PROJECT MANUAL / TECHNICAL SPECIFICATIONS
VOLUME II OF II

MIAMI INTERNATIONAL AIRPORT
V043A-4 MIA CENTRAL TERMINAL
Ticket Counters, Conveyors and
K-1 Doors for TC 12 through TC17

FOR

MIAMI DADE AVIATION DEPARTMENT
4200 Northwest 36th Street
Miami, Florida 33166

BID SET
December 06, 2021

MDAD Project Number #V043A-4
Bermello Ajamil Project Number #19001

Bermello Ajamil & Partners, Inc.
Architecture Engineering Planning & Interiors
2601 South Bayshore Drive, Suite #1000
Miami, Florida 33133

PROJECT MANUAL TECHNICAL SPECIFICATIONS

MIAMI INTERNATIONAL AIRPORT – V043A-4 CENTRAL TERMINAL
TICKET COUNTER, CONVEYORS AND K-1 DOORS FOR TC 12 THROUGH TC 17

BID SET

DECEMBER 06, 2021

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THE LISTED SPECIFICATIONS WERE PREPARED UNDER THE DIRECT SUPERVISION OF THE PERSON SIGNING AND SEALING THE SIGNATORY SHEET OF THE TECHNICAL SPECIAL PROVISIONS FOR THE RESPECTIVE DISCIPLINES INDICATED.

NOTE TO BIDDERS: DIVISION 27 TECHNICAL SPECIFICATIONS WERE PREPARED BY ROSS & BARRAZINI; AND DIVISION 34 TECHNICAL SPECIFICATIONS PREPARED BY JSM AIRPORT CONSULTANTS UNDER A SEPARATE CONTRACT WITH MIAMI DADE AVIATION DEPARTMENT AND NOT BY BERMELLO AJAMIL & PARTNERS OR ITS SUBCONSULTANTS. DIVISION 27 AND DIVISION 34 WILL BE USED FOR BIDDING UNDER THIS SCOPE OF WORK FOR PROCUREMENT PURPOSES BY THE GENERAL CONTRACTOR.

VOLUME I (DIVISION 00 THROUGH DIVISION 10)

DIVISION 26 – ELECTRICAL

DIVISION 27 – COMMUNICATIONS

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

DIVISION 34 – TRANSPORTATION

END OF TABLE OF CONTENTS

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1: GENERAL

1.01 SUMMARY

A. Section Includes:

1. Sleeves.

2. Stack-sleeve fittings.

3. Sleeve-seal systems.

4. Sleeve-seal fittings.

5. Grout.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 QUALITY ASSURANCE

A. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

PART 2: PRODUCTS

2.01 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.02 STACK-SLEEVE FITTINGS

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

1. Smith, Jay R. Mfg. Co.

2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.03 SLEEVE-SEAL SYSTEMS

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

1. Pipeline Seal and Insulator, Inc. - Link Seal System

2. Advance Products & Systems, Inc.

3. CALPICO, Inc.

4. Metraflex Company.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: Carbon steel or Stainless steel.

3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, or Stainless steel of length required to secure pressure plates to sealing elements.

4. Install 1-hour Factory Mutual (FM) approved, silicone sealing elements, carbon steel zinc dichromated pressure plates, connecting bolts and nuts where required.

2.04 SLEEVE-SEAL FITTINGS

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

1. Pre-sealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.05 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Non-shrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3: EXECUTION

3.01 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or –PP sleeves.

2. 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 above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.02 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide ¼-inch annular clear space between sleeve and pipe or pipe insulation.

2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."

3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

5. Using grout, seal the space around the outside of stack-sleeve fittings.

3.03 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Install sleeve-seal systems in all penetrations into the Parking Level Flood-proof Area. All penetrations into this area are to be waterproof.

C. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.04 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.05 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade: Will be cast-iron wall sleeves as required.

2. Exterior Concrete Walls below Grade: Will be cast-iron wall sleeves with sleeve-seal system as required. Select sleeve size to allow for 1" annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade: Will be cast-iron wall sleeves with sleeve-seal system as required. Select sleeve size to allow for 1" annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade: Will be PVC pipe sleeves as required.

5. Parking Level Flood-Proof Area: Will be cast-iron wall sleeves with sleeve-seal system as required. Select sleeve size to allow for 1" annular clear space between piping and sleeve for installing sleeve-seal system.

3.06 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.07 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.

4. Submit executed Warranties.

END OF SECTION

SECTION 210518 - ESCUTCHEONS FOR FIRE SUPPRESSION PIPING

PART 1: GENERAL

1.01 SUMMARY

A. Work of this Section includes but is not limited to the following:

1. Escutcheons

2. Floor plates

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2: PRODUCTS

2.01 ESCUTCHEONS

A. One-Piece, Stamped-Steel Type: With prime finish and set screw. To be field painted to match surroundings.

B. Split-Plate, Stamped-Steel Type: With prime finish, concealed hinge, and set screw. To be field painted to match surroundings.

2.02 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge and set screw.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors. Not required where piping is concealed above ceilings, in chases or behind cabinetry.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

b. Insulated Piping: One-piece, stamped-steel type.

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, castbrass or split-casting brass type with prime finish for field painting.

d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped steel type with concealed hinge. .

e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with chrome-plated finish.

g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with concealed hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

3.02 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

3.03 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.04 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.
2. Corrective Work:
    a. Remove, Repair and Reinstall, or Restore in Place damaged items.
    b. Replace damaged materials or items with New if repair not acceptable to Architect.
3. Provide product data to complete Operation & Maintenance Manuals.
4. Submit executed Warranties.

END OF SECTION

SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1: GENERAL

1.01 SUMMARY

A. Work of this Section includes but is not limited to the following:

1. Metal pipe hangers and supports.

2. Trapeze pipe hangers.

3. Metal framing systems.

4. Thermal-hanger shield inserts.

5. Fastener systems.

6. Equipment supports.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

2. Division 05 Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.02 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for fire suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Shall be per Division 1, Section 01340 and submitted in PDF format.

1. Metal pipe hangers.

2. Trapeze pipe hangers.

3. Metal framing systems.

4. Thermal-hanger shield inserts.

5. Fastener systems.

6. Pipe stands.

7. Equipment supports.

C. Submit layouts of all piping, hangers, supports, equipment, etc. fully coordinated with the layout or the other trades, at a suitable scale but not smaller in size than ¼" = 1'-0" scale.

1.05 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

C. All products and installations shall comply with the following:

1. MSS-SP-58, latest edition.

2. MSS-SP-69, latest edition.

3. MSS-SP-127, latest edition.

PART 2: PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. B-Line Systems, Inc.

2. VMC

3. Mason

4. Grinnel

B. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

C. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

D. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.02 FASTENER SYSTEMS

E. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.03 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon steel shapes.

2.04 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3: EXECUTION

3.01 GENERAL PIPING INSTALLATION INSTRUCTIONS

A. Vertical Piping:

1. Secure vertical piping at sufficiently close intervals to keep the pipe in alignment and to support the weight of the pipe and its contents. Support stacks at their bases and at sufficient floor intervals to meet the requirements of local codes. Approved metal clamps or hangers shall be used for this purpose.

2. If vertical piping is to stand free of any support or if no structural element is available for support and stability during construction, secure the piping in its proper position by means of adequate stakes or braces fastened to the pipe.

B. Horizontal Piping, Suspended:

1. Support horizontal piping and fittings at sufficiently close intervals to maintain alignment and prevent sagging or grade reversal. Support each length of pipe by an approved hanger located not more than 18 inches from the joint. For 12” or larger pipe hangers shall be placed on both sides of the coupling when installing full 10 foot lengths.

2. Support terminal ends of all horizontal runs or branches and each change of direction or alignment with an approved hanger.

C. Installation Inside the Building:

1. Support horizontal pipe at each joint, i.e. 5’ pipe should be supported at five foot intervals, 10’ in length may be supported at ten foot intervals. Supports shall be adequate to maintain alignment and prevent sagging and shall be placed within eighteen inches of the joint.

2. For 12” and larger pipe hangers shall be placed on both sides of the coupling when installing full 10 foot lengths.

3. Adequate provision should be made to prevent shear and to resist thrust forces. Where components are suspended in excess of twelve (12) inches by means of non-rigid hangers they shall be suitably braced against movement horizontally.

4. Horizontal pipe and fittings five (5) inches and larger must be suitably braced to prevent horizontal movement. This must be done at every branch opening or change of direction by the use of braces, blocks, rodding or other suitable method, to prevent movement or joint separation.

D. Restraints

1. All installations must comply with local codes and instructions of architect/engineer.

2. Brace all pipe 2” and larger.

3. Exceptions:

   a. Braces may be omitted when the top of the pipe is suspended 12” or less from the supporting structure member and the pipe is suspended by an individual hanger.

4. Vertical Piping Attachment –

   a. Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents. Stacks shall be supported at their bases and if over two stories in height at each floor by approved floor clamps. At vertical pipe risers, whenever possible, support the weight of the riser at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 30’-0” on center.

5. Horizontal Piping Supports –

   a. Horizontal piping shall be supported at sufficiently close intervals to prevent sagging. Trapeze hangers may be used. Pipe, where top of the pipe is 12” or more from supporting structure shall be braced on each side of a change of direction of 90 degrees or more.

6. Traverse bracing

   a. 40’-0”o.c. maximum spacing unless otherwise noted. One pipe section may act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed with 24” of the elbow or tee of similar size.

7. Longitudinal bracing

a. 80’-0”o.c. maximum spacing unless otherwise noted.

8. Miscellaneous

a. Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements.

3.02 HANGER AND SUPPORT INSTALLATION

A. Spacing and arrangement shall conform to NFPA-13. Contractor shall install hangers and supports to adequately support the lines without interfering with their inherent flexibility and as required to prevent sagging or vibration, and to brace vertical risers.

B. Hangers shall be wrought iron clevis types. UL listed and FM approved.

C. Pipe rests shall be saddle type. UL listed and FM approved.

D. Riser clamps shall be used for vertical pipe supports. UL listed and FM approved.

E. Vertical pipe shall be supported at every floor and base of riser clamped securely to the building structure.

F. Contractor shall furnish and place all inserts, bolts and expansion shields before concrete is poured.

G. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.03 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.05 PAINTING

A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24 requiring up to 4 inches of insulation.

3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 requiring clamp flexibility and up to 4 inches of insulation.

4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.

6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.

11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.

12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steelpipe base stanchion support and cast-iron floor flange or carbon-steel plate.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS ¾ to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under ceiling installations with bar-joist construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.

    b. Medium (MSS Type 32): 1500 lb.

c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.

4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary

stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.

b. Vertical (MSS Type 55): Mounted vertically.

c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. All hangers and supports shall be selected to be compatible with vibration and seismic controls Section 210548.

3.07 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.08 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.

4. Submit executed Warranties.

END OF SECTION

SECTION 210553 - IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1: GENERAL

1.01 SUMMARY

A. Work of this Section includes but is not limited to the following:

1. Identify all installed fire suppression distribution piping, equipment and components.

2. Painted identification materials.

3. Plastic pipe markers

4. Plastic tape.

5. Plastic duct markers

6. Value tags

7. Valve schedule frames

8. Equipment markers

9. Tags

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

2. Division 01 "General Requirements."

1.02 SYSTEM DESCRIPTION

A. References

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

4. Refer to Division 21 Section " Fire Suppression" for codes and standards, and other general requirements.

5. ASME A 13.1 Scheme for the identification of piping systems

1.03 SUBMITTALS

A. Submit properly identified product and technical data including printed installation instructions before commencing work for each identification material and device required.

B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Submit valve chart and schedule, for each piping system including valve tag number, location, function, and valve manufacturer's name and model number typewritten and reproduced on 8-1/2" x 11" bond paper (6) six copies. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule for review by Owner and Engineer.

D. Product Data: Provide manufacturers catalog literature for each product required.

1.04 QUALITY ASSURANCE

A. Submit under provisions of Division 01 Section "General Requirements."

B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Submit valve database as per Part 3.05 -Stenciling and Identification, D.3 - Valve Tags.

1.05 SUBMITTALS AT PROJECT CLOSEOUT

A. Provide a valve chart and insert same in the operation and maintenance manual. Valve chart shall include valve location, valve service and valve number. Format shall be accepted by Engineer.

B. Charts and Diagrams shall be photographic or equal non-fading reproductions. For each page of valve schedule, provide glazed display frame with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grad sheet glass or 1/8" plexiglass.

C. Fire Suppression identification furnished as part of factory fabricated equipment, is specified as part of equipment assembly in other Division 21 sections

1.06 EXTRA MATERIALS

A. Furnish minimum of 5% extra stock of each identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional (5%) aluminum engraving blanks of all sizes used throughout project.

1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. W. H. Brady or Westline products.

B. Seaton

C. Allen Systems

D. Industrial Safety Supply Co.

2.02 MATERIALS

A. Color coding: ASME A13.1 unless specified otherwise.

B. Plastic nameplates: laminated two-layer plastic with engraved black letters on light, contrasting background color.

C. Plastic tags: laminated three-layer (double-sided) plastic with engraved black letters on light, contrasting background color. Tag size at least 1-1/2 inch (38 mm) diameter.

D. Stencils: with clean-cut symbols and letters of following size:

OUTSIDE DIAMETER OF INSULATION OR PIPE	COLOR FIELD LENGTH	LETTER HEIGHT
¾ TO 1-1/4 INCHES (9.5 TO 31.7 MM)	8 INCHES (200 MM)	½ INCH (13 MM)
1-1/2 TO 2 INCHES (38.1 TO 50.8 MM)	8 INCHES (200 MM)	¾ INCH (20 MM)
2-1/2 TO 2 INCHES (63.5 TO 50.8 MM)	12 INCHES (300 MM)	1 ¼ INCH (32 MM)
8 TO 10 INCHES (203.2 TO 254 MM)	24 INCHES (600 MM)	2 ½ INCH (64 MM)
OVER 10 INCHES (254 MM)	32 INCHES (800 MM)	3 INCHES (75 MM)
DUCTWORK AND EQUIPMENT	---	2 ½ INCH (64 MM)

A Stencil paint: semi-gloss enamel; in accordance with Division 09 Section "Painting". Identification Paint: Standard identification enamel of colors indicated below

PIPE IDENTIFICATION CHART

SYMBOL	DESCRIPTION	PIPE COLOR	MARKER BACKGROUND COLOR
F	Fire Protection	Red	Red
FS	Fire Sprinkler	Red	White

E. Plastic pipe markers: factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.

1. Special gases shall be identified using markers with yellow background and black letters, direction arrow, and full chemical names and symbols.

F. Plastic-tape pipe markers: flexible, vinyl-film tape with pressure-sensitive adhesive backing and printed markings.

G. VALVE TAGS

1. Brass Valve Tags: Provide 19-gage polished non-corrosive brass valve tags with stamp-engraved piping system abbreviation in ¼" high letters and sequenced valve numbers ½" high, and with 5/32" hole for fastener. Letters and numbers to be black filled

2. Provide 1-1/2" diameter tags, except as otherwise indicated.

3. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

4. Access Panel Markers: Provide manufacturer's standard engraved aluminum access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

H. EQUIPMENT MARKERS

1. General: Provide manufacturer's standard aluminum nameplate with black enamel background, with etched or engraved natural aluminum lettering 1" high.

2. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

   a. Name and number.

   b. Equipment service.

   c. Area of service.

3. Size: Provide approximate 2-1/2" x 4" markers for starters, control devices, dampers, and valves; and 4-1/2" x 6" for equipment.

PART 3: EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive of identification materials.

B. Prepare surfaces in accordance with requirements of Division 9 for painting, for stencil painting.

3.02 INSTALLATION

A. Plastic nameplates: install with corrosion-resistant mechanical fasteners, or adhesive.

B. Plastic tags: install with corrosion-resistant chain.

C. Stencil painting: apply in accordance with Division 09 Section "Painting".

D. Plastic pipe markers: install in accordance with manufacturer's instructions.

E. Plastic-tape pipe markers: install completely around pipe in accordance with manufacturer's instructions.

F. Underground plastic pipe markers: install 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.

3.03 IDENTIFICATION SCHEDULE

A. Equipment: identify air-handling units, pumps, heat-transfer equipment, tanks, and water-treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with plastic tags.

B. Controls: identify control panels and major control components outside of panels with plastic nameplates.

C. Valves: identify valves in main and branch piping with tags.

D. Piping: identify piping, concealed or exposed, with stenciled painting. Tags may be used on small diameter piping. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not more than 20 feet (6 m) apart on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

E. Ductwork: identify ductwork with stenciled painting. Identify as to air-handling unit number, and area served. Locate identification at air-handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

3.04 VALVE DATABASE

A. Provide specified valve database.

3.05 STENCILING AND IDENTIFICATION

A. Stencil each piece of new and existing equipment including pumps, fans, tanks, etc., with the equipment tags scheduled on the drawings. Use minimum 2 inches (50 mm) high characters.

1. Stencil each duct leaving the mechanical room indicating fan unit, area(s), direction of flow, or room(s) served.

2. Stencil each duct branch leaving an air shaft at each floor with fan number, and identify it as a supply, exhaust, or return duct, and indicate direction of air flow.

B. Post a framed and typewritten schedule of all stencils, pipe markers, valve tags, and lubricants used, with identification, shall be framed and posted in the mechanical equipment room.

C. Identify all pipes with specified markers.

1. Install markers every 10 feet (3 m) on mains, at all branch take-offs and adjacent to valves and cocks.

2. Apply to all exposed pipes, pipes behind removable tile ceiling, pipes in concealed but accessible locations, such as behind access panels and at least once in each room.

3. Install pipe marker using pressure sensitive adhesive in accordance with the manufacturer's directions. The marker shall completely cover the circumference of the pipe and overlap itself.

D. Valve Tags: Provide numbered tags for main valves, branch valves, zone valves, shut-off valves, and balancing valves installed under this Contract, constructed of #18 gauge (1.02 mm) brass, circular, 1 ¼ inches (31.7 mm) in diameter, and with numbers cut in and blackened so as to be plainly discernible. Fasten tags to valve with brass links.

1. Valve numbers not required for valves obviously serving equipment such as air handler coils, reheat coil valves, and miscellaneous drains.

2. On the as-built drawings, indicate the location and number of each tagged valve.

3. Provide a computer file database in a form agreeable to the owner, describing the valve, number, location , type of service normally “open” or “closed”, specific duty of each tagged valve, and manufacturer and model number.

E. Place warning signs on all machines driven by electric motors which are controlled by fully automatic starters.

F. Fire dampers and fire smoke dampers: at each fire damper or fire smoke damper access panel, label "FIRE DAMPER" or “FIRE SMOKE DAMPER” in minimum 2 inches (25 mm) high letters. Fire smoke dampers shall be provided with tags to identify each fire smoke dampers as “FSD-NUMBER SEQUENCES-BLDG NUMBER”. Provide chart to Owner for approval.

G. Wherever charts, Shop Drawings, etc. Refer to specific room numbers, use room numbers that will be provided by the owner rather than the room numbers indicated on the Drawings.

3.06 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project’s Waste Management Plan.

3.07 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, `Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.

4. Submit executed Warranties.

END OF SECTION

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.

2. Fire-protection valves.

3. Fire-department connections.

4. Sprinklers.

5. Alarm devices.

6. Manual control stations.

7. Control panels.

8. Pressure gages.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

2. Division 21 Section 211200 "Fire-Suppression Standpipes" for standpipe piping.

1.2 DEFINITIONS

A. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig but not higher than 250 psig.

B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.3 SYSTEM DESCRIPTION

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from

sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.4 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated on plans.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10percent, including losses through water-service piping, valves, and backflow preventers.

2. Sprinkler Occupancy Hazard Classifications:

a. Automobile Parking Areas: Ordinary Hazard, Group 1.

b. Building Service Areas: Ordinary Hazard, Group 1.

c. Electrical Equipment Rooms: Ordinary Hazard, Group 1. Obtain clearance from AHJ to provide 2 hour rated walls around electrical rooms to eliminate wet sprinkler system within those rooms as permitted by code.

d. General Storage Areas: Ordinary Hazard, Group 1.

e. Baggage Makeup, Trash and Provisioning: Ordinary Hazard, Group 2.

f. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.

g. Office and Public Areas: Light Hazard.

h. High roof area of shell: Ordinary Hazard, Group 2

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.

b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.

c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.

d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.

e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.

f. Special Occupancy Hazard: As determined by authorities having jurisdiction.

g. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over entire area.

h. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over entire area.

i. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over entire area.

j. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over entire area.

k. Special Occupancy Hazard: As determined by authorities having jurisdiction.

