Owner and Networking Contractor, to determine and provide this additional equipment.
 3. MS shall have minimum hard drive capacity of 80 GB for storage and playback of recorded announcements and preambles.

4. MS shall act as a Configuration Server for the entire paging system.
 5. MS shall include VoIP Trunk Server and support SIP (Session Initiation Protocol) calling to allow telephone-based paging.
 - a. Note: If phone system is not VoIP, additional equipment will be required to convert analog phone line into VoIP. It is the Paging Contractors' responsibility, in coordination with the Owner and Networking Contractor, to determine and provide this additional equipment.
 6. MS shall include scheduler.
 7. MS shall store log data from all system components.
- K. Provide and integrate ceiling and wall speakers as required. Speakers shall include all required mounting hardware, tile bridges, 70V transformers, backboxes, ceiling cans, and grills as required.
- L. Integrate BGM source (provided by others) into paging system.
- M. Integrate Bar source (provided by others) into paging system.
- N. Integrate Conference Room source (provided by others) into paging system.
- O. Provide and integrate one (1) sound masking generator/EQ.
- P. Provide and integrate two (2) auxiliary input plates.
- Q. Provide and integrate one (1) UPS, sized as required for anticipated power load.
- R. Provide and integrate two (2) equipment racks with sides, fan tops, vertical and horizontal power strips, lacing bars, and all required accessories. Coordinate vertical power strip plug type and quantity with electrical drawings/engineer.
- S. Provide all loose cables, connectors, etc. required to complete a full working system.

2.2 CABLES

- A. Unless otherwise called for in these specifications and drawings, the following cables, or their approved equals, shall be used in these systems:
1. Control (4 conductor shielded)

- a. Non-Plenum: Belden 1502R
 - b. Plenum: Belden 1502P
- 2. Control (12 conductor shielded)
 - a. Non-Plenum: Belden 9556
 - b. Plenum: Belden 6309FE
- 3. Audio
 - a. Non-Plenum: Belden 9451/1266A
 - b. Plenum: Belden 9451P
- 4. Audio (8 ohm program speakers)
 - a. Non-Plenum: Belden 8473
 - b. Plenum: Belden 1861A
- 5. Audio (70 Volt Speaker)
 - a. Non-Plenum: Belden 8461
 - b. Plenum: Belden 1863A
 - c. Note: Gauges of above cables are only a recommendation. It is the Contractors responsibility to chose cable of the appropriate gauge for the required distance.
- 6. Multi-channel Audio
 - a. Non-Plenum: Belden 8774
 - b. Plenum: Belden 88778
- 7. Digital Audio (110 Ohm)
 - a. Non-Plenum: Belden 1800B
 - b. Plenum: Belden 1801B
- 8. Category 6 cable
 - a. Non-Plenum: Belden 2412
 - b. Plenum: Belden 2413
- 9. Note: These cable types are cited to illustrate the type and quality of cable required. Unless otherwise noted, cables from other manufacturers, i.e. Canare, CommScope, Extron, Gepco, Liberty, etc. will be considered acceptable **if data sheets are submitted prior to installation. Electronic submission of data sheets is acceptable.**

B. Connection Plate Receptacles:

- 1. Audio (microphone or line level) – XLR type.
- 2. Audio (loudspeaker level) – Neutrik Speakon® Type.
- 3. Data – RJ-45 type.

4. Note: All connectors on wall plates, or in other exposed locations, are to be recessed.

2.3 ALL ELECTRONIC PRODUCTS

- A. Shall operate on 120 to 240 VAC at 50/60 Hz.
- B. Shall be capable of operating continuously for 12 hours over the external ambient temperature range of +10°C to +65°C (20% to 95% humidity, non-condensing) without permanent damage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine the areas to receive the work and the conditions under which the Work would be performed. Contractor shall remedy conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General
 1. All installation practices shall be in accordance with, but not limited to, these specifications and drawings. Installation shall be performed in accordance with the applicable standards, requirements, and recommendations of National and Local authorities having jurisdiction.
 2. If, in the opinion of the Contractor, an installation practice is desired or required, which is contrary to these specifications or drawings, a written request for modification shall be made to the Consultant. Modifications shall not commence without written approval from the Consultant. Every effort will be made to respond to all written requests, in a timely manner, as to not delay the installation or completion of the project.
 3. Prior to ordering equipment, the contractor shall coordinate the frequencies of all wireless devices to prevent unwanted interaction between devices and rooms. This includes, but is not limited to, wireless microphones, assisted listening system devices, wireless control panels, etc.
 4. All accessories, including rack mounting hardware, power supplies, etc., shall be obtained from the original equipment

manufacturer. Unless otherwise noted or specified, third party accessories shall not be used.