4. Maximum Protection Area per Sprinkler: Per UL listing.

5. Maximum Protection Area per Sprinkler:

a. Office Spaces: 225 sq. ft.

b. Storage Areas: 130 sq. ft.

c. Mechanical Equipment Rooms: 130 sq. ft.

d. Electrical Equipment Rooms: 130 sq. ft. Coordinate with AHJ and codes.

e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

a. Light-Hazard Occupancies: 100 gpm for 30 minutes.

b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Shall be per Division 1, Section 01340 and submitted in PDF format. For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Coordination Drawings: Submit layouts of all piping, hangers, supports, equipment, etc. fully coordinated with the layout or the other trades, at a suitable scale but not smaller in size than ¼" = 1'-0" scale. Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers including, but limited to the following items involved:

1. Domestic water piping.
2. HVAC hydronic piping.
3. Items penetrating finished ceiling include the following:
    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Smoke detectors
    d. Speakers.
4. HVAC ductwork.
5. Electrical
    a. Conduits.
    b. Cable trays.
    c. J-hooks.
    d. Junction boxes.
    e. Pull boxes.

E. Qualification Data: For qualified Installer and professional engineer.

F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

G. Welding certificates.

H. Fire-hydrant flow test report.

I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

J. Field quality-control reports.

K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. 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.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

E. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

1.7 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

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.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers

required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

B. Imported piping materials shall not be accepted on this project.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 40, Galvanized- and Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M. Type E Pipe ends may be factory or field formed to match joining method.

C. Thinwall Galvanized- and Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

D. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

E. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

F. Galvanized Steel Couplings: ASTM A 865, threaded.

G. Galvanized Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

H. Malleable- or Ductile-Iron Unions: UL 860.

I. Cast-Iron Flanges: ASME 16.1, Class 125.

J. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

K. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

L. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Victaulic Company of America

2. Pressure Rating: 175 psig minimum.

3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.

4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

M. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

1. Manufacturers: Subject to compliance with requirements, provide products by the following :

a. Victaulic Company of America.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.

2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.

2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

3. Minimum Pressure Rating for High-Pressure Piping: 250 psig.

B. Ball Valves:

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

a. NIBCO INC.

b. Victaulic Company of America.

2. Standard: UL 1091 except with ball instead of disc.

3. Valves NPS 1-1/2 and smaller: Bronze body with threaded ends.

4. Valves NPS 2 and NPS 2-1/2. Bronze body with threaded ends or ductile-iron body with grooved ends.

5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:

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

   a. McWane, Inc.; Kennedy Valve Division.

   b. Mueller Company.

   c. NIBCO INC.

   d. Victaulic Company of America.

2. Standard: UL 1091.

3. Pressure Rating: 175 psig.

4. Body Material: Bronze.

5. End Connections: Threaded.

D. Iron Butterfly Valves:

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

   a. Grinnell Fire Protection.

   b. Kennedy Valve; a division of McWane, Inc.

   c. NIBCO INC.

   d. Victaulic Company of America.

2. Standard: UL 1091.

3. Pressure Rating: 175 psig.

4. Body Material: Cast or ductile iron.

5. Style: Lug or wafer.

6. End Connections: Grooved.

E. Check Valves:

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

a. Grinnell Fire Protection.

b. NIBCO INC.

c. Potter-Roemer, Fire Protection Division.

d. Victaulic Company of America.

2. Standard: UL 312.

3. Pressure Rating: 250 psig minimum.

4. Type: Swing check.

5. Body Material: Cast iron.

6. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:

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

a. Crane Co.; Crane Valve Group; Crane Valves.

b. Crane Co.; Crane Valve Group; Stockham Division.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. United Brass Works, Inc.

2. Standard: UL 262.

3. Pressure Rating: 175 psig.

4. Body Material: Bronze.

5. End Connections: Threaded.

G. Iron OS&Y Gate Valves:

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

   a. Crane Co.; Crane Valve Group; Crane Valves.

   b. Hammond Valve.

   c. Mueller Co.; Water Products Division.

   d. NIBCO INC.

2. Standard: UL 262.

3. Pressure Rating: 250 psig minimum.

4. Body Material: Cast or ductile iron.

5. End Connections: Flanged or grooved.

H. Indicating-Type Butterfly Valves:

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

   a. Kennedy Valve; a division of McWane, Inc.

   b. Milwaukee Valve Company.

   c. NIBCO INC.

   d. Victaulic Company of America.

2. Standard: UL 1091.

3. Pressure Rating: 175 psig minimum.

4. Valves NPS 2 and smaller:

   a. Valve Type: Ball or butterfly.

   b. Body Material: Bronze.

   c. End Connections: Threaded.

5. Valves NPS 2-1/2 and larger:

   a. Valve Type: Butterfly.

b. Body Material: Cast or ductile iron.

c. End Connections: Flanged, grooved, or wafer.

6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

I. NRS Gate Valves:

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

a. Grinnell Fire Protection.

b. Kennedy Valve; a division of McWane, Inc.

c. NIBCO INC.

d. Stockham.

2. Standard: UL 262.

3. Pressure Rating: 250 psig minimum.

4. Body Material: Cast iron with indicator post flange.

5. Stem: Nonrising.

6. End Connections: Flanged or grooved.

J. Indicator Posts:

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

a. Milwaukee Valve Company.

b. NIBCO INC.

c. Victaulic Company of America.

2. Standard: UL 789.

3. Type: Horizontal for wall mounting.

4. Body Material: Cast iron with extension rod and locking device.

5. Operation: Hand wheel.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

2. Pressure Rating: 175 psig minimum.

B. Angle Valves:

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

a. Fire Protection Products, Inc.

b. United Brass Works, Inc.

C. Ball Valves:

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

a. NIBCO INC.

b. Victaulic Company of America.

c. Allied Rubber and Gasket Company (ARGCO).

D. Globe Valves:

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

a. Fire Protection Products, Inc.

b. United Brass Works, Inc.

E. Plug Valves:

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

a. Southern Manufacturing Group.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
    a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
    b. High-Pressure Piping Specialty Valves: 250 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Globe Fire Sprinkler Corporation.
    b. Grinnell Fire Protection.
    c. Reliable Automatic Sprinkler Co., Inc.
    d. Star Sprinkler, Inc.
    e. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Reliable Automatic Sprinkler Co., Inc.

b. Tyco Fire & Building Products LP.

2. Standard: UL 1726.

3. Pressure Rating: 175 psig minimum.

4. Type: Automatic draining, ball check.

5. Size: NPS 3/4.

6. End Connections: Threaded.

2.7 FIRE-DEPARTMENT CONNECTIONS

A. Exposed-Type, Fire-Department Connection:

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

a. Elkhart Brass Mfg. Company, Inc.

b. Fire-End & Croker Corporation.

c. Guardian Fire Equipment, Inc.

d. Potter-Roemer, Fire Protection Division.

e. Reliable Automatic Sprinkler Company, Inc.

2. Standard: UL 405.

3. Type: Exposed, projecting, for wall mounting.

4. Pressure Rating: 175 psig minimum.

5. Body Material: Corrosion-resistant metal.

6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

7. Caps: Brass, lugged type, with gasket and chain.

8. Escutcheon Plate: Round, brass, wall type.

9. Outlet: With pipe threads.

10. Body Style as per plans.

11. Number of Inlets as per plans.

12. Outlet Location as per plans.

13. Escutcheon Plate Marking: Similar to AUTO SPKR & STANDPIPE.

14. Finish: To be selected by the Architect.

15. Outlet Size: NPS 6.

B. Flush-Type, Fire-Department Connection (to be used at all exterior locations on wall):

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

   a. Elkhart Brass Mfg. Company, Inc.

   b. Guardian Fire Equipment, Inc.

   c. Potter-Roemer, Fire Protection Division.

2. Standard: UL 405.

3. Type: Flush, for wall mounting.

4. Pressure Rating: 175 psig minimum.

5. Body Material: Corrosion-resistant metal.

6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

7. Caps: Brass, lugged type, with gasket and chain.

8. Escutcheon Plate: Rectangular, brass, wall type.

9. Outlet: With pipe threads.

10. Body Style as per plans.

11. Number of Inlets as per plans.

12. Outlet Location as per plans.

13. Escutcheon Plate Marking: Similar to AUTO SPKR & STANDPIPE.

14. Finish: To be selected by the Architect.

15. Outlet Size: NPS 6.

C. Yard-Type, Fire-Department Connection (Free standing – shown on civil drawings):

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

   a. Elkhart Brass Mfg. Company, Inc.

   b. Fire-End & Croker Corporation.

   c. Grinnell Fire Protection.

   d. Mueller Company.

   e. Potter-Roemer, Fire Protection Division.

2. Standard: UL 405.

3. Type: Exposed, freestanding.

4. Pressure Rating: 175 psig minimum.

5. Body Material: Corrosion-resistant metal.

6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

7. Caps: Brass, lugged type, with gasket and chain.

8. Escutcheon Plate: Round, brass, floor type.

9. Outlet: Bottom, with pipe threads.

10. Number of Inlets as per plans.

11. Sleeve: Brass.

12. Sleeve Height: 18 inches.

13. Escutcheon Plate Marking: Similar to AUTO SPKR & STANDPIPE.

14. Finish, Including Sleeve: To be selected by the Architect.

15. Outlet Size: NPS 6.

2.8 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

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

   a. Anvil International, Inc.

   b. National Fittings, Inc.

   c. Shurjoint Piping Products.

   d. Tyco Fire & Building Products LP.

   e. Victaulic Company of America.

2. Standard: UL 213.

3. Pressure Rating: 175 psig minimum.

4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.

5. Type: Mechanical-T and -cross fittings.

6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.

7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.

8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

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

   a. Reliable Automatic Sprinkler Co., Inc.

   b. Tyco Fire & Building Products LP.

   c. Victaulic Company of America.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

3. Pressure Rating: 175 psig minimum.

4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

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

a. Elkhart Brass Mfg. Company, Inc.

b. Fire-End & Croker Corporation.

c. Potter-Roemer, Fire Protection Division.

2. Standard: UL 199.

3. Pressure Rating: 175 psig.

4. Body Material: Brass.

5. Size: Same as connected piping.

6. Inlet: Threaded.

7. Drain Outlet: Threaded and capped.

8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

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

a. AGF Manufacturing Inc.

b. Triple R Specialty.

c. G/J Innovations, Inc.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

3. Pressure Rating: 175 psig minimum.

4. Body Material: Cast- or ductile-iron housing with sight glass.

5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

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

a. CECA, LLC.

b. Corcoran Piping System Co.

2. Standard: UL 1474.

3. Pressure Rating: 250 psig minimum.

4. Body Material: Steel pipe with EPDM-rubber O-ring seals.

5. Size: Same as connected piping.

6. Length: Adjustable.

7. Inlet and Outlet: Threaded.

2.9 SPRINKLERS

A. Applications

1. Interior Ceiling Mounted

2. Interior Wall Mounted

3. Exterior Ceiling Mounted

4. Exterior Wall Mounted

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

1. Tyco Fire & Building Products LP.

2. Victaulic Company.

3. Viking Corporation.

C. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

2. Pressure Rating for Residential Sprinklers: 175 psig maximum.

3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.

D. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767

2. Nonresidential Applications: UL 199

3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

E. Thermal Sensitivity of Sprinkler Heads.

1. Sprinkler heads shall be quick-response type as defined by NFPA 13 except as permitted in 2.

2. Where quick-response sprinkler heads are installed, all sprinkler heads within a compartment shall be quick response unless otherwise permitted in 3.

3. Where there are no listed quick-response sprinkler heads in the temperature range required, standard response sprinklers shall be permitted to be used.

4. A compartment shall be as defined by NFPA 13.

5. Do not mix sprinkler heads of different thermal sensitivities in the same compartmented space.

F. Sprinkler Finishes:

1. To be selected by the Architect.

G. Special Coatings:

1. Wax.

2. Lead.

3. Epoxy

4. Corrosion-resistant paint.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat.

2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

3. Attachment: All sprinkler escutcheons shall be thread-on and shall not be push-on.

4. All sprinkler escutcheons for exterior sprinklers or garage sprinklers to be stainless steel and have corrosion proof Teflon coating.

I. Sprinkler Guards:

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

a. Reliable Automatic Sprinkler Co., Inc.

b. Tyco Fire & Building Products LP.

c. Victaulic Company of America.

d. Viking Corporation.

2. Standard: UL 199.

3. Type: Wire cage with fastening device for attaching to sprinkler.

4. Attachments: All upright heads within mechanical rooms shall have guards installed.

J. Sprinkler Expansion Plates: Materials, types and finishes shall match the materials and finishes of the sprinkler escutcheons. Required when the authority having jurisdiction requires the ceiling tiles holes to be cut with clearance all around the sprinklers to avoid sprinkler impact with the ceiling tiles during a seismic event.

2.10 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

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

a. Globe Fire Sprinkler Corporation.

b. Grinnell Fire Protection.

c. Reliable Automatic Sprinkler Company, Inc.

d. Star Sprinkler, Inc.

e. Viking Corporation.

2. Standard: UL 753.

3. Type: Mechanically operated, with Pelton wheel.

4. Alarm Gong: Cast aluminum with red-enamel factory finish.

5. Size: 10-inch diameter.

6. Components: Shaft length, bearings, and sleeve to suit wall construction.

7. Inlet: NPS 3/4.

8. Outlet: NPS 1 drain connection.

C. Electrically Operated Alarm Bell:

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

a. Potter Electric Signal Company.

b. System Sensor, a Honeywell Company.

2. Standard: UL 464.

3. Type: Vibrating, metal alarm bell.

4. Size: 6-inch minimum diameter.

5. Finish: Red-enamel factory finish, suitable for outdoor use.

D. Water-Flow Indicators:

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

a. Grinnell Fire Protection.

b. McDonnell & Miller; ITT Industries.

c. Potter Electric Signal Company.

d. System Sensor; a Honeywell company.

2. Standard: UL 346.

3. Water-Flow Detector: Electrically supervised.

4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

5. Type: Paddle operated.

6. Pressure Rating: 250 psig.

7. Design Installation: Horizontal or vertical.

E. Pressure Switches:

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

a. Grinnell Fire Protection.

b. Potter Electric Signal Company.

c. System Sensor; a Honeywell company.

d. Viking Corporation.

2. Standard: UL 346.

3. Type: Electrically supervised water-flow switch with retard feature.

4. Components: Single-pole, double-throw switch with normally closed contacts.

5. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches:

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

a. Kennedy Valve; a division of McWane, Inc.

b. Potter Electric Signal Company.

c. System Sensor; a Honeywell company.

2. Standard: UL 346.

3. Type: Electrically supervised.

4. Components: Single-pole, double-throw switch with normally closed contacts.

5. Design: Signals that controlled valve is in other than fully open position.

G. Indicator-Post Supervisory Switches:

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

a. Potter Electric Signal Company.

b. System Sensor; a Honeywell company.

2. Standard: UL 346.

3. Type: Electrically supervised.

4. Components: Single-pole, double-throw switch with normally closed contacts.

5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.11 PRESSURE GAGES

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

1. AMETEK; U.S. Gauge Division.

2. Dresser Equipment Group; Instrument Division.

3. Marsh Bellofram.

4. Weiss Instruments, Inc.

5. Weksler Instrument Operating Unit; Dresser Industries; Instrument Division.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" label on dial face.

F. Pressure gages shall be liquid-filled.

PART 3 EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Provide galvanized schedule 40 piping for all underground applications.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

M. Fill sprinkler system piping with water.

N. Provide corrosion resistant coating on all piping and sprinklers located in the LSS rooms, above tanks, in all areas exposed to the exterior (non-air conditioned spaces) and any other area subject to corrosion.

O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section "Escutcheons for Fire-Suppression Piping."

R. Install drains on all systems where water flows can be tested without taking a hose around to drain for a waterflow test. All drains need to have a drain valve that can be a main drain or can be inspectors test drain.

S. Provide continuous, fully sealed sheet metal drip pans below any wet utilities suspended above electrical, IT, AV, or server rooms. This includes wet utilities above ceilings, as well as those in exposed ceilings

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for above ground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. 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.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

N. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

O. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3. Deluge Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Contractor to provide sprinkler guards in spaces without ceilings where upright heads may be hit or damaged by equipment. This includes, but is not limited to:

1. Loading dock areas and parking

2. Mechanical rooms

3. Electrical rooms

4. Custodial spaces

5. IT rooms

6. A/V control rooms

7. Back-Of-House areas

3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Division 03 Section.

1. Install two protective pipe bollards [on sides of] each fire-department connection. Comply with requirements for bollards in Division 05 Section "Metal Fabrications."

C. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.8 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

4. Energize circuits to electrical equipment and devices.

5. Coordinate with fire-alarm tests. Operate as required.

6. Coordinate with fire-pump tests. Operate as required.

7. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.12 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded joints.

B. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig Maximum Working Pressure, Interior Spaces:

1. NPS 2 and Smaller: Threaded-end, black, standard-weight schedule 40 steel pipe; castor malleable-iron threaded fittings; and threaded joints.

2. NPS 2-1/2 and Larger: Grooved-end, Schedule 10 steel pipe; grooved-end fittings; grooved end-pipe couplings; and grooved joints.

C. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig Maximum Working Pressure, exterior and spaces exposed to the outside and harsh or corrosive environments:

1. NPS 2 and Smaller: Threaded-end, galvanized, standard-weight schedule 40 steel pipe; castor malleable-iron threaded fittings; and threaded joints.

2. NPS 2-1/2 and Larger: Grooved-end, galvanized, Schedule 10 steel pipe; grooved-end fittings; grooved end-pipe couplings; and grooved joints.

3.13 SPRINKLER SCHEDULE

A. Use quick response sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.

2. Rooms with Suspended Ceilings: Pendent, semi-recessed, and concealed sprinklers as indicated.

3. Wall Mounting: Sidewall sprinklers, stainless steel, epoxy coating where noted herein.

4. Special Applications: Extended-coverage where indicated or as needed. Provide epoxy coating where noted herein.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted cover plate, finish to be selected by Architect.

2. Semi-Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

3. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; epoxy coated where exposed to acids, chemicals, or other corrosive fumes.

C. Sprinklers in exterior areas, areas exposed to weather, and corrosive/harsh environments:

1. Stainless steel with corrosion protection epoxy coating.

2. Extended coverage heads shall have epoxy coating for corrosion resistance.

3.14 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.15 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.

4. Submit executed Warranties.

END OF SECTION

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. The requirements of this section apply to all the Work of Division 23.

B. Section Includes:

1. Applicable codes.

2. General project requirements.

3. Concrete pads.

4. Grout.

5. Access panels.

6. General installation requirements.

7. General testing requirements.

8. Sleeve Seal Systems.

C. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

2. Related Work in other Divisions:

a. Sections 033000 Cast in Place Concrete.

b. Division 09 Painting.

c. Section 220517 Sleeves and Sleeve Seals for Plumbing Piping.

d. Division 26 Electrical.

3. The Heating, Ventilating and Air Conditioning Trade is required to supply all necessary supervision and coordination information to any other trades who are to supply work to accommodate the Heating, Ventilating and Air Conditioning installations.

4. Where the Heating, Ventilating, and Air Conditioning trade is required to install items which it does not purchase, it shall include for such items:

a. The coordination of their delivery.

b. Their unloading from delivery trucks driven in to any designated point on the property line at grade level.

c. Their safe handling and field storage up to the time of permanent placement in the project.

d. The correction of any damage, defacement or corrosion to which they may have been subjected.

e. Their field assembly and internal connection as may be necessary for their proper operation.

f. 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.

g. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.

5. Items that are to be installed but not purchased as part of the work of the Heating, Ventilating, and Air Conditioning trade 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 Heating, Ventilating and Air Conditioning trade 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 Heating, Ventilating and Air Conditioning trade 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.

6. Other Related Sections:

a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. Where conflicts occur between divisions, the more stringent requirement shall apply.