5. All installation practices shall be in accordance with, but not limited to, these specifications and drawings. Installation shall be performed in accordance with the applicable standards, requirements, and recommendations of National and Local authorities having jurisdiction.
6. If, in the opinion of the Contractor, an installation practice is desired or required, which is contrary to these specifications or drawings, a written request for modification shall be made to the Consultant. Modifications shall not commence without written approval from the Consultant. Every effort will be made to respond to all written requests, in a timely manner, as to not delay the installation or completion of the project.
7. During the installation, and up to the date of final acceptance, the Contractor shall be under obligation to protect his finished and unfinished work against damage and loss. In the event of such damage or loss, the damage shall be replaced or repaired at no cost to the Owner.

B. Coordination

1. Power Distribution
 - a. Coordinate power distribution requirements with the Electrical Contractor.
2. Communications Cabling
 - a. Coordinate all communications cabling with Telecom Cabling Contractor.

C. Physical Installation

1. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise.
2. All equipment shall have an engraved plaque permanently affixed, denoting its function.
3. Fastenings and supports shall be adequate to support their loads with a safety factor of at least five. All boxes, equipment, etc., shall be secured plumb and square.
4. In the installation of equipment and cable, consideration shall be given not only to operational efficiency, but also to overall aesthetic factors.

D. Trim and Escutcheon Components

1. To insure a proper finished appearance, the PAGING Contractor shall furnish and install trim/escutcheon components at all conditions where paging components pass through the finished

ceilings. This would include but not be limited to any component which is not specifically supplied with integral flanges/trim components; i.e. speaker mounts.

2. All trim components at the ceiling plane shall be finished to match the approved ACT ceiling grid system components. The paging contractor should obtain a sample from the General Contractor, including any custom color information, or standard color numbers. All trim components shall be submitted to the Architect for review and approval prior to fabrication.

E. Cable Installation

1. All wire bundles are to be neat and combed free of cable crossovers.
2. All cables, regardless of length, shall be marked with a permanent, self-laminating wrap-around number or letter cable marker at both ends, similar to the Panduit "Pan-Code" system. Labels must be computer-generated for legibility. Wire labels done by hand in the field must be replaced with computer generated labels. There shall be no unmarked cables at any place in the system. Marking codes used on cables shall correspond to codes shown on drawings and or run sheets.
3. All cables shall be grouped according to the signals being carried. In order to reduce signal contamination, separate groups shall be formed for the following cable families:
 - a. Power cables
 - b. Control cables
 - c. Network cables
 - d. Audio cables carrying signals less than – 20 dBm
 - e. Audio cables carrying signals between – 20 dBm and +20 dBm
 - f. Audio cables carrying signals above +20 dBm
4. As a general practice, all power cables, control cables, and high level cables shall be run on the left side of an equipment rack as viewed from the rear. All other cables shall be run on the right side of an equipment rack, as viewed from the rear.
5. Cables ties shall be placed at appropriate intervals of no greater than six inches for vertical bundles, two inches for horizontal bundles.
6. All vertical cable bundles shall be attached to the rack frame.

F. Wire Terminations

1. All cables shall be continuous lengths without splices.

2. All system wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means.
3. Except where noted otherwise in the specifications, NO BARE WIRE TERMINATIONS WILL BE ACCEPTED. Heat-shrink tubing shall be used to insulate the ground or drain wire.
4. Unused wires at the end of a cable shall remain unstripped and shall be laid back and held in place with wire ties.
5. All solder connections shall be made with rosin-core solder using temperature-controlled solder stations. Care shall be taken to avoid cold or cracked solder joints. Any connections that do not appear to be clean and shiny, or which show signs of cracking, shall be re-soldered by the contractor before final acceptance of the system.
6. Mechanical connections using insulated, crimp-type connectors shall be bonded to the connector by soldering the wire to the metal part of the connector.
7. Connections made with screw actuated pressure type terminal strips shall be made by stripping approximately 1/4 inch of insulation from the stranded conductor. Then the un-tinned wire shall be inserted into the terminal and the screw tightened using a secure fitting precision screwdriver.
8. Terminal blocks, boards, strips, or connectors shall be furnished for all cables which interface with racks, cabinets, consoles, or equipment modules. No audio cables shall run directly to the audio patch panel jacks. Each audio patch panel shall be furnished with an audio terminal block and all audio cables to and from the audio patch panel shall terminate on this block.
9. All network cabling shall terminate to appropriate patch panels, and shall be then patched into the Network switches.

G. Cable Management

1. All wire markers shall face a common direction.
2. All cables shall have proper connector housing.
3. Cables shall not protrude from the back of racks.
4. All cable entry shall be through the tops of racks or through entrance holes in the base of the rack. No cable shall enter racks through front, rear or side panel openings.
5. Cables running in plenum areas without conduit shall be plenum rated cable, and match the specified cable above. It is the responsibility of the Bidder to inspect the electrical drawings, and verify in what spaces plenum cable shall be used. No claims for additional monies, based on the use of plenum cable, will be allowed.

6. All cables (except video and pulse cables, which must be cut to an electrical length) shall be cut to the length dictated by the run. No splices shall be permitted in any pull boxes without prior permission of the Consultant. For equipment mounted in drawers or on slides, the interconnecting cables shall be provided with a service loop of appropriate length.
7. No cable shall be installed with a bend radius less than that recommended by the cable manufacturer.
8. Where cables are installed in architectural niches, ensure that the cables are black, unless otherwise directed, to reduce visibility from the audience.
9. Where cables are installed that is visible, the cables will be sheathed in a color wrap that has been pre-approved for the location.

3.3 PERFORMANCE STANDARDS

- A. Unless restricted by the published specifications of a particular piece of equipment, or unless otherwise required under the Detailed Specifications, the following performance standards shall be met by each system:

1. Audio
 - a. Frequency Response
 - 1) Within plus or minus 0.5dB, 20 Hz to 20,000 Hz.
 - b. Signal to Noise Ratio
 - 1) Greater than 90dB (including crosstalk and hum at all input/output levels)
 - c. Total Harmonic Distortion
 - 1) 0.05% maximum from 20 Hz to 20,000 Hz.
 - d. Input Levels
 - 1) Microphone (Nominal): -50dbu
 - a) Overload (Minimum gain) : -5dbu
 - b) Maximum Gain: -26dbu
 - 2) Line (Nominal): +4dbu
 - a) Overload (Minimum gain): +24dbu
 - b) Maximum Gain: +9dbu
 - c) Input Common Mode Rejection: >100db
 - e. Output Levels
 - 1) Line (Nominal): +4dbu
 - a) Maximum: +24dbu

- 2) Output Impedance: <0.5 Ohms
- 3) Load Impedance: >150 Ohms
- 2. Video (signal)
 - a. Frequency Response:
 - 1) Within plus or minus 0.5dB, DC to 4.2 MHz.
 - b. Signal to Noise Ratio:
 - 1) 55 dB minimum. (peak to RMS) unweighted, DC to 4.2 MHz
 - c. Crosstalk:
 - 1) 45 dB minimum unweighted DC to 4.2 MHz
 - d. Line and Field Tilt:
 - 1) 2% maximum.
 - e. Differential Gain:
 - 1) 3% maximum.
 - f. Differential Gain:
 - 1) 2 degrees maximum.
- 3. Network
 - a. As required by manufacturer for specified devices.

B. Performance Test Signal Paths

- 1. The signal paths for the above Performance Standards shall be as follows:
- 2. Audio:
 - a. From all source inputs (for microphones, Blu-Ray players, CATV receivers, etc.) through all mixers, switchers, etc., to all signal destinations.
- 3. Data
 - 1) From all sources to patch panels.

3.4 CONTRACTOR SYSTEM CHECKOUT

- A. Before Acceptance Tests are scheduled, the Contractor shall perform their own system check-out. They shall furnish all required test equipment and shall perform all work necessary to determine and/or modify performance of the system to meet the requirements of this specification. This work shall include the following:
 - 1. Provide documentation that all Cobranet bundles and audio signal lines have been tested and verified, if applicable.

2. Test all audio/video systems for compliance with the Performance Standards, using the following test procedure:
3. Test Equipment: Assemble the following test equipment (or equivalent) on site.

B. Audio check:

1. Signal generator, Leader LAG-120B
2. AC millivoltmeter, Leader LMZ-181A
3. Audio test set, Audio Precision P1PLUS
4. Audio cable
5. Set of terminations, adapters etc.