1.2 REFERENCES

A. References to standard codes, specification of regulatory agencies shall mean editions in effect at date of proposal. Reference to technical societies, trade organizations, and governmental agencies is made in this Division in accordance with the following abbreviations:

1. AABC Associated Air Balance Council

2. ADCD Air Diffusion Council - Test Code

3. AGA American Gas Standard

4. AMCA Air Moving and Conditioning Association

5. ANSI American National Standards Institute

6. AHRI Air Conditioning, Heating and Refrigeration Institute

7. ASA American Standards Association
8. ASC Adhesive and Sealant Council
9. ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
10. ASME American Society of Mechanical Engineers
11. ASSE American Society of Sanitary Engineering
12. ASTM American Society for Testing and Materials
13. AWS American Welding Society
14. AWWA American Water Works Association
15. CISPI Cast Iron Soil Pipe Institute
16. CS Commercial Standards - US Dept.
17. EPA Environmental Protection Agency
18. FBC Florida Building Code
19. FMS Factory Mutual System General Industry Safety Orders, Article 3281
20. HEW US Dept. of Health, Education and Welfare
21. HI Hydraulic Institute
22. IAPMO International Association of Plumbing and Mechanical Officials
23. IFC International Fire Code
24. IMSS Manufacturers' Standardization Society
25. IPC International Plumbing Code
26. IRI Industrial Risk Insurers
27. NBS National Bureau of Standards
28. NCWB National Certified Piping Welding Bureau
29. NEBB National Environmental Balance Bureau
30. NEC National Electrical Code
31. NEMA National Electrical Manufacturers' Association
32. NFPA National Fire Protection Association
33. OSHA Occupational Safety and Health Administration

34. PDI Plumbing and Drainage Institute

35. SMACNA Sheet Metal and Air Conditioning Contractors National Association

36. UL Underwriters Laboratories, Inc.

37. UPC Uniform Plumbing Code

38. USGBC United States Green Building Council

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below ceiling spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces, finished occupied spaces without ceilings, and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

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. “Regulating Authorities” means all governmental, utility and fire protection authorities having jurisdiction.

G. “Provide” means to supply, erect, install and connect up completely, in readiness for regular operation, the particular work referred to.

H. “Furnish” means purchase, store and deliver the specified material, equipment or other item to the person or party indicated.

I. “Approved Equal” means any equipment or material which in the opinion of the architect, is equal in quality, durability, appearance, strength, design and performance to the equipment or material specified and will function adequately in accordance with the general design.

J. “Singular Number”: Where any device is herein referred to in the singular number, such reference shall be deemed to apply as many such devices as are required to complete the installation or as many as are shown.

K. “Piping” as used in the drawings and specifications means all pipe, fittings, nipples, flanges, valves, unions, hangers, supports, and anchors that are required for a complete functional system.

L. “Ductwork” as used in the drawings and specifications means all ductwork, fittings, dampers, air terminal devices, diffusers, registers, grilles, hangers, supports, and anchors that are required for a complete functional system.

M. "Wiring" includes, in addition to conductors, all raceways, conduit, fittings, boxes, switches, hangers and other accessories related to such wiring.

N. "Contract Documents" or "Documents" shall mean the latest version of all drawings and specifications prepared by the Engineer and Architect.

O. "Authority Having Jurisdiction" or "AHJ" shall mean the building department, fire department, inspectorate or other authority having legal jurisdiction relevant to the specific work being described in the City or State where the project is located.

P. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.

2. NBR: Acrylonitrile-butadiene rubber.

1.4 REGULATIONS, CODES, PERMITS AND FEES

A. Before bidding, be familiar with rulings of inspection departments and comply with such requirement. Codes, standards and specifications applicable to this work shall be the latest editions in effect at the date of the proposal.

B. It is not the intent of Drawings and Specifications to repeat requirements of codes except where necessary for completeness or clarity. The contractor's work and materials shall comply with all requirements of codes whether or not shown or detailed.

C. All work and material shall be in full accordance with the latest rules and regulations of the following agencies:

1. Florida Building Code

2. National Electric Code

3. National Fire Protection Association Standards

4. Listing and approval of Underwriters' Laboratories, Inc. where available and applicable.

5. Listing and approval of American Gas Association where available and applicable.

D. Rulings and interpretations of authorities shall be considered a part of the regulations.

E. Where the standards of the drawings and specifications for materials and/or workmanship are higher than the requirements of the documents cited above, the drawings and specifications shall take precedence; otherwise the documents shall govern.

F. Nothing in these plans or specifications is to be construed to permit work not conforming to these codes and regulations.

G. Should there be any direct conflict between the above rules and the specifications, the rules shall govern.

H. Charges for all materials and labor required for compliance with these rules and regulations shall be included in the Bid Price.

I. Give necessary notices, obtain permits and pay taxes, fees and other costs in connection with work; file necessary plans, prepare documents and obtain necessary approvals of regulating authorities having jurisdiction; obtain all required Certificates of Inspection for Work and deliver to Architect before request for acceptance and final payment for Work.

J. Include in Work, without extra cost to Owner, labor, materials, services, apparatus, drawings (in addition to Contract Drawings and Documents) required to comply with applicable laws, ordinances, rules and regulations.

K. Conform to all rules, regulations, laws, and ordinances governing the area in which this construction occurs.

L. Obtain the required permits from the local authorities for this work and pay for all fees required by the State and Federal authorities for permits, inspections and review, including special agency construction and operating permits. Make corrections in the work as required by the Owner's Representative or Inspector to pass local regulations.

M. Provide local authorities with all notices relating to this Division.

N. Provide Owner, Owner's Representative and local Inspectors access to work at all times.

O. Contractor shall be responsible for all law violations caused by the work under this Division. Notify the Owner's Representative in writing when a discrepancy occurs between code requirements and work shown on drawings and resolve matter before proceeding with work.

P. Make application and pay for all certificates of inspection, taxes and permits required by Local, State or Federal Governments, public utilities, or other authorities having lawful jurisdiction. Deliver to the Owner's Representative any and all certificates of inspections, permits, and approvals that may be required by such authorities.

Q. Permits and Fees

1. Make application and pay for all certificates of inspection, taxes and permits required by AHJs. Deliver to the Owner any and all certificates of inspections, permits, and approvals which may be required by AHJs.

2. Pay all utility charges and charges for providing temporary and permanent water, sewer, and gas services to buildings.

1.5 GENERAL REQUIREMENTS

A. Provide a complete mechanical system in full working order without objectionable noise or vibration. The documents do not undertake to show or list every item to be provided. The Contractor shall examine the Documents at the time of the bid and notify the Architect/Engineer in writing of any and all discrepancies. When an item not shown or listed is necessary for the proper operation of equipment which is shown or listed, provide an item which will allow the system to function properly at no increase in Contract Sum. Should there be any direct conflict in the specifications and drawings, an RFI shall be submitted with the Contractor’s suggestion for resolution.

1. Provide and install complete direct digital control system, including devices, controllers, and

sensors.

2. Provide testing, adjusting and balancing for all systems. Refer to Section 230593.

3. Provide commissioning services to carry out the collection of data for Pre-Functional and Functional tests per the commissioning requirements specified in Section 230593.

4. Provide, design, dimension, coordinate, and install the following items specified as design build under specified performance criteria:

   a. Support and anchorage of all equipment, valving, piping, duct work, duct silencers and controls equipment and conduit. Refer to Section 230529.

   b. Thermal and seismic expansion. Refer to Section 230516.

   c. Vibration isolation and anchorage. Refer to Section 230548.

   d. Controls programming, architecture, and conduit sizing and routing.

5. Provide all control devices for mechanical equipment and systems in conjunction with control system requirements, including coordination with Division 26 for electrical connection for complete, tested and operational systems.

B. Construction Documents Drawings and Data

1. The drawings show the general arrangement of all piping, ductwork, conduit and equipment. Examine drawings and specifications carefully, and notify the Owner's Representative by letter or Request for Information (RFI) of any discrepancies so these can be rectified at an early date.

2. Should conditions necessitate any rearrangements, the Contractor shall prepare and submit drawings showing the changes before proceeding with the work. If such changes are approved, they shall become a part of this contract after their approval.

3. Due to the small scale of the drawings, it is not possible to show all offsets and every detail of construction. Additional fittings, valves, traps, transitions, ducts, etc., shall be furnished and installed at no extra cost to the Owner. It is not the intent of Drawings and Specifications to repeat requirements of codes except where necessary for completeness or clarity.

4. The drawings are diagrammatic and are a graphic representation of the Contract Requirements, and are intended to convey scope of work. Dimensions of work as indicated on plans are not guaranteed to be as-built dimensions. No measurements shall be scaled from the Drawings for use as a definite dimension for layout or fitting work in place. Locations of all items not definitely fixed by dimensions are approximate only. The Contractor is solely responsible for dimensional control and coordination of the work to be installed.

5. The layout of equipment, as shown on the plans, shall be checked and exact location determined by dimensions of equipment accepted for installation. Consult the Architectural and Structural Drawings for all dimensions, locations of partitions, sizes of structural members, foundations, etc. Exact locations necessary to secure best conditions shall be determined in field coordination and shall be approved by the Owner’s Representative prior to installation. In addition, the Owner’s Representative reserves right at no increase in

contract sum to make any reasonable change in location of mechanical items exposed at ceilings or on walls to group them in an orderly relationship or increase utility and access.

6. The Contractor shall be responsible for the coordination of the mechanical ducting and piping distribution with the fire sprinklers, lighting, conduit, cable tray, structural members, ceiling support and all other trades present within the project.

7. At the Owner's direction, electronic files of the documents may be available to the Contractors subject to the following caveats:

    a. Provision of electronic files does not release the contractor from the requirements of the Contract Documents regarding coordination, submittals or any other issues outlined in the Contract Documents.

    b. The official Contract Documents are the hard copy versions, not the electronic files.

    c. The Contractor is responsible for all information extracted or inferred from the electronic files.

    d. Submission of the electronic file unchanged as a shop drawing will be rejected without review.

    e. These documents are provided only as a convenience to the Contractor. The Architect/Engineer is under no obligation to provide updated drawings during the Construction Phase or to track changes arising from RFIs, change orders, substitution requests, or submittal-generated alterations.

Information Location Precedence Chart.

(1st means primary precedence. A blank means that no geometrical information from that source may be used.)

Item	2D plan or section drawings	Detail Drawings/single line diagrams	Specifications
Elevation	2nd	1st	
Horizontal Location	2nd	1st	
Duct Size	2nd	1st	
Pipe Size	3rd	2nd	1st for size limitations only
Equipment Physical Size	2nd	1st	
Descriptive annotations	1st	2nd	

Repeated details such as equipment connection details		2nd	1st
Insulation thickness			1st
Pipe, duct, and equipment support/vibration isolation devices and locations		2nd	1st. Performance Specification
Piping expansion compensation devices and locations		2nd	1st. Performance Specification
Control panel locations			1st. Performance Specification
Pad locations	1st		
Visible control sensor locations	1st, in conjunction with architect		
Diffuser locations	1st, in conjunction with architect		

8. Any conflicts between 2D files, sections, detail drawings, single line drawings, and specifications are to be resolved by a Request for Information (RFI).

C. Minor Deviation from Construction Documents

1. The equipment listed by model number and manufacturer in the plans and specifications has been selected for its capacity, certain standard construction features and specified optional features.

2. The dimensions and ratings of equipment herein specified or indicated on the Drawings are intended to establish the desired performance characteristics of such equipment. Minor deviations may be permitted after review by the Owner's Representative to allow manufacturers specified to bid on their nearest standard equipment that provides at least the performance required.

3. Manufacturers' catalog or model numbers and types mentioned in the Specifications or indicated on the drawings are intended to be used as guides and shall not be interpreted as taking precedence over specific ratings or duty called for or shown, which modify stipulations in such catalogs. In all cases, the manufacturer shall verify the duty specified with the particular characteristics of the equipment he intends to submit, and shall submit only items which comply with Specification requirements.

4. Where the equipment furnished differs in physical character from that specified or indicated, or where Contractor's substituted equipment requires increased service and facilities to be provided by other trades, and such substitution is acceptable to the Owner's Representative, the Contractor shall bear all costs of providing services, facilities and modifications to the system or building.

5. Where the equipment furnished requires redesign of systems, connections, or configuration, and such substitution is acceptable to the Owner's Representative, the contractor shall bear all costs associated with design engineering and shall pay the time and materials cost of the Owner's Representative's review of this documentation. In addition, it is the contractor's responsibility to obtain approval from the authority.

6. For routing of air, water, or steam distribution and conduits, the contractor is empowered to suggest an optimized routing or resizing, given that the routing has been entirely field coordinated, it adds no pressure drop, it does not disturb the functional intent, there is no charge to the client, and all changes are explicitly annotated through symbols in the shop drawings as having deviated from the construction documents proposed routing solution.

7. The shifting of any item horizontally by less than 10', the change of any elevation by less than 3', the resizing of ductwork for equivalent frictional loss, and the necessary fittings in order to accomplish this shall all be construed as accommodation for field coordination and cannot be back-charged as change orders to the client.

1.6 SUBMITTALS PROCEDURES

A. Section 01340 Submittal Procedures apply to this section. Where conflicts occur between divisions, the more stringent requirement shall apply.

B. Preliminary Submittals

1. Preliminary List of Materials, Equipment and Subcontractors

a. Submit a Preliminary List of Materials, Equipment and Subcontractors to the Owner's Representative for approval of manufacturers of all materials and equipment proposed to be provided for this project, and contact information for all proposed Subcontractors. List shall be configured as follows:

Specification/ Section Number	Clause Number	Equipment Type	Proposed Manufacturer/ Contractor Name	Proposed Manufacturer Model Series/ Contractor contact information	Is this Manufacturer/ Contractor named in the drawings?	Is this Manufacturer/ Contractor named in the Specifications?	(For Owner's Representative)	
							Is this a substitution?	Rejected?

b. List will be returned to the contractor with marks in the far right column with regards to whether the particular manufacturer is rejected due to poor past performance or known incompatibilities with the requirements. Lack of comment in these columns does not imply that the final manufacturer/model proposed will be acceptable. In all cases, the contractor bears the responsibilities to prove that the proposed product meets the specification and the performance required in the documents.

c. The review of the Preliminary List of Material, Equipment and subcontractors shall only be construed to be a general review that the manufacturer or subcontractor is a recognized and reputable supplier of that general type of product or service and therefore eligible to submit in detail for review. The review designation of "no exception taken" to the Preliminary List does not exempt the Contractor from proving that the particular and specific equipment or Subcontractor meets the project's requirements during the Submittal phase.

d. Submit the List of Materials, Equipment and Subcontractors for review in accordance with Section 01340. Submit at least two months prior to the first submittal.

2. Submittal Schedule

a. Provide a submittal schedule at least two months prior to the first detailed submittal.

b. The submittal schedule shall be a complete list of all submittals to be made with submittal number, projected date of submittal, description of submittal by Specification or drawing number and whether a substitution is proposed.

c. The submittal schedule shall include worst-case submittal status, resolution date and the critical path's target installation date, assuming at least one "Revise and Resubmit" cycle, and shall include the turnaround time period per Division 1. Complicated submittals, such as controls and motorized machinery, shall incorporate time for at least 2 "Revise and Resubmit" cycles. Delay to schedule associated with submittals' "Revise and Resubmit" designation are ineligible for change orders or extensions of time, as timely and correct work is a requirement of this contract.

d. Concurrent submissions of multiple submittals shall incur a minimum of two times the turnaround time listed in Division 1, or longer, as agreed between reviewing party and the Owner's Representative, based upon the amount and detail level of the documents requiring review. The following items shall be submitted for concurrent reviews:

1). All controls submissions shall arrive concurrently to allow cross-referencing.

2). All HVAC equipment and duct shall arrive concurrently.

e. The contractor shall be responsible for equipment ordered and/or installed prior to receipt of submittals returned bearing the Architect/Engineers stamp of "No Exception Taken". Corrections or modifications to equipment as noted on returned submittals shall be at the Contractor's sole expense without additional compensation.

3. Shop Drawing Schedule

a. Provide a shop drawing submittal schedule that includes fixed dates of inter-trade

coordination sign-off prior to submission, including TAB and controls Contractors.

b. The schedule shall be a complete list by drawing number of all shop drawings to be made, along with projected date of submission, worst-case shop drawing status resolution date, and critical path's target installation date.

c. The submittal schedule shall assume at least one "Revise and Resubmit" cycle, and shall include the turnaround time period per Division 1. Delay to schedule associated with submittals' "Revise and Resubmit" designation are ineligible for change orders or extensions of time, as timely and correct work is a requirement of this contract.

C. General Organization of Submittals

1. Submit as a minimum all the required data listed in the documents as specifying performance, material, and dimensions. Refer to individual specification sections, schedules, and drawings for requirements.

2. Organize submittals in the same sequence as they appear in specification sections, articles or paragraphs. Label each page with the appropriate specification clause number or drawing detail number.

3. Each submission shall be made under the Specification Section Number it has been specified under. Submittals including equipment specified under a different specification section will be rejected and returned without review. Each section is required to be tracked separately for status designation, even if multiple sections are physically collated into a single binder.

4. Identify each item within each submittal by reference to Specification Section paragraph in which the item is specified, or Drawing and Detail number. Annotate the submittal sheets with the equipment identification numbers appearing on the equipment schedule.

5. Include all information requested by the Specification Section in a single submittal. With the exception of shop drawings, incomplete submittals or phased submittals under the same specification section are not acceptable and will be returned without review, with the Contractor responsible for any resultant consequence.

6. Submit pertinent catalog and performance data sheets only. Annotate pages to clearly identify which specific product is submitted and for what tag number or application. Contractors shall not submit entire catalogs, extraneous information or optional choices. Contractor shall cross out any irrelevant information that may exist on the page, including un-adopted options or alternative model types.

7. Submission shall be made in the form of a tab-indexed 3-ring brochure or binder of 8½" x 11" pages or 11" x 17" pre-folded to fit. Index sheets shall be required for all material and equipment, including pipe, valves, insulation, conduit and wire as listed. Index sheets shall be set up, in the same sequence as the specifications, with columns to identify the following:

   a. Specification clause number or drawing/detail number

   b. Item type

   c. Tag number as appropriate and/or application

d. Requirement from drawing schedule and specification (multiple rows may be used)

e. Equipment or manufacturer substitution request: yes or no

f. Feature data provided to show compliance: yes or no

g. Compliance: yes or no

h. Notes from Contractor

8. Provide the number of submittal and shop drawing copies as defined under Section 01340.

9. Illegible submittals will be rejected and returned without review.

D. Protect existing active services (water, gas, sewer, electric) when encountered, against damage from construction work. Do not prevent or disturb operation of active services which are to remain.

E. Equipment Submittals:

1. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment. At a minimum, this should include all information scheduled. Words "as specified" are not sufficient identification.

2. Mark the exact equipment item and data on each sheet. Where multiple product model types are listed on a single sheet, the contractor shall clearly indicate which specific item is submitted. If different model numbers of a single product line are submitted for different uses, this should be clearly annotated, identifying each individual use cross-referenced by the requirement it intends to fulfill. Submittals without annotation will be rejected and returned without review.

3. Submittal literature, drawings and wiring diagrams shall be specifically applicable to this project and shall not contain extraneous material or optional choices. Clearly mark literature to indicate the proposed item and its relevant features or options. Submittals shall include all those items listed in each individual Section.

4. Where a certificate from a regulatory agency cannot be provided at time of submission, provide a letter describing methodology used to obtain certification, authority having jurisdiction, and anticipated date of certification.

5. All built-up equipment (such as air handlers or pump packages) shall be provided with a fully dimensioned shop drawing showing all hardware, points of connection, point loads at supports and center of gravity, including factory joints for breakdown and reassembly for restricted access locations.

6. Submittals for all factory-built equipment weighing 40 lbs or more shall include a dimensional drawing, equipment weight, and center of gravity.

7. Provide the name and contact information for the three closest manufacturer representatives/service companies for the product.

8. Manufacturer's certificate of performance and construction.

9. All equipment shall be UL listed as a complete assembly. Submit UL listing documentation with equipment submittals.

F. Shop Drawings:

1. Refer to Section 01340 – SUBMITTAL PROCEDURES.

2. Shop drawings to be provided in PDF Format.

3. Shop drawings shall be provided for all systems included in Division 23 and for all areas addressed in the Construction Documents.

4. Ductwork and piping installation drawings shall be fully dimensioned complete with elevations and all fittings, valves, dampers, devices. Include details and dimensioned locations of supports, anchors and expansion devices. Dimensions shall be from gridlines. All equipment shall be shown to scale and shall match the required dimensions from the equipment submittals. All equipment access clearances shall be marked explicitly on the Shop Drawings with manufacturer and code required distances dimensioned and annotated as such.