C. Data checks:

1. Data line tester, as required.

D. Signal Paths

1. Audio
2. Connect the output of the video signal generator to a floor box/table/rack connector and select the "Full Field Color Bar" signal. Connect the combined waveform monitor/vectorscope to a final output point, e.g. an input to a picture monitor or video projector. Ensure that the test signal is routed to the selected output.
3. Measure and record the signal amplitudes.
4. Repeat item '2' after selecting the "Multiburst, 50 IRE" test signal.
5. Measure and record the signal amplitudes.
6. Repeat item '2' after selecting the "Modulated 5-step" test signal.
7. Measure and record the signal differential phase and gain.
8. Repeat item #'s '2' through '7' for other video signal paths.
9. Repeat item '2' after selecting the Window test signal.
10. Measure and record the signal line and field tilt.
11. Repeat item '2' after connecting the Black Burst signal from a rear mounted connector.
12. Measure and record the signal/noise ratio.
13. Connect the output of the audio test set to a floor box/table/rack program audio connector and connect the input of the audio test set to a final output point, e.g. an input to a program speaker power amplifier. Ensure that the test signal is routed to the selected output, that the volume control is set to 100% and that the equalizers are bypassed.

14. Measure and record the signal/noise ratio, total harmonic distortion and frequency response.
15. Repeat items '13' and '13' for other audio signal paths.

3.5 SYSTEM ACCEPTANCE TESTS

- A. System Acceptance Tests will not be performed until the Contractor's System Checkout has been completed and the test results have been reviewed. The System Acceptance Tests will be supervised by the Consultant and will consist of the following:
- B. A physical inventory will be taken of all equipment on site and will be compared to equipment lists in the contract documents.
- C. The operation of all system equipment shall be demonstrated by the Contractor.
- D. Both subjective and objective tests will be required by the Consultant to determine compliance with the specifications. The Contractor shall be responsible for providing test equipment for these tests.
- E. All final, "as-built" drawings, run sheets, manuals, and other required documents, as detailed in Part I, shall be on hand. Two complete sets of these documents shall be delivered to the Owner at this time. (One complete set shall have been delivered to the Consultant prior to the scheduling of Acceptance Tests).
- F. In the event further adjustment is required, or defective equipment must be repaired or re-placed, tests may be suspended or continued at the option of the Consultant.
- G. Any charge for additional time incurred by the Consultant required to oversee the system tests, due to improper system installation or previous failed systems, shall be the responsibility of, and charged directly to the contractor.
- H. Some specification sections have additional requirements. Refer to individual specifications section for more information.

3.6 BIDDING FORMS

- A. See below for Appendix for: Paging systems equipment list, Warranty, and Master Recapitulation forms that must be competed as part of the bidding process. This is provided for the post-bidding evaluation process.

Appendix A							
Section 16 7 26 – Paging System							
Item		Product	Manuf	Model #	Unit	Qty	Ext
1		PoE Network Switches	Provided by others		_____	Provided by others	_____
2		Rackmount Computer	Dell	Precision Rack Workstation Series	_____	1	_____
3		Rackmount KVM	Middle Atlantic	RM-KB-LCD17	_____	1	_____
4		Audio Amplifier with Appropriate Amplifier Modules	Biamp	VA-8600 with AM-600 modules	_____	Quantity as required	_____
5		Ambient Noise Microphone	Clock Audio	C 007E	_____	Quantity as required	_____
6		Ambient Noise Compensator	Biamp	ANC-1	_____	Quantity as required	_____
7		Audio Input Expansion Device	Biamp	VI-6	_____	Quantity as required	_____
8		Audio Output Expansion Device	Biamp	VO-4	_____	Quantity as required	_____
9		4-Button Desktop Paging Station	Biamp	DS-4	_____	Quantity as required	_____

10	4-Button Wall/Millwork- Mounted Paging Station	Biamp	WS-4	_____	Quantity as required	_____
11	Message Server	Biamp	MS-1	_____	1	_____
12	CS1 Ceiling Speaker	EV/Atlas	EV 205 series speaker with Atlas T7 series grill and appropriate backbox	_____	Quantity as required	_____
13	CS2 Ceiling Speaker	EV/Atlas	EV 205 series speaker with Atlas T7 series grill and appropriate backbox	_____	Quantity as required	_____
14	CS3 Ceiling Speaker	EV	EVID C8.2LC Ceiling	_____	Quantity as required	_____
15	CS4 Ceiling Speaker	Innovox	Micro MTM with 70V transformer	_____	Quantity as required	_____
16	CS5 Ceiling Speaker	Innovox	SLA-4.1-9035 with 70V transformer	_____	Quantity as required	_____
17	CS6 Ceiling Speaker	Atlas	PM4FA-B	_____	Quantity as required	_____
18	WS1 Wall Speaker	QSC	AD-S52	_____	Quantity as required	_____
19	WS2 Wall Speaker	Renkus- Heinz	CDT500K Series	_____	Quantity as required	_____

20	BGM source	By Others	By Others	_____	1	_____
21	Bar Source	By Others	By Others	_____	1	_____
22	Conference Room Source	By Others	By Others	_____	Quantity as required	_____
23	Sound Masking Generator/EQ	Atlas	ASP-MG24	_____	1	_____
24	Auxiliary Input Plates	Custom	Custom	_____	2	_____
25	UPS	APC	Smart-UPS series	_____	1	_____
26	Equipment Rack with sides, fan top, horizontal and vertical power strips, lacing bars, and all required accessories	Middle Atlantic	MRK-4431 with required accessories	_____	2	_____
27	Miscellaneous hardware, switches, relays panels, connectors, cabling, lamps, terminal blocks, etc., necessary to insure a complete and operating system.			_____	LOT	_____

28	Set audiovisual systems functional drawings, shall be photo-reproduced laminated & stored in pocket, audiovisual equipment racks.			LOT	
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**Appendix A
Warranty
SECOND YEAR WARRANTY
PERIOD**

- | | | |
|---|---|---------------|
| 1 | Preventative Maintenance, Four
(4) PM Visits and Service within 24
hours. | _____ |
| 2 | Preventative Maintenance, Four
(4) PM Visits and Service within 4
hours. | _____ |
| 3 | Emergency Service Hourly Rate | _____ Per/Hr. |
| 4 | In Shop Hourly Rate | _____ Per/Hr. |

**THIRD YEAR WARRANTY
PERIOD**

- | | | |
|---|---|-------|
| 5 | Preventative Maintenance, Four
(4) PM Visits and Service within 24
hours. | _____ |
| 6 | Preventative Maintenance, Four
(4) PM Visits and Service within 4
hours. | _____ |

**FOURTH YEAR WARRANTY
PERIOD**

- | | | |
|---|---|-------|
| 7 | Preventative Maintenance, Four
(4) PM Visits and Service within 24
hours. | _____ |
| 8 | Preventative Maintenance, Four
(4) PM Visits and Service within 4
hours. | _____ |

**FIFTH YEAR WARRANTY
PERIOD**

- | | | |
|----|---|-------|
| 9 | Preventative Maintenance, Four
(4) PM Visits and Service within 24
hours. | _____ |
| 10 | Preventative Maintenance, Four
(4) PM Visits and Service within 4
hours. | _____ |

Appendix A Master Recap.								
AREA	EQUIPMENT	ENGINEERING	PRE-INSTALL	INSTALL	G&A	TAXES	AREA TOTAL	TOTALS
Section 16 7 26 – Paging System								

END OF SECTION 16726

**NEW PASSENGER TERMINAL
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

SECTION 16730 – SECURITY TELEPHONES

PART 1. GENERAL

- 1.1 The Emergency Phone shall consist of a vandal resistant and ADA-compliant hands-free speakerphone communications device with a stainless steel faceplate and metal buttons.
- 1.2 The Emergency Phone shall have one tactile button labeled "EMERGENCY" and one red light emitting diode (LED) labeled "LIGHT ON INDICATES CALL RECEIVED".
- 1.3 Unit shall comply with Part 68 of the FCC rules for the United States.
- 1.4 Contractor shall submit manufacturer's product data and cut sheet.
- 1.5 Equipment shall be warranted against any defects in material and workmanship, under normal use, for a period of twelve months from date of installation. In the event system is found by manufacturer to be defective within the warranty period, manufacturer shall repair and/or replace any defective parts, provided the equipment is returned to manufacturer.