5. The drawings shall be minimum 1/4" = 1'-0" scale

6. Ductwork and Piping shall be on separate drawings.

   a. Ductwork drawings shall include and show equipment with tags, access space, duct construction/material and reinforcing, pressure classification information, flexible duct, flexible connectors, duct support and seismic restraints (internal and external), Balancing devices, gauges/thermometers, controls, devices, penetration locations (including dimensions and elevation), insulation type and location.

   b. Piping drawings shall include and show equipment with tags, access space, pipe material, flexible pipe connectors, pipe support type and seismic restraints, balancing devices, gauges/thermometers/Pete's plugs, controls devices, penetration locations (including dimensions and elevation), insulation type and location.

   c. Contractor shall ensure that all piping and ductwork shall be coordinated to avoid any conflicts and allow for proper service access.

7. Penetration locations, structural support and structural pad drawings shall be submitted for review by Structural Engineer.

8. All equipment shall be labeled to match the schedules. All equipment shall be drawn to scale per the approved submittals, providing notes to identify approved submittal number for all pieces of equipment.

9. The Contractor shall ensure that each trade has coordinated work with other trades, prior to submittal. Division 23 shop drawings shall be issued after the coordination drawings are signed off by all other trades and after the system pressure loss calculations are complete. Any conflicts that occur with other trades shall be brought to the attention of the Owner's Representative prior to issuance of the shop drawings.

10. Shop fabrication, coordination and installation drawings that are prepared to scale by the Contractor are for his use and shall be his responsibility. These Drawings indicate where he intends to install the material and equipment as required by the Contract Documents. Submission of contract documents or electronic files of contract documents for shop drawings is not sufficient as this would be an indication that field-level construction coordination has not taken place. Any such submittal will be rejected and returned without review.

11. Prepare and submit supplementary Shop Drawings for all Work in "tight" areas, clearly indicating solutions to space problems and coordination with Work in other Sections. Identify congested conditions and provide a sufficient number of sections to demonstrate the solution proposed. These Drawings, as a requirement of this Division, shall indicate, superimposed, Work of all Sections involved in congested area, including ductwork, piping, electrical work, ceiling work, equipment access requirements, etc. Include all mechanical rooms at larger scale and with sections under this clause. Identification of space problems without solutions is not acceptable within a shop drawing.

12. During the shop drawing review process the Owner's Representative may request that supplementary shop drawings be produced for clarification and explicit demonstration of coordination in congested areas. This work shall be performed by the contractor at no cost as necessary under the previous clause.

13. Prepare and submit Shop Drawings for all Work deviating from that indicated on Contract Drawings. Clearly indicate deviations and cross reference through notes the reason why the deviation was made.

14. Shop Drawings shall show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, weight.

    a. Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of the Contract Documents.

    b. Drawings shall be to scale and dimensioned (except isometric piping diagrams not to scale).

    c. Drawings shall clearly show all required openings in construction, points of connection of other trades, and support locations and loads.

    d. Drawings may be prepared by vendor but shall be submitted as instruments of the Contractor. Such drawings shall be thoroughly checked and developed by the contractor to include the full contract scope. They shall be stamped by Contractor before submission for review.

    e. Catalog cuts and published material may be included to supplement scale drawings.

15. Each drawing shall have a blank space for use by the Owner's Representative and Contractor in recording disposition of material per Section 01340.

G. Coordinated Drawings:

1. Refer to Section 01340 for requirements.

2. Color Coordinated drawings (with different color per trade) shall be provided for all areas with acceptance sign off from all trades required at time of shop drawing submittals, including, but not limited to:

    a. Mechanical Contractor

    b. Electrical Contractor

    c. IT Contractor

    d. AV Contractor

    e. Ceiling Support Contractor

    f. General Contractor

    g. Testing Adjusting and Balancing Contractor

    h. Controls Contractor

    i. Fire Sprinkler Contractor

    j. Fire Alarm Contractor

3. Coordinated Drawings shall show work of all trades including, but not limited to:

    a. Ductwork with fully-dimensioned sized and locations of penetrations at floors, walls and ceiling, access panels, sensors and instrumentation with clearances.

    b. Piping, including:

        1). HVAC, Plumbing and Fire Protection.

        2). Minor Piping such as Drains, Air Vents, Condensate Piping, etc.

        3). Sleeves and fully-dimensioned sized and locations of Penetrations.

        4). Expansion Devices, Anchors, Guides and Hangers, Seismic Anchorage Devices.

    c. Actual Mechanical Equipment at submitted dimensions, including points of connection and manufacturer's recommended access space. Nothing shall enter or cross through the code-required and manufacturer recommended access space, which is defined as the volume extending from the top of the device to be maintained down to the floor (inclusive of access door locations and swings). Any ceiling which interrupts this space shall be entirely removable including T-bars, vertical supports and seismic bracing of ceiling which shall be arranged to avoid the access zone.

    d. Pipe Supports and Suspension Devices, including seismic restraints.

    e. Ductwork

f. Piping High Points and Low Points.

g. Electrical Equipment.

h. Main Electrical Conduits and Bus Ducts.

i. Equipment Support and Suspension Devices including Hangers, Supports and Bracing.

j. Structural and Architectural Constraints including Beams, Braces, Trusses, Flanges, Constraints, Walls, Openings Ratings, Doors, Wall Types and Glazing.

k. Show location of:

1). Valves

2). Piping Specialties.

3). Dampers.

4). Access Doors and Equipment Removal Paths.

5). Control and Electrical Panels.

6). Disconnect, Hand/OFF/Auto, and Emergency Power Off Switches.

7). Temperature / Humidity Sensors and Thermostats / Humidistats.

8). All control sensors, control panels and required installation distances for access and stable performance.

9). Mounting Brackets

l. Testing, Adjusting and Balancing devices

m. Controls devices and sensors, including required distances for uninterrupted flows to obstruction

n. Electrical point of connections

o. Controls points of connection

p. Fire Alarm points of connection

4. Drawings shall indicate coordination with work in other Divisions which must be incorporated in mechanical spaces, including, but not limited to:

a. Electrical Equipment.

b. Cable Trays.

c. Architectural features, including doors and partitions

d. Fire Alarm Equipment

e. IT/Electrical outlets

5. Provide sections and elevations for all mechanical rooms, mechanical areas, areas with routed duct mains, areas with routed piping mains, and areas adjacent to the existing structure.

6. Difference or disputes concerning coordination, interference or extent of Work between sections shall be decided by Contractor, his decision, if consistent with Contract Document requirements, shall be final.

7. Provide templates, information and instructions to other Divisions to properly locate holes and openings to be cut or provided.

8. Not all offsets in ductwork or piping are shown. Contractor shall decide which item to offset or relocate. Maintain required slope in piping.

9. Provide wiring diagrams for electrical, controls and fire alarm systems cross referencing panel location/circuit number/point name as appropriate.

H. Substitutions:

1. Specified products or equipment mean those named on the equipment schedules or identified as Specified Manufacturers herein. All other manufacturers listed are considered substitutions and must meet the requirements of this Section. Only manufacturers identified as Possible Substitutions in this specification may be offered as substitutions for approval.

2. Substitution requests shall come simultaneous to the relevant submittal and shall not come through the RFI process, unless directed by the Owner's Representative. The first page of the submittal containing the substitution request shall explicitly include a table of contents identifying the location of the official substitution request paperwork, the table of comparisons, and the supporting data.

3. Submit shop drawings of proposed products that differ from the specified products to demonstrate equivalency of connections and physical arrangements. Show necessary modifications of architectural, structural, plumbing, electrical and mechanical Work required by the proposed products, including relocation of drains, revised electrical circuits, relocation of wall penetrations, and revised foundations.

4. Accompany request for substitution review with table of comparison listing pertinent features of both specified and proposed materials including all scheduled data, material of construction, performance criteria, overall length, width, height dimensions, space required for replacement or maintenance access, motor type, horsepower, voltage, phase service factor, noise levels and controls. This is to be submitted in addition to the index sheet required above for all submittals. Review of proposed substitution will not be made without simultaneous receipt of satisfactory comparison tabulation. The substitution request shall also identify the offered reduction in contract value, which shall be inclusive of all cost associated with work by other trades. If paper copies of data from the referenced manufacturer are provided along with the submitted manufacturer as backup data for the table of comparisons, these shall be explicitly separated via tabs clearly marked as follows:

a. Substitution request, comparison table, letter sign-off by all affected subcontractors

verifying that there is no charge to the project associated with the substitution

b. Submitted data from requested manufacturer

c. Reference data from specified manufacturer

5. Limit submittal of substitutions to one proposal for each type or kind of item. If the proposed product substitution is rejected, submit the specified product at no cost to the project.

6. Review of drawings and other material submitted as a substitution shall not be construed as a complete check or constitute a waiver of the requirements of the Contract Documents. This review shall not relieve the Contractor of the responsibility to fit the proposed materials to the spaces provided, and to effect necessary rearrangement or construction of other Work. The submittal response of "No Exception Taken" to a substitution request does not constitute a design change or a direction from the Owner and it is not eligible for a change order request.

7. Any additional work required by other trades as a result of a substitution shall be covered under this Contract, without any additional cost or time delay imposed on the project. Submittals with substitution requests shall include a letter signed by all affected parties (electrical, controls, testing, adjusting, and balancing, general contractor, structural capacity) verifying that the substitution will not incur any additional cost or time delay to the overall project.

8. When a substitution is proposed, the Contractor shall be responsible to ensure that the performance and quality of the scheduled or specified equipment is met. If additional accessories are required to achieve performance, they shall be provided at no cost.

9. Substitutions shall be made explicit during the project buy-out/bid phase (e.g. guaranteed maximum pricing). Selection of the sub-contractor does not imply acceptance of substitutions.

I. Submittals – Checking

1. Before submitting shop drawings or equipment submittals to the Owner's Representative, the contractor shall check them in detail to be sure that all requirements of the plans and specifications have been fully met.

2. Incomplete submittals and submittals not in accordance with the above requirements shall be returned without action, and resubmittal shall be required.

3. Review of drawings and other material submitted shall not be construed as a complete check or constitute a waiver of the requirements of the Contract Documents. This review shall not relieve the Contractor of the responsibility to fit the proposed materials to the spaces provided, to coordinate with the other trades and to effect necessary rearrangement or construction of other Work.

4. Review is not intended to verify dimensions or quantities, or to coordinate items shown on these Drawings. Review is for general conformance with design concept of the Project and general compliance with the information given in the Contract Documents. Contractor is responsible for dimensions, which shall be confirmed and correlated at the Jobsite, for

fabrication processes and techniques or construction, for coordination of his Work with that of all other trades, for installed performance and the satisfactory quality of his work.

5. Review by the Owner's Representative of Submittals does not release the Contractor from full compliance with the requirements of the plans and specifications when Submittals deviate from these requirements.

6. Even though Submittals have been stamped "Reviewed" and no exceptions have been taken by the Engineer, the Contractor shall be fully responsible for all unauthorized deviations from the Drawings and specifications. Authorization for deviation will be made only by means of a letter from the Owner's Representative. The Owner's Representative's reviewed "No Exceptions Taken" stamp on a Submittal is not an authorization for a deviation from the plans and specifications.

7. Any corrections or modifications made by the Owner's Representative shall be deemed acceptable to the Contractor with no change in contract amount unless written notice is received by the Owner's Representative prior to the performance of any work affected by any corrections or modifications.

8. No material or equipment shall be released for manufacturer or shipment without first obtaining the Owner's Representative approved shop drawings.

J. Resubmittals

1. Resubmittals shall be reviewed for compliance with the comments made on the original submittal. Clearly identify replies to comments, through a cover letter by the Contractor that lists each comment and the resolution of that comment. Mark with submittal number and date.

2. Non-compliant items which were not noticed in an earlier submittal but are noticed in a resubmittal shall be noted as non-compliant and the resubmittal tagged for corrective action. The fact that the Owner’s Representative may have overlooked the defect shall not constitute total or partial acceptance of it. The contractor remains responsible for delivering an installation that meets the design intent. All corrective action shall be performed at no additional cost or delay to the project.

3. Re-submittals shall be complete and shall be explicitly annotated to note all changes. Contractor shall not just include specific responses to review comments, but shall show how the resubmittal data has been corrected and how all consequences of the change have been accommodated.

4. Changes made in the resubmittal which are not directly a response to an earlier review comment shall be clearly identified on the letter of transmittal provided with the re-submittal and annotated within the body of the submittal. The reason for the change shall be included.

5. One resubmittal will be reviewed. Review time for all second and higher resubmittals will be charged on a time and materials basis to the contractor regardless of the cause of the resubmittal. This will include all submittals to change manufacturer or equipment type after an original submittal was returned with no exceptions taken, unless the change is directly related to a Bulletin.

1.7 PROJECT RECORD DOCUMENTS

A. In accordance with Division 01 GENERAL REQUIREMENTS, and as follows the contractor shall:

1. Keep up-to-date during the progress of the job through, one set of drawings indicating the Record installation. In addition to changes made during course of Work, show following by dimension from readily obtained base line reference points:

a. Exact location, type, and function of all valves, dampers, and controllers (cross referenced to valve, damper and sensor/controller charts).

b. Exact size, invert elevations and location of underground and under-floor piping and ducts, and ducts and piping concealed or exposed in walls.

c. Dimensional changes to Drawings.

1). Revision to details shown on Drawings.

2). Depths of foundations.

3). Locations and depths of underground utilities.

4). Revisions to routing of piping and conduits.

5). Revisions to electrical circuitry.

6). Actual equipment locations.

7). Duct size and routing.

8). Locations of concealed internal utilities.

9). Changes made by Change Order or Construction Change Directives.

10). Details not on original Construction Drawings.

B. Underground utility services, both inside and outside of buildings, shall be dimensioned from permanent structures or bend mark. Utility services outside of buildings shall also show depth of burial with reference to the finished ground floor elevation. Mark record prints of Construction Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Construction Drawings location.

1. Mark record sets with red erasable colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location. All notations shall be dated and initialed. Record drawings shall note related change order designations (numbers) on impacted work.

2. Mark important additional information that was either shown schematically or omitted from original Drawings.

3. Note alternate numbers, Change Order numbers, and similar identifications.

4. Responsibility for Markup: Under direct supervision of Contractor, the individual, installer, subcontractor or other entity who obtained record data shall prepare markup on record drawings.

    a. Accurately record information in an understandable drawing technique.

    b. Record data as soon as possible after obtaining it. Record and check markup prior to enclosing concealed installations.

    c. Encircle each area of change or additional information with a free-form cloud-shape drawn on the reverse side of the transparency.

    d. Identify changes and additional information by printing Change Order Number or other change reference designation, when applicable, within the cloud-shape encircled area.

5. During construction phase, maintain in addition to hard copy, an electronic record document of drawings on CAD file, with 2 back up copies.

6. Transfer markup's from hard copy to CAD files on a monthly basis.

7. Submit one hard copy of changes made to CAD files as part of monthly request for payment,

8. Provide and maintain a list of drawings.

C. A complete progress set of drawings shall be kept on the project site at all times and shall be available for inspection by Owner's Representative or Construction Manager weekly, as a "record" set.

D. Each trade shall submit record copies of their respective shop drawings as part of the project closeout. These record copies shall indicate as-built conditions and shall show all work installed by that trade. All elements shall be dimensioned from grid lines or bench marks and all elevations shall be noted. Construction notes such as component number or conflict notes shall be removed and the drawings shall clearly be noted in the title block as being as-built drawings.

E. Newly Prepared Record Drawings: Prepare new drawings instead of following procedures specified for preparing record drawings where new drawings are required when neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation. New drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.

    1. Provide Drawings in a scale that allows for scope of detailing and notations required to record actual physical installation and its relationship to other construction.

    2. When completed and accepted, integrate newly prepared Drawings with procedures specified for organizing, copying, binding and submitting record drawings.

F. Submit as a normal submittal, a copy of the completed progress set Drawings and the final draft of the project record drawings to Owner's Representative for approval prior to authorization for final payment. Record drawings shall be certified as to their correctness by the signature of the Contractor and shall be stamped or otherwise identified as record drawings.

G. Prior to Final Acceptance, submit record drawings to the Owner. Organize into sets, and bind

and label.

H. At the completion of the project prior to the authorization for final payment, the Contractor shall submit record as-built drawings with numbers of copies as specified under Division 01 GENERAL REQUIREMENTS and their electronic CAD files, including all associated reference files, files related to line weights/color for printing, and a PDF print of the intended final drawing product. Drawings shall incorporate all the Owner's comments and corrections, submittal information, RFI information and all addenda and represent completed as-built conditions. Reference to RFI's or Change Orders in lieu of drawing the exact change will not be acceptable. Title block shall explicitly note these as "PROJECT RECORD DRAWINGS" in a prominent location on each drawing.

I. Contractor shall deliver rolls or binders that contain each drawing, whether or not changes and additional information were recorded, such that each copy is a complete as-built representation of the installed work.

1. Organize hard copies into manageable sets. Bind each set with durable-paper cover sheets. Include appropriate identification, including titles, dates, and other information on the cover sheets.

2. Organize and bind original marked-up set of prints that were maintained during construction period in same manner.

3. Submit marked-up progress set, record set, CAD files, and copy sets to the Owner.

1.8 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Instructions and Manuals: Provide number of copies in accordance with requirements of Division 01 GENERAL REQUIREMENTS and parallel electronic documentation organized in directories. Additional requirements are parallel to the paper copies. Additional requirements are as follows:

1. Subsequent to completion of balancing and testing operations, this Division is responsible for instructing the Owner's authorized Representatives in all aspects of operation, adjustment and maintenance of mechanical plant and other mechanical equipment. Provide professional video documentation of training session on DVD.

1.9 TRAINING REQUIREMENTS

A. Provide a minimum of 8 hours Owner training for each major system (e.g. boiler plant, chiller plant, air handlers, BAS, etc.). Provide a minimum 4 hour Owner training session for the building's non- major systems (e.g. toilet exhaust fans, valves, etc.). Refer to list below as a minimum.

B. Submit certificate, signed by Owner's Representative, attesting to their having been instructed per Division 01 GENERAL REQUIREMENTS and as specified under individual Equipment sections of this specification.

C. Instructions on major items such as pumps, chillers, boilers, water heaters, water treatment, fans, air handlers, and temperature control shall be by representative of manufacturer of the respective equipment.

D. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.

E. The GC shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel.

F. Schedule training with Owner's representative a minimum of 15 working days in advance. All Owner training shall be completed prior to scheduling final inspection.

G. Submit Operating and Maintenance manuals and electronic documentation.

H. Mechanical Contractor. The mechanical contractor shall have the following minimum training responsibilities:

1. Provide the GC with a training plan two weeks before the planned training.

2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, pumps, boilers, furnaces, chillers, heat rejection equipment, air conditioning units, air handling units, fans, terminal units, controls and water treatment systems, etc.

3. Training shall normally start with classroom sessions followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.

4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

8. Training shall include:

a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.

b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut

down, seasonal changeover and any emergency procedures.

c. Discussion of relevant health and safety issues and concerns.

d. Discussion of warranties and guarantees.

e. Common troubleshooting problems and solutions.

f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.

g. Discussion of any peculiarities of equipment installation of operation.

h. The format and training agenda in the HVAC commissioning Process. ASHRAE Guideline 1-989R, is recommended.

i. Classroom sessions shall include the use of overhead projections, slides, video, and audio taped material as might be appropriate. A copy of these materials shall be submitted with the training documentation.

9. Hands on training shall include start up, operation in all modes possible, including manual, shut down and any emergency procedures and preventative maintenance for all pieces of equipment.

I. Training Plan. The mechanical contractor shall have the following minimum training responsibilities.

1. Provide the GC/PM with a training plan four weeks before the planned training According to the following outline:

2. The controls contractor shall provide designated Owner personnel training on the control system in this facility. The intent is to clearly and completely instruct the Owner on all the capabilities of the control system.

3. Training manuals. The standard operating manual for the system and any special training manuals will be provided for each trainee, with three extra copies left for the O & M manuals. In addition, copies of the system technical manual will be demonstrated during training and three copies submitted with the O & M manuals. Manuals shall include detailed description of the subject matter for each session. The manuals will cover all control sequences and have a definition section that fully describes all relevant words used in the manuals and in all software displays. Manuals will be approved by the GC Copies of audiovisuals shall be delivered to the Owner.

4. The training will be tailored to the needs and skill-level of the trainees.

5. The trainers will be knowledgeable on the system and its use in buildings. For the on-site sessions, the most qualified trainer(s) will be used. The Owner shall approve the instructor prior to scheduling the training.

6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

7. There shall be one control training session:

8. TAB:

    a. The TAB contractor shall have the following training responsibilities:

        1). TAB shall meet for 16 hours with facility staff after completion of TAB and instruct them on the following:

            a). Go over the final TAB report, explaining the layout and meanings of each data type.
            b). Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
            c). Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
            d). Discuss any temporary settings and steps to finalize them for any areas that are not finished.
            e). Other salient information that may be useful for facility operations, relative to TAB.

9. Manuals shall be prepared to ASHRAE Guideline 4-2008. The manuals shall be predominantly typewritten with occasional printing or hand-drawn demarcations and notes. Shall include the following in the Equipment Binder(s):

    a. Section 1: Overview documents:

        1). A comprehensive table of contents and guide to the manuals contents and layout. This section shall enable the reader to comprehend the scope and purpose of the document and to identify readily where specific information can be obtained.

        2). Equipment List: List of all major equipment as installed. Include tag reference model number, normal capacities, location in building, and location tab number in Section 3 binders.

        3). Manual valve charts organized on a room and sequence basis, identifying room, system, valve numbers, valve type, valve usage, and associated equipment.

        4). Manual fire and fire smoke damper charts organized by type on a room and system basis, detailing room system and damper number.

    b. Section 2: Contractual and Legal Records including:

        1). Name and Address of the installation.

        2). Contact Name and telephone number for emergency repairs.

        3). Details of City and State approvals.

        4). Name and Contact details of the Design Team and Installing Contractors and associated sub-contractors.

        5). Copies of maintenance service contracts and contact details for local service company.

6). Master Equipment List containing Dates for Start of Installation, Substantial Completion, and Expiry of Warrantee period.

7). Copies of warrantees, guarantees and bonds.

c. Section 3: Individual Equipment Sections:

1). Startup and Shutdown Procedures:

a). Provide a step-by-step write-up of all major equipment. When manufacturer's printed start-up, troubleshooting and shut-down procedures are available, they shall be incorporated into the operating manual for reference.

2). Operating Instructions: Written operating instructions shall be included for the efficient and safe operation of all equipment.

3). Service Instructions: Provide the following information for all pieces of equipment:

a). A detailed parts list

b). Recommended spare parts, including catalog number and the name, manufacturer’s name and contact information, address and telephone number of local suppliers of factory representative.

c). Lubrication and maintenance instructions and recommended service maintenance schedule for all equipment including all electric motors. Sample maintenance record forms for each equipment type.

d). A lubrication chart listing each item of equipment, all points of lubrication, proper lubricant, dates lubricated, and lubrication schedule.

e). Belt sizes, types and lengths – adjustments made to install systems.

4). Data sheets to show model number, capacity, nameplate data, complete internal wiring, mechanical and electrical ratings and characteristics, catalog data on component parts whether furnished by equipment manufacturer or others, names, addresses and telephone numbers of source of supply for parts subject to wear or electrical failure, and description of operating, test, adjustment, and maintenance procedures.

a). Where data sheets included in the manual include equipment, options, or other features not part of equipment actually furnished, line out these references or otherwise clearly mark so remaining text, diagrams, drawings, schedules, and similar information shall apply specifically to equipment furnished.

b). Parts catalog references for each item of equipment furnished with components identified by number for replacement.

c). Final submittals for equipment shall have final corrections included in the points used for the manual.

5). Testing and Balancing reports:

a). Sheets detailing all set points, and final balance figures of air and water systems.

b). Cross-reference diagrams in plan to identify air terminals and equipment location.

c). NC levels by room

d). Pressurization testing results (as applicable).

d. Section 4: Controls:

1). Title index tabs identifying items therein.

2). Detailed list of all sensors, devices, and controllers cross reference to control set points names. List shall cross reference physical location in building, control and wiring diagrams and documentation in this section.

3). Software name/version and support contact information.

4). Detailed description of sequence of operation of each system, with charts and diagrams. Include emergency operation performance and resetting procedures as appropriate. Include explicit definition of all setpoints, alarm triggers, loop tuning coefficients, and ranges present within programming at time of handover.

5). Provide full size copies of Record one-line diagrams and plans, thin laminated and folded into plastic envelopes for inclusion in the binder.

6). Provide laminated control diagrams. Diagrams shall show complete equipment, controls, model numbers, etc., marked to correspond to identification on equipment.

e. Section 5: Certifications:

1). Title index tabs identifying items therein.

2). Certificates: Submit final inspection certificates signed by governing authorities.

3). Letters from manufacturers certifying their supervision of equipment installation and start-up procedures.

4). Machinery vibration test reports.

5). Room NC levels at handover as tested by an acoustical engineer.

6). Test certificates.

7). Instruction certificates.

8). Inspection certificates.

9). Fire Marshal and/or Fire Department approvals of system.

10). Final inspection certificate signed by governing authorities.

11). UL, ASME and ASTM rating certificates (as appropriate).

12). Air Quality Management District certification of boilers.

13). Other certification as noted in other Division 23 sections.

14). Final Commissioning certificates of approval

f. Section 6: Record As-Built Drawings: Submit drafts of service and maintenance instruction sheets to Owner's Representative for review before preparing final sets.

g. Section 7: Professional Video documentation of training sessions

h. Section 8: CD's containing O&M Manual as electronic versions

1.10 WARRANTY

A. Conform to the requirements of Division 01 GENERAL REQUIREMENTS.

B. Unless otherwise noted within a particular section, under special warranty each complete system shall be warranted by the Contractor. Each system shall be free of defects of materials and workmanship, and shall perform satisfactory under all conditions of load or service. The warranties shall provide that all additional controls, protective devices or equipment provided as necessary to make the system or equipment operate satisfactorily and than any faulty materials or workmanship shall be replaced or repaired. On failure of the warrantor to do the above after written notice from Owner, the Owner shall have the Work done at the cost of the warrantor. Loss of refrigerant is considered a defect in workmanship and/or equipment, to be corrected at no extra cost to the Owner.

C. Provide new materials, equipment, apparatus and labor to replace that determined by Owner to be defective or faulty within the warranty period.

D. This guarantee also applies to services including Instructions, Testing, Adjusting, Balancing, Noise and Commissioning.

E. Furnish Manufacturers' standard Warranties only as specifically required under the individual equipment section.

F. Unless otherwise noted, warranties shall commence upon the Owner's final acceptance of the project.

1.11 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum

energy ratings or efficiencies are specified, equipment shall comply with requirements.

C. Nothing in these plans or specifications is to be construed to permit work not conforming to the prevailing codes and regulations. Should there be any direct conflict between any referenced standard and the governing code, the mandatory code language shall govern to set only the minimum requirements and the most stringent requirement shall govern. A letter or Request for Information (RFI) shall be generated to highlight the discrepancy.

D. Install Work by craftsmen skilled in the trade involved and by apprentices as indicated in the General Conditions.

E. The Contractor recognizes that the design is based upon the equipment and material specified by name or construction and the Contractor accepts full responsibility for assuring that the quality, utility and performance of a substitution equals or exceeds that of the specified item.

F. Electrical Testing: Provide the services of a qualified testing laboratory/agency to perform the specified field tests. Notify the Owner's Representative 24 hours in advance of performance of Work requiring testing. Provide all materials required for testing. Refer to Division 26 for detailed requirements of electrical testing.

G. Factory and Field Testing

1. See each Section for the required testing and procedures.

2. Provide the services of a qualified testing laboratory/agency to perform the specified field tests.

3. Notify the owner’s representative at least 72 hours in advance of tests.

4. Provide all materials required for testing.

5. Test reports shall include:

a. Description of equipment tested.

b. Description of test procedures.

c. Test results.

d. Names and signatures of witnesses of tests.

H. Performance testing

1. Upon completion of the Work and following adjustment of all equipment, conduct an operating test for each system's acceptance. Demonstrate all systems and equipment to be operational and free from all electrical and mechanical defects.

2. Notify the Owner’s Representative fourteen days in advance of when tests will be performed. At that time, provide a test procedure plan, test schedule and test procedure forms.

3. Coordinate the work of Performance Testing with the Commissioning Requirements for Pre-Functional and Functional Testing.

I. Commissioning Testing Requirements:

1. See each Section for the required testing and procedures.

2. Notify the owner's representative at least 72 hours in advance of tests.

3. Provide all materials required for testing.

4. Test reports shall include:

   a. Description of equipment tested.

   b. Description of test procedures.

   c. Test results.

   d. Names and signatures of witnesses of tests.

5. Upon completion of the Work and following adjustment of all equipment, conduct an operating test for each system's acceptance. Demonstrate all systems and equipment to be operational and free from all electrical and mechanical defects.

6. Notify the Owner's Representative fourteen days in advance of when tests will be performed. At that time, provide a test procedure plan, test schedule and test procedure forms.

7. Coordinate the work of Performance Testing with the Commissioning Requirements for Pre-Functional and Functional Testing.

J. Any appliance for which there is an ASHRAE 90.1 standard established regarding appliance efficiency shall comply with the applicable standard.

K. Materials and Workmanship

1. Materials shall be new, meet detailed requirements of the contract document and be identifiable as being specified or substitute products. Materials shall be kept in original packing material and protected from the elements by plastic and placed on dunnage until the item is installed. Once installed, all electrical devices exposed interior materials and all insulation installed shall be covered with sealed plastic until the building is fully enclosed and all spraying applications are complete.

2. Materials that do not conform to the requirements of the contract documents, are not equal to approved samples or are unsatisfactory or unsuited to the purpose for which they are intended, will be rejected and shall not be installed.

3. All work shall be performed by properly licensed plumbers, mechanics, and technicians with work limited to their respective trades.

4. All equipment shall be installed in accordance with the recommendation of the manufacturer. Use printed descriptions, specifications and recommendations of manufacturers as a guide for installation of Work.

5. Defective work, whether the result of poor workmanship, use of defective materials, damage

through carelessness, or other cause shall be removed within ten (10) days after written notice is given by the Owner's Representative, and the work shall be re-executed by the Contractor. The fact that the Owner's Representative may have previously overlooked such defective work shall not constitute acceptance of it.

6. In no case shall a Bidder base his bid on a class of material or workmanship less than that required by the contract documents and the governing codes and ordinances.

7. Materials and adhesives used throughout the mechanical systems for insulation, filters, ducts, flexible connections and jackets or coverings regardless of kind for piping and ducting system components, shall have a flame spread rating not over 25 without evidence of continued combustion and with a smoke developed rating not higher than 50. "Flame Spread Rating" and "Smoke Developed Rating" shall be as determined by the "method of test of surface burning characteristics of building materials, NFPA No. 244, ASTM E84, Underwriters Laboratories, Inc., Standard". Such materials are listed in the Underwriters Laboratories, Inc., "Building Materials List" under the heading "Hazard Classification (Fire)".

8. Equipment shall be approved for use by all relevant Authorities Having Jurisdiction, where applicable.

9. Equipment required to have test labels by requirements of individual equipment sections shall have labels permanently affixed.

10. Manufacturer’s nameplate, name or trademark shall be permanently affixed to all equipment and material furnished under this Specification. The nameplate of the Subcontractor or Distributor is not acceptable.

L. All Base Materials: Comply with standard ASTM and ANSI.

M. All Pressure Vessels, Relief Valves, Safety Relief Valves and Safety Valves: Comply with standards, ASME stamped.

N. All Electrical Devices and Wiring: Conform to standards of NEC. All devices: UL listed and identified.

O. CORROSION-COATING

1. Nokorode Seal-Coat (standard) manufactured by the Lion Oil Company, El Dorado, Arkansas, or approved equal.

P. Applicator (Erector) Qualifications:

1. All equipment and accessories shall be the product of a manufacturer regularly engaged in its manufacture.

2. All equipment and accessories new, free from defects.

3. Supply all equipment and accessories in compliance with the applicable standards listed in this Section and with all applicable national, state and local codes.

4. All items of a given type shall be the product of the same manufacturer.

5. Electrical equipment: Listed by UL and bearing their label.

Q. Checking and Testing Equipment By Contractors and Manufacturer's Representative

1. All equipment shall be installed per the manufacturer's instructions. During construction request supervisory assistance from equipment manufacturer's representatives so the equipment will be correctly installed. After installation, request the Owner's Representative to inspect and see the equipment is in proper working order.

2. Manufacturer's representative shall review the overall system design relative to the proper application of his equipment in the particular system. He shall note conduit, wiring, control, location, and other relevant relationships, and furnish appurtenances necessary for satisfactory operation.

3. Before equipment start up, the manufacturer's representative shall submit to the Owner's Representative, a signed statement certifying to their inspection and noting that the equipment is properly installed and ready for operation.

1.12 PRE-INSTALLATION MEETINGS

A. Refer to Section 01340 – SUBMITTAL PROCEDURES.

B. Convene minimum one week prior to commencing work of this section.

1.13 PROTECTION, DELIVERY, STORAGE, AND HANDLING

A. Contractor to provide an authorized representative to constantly supervise Work of this Division, check all materials prior to installation for conformance with Drawings, Specifications, and reviewed Shop Drawings.

B. Delivery

1. Deliver materials or equipment to the Project in the manufacturer’s original unopened, labeled containers and adequately protect against moisture, tampering or damage from improper handling or storage, ingress of dirt or contamination of any kind. Do not deliver materials to the job before they are ready for installation, unless adequate security is provided.

2. Perform all handling and shipping in accordance with manufacturer's instructions.

3. All ductwork shall be delivered to site with all ends and openings capped with heavy gauge polythene sheeting taped all around to prevent ingress of moisture, dust, and debris.

4. Deliver equipment in its original package to prevent damage or entrance of foreign matter. Perform all handling and shipping in accordance with manufacturer’s recommendations. Provide protective coverings during construction.

5. 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.

C. Identification

1. Identify materials and equipment delivered to Site to permit check against approved materials list, reviewed Shop Drawings. Identify materials and equipment by manufacturer's name, tag reference and nameplate data. Remove unidentified materials, equipment from Site.

D. Loss or Damage

1. All materials, appliances, and equipment shall be new and free from defects, and of the make, brand or quality specified or as accepted by the Owner. All materials and equipment shall be installed in a neat and workmanlike manner. Any work not so installed shall be removed and replaced in a satisfactory manner at no charge to the Owner.

2. Equipment or material damaged during transportation, installation or operation is considered as totally damaged. Replace with new. Variance from this permitted only with written acceptance.

3. The Contractor shall replace lost or damaged materials and equipment with new at no increase in Contract Sum.

E. Storage

1. All stock-piled material shall be placed on pallets, and protected from weather and from entry of foreign material and construction dust by plastic. All stored materials and equipment shall be carefully inspected and cleaned prior to installation and replaced with new material or equipment if found to be damaged, corroded, etc.

2. Equipment which is observed to be exposed to the weather, dirt or construction debris can be interpreted by the Owner's Representative as defective equipment under this clause.

3. All stored materials and equipment shall be carefully inspected prior to installation and replaced with new material or equipment if found to be damaged or corroded.

4. Completely cover motors and other moving machinery to protect from dirt and water during construction, including after installation.

5. Cap all openings in pipe and ductwork daily to protect against entry by foreign matter.

6. Store plastic pipes protected from direct sunlight. Support pipe to prevent sagging and bending.

7. Protect all finished surfaces of fixtures and exposed to view materials with heavy plastic or by other means, throughout the period of construction.

1.14 TEMPORARY FACILITIES

A. Temporary Water: Provided under Section 015000.

B. Temporary Light and Power: Provided under Section 015000.

C. Temporary air-conditioning: Provide conditioning sources for use during construction that are independent of the building's air handling systems. Building air handlers shall not be used during construction unless explicitly approved for use by the Owner's Representative.

D. Temporary heating and ventilation: Provide heating and ventilation sources for use during construction that are independent of the building's air handling systems.. Building air handlers shall not be used during construction unless explicitly approved for use by the Owner's Representative.

E. Where retrofit work requires connection to the central plant or other building plant, the contractor shall complete the work prior to the connection with the plant to minimize the impact of the plant shutdown (e.g. time or cost), subject to the requirements of the Owner.

F. Assume responsibility for chemical treatment and freeze protection during use of temporary facilities.

G. All temporary facilities shall be removed at completion of project, with permanent facilities returned to proper working order.

1.15 COORDINATION

A. Refer to Section 01340 – SUBMITTAL PROCEDURES.

B. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

C. Cooperate with all other Divisions performing work on this project as necessary to achieve a complete neatly fitted installation for each condition. Consult the Drawings and Specifications to determine nature and extent of work specified in other Divisions that adjoins, shares space with, or attaches to the work of this Division. Confer with other Divisions at the site to coordinate this work with theirs in view of job conditions to the end that interferences may be eliminated and that maximum headroom and clearance may be obtained. In the event that interferences develop, the Owner's Representative's decision will be final as to which Division shall relocate its work, and no additional compensation will be allowed for the moving of piping, ductwork, conduit or equipment to clear such interferences.

D. For Testing and Balancing of the system, ensure full co-ordination between the Testing and Balancing subcontractor and all other Trades to achieve access to all system components including leaving wall/ceiling sections down for access.

E. Coordination with Structural Work

1. Schedule of Work: In accordance with Division 01 - General Requirements and as follows:

   a. Arrange work to conform to schedule of construction established or required to comply with Contract Documents.

   b. In scheduling, anticipate means of installing equipment through available openings in structure.

   c. Ascertain temporary openings required for admission of apparatus. Notify the General Contractor and Architect accordingly. Provide such openings at no additional cost to the Owner.

2. Openings and penetrations are prohibited in structural members, except where shown or as

directed by the Owner's Representative and the building's Structural Engineer in writing.

3. At the start of the project, meet with the Owner's Representative to obtain information regarding allowable sleeve or penetration spacing and size.

4. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

5. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

6. The Contractor shall be responsible for being aware of the nature and arrangement of the materials and construction to which the work attaches or passes through, and shall propose support and penetration details that are consistent with maintaining the integrity and performance of the construction such as, but not limited to, fire-resistive construction, acoustically rated construction, vibrated isolated construction, water tight construction, fire proofed construction, and isolated construction.

7. The Contractor shall do all cutting, sleeving, core drilling and carpentry of building materials, piping, etc., as required for the installation of work and in accordance with Division 01 GENERAL REQUIREMENTS.

8. All cutting shall be performed with machine saw. Holes for pipes in concrete walls or floors shall be drilled with core drilling equipment. Verify location of all such cutting or core-drilling with the structural engineer prior to execution.

9. Where any Mechanical work cannot be installed as the work progresses, the Contractor shall provide and arrange for the building in of boxes, sleeves, inserts, fixtures or devices as necessary to permit installation of the omitted work during later phases of construction. This field coordination work shall be completed prior to structural shop drawings and shall follow the principles set forth in the meeting reference above. Arrange for and lay out any chases, holes, or other openings that must be provided in masonry, concrete or other work.

10. This work shall be incorporated into the initial shop drawing review of the construction (wall, floor, etc.) that is affected so that the Owner's Representative may review the impact of the holes.

11. Once the structural shop drawings are returned with no exception taken, the contractor shall bear the cost of time and materials for the Owner's Representative to review the appropriateness of cutting or drilled holes in planned or existing construction.

12. The Contractor shall be responsible for ensuring that all openings shown on the drawings or otherwise required are provided by the relevant trade contractor during the construction of the wall.

13. No structural members shall be cut without the prior approval of the Owner's Representative. To gain approval to cut concrete, X-ray the affected area (or use another non-destructive method to examine the affected area) and submit results to Structural Engineer for review. Submit to Owner's Representative, drawings and details for the support of structure around the opening. If the standard structural details are to be used, then submit a plan that cross-references all penetrations against detail numbers for review. Otherwise, submit drawings,

design, and calculations stamped by a Registered Professional Structural Engineer in the state of Florida. Any cutting and remedial support shall be done in a manner satisfactory to the Owner's Representative.

14. Where openings break into an existing wall, the Contractor shall provide lintels as required for the support of building construction above the opening. Lintels shall be structural steel angles, channels or tees of proper size and sections for the supported load. The Contractor shall submit structural load calculations to the Owner's Representative signed and sealed by a professional engineer prior to installation.

15. The contractor shall bear the cost of time and materials for the Owner's Representative to re-analyze the construction if the original penetration spacing principles are not adhered to, for whatever reason.