PART 2. PRODUCTS

- 2.1 Approved Manufacturers:
 - A. Talk-A-Phone Model ETP 100MB (Basis of Design)
 - B. Hubbell GAI-Electronics Model 296-297
 - C. Code Blue Model FME
- 2.2 Chassis and face plate shall be constructed of stainless steel with a #4 brushed finish. Push button and switch shall be a single assembly rated for 1,000,000 cycles. Epoxy seals shall protect contacts and terminals from hostile environments and solder flux. Case shall be moisture-proof, dust-tight and designed to accommodate the high shock military specifications of MIL-STD-202, method 207. Case shall be aluminum alloy, anodized clear. Button shall be black anodized aluminum. Unit shall be designed for surface or flush mounting on a wall or in an elevator, as specified on the drawings.
- 2.3 Speaker and microphone shall be protected by non-ferrous metal screen to provide a barrier against vandalism. Signage shall be constructed of cast metal with lettering and Braille raised approximately 3/32" for ADA compliance. Word "EMERGENCY" shall be black
- 2.4 The unit shall be totally hands-free on both sides after connection is initiated at site or by attendant. The unit shall be programmable from a remote telephone via keypad entry. All programming shall be stored in non-volatile EEPROM memory.
- 2.5 Unit shall be programmable with two different telephone numbers of up to 18 digits each including pauses. If first number does not answer or is busy, unit shall automatically call the second number. If that number is busy or does not answer, unit shall call the first

number again. Unit shall continue alternating until call is answered or call timer limit is reached. When call is finished, unit shall automatically shut off.

- 2.6 The unit shall be capable of operating on standard phone lines or analog PBX extensions and shall be phone line powered, requiring no outside power source or battery back-up. DIP switch programming, push to talk devices, and devices requiring external power are not acceptable. The unit shall have a dedicated communication line.
- 2.7 Unit shall be capable of automatically notifying attendant of location via programmable ID.

PART 3. EXECUTION

- 3.1 Install per manufacturer's instructions.
- 3.2 Demonstrate complete system operation to owner and Architect/Engineer..
- 3.3 Provide two hours of training for owner's personnel.

End of Section 16730

**NEW PASSENGER TERMINAL
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 16801
ADMINISTRATIVE WORKSTATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative workstations.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's complete data sheet for each type of product indicated.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit manufacturer's data sheet and original software disks provided with computer.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer and Microsoft certified technician.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a NRTL, and marked for intended location and application.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate installation and setup of workstations with administrative staff and network installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Dell Computer
 2. Lenovo Computer
 3. Toshiba Computer

2.2 HARDWARE DESCRIPTION

- A. Desktop Workstation
1. The workstations shall be Windows 7-certified computers.
 2. At a minimum, each client workstation shall include the following:
 - a. Intel Core i5 2400 Processor (3.1 GHz)
 - b. 4GB DDR3 non-ECC 1333 MHz Dual Channel SDRAM
 - c. Integrated Intel HD Graphics Video
 - d. 250GB 7200 rpm 3.5" SATA hard drive (6Gb/s with 8MB Cache)
 - e. Ethernet network interface card (10/100/1000)
 - f. Keyboard, mouse
 - g. 20-inch LED flat panel monitor
 - h. 16X DL DVD + / - RW, optical drive
 - i. 4 USB 2.0 Ports, 2 USB 3.0 Ports
 - j. High efficiency power supply
 - k. Small or Ultra Small Form Factor Chassis
- B. Laptop Workstation
1. The workstations shall be Windows 7-certified computers.
 2. At a minimum, each client workstation shall include the following:
 - a. Intel Core i5 2410M Processor (2.3 GHz)
 - b. 6GB DDR3 non-ECC 1333 MHz Dual Channel SDRAM
 - c. Integrated Intel HD Graphics Video
 - d. 250GB 7200 rpm 3.5" SATA hard drive (6Gb/s with 8MB Cache)
 - e. Ethernet network interface card (10/100/1000)
 - f. 8X DL DVD + / - RW, optical drive
 - g. 3 USB 3.0 Ports, 1 eSATA/USB 2.0 Combo, 1 external VGA monitor, 1 IEEE 1394a, and 1 DisplayPort
 - h. Integrated sound with stereo speakers
 - i. Integrated 2MP webcam
 - j. 802.11 a/b/g/n wireless
 - k. 6-cell (55W-Hr) Li-ion battery
 - l. Energy Star rated
- C. Accessories
1. Desktop Workstation
 - a. Stereo speaker system
 2. Laptop Workstation

- a. Laptop carrying case
- b. USB travel mouse

2.3 SOFTWARE DESCRIPTION

- A. Operating System
 - 1. Microsoft Windows 7 Professional with XP mode
- B. Productivity Software
 - 1. Microsoft Office 2010 Professional
 - 2. Roxio Creator
 - 3. Cyberlink PowerDVD

2.4 WARRANTY

- A. Four year basic warranty service with four year next-business-day limited on-site service.

END OF SECTION 16801