F. Cutting And Patching

1. Patching of building structure, walls, floors, etc. during normal work progress with Requirements of Division 01 GENERAL REQUIREMENTS.

2. All patching of or repair of damage to completed work in place shall be done to meet with the approval of the Owner's Representative.

3. Work in place that is subsequently cut is seen as evidence of the contractor's lack of field coordination during the shop drawing production phase. Because field coordination is a requirement of the contract, the contractor must bear all costs of cutting, patching and repair for corrective work.

4. Assume responsibility for damage to any part of premises or Work of other Divisions, caused by leaks or breaks in piping or equipment furnished or installed under this Division during construction and guarantee/warranty period.

5. Provide sleeves, caps, plates, escutcheons, flashing, etc., required to fill or close the openings. Provide final grouting, concrete, asphalt, masonry, painting and other materials as required. Make repairs in like and kind for exact patching or surfaces and finishes.

6. Where cutting and patching occurs in streets, sidewalks, alleys and the like, cooperate fully with Owner's Representative and municipal or other government bodies.

7. All patching shall be equal to the condition of the element prior to cutting as defined by the Owner's Representative.

G. Coordination with Electrical Work

1. Division 26 Contractor: Wire all mechanical equipment furnished by this Division (excluding internal factory wiring) in accordance with the following general provisions:

   a. Provide 120-volt emergency power circuits available at panel for control contractor's use.

   b. Provide and wire heavy-duty, quick-make, quick-break type disconnect switches, manual pushbuttons and other fire alarm hard-wiring specifically called for in the documents or noted in electrical specifications and wherever required by Code. This

excludes factory-mounted disconnects on equipment.

c. Receive, unload, set, and rough align all separately shipped motors.

d. Receive, unload, set and install all motor starters and variable frequency drives, except those clearly specified as an integral piece supported on the body of a piece of equipment.

e. Wire all miscellaneous relays and other components provided with equipment which is not factory wired or part of control contractor's scope.

f. Wire lighting controls and other monitoring systems for interface with Building Management and Control System if existing.

g. Wire interlocks between equipment as called for in Controls specifications.

h. Provide final equipment power connections for all equipment with voltage 110-volt and greater, including overcurrent protection and disconnect.

i. Provide final connection to motorized smoke and fire-smoke dampers with voltage 110-volt and greater.

j. Provide 120V wiring and conduit from Electrical Panel to dedicated J-boxes located for controls Contractor’s exclusive use.

2. Division 23 shall provide the following:

a. All motor starters and variable frequency drives or control devices called for to be factory prewired to mechanical equipment.

b. All control devices noted on the drawings and within the specifications, including devices required to achieve Sequences of Operations but not explicitly mentioned or called out. Provide controls, controllers, relays, transformers, switches, etc. required by Work of this Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC).

c. Complete and accurate wiring diagrams to Division 26 for all equipment requiring electrical power wiring.

d. Information for separately shipped motors and variable frequency drives to be installed by Division 26. Adjustable motor bases and all bolts and nuts required for installation of base and motor shall be provided and installed by Division 23.

e. Align and adjust mechanical coupling for direct-driven motorized equipment. Adjust and align drive and belt tension on belt-driven equipment.

f. Field lubricate all motors prior to operation and maintain lubrication prior to acceptance of equipment by the Owner's Representative.

g. Provide motor terminal connection diagram as prepared by motor manufacturers.

h. Provide low- voltage (less than 100V) control wiring from Control Panel or controller to controlled device.

i. Electrical work in this Division shall conform to the requirements of Division 26.

j. Provide controls relay for Building Automation System's position monitoring of motorized smoke and fire-smoke dampers (in coordination with Division 28).

k. Equipment shall be ordered with factory-wired assemblies or panels, pre-wired to numbered terminal strips for connection to field wiring.

l. Contractor to coordinate piping routing to ensure piping does not run above electrical equipment.

3. Division 28 Contractor: Wire all mechanical equipment furnished by this Division in accordance with the following provisions:

a. Product of combustion (duct smoke) detectors to be furnished under Division 28. Damper and duct smoke detectors to be installed by Division 23. Duct smoke detector to be wired by Division 28 to the fire alarm system.

b. Provide hard-wired air handling equipment shut-down relay connection as required by code.

c. Provide hard-wired connections for smoke control systems.

d. Provide hard-wired connections for control to all motorized smoke and fire-smoke dampers.

e. Provide fire alarm system position-monitor wiring for all motorized smoke and fire/smoke dampers.

f. Provide Fire Alarm location signals to the Building Management System, as applicable.

4. Where Drawings clearly and explicitly differ from the preceding wiring paragraphs, Drawings have precedence.

H. Commissioning Responsibilities

1. Provide testing adjusting and balancing services to assist the Commissioning agent to provide diagnostic measurements during Functional Testing.

PART 2 PRODUCTS

2.1 GENERAL COMMENTS ON MATERIALS

A. Equipment specified by manufacturer's number shall include all accessories, controls, etc., listed in catalog as standard with equipment. Furnish optional or additional accessories as specified.

B. Where no specific make of material or equipment is mentioned, an RFI shall be submitted suggesting any first class product of reputable manufacturer selected at the Contractor's discretion, provided it conforms to requirements of system.

C. All items of materials in each category of equipment shall be of one manufacturer.

D. Equipment shall be as described in the respective Sections of Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC) and as shown.

E. Design of mechanical systems is generally based on the product of one of the manufacturers cited. Where systems for product installed necessitate modification of systems shown on plans, Contractor is responsible for installation of systems appropriate to product installed.

2.2 MANUFACTURERS

A. In other Division 23 specifications, the following applies in Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements and manufacturer's offerings, products that may be incorporated into the Work include, but are not limited to, the manufacturers specified. The first manufacturer listed first represents the basis of design as scheduled and drawn in the Construction Documents.

2.3 SLEEVE-SEAL SYSTEMS

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

1. Pipeline Seal and Insulator, Inc.

2. CALPICO, Inc.

3. Metraflex Company (The).

4. Advance Products & Systems, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: Carbon steel.

3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

4. Install 1-hour Factory Mutual (FM) approved, silicone sealing elements, carbon steel zinc dichromated pressure plates, connecting bolts and nuts where required.

PART 3 EXECUTION

3.1 LOCAL AND EXISTING CONDITIONS

A. Prior to bidding, visit the site and determine all existing conditions affecting work in this

Division and make adequate provisions in the bid proposal. Examine all Drawings and Specifications to familiarize with the type of construction to be used, and the nature and extent of work of other trades.

B. Observe the conditions under which deliveries of materials and equipment shall be made and under which such materials and equipment can be stored, and shall include adequate provision in the bid proposal.

C. Anticipate means of installing equipment through available openings in structure and make adequate provisions in the bid.

D. The location and elevation of the utilities, existing ductwork, piping, conduit, or equipment is that which can be determined from available information and its accuracy cannot be guaranteed. Exact location and elevation of these items shall be verified by the Contractor prior to excavation, demolition, or installation of any portion of the work indicated. Exercise special care when excavating at or near the general location of underground utilities to avoid damage to the utility services, as well as to ensure worker safety. Protect existing active services (water, gas, sewer, electric) when encountered, against damage from construction work. Do not prevent or disturb operation of active services which are to remain.

E. Any connections to or relocation of any existing utility line requiring temporary discontinuance of utility services which are in active use shall be scheduled and coordinated with the utility companies and the Owner's Representative at least 10 working days in advance. Provide description of disconnect, procedure to be done, and date/time duration of shutdown. The Work may require shutdowns to be accomplished on an “overtime” basis without additional cost to the Owner. Arrange work for continuous performance to assure that existing operating services will be shut down only during the time required to make necessary connections. If a system cannot shut down, install temporary bypasses or jumpers until connections are complete. In no case shall the services be left disconnected at the end of a working day or weekend unless authorized by representatives of the utilities and the Owner’s Representative. Any existing utility service damaged shall be repaired to the satisfaction of the Owner's Representative.

F. If existing active utility services are encountered which require relocation, make request proper authorities for determination of procedures. Properly terminate existing services to be abandoned in conformance with requirements of authorities having jurisdiction.

G. All removed equipment shall remain the property of the Owner and stored on site as directed.

H. Where connections or disruptions are made to existing system, reactive, refill and recharge all components and restore systems to the same operating conditions prior to the time of disruption.

I. Equipment Rough-In:

1. Rough-in locations shown on Mechanical Drawings for equipment furnished by Owner and for equipment furnished under other Divisions are approximate only. Obtain exact rough-in locations from following sources:

    a. From Shop Drawings for Contractor furnished and installed equipment.

    b. From Architect for Owner furnished-Contractor installed equipment

c. From existing equipment where such equipment is relocated under this Contract

2. Verify mechanical characteristics of equipment before starting rough-in. Where conflict exists between equipment and rough-in shown on Drawings obtain clarification from Architect and provide as directed at no increase in Contract Sum.

3. Make final connections.

3.2 FIELD VERIFICATION

A. All dimensions, locations of equipment and connections to utilities or pre-existing equipment shall be verified in field prior to construction and installation.

B. Architectural plans will hold precedence over mechanical plans as to location of partitions, louvers and diffusers.

C. Measurements in existing buildings shall take precedence over all other plans with regards to identifying location of existing installations.

D. All roughing in construction dimensions shall be made from architectural plans where discrepancies may exist. No change orders will be allowed for shifts in mechanical piping, ductwork, or equipment to match rough-in hole locations within 10 feet of original mechanical drawings.

E. Mechanical plans shall take precedence over electrical and plumbing plans with regards to placement of mechanical equipment and layout of electrical and plumbing equipment within rooms designated as “mechanical rooms.”

3.3 HOIST, RIGGING, TRANSPORTATION AND SCAFFOLDING

A. Provide all scaffolding, staging, cribbing, tackle hoist and rigging necessary for placing all materials and equipment in their proper places in the project. All temporary work shall be removed from the premises when its use is no longer required.

B. Prior to placing equipment or scaffolding, the contractor shall provide written verification that the structure on which the load is imposed has sufficient strength to accommodate the point and/or line loads.

3.4 PREVENTION AND RESTORATION OF DAMAGE

A. Protect premises and Work of other Divisions from damage arising out of installation of Work of this Division.

B. Perform Work in manner precluding unnecessary fire hazard.

C. Repair and replace work installed by this Division when it becomes damaged.

1. Wetted insulation shall be considered damaged.

2. Any NEMA1 or NEMA2 motor for actuators that is wetted shall be considered damaged.

3. Any metal showing evidence of rust, white rust, or other corrosion shall be considered damaged.

4. Any caulking or adhesive which is observed to be flaking, delaminating or otherwise appearing to lose its bond shall be considered to be damaged, even if no evidence of actual leakage is as yet available.

5. Any device or material exposed to fire or fire-generated smoke shall be considered damaged. This excludes localized use of controlled welding equipment for installation.

6. Any device or material not in compliance with the Construction Documents shall be considered damaged.

7. Ductwork, insulation and piping which shows evidence of denting, bending or compression greater than 1/8" deep shall be considered to be damaged. Any of these items showing evidence of having walked on will be considered damaged with replacement of the affected part and a 10' length on either side of the main damaged area.

D. Repair or replace, as directed by Owner's Representative, materials and parts of the Owner's premises which become damaged as result of installation of Work of this Division. Remove replaced parts from premises.

E. Contractor shall be responsible for repair to work of all other Divisions caused by installation of the work of Division 23 or by leaks from piping or equipment furnished or installed under Division 23 during construction and guarantee/warranty period.

F. Where damage to another trades work occurs the Contractor shall pay the relevant trade contractor to make the repairs.

G. All repairs shall be equal to the condition of the element prior to cutting as defined by the Owner's Representative.

H. Review of Construction

1. Work may be reviewed at any time by the Owner's Representative.

2. Advise the Owner's Representative that work is ready for review at following times:

   a. Prior to backfilling buried work

   b. Prior to concealment of work in walls and above ceilings.

   c. When an area or section of work is ready for punchlisting by the Owner's Representative.

   d. When all requirements of Contract have been completed.

3. Maintain on job a set of Specifications and Drawings for use by Owner's Representatives.

4. The Owner's Representative will provide field observations of construction, will inform the Owner regarding progress and problems related to construction, and will endeavor to guard the Owner against defective materials and faulty workmanship. Field observations will be periodic depending upon nature of construction. The Owner's Representative does not perform an extensive or continuous inspection, is not responsible for execution of Contract Documents by Contractor, and is not responsible for construction methods, sequences, or

safety precautions.

3.5 TOOLS AND EQUIPMENT

A. Furnish all tools and equipment necessary for the proper installation, protection and upkeep of the work.

B. Furnish to Owner the following:

1. One set of any special tools required to operate, adjust, dismantle or repair any equipment of this Division. “Special Tools” means those not normally found in possession of mechanics or maintenance personnel.

2. One pressure grease gun for each type of grease required, complete with adaptors to fit all lubricating fittings on equipment.

3.6 INSTALLATION

A. Install equipment according to the manufacturer’s instructions, code requirements, and required access clearances.

B. Equipment Installation

1. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

2. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

3. Install HVAC 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.

4. Install equipment to allow right of way for piping installed at required slope.

5. Assemble equipment which is required to be field assembled under the direct supervision of the manufacturer’s agent. Prior to the final acceptance submit letters from the manufacturers that this has been done.

6. Accurately set and level with supports neatly placed and properly fastened. Properly fasten equipment in place with bolts to prevent movement in earthquake. No allowance of any kind will be made for negligence on part of Contractor to forsee means of bringing in, installing equipment into position inside building.

C. Vibration and Seismic Control

1. Coordinate with Division 1.

2. Design criteria and extent of bracing, anchorage, etc., for all the Work of Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC) are specified in Section 230548 – VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT and Section 233100 – HVAC DUCTS AND CASINGS.

D. Hangers, Inserts, Supports and Bases

1. Provide required structural members, hangers, supports and inserts to keep piping and conduit in proper alignment and prevent transmission of injurious thrusts and vibrations. Where supported from concrete construction, do not weaken concrete or post-tension strands or penetrate waterproofing. Hangers and supports shall be finally adjusted in vertical and horizontal direction under operating conditions.

2. Support equipment and other mechanical items on curbs, legs or steel framework. Provide all metal bases and supports, not part of the building structure, unless specifically indicated to be provided under this Division shall be as described for similar work under other Division. Materials and equipment furnished or provided under this Division shall be as described for similar work under other Division. Concrete, masonry and wood bases and supports shall be provided under other division of this Specification. Furnish required foundation sizes, bolts, washers, sleeves, plates, templates, etc., for mechanical equipment provided.

3. Coordinate inserts with Division 3 prior to pouring of concrete. In the infrequent event that an insert is dislodged or misplaced, provide a request for information that includes a precisely dimensioned drawing and a ferroscan of that area for Owner's Representative to review for potential expansion anchor drill locations.

E. Equipment Rough-In

1. Rough-in locations shown on Mechanical Drawings for equipment furnished by Owner and for equipment furnished under other Divisions are approximate only. Obtain exact rough-in locations from following sources:

   a. From Shop Drawings for Contractor furnished and installed equipment.

   b. From Architect for Owner furnished-Contractor installed equipment.

   c. From existing equipment where such equipment is relocated under this Contract.

2. Verify mechanical characteristics of equipment before starting rough-in. Where conflict exists between equipment and rough-in shown on Drawings obtain clarification from Architect and provide as directed at no increase in Contract Sum.

3. Make final connections.

F. ESCUTCHEONS

1. Provide chrome plated cast brass spring clamp escutcheons (for 1/2 or 1 inch projecting sleeves as required) at each point where an un-insulated pipe passes through a finished surface.

G. SLEEVES

1. Use steel pipe sleeves. Size sleeve lengths to extend through full thickness of sleeved construction and 4 inches above finished concrete floors. Size sleeve diameters to permit clearance for pipe movement and proper grading of pipe. Sleeves for insulated pipe to be of adequate size to clear insulation. All sleeves shall be caulked, airtight and water tight. Multiple pipe penetrations to grouped together and provided with one (1) sleeve or for floor penetration a 4" high water proof concrete curb. All sleeves penetrating Fire Rated walls, floors, slabs etc.

are fo be sealed with a U.L. Listed penetration assembly.

2. All duct, pipe (multiple) and other mechanical service penetrations through walls, floors, shaftways, etc., shall be caulked, air tight, and water tight. All mechanical service floor penetrations shall be provided with a four (4) inch high water proof concrete curb around the entire perimeter of the opening. Proper routing of and sealing and/or lagging (enclosure) around mechanical services penetrating these structures are necessary to maintain the integrity of the isolating structure. All sleeves penetrating Fire Rated walls, floors, slabs etc. are to be sealed with a U.L. Listed penetration assembly.

H. SLEEVE-SEAL-SYSTEM INSTALLATION

1. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

2. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal

I. SLEEVE AND SLEEVE-SEAL SCHEDULE

1. Use sleeves and sleeve seals for the following piping-penetration applications:

   a. Exterior Concrete Walls above Grade shall be cast-iron wall sleeves as required:

   b. Exterior Concrete Walls below Grade shall be cast-iron wall sleeves with sleeve-seal system as required. Select sleeve size to allow for 1 inch annular clear space between piping and sleeve for installing sleeve-seal system.

   c. Concrete Slabs-on-Grade shall be cast-iron wall sleeves with sleeve-seal system as required. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

   d. Concrete Slabs above Grade shall be PVC-pipe sleeves as required.

J. Grout

1. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

   a. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

   b. Design Mix: 5000-psi , 28-day compressive strength.

2. Packaging: Premixed and factory packaged.

3. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

a. Clean surfaces that will come into contact with grout.

b. Provide forms as required for placement of grout.

c. Avoid air entrapment during placement of grout.

d. Place grout, completely filling equipment bases.

e. Place grout on concrete bases and provide smooth bearing surface for equipment.

f. Place grout around anchors.

g. Cure placed grout.

K. Access Panels

1. Place no valves, traps, controls, unions, dampers, coils, air distribution boxes, cleanouts, junction boxes, pull boxes, expansion joints, etc., in any system at a location that will be inaccessible after construction is completed. Maintain accessibility for all components in systems.

2. Furnish all access doors required for all items located above finished ceilings, ceiling breaks or extensions behind finished walls or below finished floor, needed to reach and service all service and maintenance points of this Division's work concealed behind finished construction, even though access doors may not be shown with the documents of this Division. Mark each door with a hidden identification tag cross-referenced to a plan location to ease installation by others.

3. Furnish access door and panel types to ensure the same manufacturer for identical appearance and keying. Installation by Division 08 Contractor. Finish steel panels and frames with prime coat or rust inhibitor enamel.

4. Sizes: 12 by 12 inches for easily accessible items within 6 inches behind walls; 18 by 18 inches where partial body access is required; 24 by 24 inches at ceilings or where entire body access is necessary.

5. Furnish required number of access panel styles to suit location and finish of surface where installed to be coordinated with Architect.

a. Furnish panels with the required fire rating where panels are to be installed in a fire treated partition, shaft, etc.

6. Indicate the required location of panels to those performing their installation.

7. All access panels shall be keyed or otherwise secured to prevent unauthorized access.

L. All work shall be performed by licensed contractors skilled in their respective trades.

3.7 START UP AND FIELD ADJUSTMENT

A. Startup Service:

1. Prior to startup, ensure that systems are ready, including checking the following: Proper

equipment rotation, proper wiring, auxiliary connections, lubrications, venting fan balance, controls and installed properly set relief and safety valves.

2. Start and operate all systems. Provide services of factory trained technicians for startup of major equipment and systems including boilers, fire pumps, etc.

B. Contractor shall be responsible to change or adjust belts, drives, pulleys, motors, impellers, as required by balancing company to achieve the desired air and water delivery in an energy efficient manor by all air handling equipment, fans and pumps. Refer to Section 230593.

3.8 OPERATION BY OWNER

A. Owner may require operation of parts or all of respective installations prior to final acceptance. Cost of utilities for such operation shall be paid by Owner.

B. Operation of installation shall not be construed as acceptance of Work.

3.9 TESTING

A. Labor, materials, instruments and power required for testing provided under respective Sections for Work under that Section. Test all systems as specified under various applicable Section. Duration of tests shall be determined by the authority having jurisdiction and in no case less than the time specified.

B. Test shall be performed to the satisfaction of the Owner's Representative and regulating authority having jurisdiction. Submit written certificates that tests have been performed in accordance with Specification requirements.

C. Repair or replace defective Work and repeat tests until particular systems, and component parts thereof, receive approval of Architect and regulating authority. Any damages resulting from tests shall be repaired and damaged material replaced, all satisfaction of Architect and at no cost to Owner.

D. Tests shall be performed on individual equipment, systems and their controls. Whenever the equipment or system under test is inter-related with, and depends upon, the operation of other equipment or systems and their controls for proper operation, functioning, and performance, the latter shall be operating simultaneously with equipment or system being tested.

E. Testing, adjusting and balancing of air and hydronic systems is specified under Section 230593.

F. Pressure test piping before connection to equipment. No piping equipment or accessories shall be subjected to pressures exceeding their rating.

G. No piping shall be closed up, furred in, or covered before testing. Notify regulating authority and Owner's Representative with advanced notice.

H. Drain water used for testing from the system after tests are complete. Repair or replace any damage caused by freezing of water left in system at no expense to the Owner.

I. Equipment and systems which normally operate during certain seasons of year shall be tested during the appropriate season.

J. After completion of testing and adjustment, operate the different systems and equipment under normal working conditions for 72 hours continuously and show specified performance. If, in the opinion of the Architect, performance of equipment or systems is not in accordance with specifications or submitted data, alter or replace equipment at no increase in Contract Sum. Contractor, at his opinion, may order tests from an independent approved laboratory to prove compliance. All such tests shall be at no increase in Contract Sum. Repeat process as often as required.

K. At completion of Work, provide written certification that all systems are functioning properly without defects.

3.10 PAINTING

A. All unpainted, non-insulated, non-galvanized, ferrous metal surfaces of pipes, equipment, fixtures, hangers, supports, and accessories painted under Section 099000 – PAINTING.

B. Properly prepare Work under this Division to be finish painted under Section 099000 – PAINTING.

C. All work that is cut, ground, welded, bent or had the original finishes damaged or the underlayer material exposed shall be cleaned, primed, and prepared for finish painting by this division.

D. Refinish Work supplied with final finish under this Division if damaged under this Division to satisfaction of Architect.

E. Provide moisture resistant paint for exterior painting and heat resisting paint for hot piping, equipment and materials.

F. Provide colors as directed by Architect unless specified otherwise.

G. Provide factory finishes as noted in the individual Equipment Sections.

H. For the following, provide factory prime coat.

1. Air outlets: identified within relevant Section to be painted to match adjacent mounting surfaces.

2. Access panels.

I. Paint all equipment out-of-doors and equipment supports with two coats of weather resistant enamel.

3.11 CLEANING

A. At all times keep the premises free from accumulation of waste material and debris caused by his employees. At the completion of the project, and at other times as Architect may direct, remove refuse from within and around the building. All tools, scaffolding and surplus materials shall also be removed, leaving the Site of his Work clean.

B. The Work of each Section includes removing tools, scaffolding, surplus materials, barricades, temporary walks, debris and rubbish from the Project promptly upon completion of that portion of the Work. Leave the area of operations completely clean and free of these items.

C. Clean premises of all excess construction material and debris caused by work, in accordance with Division 01 GENERAL REQUIREMENTS.

D. During the course of construction, cap all ducts, pipe and electrical conduit in approved manner to ensure adequate protection against entrance of foreign substances.

E. Disconnect, clean and reconnect, whenever necessary, to locate and remove obstructions from any system. Repair or replace any Work damaged in the course of removing said obstructions at no additional cost to the Owner.

F. Clean all ductwork surfaces inside and out that have dust, debris, or foreign substances before grilles are installed and before fans are operated.

G. Surfaces shall be left clean, debris shall be removed, and equipment shall be furnished in prime coat finish unless otherwise specified.

H. Clean exterior of piping, ductwork and equipment, exposed in complete structure. Remove rust, paint overspray, fireproofing overspray, plaster and dirt by wire brushing; remove grease, oil and similar materials by wiping with clean rags and suitable solvents.

I. Motors, Pumps, Air Moving Equipment and Other Items with Factory Finish: Remove grease, oil, paint overspray, fireproofing overspray, gypsum board mud splatters and leave surfaces clean.

J. Surfaces used in a raised floor plenum for air distribution shall be vacuumed and mopped clean.

3.12 LUBRICATION

A. Lubricate all equipment at completion of Work. Furnish Owner with a written lubrication schedule for all equipment.

B. Extend grease fittings on all bearings to points of ready and easy accessibility.

C. Lubricate, as required, all motor and fan bearings, etc., before operation of any equipment.

D. Provide a final lubrication to all equipment requiring same immediately before turning over to Owner.

3.13 FINAL INSPECTION

A. The Contractor shall arrange for the all AHJ’s to make final inspections and correct all defects identified.

B. Prior to substantial completion the Contractor shall verify that the work is complete and that all incidental defects identified by the Architect/Engineer during construction have been corrected.

C. As the work nears completion, review the requirements of the Contract Documents, inspect the work and inform all parties involved in work to be corrected or completed before the project can be deemed substantially complete.

D. When the project is substantially complete, notify the Owner's Representative in writing of this fact, listing those items of work remaining incomplete, the reason for incompleteness, and the

anticipated date that all remaining work will be completed. Carry out own final inspection and be satisfied that the work is complete. Final inspection of the project will then be scheduled by the Owner's Representative.

E. The Owner's Representative reserves the right to cancel and reschedule the inspection in the event considerable more work remains to be completed or corrected than indicated in the written request for inspection.

F. All items not completed or found not complying with drawings or specifications by the Owner's Representative will be identified in an inspection report by Owner's Representative.

G. Correct all items on inspection report. Make the correction and initial and date each item on the report after corrections have been completed.

H. Verify that all defective work has been corrected before offering the system for re-inspection.

3.14 PROJECT CLOSE-OUT

A. Prior to requesting Owner's Representative's inspection for certification of substantial completion, complete the following and list known exceptions in request:

1. Obtain final inspections and approvals from all governmental jurisdictions that are required for the project.

2. Submit record drawings, maintenance manuals, warranties, and similar final record information.

3. Deliver tools, spare parts, extra stocks of materials, and similar physical items to the Owner.

4. Complete start-up, testing and demonstration of systems to the satisfaction of the Owner's Representative that the entire installation is complete, properly adjusted and is in proper operating condition.

5. Complete final cleaning requirements.

6. Complete all training requirements for Owner’s Staff.

7. Complete the Commissioning process.

END OF SECTION

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following hangers and supports for HVAC system piping and equipment:

1. Steel pipe hangers and supports.

2. Trapeze pipe hangers.

3. Metal framing systems.

4. Thermal-hanger shield inserts.

5. Fastener systems.

6. Pipe stands.

7. Equipment supports.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

2. Other Related Sections:

a. Section 230516 – EXPANSION FITTINGS AND LOOPS FOR HVAC.

b. Section 230548 – MECHANICAL SOUND AND VIBRATION CONTROL AND SEISMIC RESTRAINTS.

c. Section 233100 – HVAC DUCTS AND CASINGS.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 PRODUCT DATA: For the following:

A. Steel pipe hangers and supports.

B. Thermal-hanger shield inserts.

C. Powder-actuated fastener systems.

1.5 Shop Drawings: Signed and sealed by a qualified professional engineer**.** Show fabrication and installation details and include calculations for the following:

A. Trapeze pipe hangers. Include Product Data for components.

B. Metal framing systems. Include Product Data for components.

C. Pipe stands. Include Product Data for components.

D. Equipment supports.

E. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-- Steel." And AWS D1.3, "Structural Welding Code--Sheet Steel."

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

2. AWS D1.2, "Structural Welding Code--Aluminum."

3. AWS D1.3, "Structural Welding Code--Sheet Steel."

4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

5. ASME Boiler and Pressure Vessel Code: Section IX.

C. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

D. All products and installations shall comply with the following:

1. MSS-SP-58, latest edition.

2. MSS-SP-69, latest edition.

3. MSS-SP-127, latest edition.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to 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, manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with rubber or felt isolator for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, U-bolts, and padded hangers

(rubber or felt isolator).

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.

2. ERICO/Michigan Hanger Co.; ERISTRUT Div.

3. GS Metals Corp.

4. Power-Strut Div.; Tyco International, Ltd.

5. Thomas & Betts Corporation.

6. Tolco Inc.

7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with rubber or felt isolator for support of bearing surface of piping.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. Carpenter & Paterson, Inc.

2. ERICO/Michigan Hanger Co.

3. PHS Industries, Inc.

4. Pipe Shields, Inc.

5. Rilco Manufacturing Company, Inc.

6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.

b. Empire Industries, Inc.

c. Hilti, Inc.

2.7 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support piping.

B. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for installation without membrane penetration.

1. Manufacturers:

a. MIRO Industries.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and non-metallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.1 GENERAL PIPING INSTALLATION INSTRUCTIONS

A. Vertical Piping:

1. Secure vertical piping at sufficiently close intervals to keep the pipe in alignment and to support the weight of the pipe and its contents. Support stacks at their bases and at sufficient floor intervals to meet the requirements of local codes. Approved metal clamps or hangers shall be used for this purpose.

2. If vertical piping is to stand free of any support or if no structural element is available for support and stability during construction, secure the piping in its proper position by means of adequate stakes or braces fastened to the pipe.

B. Horizontal Piping, Suspended:

1. Support horizontal piping and fittings at sufficiently close intervals to maintain alignment and prevent sagging or grade reversal. Support each length of pipe by an approved hanger located not more than 18 inches from the joint. For 12" or larger pipe hangers shall be placed on both sides of the coupling when installing full 10 foot lengths.

2. Support terminal ends of all horizontal runs or branches and each change of direction or alignment with an approved hanger.

C. Installation Inside the Building:

1. Support horizontal pipe at each joint, i.e. 5' pipe should be supported at five foot intervals, 10' in length may be supported at ten foot intervals. Supports shall be adequate to maintain alignment and prevent sagging and shall be placed within eighteen inches of the joint.

2. For 12" and larger pipe hangers shall be placed on both sides of the coupling when installing full 10 foot lengths.

3. Adequate provision should be made to prevent shear and to resist thrust forces. Where components are suspended in excess of twelve (12) inches by means of non-rigid hangers they shall be suitably braced against movement horizontally.

4. Horizontal pipe and fittings five (5) inches and larger must be suitably braced to prevent horizontal movement. This must be done at every branch opening or change of direction by the use of braces, blocks, rodding or other suitable method, to prevent movement or joint separation.

D. Restraints

1. All installations must comply with local codes and instructions of architect/engineer.

2. Brace all pipe 2" and larger.

3. Exceptions:

   a. Braces may be omitted when the top of the pipe is suspended 12" or less from the supporting structure member and the pipe is suspended by an individual hanger.

4. Vertical Piping Attachment –

   a. Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents. Stacks shall be supported at

their bases and if over two stories in height at each floor by approved floor clamps. At vertical pipe risers, whenever possible, support the weight of the riser at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 30'-0" on center.

5. Horizontal Piping Supports –

    a. Horizontal piping shall be supported at sufficiently close intervals to prevent sagging. Trapeze hangers may be used. Pipe, where top of the pipe is 12" or more from supporting structure shall be braced on each side of a change of direction of 90 degrees or more.

6. Traverse bracing

    a. 40'-0"o.c. maximum spacing unless otherwise noted. One pipe section may act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed with 24" of the elbow or tee of similar size.

7. Longitudinal bracing

    a. 80'-0" o.c. maximum spacing unless otherwise noted.

8. Miscellaneous

    a. Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements.

3.2 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Floor support hanger devices or systems shall not be used.

G. Angle iron or Unistrut type wall brackets shall not be used.

H. Pipe saddle supports are not acceptable. Any (non-cooling tower condenser) water piping in direct contact with any part of a hanger is not acceptable.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.

3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 , if little or no insulation is required.

4. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

5. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.

6. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.

7. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

8. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

9. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Provide all-directional, resiliently supported vertical riser piping support/suspension from structure. Single point of support desired. Multiple points of support acceptable, but must be engineered, complete with detailed installation and adjustment instructions by supplier. Resilient anchors to preclude direct contact of piping with structure, yet provide a neutral point for expansion/contraction or piping. Mason ADA or VSG.

   a. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.

   b. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under ceiling installations with bar-joist construction to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.

    b. Medium (MSS Type 32): 1500 lb.

    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): not acceptable

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1- 1/4 inches.

3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.

4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.

b. Vertical (MSS Type 55): Mounted vertically.

c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.3 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

M. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation. Insulation to cover clamp.

b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

d. Include piping isolators for clamps in direct contact with piping.

2. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.

c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

4. Pipes NPS 8 and Larger: Include wood inserts.

5. Insert Material: Length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

7. Provide all vibration isolation of piping per specification Section 230548 – MECHANICAL SOUND AND VIBRATION CONTROL AND SEISMIC RESTRAINTS.

3.4 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.5 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be

shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.6 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.7 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.8 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.9 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.

4. Submit executed Warranties.

END OF SECTION

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 General Requirements Specification Sections, apply to this Section.
2. Other Related Sections:
   a. Section 230500 – COMMON WORK RESULTS FOR HVAC.
   b. Section 230700 – HVAC INSULATION.
   c. Section 233100 – HVAC DUCTS AND CASINGS.
   d. Section 23 – All Equipment sections.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

F. O&M manuals shall include a valve listing with service, numbers and location.

G. Submit valve chart for each piping system including valve tag number, location, function, and valve manufacturer's name and model number typewritten and reproduced on 8-1/2" x 11" bond paper (6) six copies. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule for review by Owner and Engineer.

1.3 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Coordinate and install identifying devices on ceiling tile/ceiling support grid to locate concealed items above ceiling with Facility Director. Identifying devices shall indicate what is concealed above the ceiling including the item's valve number/equipment number per the Owner's requirements.

1.4 SUBMITTALS AT PROJECT CLOSEOUT

A. Provide a valve chart and insert same in the operation and maintenance manual. Valve chart shall include valve location, valve service and valve number. Format shall be accepted by Engineer.

B. Charts and Diagrams shall be photographic or equal non-fading reproductions. For each page of valve schedule, provide glazed display frame with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grad sheet glass or 1/8" plexiglass.

C. Fire Suppression identification furnished as part of factory fabricated equipment, is specified as part of equipment assembly in other Division 21 sections

1.5 EXTRA MATERIALS

A. Furnish minimum of 5% extra stock of each identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional (5%) aluminum engraving blanks of all sizes used throughout project.

1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. W. H. Brady

B. Seaton

C. Westline

D. Allen Systems

E. Industrial Safety Supply Co.

2.2 EQUIPMENT LABELS

A. Aluminum Labels for Equipment:

1. Material and Thickness: Designed for etching or mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

2. Letter Color: Natural aluminum lettering

3. Background Color: Black.

4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

5. Minimum Label Size: Length and width vary for required label content, but not less than 2½" x 4" for control devices, dampers and valves; 4½" x 6" for equipment.

6. Minimum Letter Size: 1”

7. Fasteners: Stainless-steel self-tapping screws.

8. Manufacturer: Seaton Name Plate Co., Inc.

B. Label Content: Identify type of equipment. Include equipment's Drawing designation or unique equipment number.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules). Equipment schedule shall be included in operation and maintenance data.

2.3 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 200 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2

by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: Include identification of piping service using same designations as used on Drawings, pipe size, and an arrow indicating flow direction. Colored background shall conform to American National Standards Institute (ANSI) Standard A13.1:

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: At least 1-1/2 inches high.

3. Make: Seton Name Plate Company, Setmark or approved equal

2.5 DUCT LABELS

A. Material and Thickness: Aluminum with black enamel background

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

C. Minimum Label Size: Length and width vary for required label content, but not less than 4 by 1-1/2 inch.

D. Minimum Letter Size: 1 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

F. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2. Lettering Size: At least 1 inch high.

2.6 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard.

2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.

3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.7 VALVE TAGS

A. Valve Tags:

1. Tags shall be 1-3/4" by 3-1/4" laminated with two (2) 0.020" thick plastic sheets with matte finish and with a brass eyelet in the corner.

2. Typed information shall include appropriate alphanumeric code (prefixed with "H" for heating, etc.), system designation, the fluid in the pipe, and size and function of the valve.

3. Fasteners: Brass beaded chain around the valve and through the tag eyelet.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.8 VALVE SCHEDULE FRAMES

A. General: In each Mechanical room for each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. If valves are located outside of a mechanical room, provide a separate valve schedule with the description of where the valve(s) are located, in a separate display frame at the closest mechanical room. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass or 1/8 plexiglass.

2.9 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.

2. Fasteners: Reinforced grommet and wire or string.

3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT

OPERATE."

4. Color: Yellow background with black lettering.

2.10 Pipe identification chart

A. Identification Paint: Standard identification enamel of colors indicated below

PIPE IDENTIFICATION CHART

SYMBOL	DESCRIPTION	PIPE COLOR	MARKER BACKGROUND COLOR
SD	Storm Drain	Brown	Brown
F	Fire Protection	Red	Red
SAN	Sanitary Sewer	Green	White
CD	Condensate Drain	Black	White
Air	Compressed Air-instrumentation	Yellow	Yellow

PART 3 EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section “099000 - Painting”.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 30 feet along each run. Reduce intervals to 15 feet (4.5 m) in areas of congested piping and equipment.

7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

8. Pipe label lettering must be installed right side up for easy reading.

3.4 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. White lettering with green background:

a. Supply Air

2. White lettering with blue background:

a. Outside Air Intake

3. Black lettering with yellow background:

a. Return Air

b. Exhaust Air

c. Relief Air

4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 30 feet in each space where ducts are exposed or concealed by removable ceiling system.

C. Pipe label lettering must be installed right side up for easy reading.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.8 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.
2. Corrective Work:
    a. Remove, Repair and Reinstall, or Restore in Place damaged items.
    b. Replace damaged materials or items with New if repair not acceptable to Architect.
3. Provide product data to complete Operation & Maintenance Manuals.
4. Submit executed Warranties.

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING AND BALANCING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing and Balancing Methods

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

2. Other Related Sections:

a. Section 230500 – COMMON WORK RESULTS FOR HVAC.

b. Division 23 – Sections for equipment subjected to Testing, Adjusting, and Balancing.

C. Provide all labor, materials, tools and equipment, man-lifts, incidentals and services to carry out the work of this section. This Section includes TAB to produce design objectives for the following:

1. Air Systems:

a. Constant-volume air systems.

b. Variable-air-volume systems.

c. All Miscellaneous air moving devices.

d. Smoke exhaust system

1.2 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including sub-mains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Smoke-Extract System: A system that uses fans to exhaust smoke from the building with makeup air by infiltration through dedicated openings or fan powered.

J. Smoke-Extract Zone: A space within the building that is part of a zoned smoke-purge system.

K. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

L. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

M. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

N. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

O. TAB: Testing, adjusting, and balancing.

P. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

Q. Test: A procedure to determine correct operation and quantitative performance of systems or equipment.

R. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.3 SUBMITTALS

A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 6 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 60 days from Contractor's Notice to Proceed, submit 6 copies of the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 90 days from Contractor's Notice to Proceed, submit 6 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation". Include a complete (all design data filled in) set of report forms intended for use on this Project. Submit plan drawings of the systems keying individual devices to be balanced to the forms.

D. Certified TAB Reports: Submit two copies of final reports prepared, as specified in this Section, on approved forms certified by TAB firm. Submit plan drawings of the systems keying

individual devices balanced to the forms.

E. Instruments: A complete list of instruments proposed to be used, organized in appropriate categories, with data sheets for each. Show:

1. Manufacturer, model and serial number.

2. Description and use when needed to further identify the instrument.

3. Size or capacity range.

4. Latest calibration date and certificates of calibration.

F. Reports on “Examinations” specified in Part 3 of this Section.

G. Warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Qualifications: Engage a TAB firm certified by either AABC or NEBB. TAB Technicians shall have a minimum of 2 years experience and shall be certified by either the AABC or NEBB. All work shall be carried out under the supervision of the approved TAB technicians. The TAB firm shall submit certification of their current membership of either NEBB or AABC.

B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following.

a. Submittal distribution requirements.

b. The Contract Documents examination report.

c. TAB plan.

d. Work schedule and Project-site access requirements.

e. Coordination and cooperation of trades and subcontractors.

f. Coordination of documentation and communication flow.

C. TAB Report Forms: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", or similar by AABC.

D. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following.

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

2. Certify that TAB team complied with approved TAB plan and the procedures specified and

referenced in this Specification.

3. The TAB Contractor shall provide a NEBB or AABC Certificate of Conformance Certification (issued by the NEBB or AABC national office) for all work specified to confirm that the work has been carried out in accordance with the applicable NEBB or AABC Standards and Procedures, and the provisions of the NEBB or AABC Quality Assurance Conformance Certification Rules of Procedures.

E. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification", or similar by AABC.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

F. Reference Standards:

1. General mechanical systems: Comply with applicable procedures and standards of “National Standards for Field Measurements and Instrumentation, Total System Balance” by the Associated Air Balance Council (AABC).

2. NEBB – National Environmental Balancing Bureau

3. SMACNA – Sheet Metal and Air Conditioning Contractors National Association

4. ASHRAE – Handbook of Fundamentals

1.5 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion, however, TAB must be complete (air and water) prior to any Owner occupancy. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. System Readiness

1. The building envelope must be complete. All windows, doors, insulation, internal sheet finishes (such as gypsum wall board), cladding curtain walling, etc., must be installed so that the full specified performance of the envelope is achieved.

2. The specified system being tested and balanced must be complete. Balancing of partially completed systems will not be acceptable. Sub-systems may be tested and balanced separately, however, full/complete system testing is required. A mechanical sub-system is an air handling unit or fan together with its associated ductwork, terminal units, dampers, grilles and diffusers. Fans that operate together, such as AHU supply and return fans, or ventilation supply and exhaust fans serving common area shall be tested together as a common mechanical sub system.

3. The system must be running fault free.

4. Pressure testing and leak testing must be satisfactorily complete.

1.6 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Coordinate with the Construction Manager to produce a complete schedule for the TAB work including identifying all other aspects of the construction work by other trades upon which successful completion of the TAB work depends. All such dependencies shall be identified to allow proper sequencing of the required work. This schedule shall be prepared using the same computer software as the construction manager's schedule such that it can be added to the construction manager's schedule. Schedule shall be kept up-to-date. The schedule shall show, as a minimum:

1. Itemize all systems to be made operational, tested and balanced.

2. Identify the dates that system construction, cleaning, pressure testing and pre-testing will be completed.)

3. Identify interdependencies between systems that impact the TAB work. (For example, the heating system cannot be considered complete until the associated electrical power system and controls system are complete.

4. Each trade affected by and required for the TAB will be identified to ensure that the adequate time for their work is scheduled.

5. Identify the beginning and end of the TAB work for each building system.

6. All submittal dates for first, second, etc., submittals shall be clearly identified on the schedule. Required review and re-submittal dates shall also be included.

7. Requirements for tests and inspections required by AHJ and schedule for inspections completion, submission, and approval.

8. Include dates for training of Owner's staff.

C. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

D. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

E. Coordinate to determine positions of all dampers and control valves in accordance with the outlined sequences of operation.

F. In the event the TAB Contractor fails to coordinate with any party and costs are incurred for testing or retesting by any party as a result of this failure to coordinate, then the TAB Contractor shall be responsible for these costs.

G. TAB Meetings

1. The TAB Contractor's Project Manager shall attend regular commissioning meetings as required by the Construction Manager.

1.7 WARRANTY

A. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.

2. Systems are balanced to optimum performance capabilities within design limits.

B. During the warranty period of one year following substantial completion of TAB, seasonal testing and other deferred testing required shall be completed. The TAB firm shall coordinate this activity with the Owner and CM.

1. Approximately six months after completion of the TAB, the TAB firm shall return to the project site for Seasonal Testing and carryout a 72-hour run test of the complete building systems as described above. All sensors, devices, etc., shall be trended for this period and presented in graphical format at a useful resolution. The TAB firm shall make any adjustments necessary to the system to ensure all systems and systems components are operating in a correct manner and that design conditions are being maintained within the building without hunting. See also paragraph 3.4.F. of this Section.

2. In addition the TAB firm will return to the project approximately 10 months into the warranty period. During this visit(s) the TAB firm will review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning. The TAB firm will also interview facility staff and identify problems or concerns they have operating the building as originally intended. The TAB firm will make suggestions for improvements and will record these changes in the O&M manuals.

3. Deferred Testing: any system or item that cannot be properly tested during the construction period, due to, for example, weather conditions, shall be tested and balanced as far as possible. The TAB process shall be completed when conditions are favorable.

C. Final Acceptance

1. When all TAB work has been carried out, the building systems will be run in full automatic mode for a minimum period of 72 hours. All FMS sensors, devices, etc., shall be trend logged every minute and presented in a graphical format at a useful resolution. Final acceptance of the building systems will be contingent upon the system maintaining conditions within design tolerances without hunting for all of the 72 hours.

PART 2 PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents, and any subsequent revisions to these, to become familiar

with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

1. Contract Documents are defined in the General and Supplementary Conditions of Contract.

2. Verify that the necessary TAB devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, access doors and panels, manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing and for efficient system and equipment operation.

3. The lead TAB technician shall visit the job bi-weekly during construction to review the installation. Submit written report with suggestions for work to be performed or devices added to allow for proper balancing. This technician shall verify that Work, fittings, dampers, balancing devices, etc. are properly fabricated and installed as specified or shown and that proper balancing can be done.

B. Examine approved submittal data of HVAC systems and equipment and use in TAB process.

C. Examine Project Record Documents described in Division 1 Section "Project Record Documents" to ensure all TAB devices and final approved values are recorded.

D. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

E. Examine system and equipment installations to verify that they are complete and that testing, flushing, cleaning, and adjusting specified in individual Sections have been performed.

F. Examine system and equipment test reports.

G. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation. Perform this inspection as often as necessary to ensure all work is inspected prior to closing-in or concealment.

H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

I. Examine HVAC equipment to ensure that clean filters have been installed, coils, fans, dampers, plenums, ducts, etc. are clean, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

K. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine equipment for installation and for properly operating safety interlocks and controls.

O. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.

2. Dampers and valves are in the position indicated by the controller.

3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes all motorized dampers and valves and variable-air-volume terminals.

4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.

5. Thermostats and humidistats and sensors are located to avoid adverse effects of sunlight, drafts, and cold walls.

6. Sensors are located to sense only the intended conditions.

7. Sequence of operation for control modes is according to the Contract Documents.

8. Controller set points are set at indicated values.

9. Interlocked systems are operating.

10. Changeover from heating to cooling mode occurs according to indicated values.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.

2. Automatic temperature-control systems are operational.

3. Equipment and duct access doors are securely closed.

4. Balance, smoke, and fire dampers are open.

5. Isolating and balancing valves are open and control valves are operational.

6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 PRELIMINARY TESTING

A. The Mechanical Contractor will carry out a series of preliminary tests prior to the commencement of the TAB work of this contract. The intent of these tests is to demonstrate that the equipment operates properly in all modes. The TAB Contractor shall review these test reports and shall record from these reports any data required to carry out the work of this contract.

B. The Mechanical Contractor shall, as a minimum, carry out the tests, procedures and checks recommended by the equipment manufacturer and shall use the services of equipment manufacturer representatives to ensure the successful start-up and correct operation of all systems and equipment.

C. The TAB Contractor shall witness the above work and submit a deficiency report for any incomplete work that will affect the work of this Contract.

D. The TAB Contractor shall review and report on the following, as a minimum:

1. Installation of equipment

2. Installation of devices

3. Completeness of the ductwork and pipework installation

4. Installation of access doors or other access provisions for balancing devices, fire and smoke dampers

E. The TAB Contractor shall issue reports weekly during the Mechanical Contractors preliminary testing process. Any major deficiencies shall be reported daily.

F. The TAB Contractor shall witness the Mechanical Trade Contractors ductwork leakage and pipe pressure tests.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes and equipment cabinets for installation for test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes to prevent leakage and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-

controllers, and similar controls and devices, to show final settings.

D. Take readings as shown, specified and as required to demonstrate that all equipment terminal devices, controls, etc. are operating in accordance with scheduled or manufacturer's published ratings.

E. Make adjustments and/or corrections to equipment, air systems necessary for proper balancing.

F. Perform capacity checks of heating systems during the balancing period and again during design condition the following winter. Perform capacity checks for cooling systems during the balancing period and again during design the following summer.

G. Operating tests of heating and cooling apparatus, fans, and other equipment to be of not less than four hours duration, after stabilized operating conditions have been established. Capacities to be based on temperatures, air and water quantities measured during such tests.

H. Take and report testing and balancing measurements in inch-pound (IP) units.

I. The TAB Contractor shall confirm in the reports that deficiencies identified in Mechanical Services installation have been corrected prior to the commencement of the TAB work.

J. The specified systems shall be reviewed and inspected for conformance to the design documents. Testing, adjusting and balancing on each system shall be performed. The accuracy of measurements shall be in accordance with AABC or NEBB Standards. See below for tolerances on measured quantities.

K. Any deficiencies in the installation or performance of a system or component shall be reported in writing to both the Mechanical Trade Contractor and Consultant.

L. Should the results of balancing indicate that a mechanical system does not provide the design intent performance, then the Consultant, the Mechanical Contractor and the TAB Contractor shall review the results. The Consultant shall approve any corrections that are to be made by the Mechanical Contractor.

M. Should the results of balancing indicate that particular equipment does not provide the design intent performance then the Mechanical Contractor shall repair or replace the equipment. The TAB Contractor shall retest the equipment.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans, ducts and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems "as-built" duct layouts for use in recording measurements. Diagram shall show all equipment components and be cross-referenced to the TAB forms and reports.

C. For variable air-volume systems, develop a plan to simulate diversity, where system capacity (fans) is less than the sum of the outlet volumes.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return-and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path and proper operation. For automatic dampers, fan speeds, etc., work with controls contractor to establish and set required positions and values to maintain design airflow for different operating conditions specified.

I. Check airflow blockages and resolve.

J. Check condensate drains for proper connections and proper function.

K. Check for proper sealing of air-handling unit components

L. Adjust air quantities to following tolerance:

1. Each outlet of 200 cfm or less: Minus 0 to plus 10 percent of design.

2. All other outlets: Minus 0 to plus 5 percent.

3. Each room with multiple outlets: Minus 0 to plus 5 percent.

4. Each floor or major zone: Minus 0 to plus 5 percent.

5. Fans: Minus 0 to plus 5 percent.

6. Temperature readings: Within ½ degree F.

7. Equipment Pressure drops readings: 0.10 inch W.G.

8. Space pressure readings: 0.05 inch W.G.

M. Final Measurements of Air Quantity: Make final measurement of air quantity, after the air terminal has been adjusted to provide the optimum air patterns of diffusion. Adjust all diffusers and registers to eliminate drafts in all areas and result in uniform distribution.

N. Verify that ductwork, dampers, grilles, registers and diffusers have been installed per design.

O. Balance air handling systems at minimum outdoor air quantities. On completion of balancing procedures, retest at maximum outdoor air quantities.

P. Test and record motor voltage and amperage. Compare data with nameplate limits.

Q. Perform pitot tube traverse at all main and branch ducts. Compare traverse total with measured outlet total to determine actual duct leakage.

R. Test and adjust minimum outdoor and relief air volumes.

S. Test and record system static pressure profile for each air handling system at minimum outdoor air volume. Note coil (i.e. wet/dry) and filter condition of time of testing.

T. Test and record entering and leaving air conditions for each heat transfer coil and device. Simulate conditions to achieve winter or summer design patterns.

U. Test and record settings of motor thermal overload devices. Adjust settings where required.

V. Verify air flow measurement at all airflow monitoring stations. Coordinate positioning of dampers with the FMS Trade Contractor and the air monitoring station manufacturer.

W. Verify minimum outside air flow requirements. Coordinate damper position with the FMS Trade Contractor.

X. Adjust duct distribution to obtain specified air quantities. At least one zone balancing damper shall be completely open. Multi diffuser/grille branch ducts shall have at least one volume damper completely open.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.

b. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.

c. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters

3. Measure static pressures entering and leaving other devices, such as sound traps, under final balanced conditions to create a complete static pressure profile for the system.

4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.

5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes. Provide sheaves and belts for a minimum of one change per fan.

6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor

amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, sub-main ducts, and branch ducts to indicated airflows within specified tolerances.

1. Where sufficient space in sub-main and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust and measure to indicated airflows within specified tolerances.

C. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch duct volume dampers rather than dampers at air terminals where relevant.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR TYPICAL VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.

2. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.

3. Select the terminal that is most critical for the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

4. Measure total system airflow. Adjust to within indicated design airflow tolerances.

5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Test and record the amplified velocity pressure signal and inlet static pressure for maximum and minimum for each terminal unit.

7. Re-measure the return airflow to the fan while operating at maximum return airflow. Balance the return-air ducts and inlets as described for constant-volume air systems. Where the return fan is controlled by static pressure sensor measure static pressure at the most critical terminal unit and adjust the static-pressure controller to ensure that adequate static pressure is maintained at the most critical unit.

8. Record the final fan performance data.

9. Test and measure supply and return fan tracking by total air flow measurements at 50%, 80% and 100% of maximum supply flow.

10. Refer to paragraph “Procedures For Outside Air Volume And Space Pressurization Measurements and Adjustments for further information and to determine corresponding return fan performance.

3.8 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.

2. Motor horsepower rating.

3. Motor rpm.

4. Efficiency rating.

5. Nameplate and measured voltage, each phase.

6. Nameplate and measured amperage, each phase.

7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.9 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic

temperature-control system.

3.10 PROCEDURES FOR OUTSIDE AIR VOLUME AND SPACE PRESSURIZATION MEASUREMENT AND ADJUSTMENTS

A. General

1. Outside air is introduced to the building via the air handling units for 3 functions:

   a. Space pressurization

   b. Exhaust system make-up air

   c. Ventilation air for occupants

2. Air is removed from the building by:

   a. Exfiltration due to over pressurization

   b. Return fans in air handling systems which spill some of this return air.

   c. Miscellaneous building exhaust systems including, but not limited to, bathroom exhaust, retail exhaust, combustion air, air craft loading walkway pressurization, etc.

3. The building shall be positively pressurized at all times. Refer to building air balance information on the drawings.

B. Test and adjust so that space pressurization is achieved in the following operating modes:

1. Unoccupied with all exhaust systems off.

2. Unoccupied with all fixed rate, 24/7 exhaust systems operating.

3. Unoccupied with variable run-time exhaust systems operating, in addition to the systems in paragraph (2) above. Begin with none of these variable run-time systems operating, start one at a time and ensure positive pressurization is obtained and stability maintained before starting the next. Repeat test for shutdown of these systems, one at a time.

4. Simulate building occupancy by adjusting the CO2 measured values to test that the ventilation air quantity control is correctly operational. Ensure system air balance maintains positive building pressurization under varying values of return air CO2 levels. Test for 3 different CO2 values.

5. Where space pressure sensors and controls are provided ensure specified differential is achieved.

C. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.

D. Measure, adjust, and record the pressurization of each room and each zone by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions: air flow is used as the

design criteria for space pressurization, except where pressure differential control is specified.

E. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.

3.11 PROCEDURES FOR VIBRATION MEASUREMENTS

A. Use a vibration meter meeting the following criteria:

1. Solid-state circuitry with a piezoelectric accelerometer.

2. Velocity range of 0.1 to 10 inches per second.

3. Displacement range of 1 to 100 mils.

4. Frequency range of at least 0 to 1000 Hz.

5. Capable of filtering unwanted frequencies.

B. Calibrate the vibration meter before each day of testing.

1. Use a calibrator provided with the vibration meter.

2. Follow vibration meter and calibrator manufacturer's calibration procedures.

C. Perform vibration measurements when other building and outdoor vibration sources are at a minimum level and will not influence measurements of equipment being tested.

1. Turn off equipment in the building that might interfere with testing.

2. Clear the space of people.

D. Perform vibration measurements after air and water balancing and equipment testing is complete.

E. Clean equipment surfaces in contact with the vibration transducer.

F. Position the vibration transducer according to manufacturer's written instructions and to avoid interference with the operation of the equipment being tested.

G. Measure and record vibration on rotating equipment over 3 hp.

H. Measure and record equipment vibration, bearing vibration, equipment base vibration, and building structure vibration. Record velocity and displacement readings in the horizontal, vertical, and axial planes.

1. Fans and HVAC Equipment with Fans

a. Fan Bearing: Drive end and opposite end.

b. Motor Bearing: Drive end and opposite end.

c. Equipment Casing: Top and side.

d. Equipment Base: Top and side.

e. Building: Floor.

f. Ductwork: To and from equipment after flexible connections.

g. Piping: To and from equipment after flexible connections.

2. HVAC Equipment

a. Compressor Bearing: Drive end and opposite end.

b. Motor Bearing: Drive end and opposite end.

c. Equipment Casing: Top and side.

d. Equipment Base: Top and side.

e. Building: Floor.

f. Piping: To and from equipment after flexible connections.

I. For equipment with vibration isolation, take floor measurements with the vibration isolation blocked solid to the floor and with the vibration isolation floating. Calculate and report the differences.

J. Inspect, measure, and record vibration isolation:

1. Verify that vibration isolation is installed in the required locations.

2. Verify that installation is level and plumb.

3. Verify that isolators are properly anchored.

4. For spring isolators, measure the compressed spring height, the spring OD, and the travel-to-solid distance.

5. Measure the operating clearance between each inertia base and the floor or concrete base below. Verify that there is unobstructed clearance between the bottom of the inertia base and the floor.

3.12 PROCEDURES FOR SOUND-LEVEL MEASUREMENTS

A. Perform sound-pressure-level measurements with a sound meter complying with IEC 651, Type 1 or 2, set to an “A” weighting and “slow” meter response.

B. Calibrate sound meters before each day of testing. Use a calibrator provided with the sound meter complying with ANSI S1.40 and that has NIST certification.

C. Use a microphone that is suitable for the type of sound levels measured. For areas where air velocities exceed 100 fpm (0.51 m/s), use a windscreen on the microphone.

D. Perform sound-level testing after air and water balancing and equipment testing are complete.

E. Close windows and doors to the space.

F. Perform measurements when the space is not occupied and when the occupant noise level from other spaces in the building and outside are at a minimum.

G. Clear the space of temporary sound sources so unrelated disturbances will not be measured. Position testing personnel during measurements to achieve a direct line-of-sight between the sound source and the sound-level meter.

H. Take sound measurements at a height approximately 60 inches above the floor and at least 36 inches from a wall, column, and other large surface capable of altering the measurements.

I. Take sound measurements in dBA and in each of the 8 unweighted octave bands in the frequency range of 63 to 8000 Hz.

J. Take sound measurements with the HVAC systems off to establish the background sound levels and take sound measurements with the HVAC systems operating.

1. Calculate the difference between measurements. Apply a correction factor depending on the difference and adjust measurements.

K. Perform sound testing for each occupied space. For each space tested, select a measurement location that has the greatest sound level. When testing multiple locations for each space type, select at least one location that is near and at least one location that is remote from the predominant sound source.

3.13 PROCEDURES FOR SMOKE EXHAUST SYSTEM TESTING

A. Before testing smoke-extract systems, verify that construction is complete and verify the integrity of each smoke extract zone boundary. Verify that windows and doors are closed and that applicable safing, gasket, and sealants are installed. Verify the boundaries of each smoke extract zone and the proper operation of all related dampers. Report deficiencies and postpone testing until after the reported deficiencies are corrected.

B. Measure and record wind speed and direction, outside-air temperature, and relative humidity on each test day.

C. Measure, adjust, and record airflow of each smoke extract system with all fans that are a part of the system operating as intended by the design.

D. Measure, adjust, and record the airflow of each fan and static pressure profile as specified above. For ducted systems, measure the fan airflow by duct Pitot-tube traverse. For non-ducted fans or inlets/outlets provide temporary ducts/hoods to conduct measurement.

E. After air balancing is complete, perform the volume testing for each smoke extract zone in the system.

1. Each system shall provide 6 ach-1 of exhaust from its zone above and below ceilings. Make-up air shall be introduced as shown on the drawings. Refer to drawings for smoke extract volumes.

F. Operational Tests:

1. Check the proper activation of each zoned smoke extract system in response to manual start signal from the smoke control panel (scp).

2. Check and record the proper operation of fans, dampers, make-up air path devices, and related equipment for each separate zone of the smoke extract system. Include test of the following:

   a. Auxiliary functions to achieve the smoke extract system configuration such as changes or override of normal operating fan conditions and temperature-control functions, damper positions and set points.

   b. Test to verify that the system functions while operating under both normal and standby power.

G. Conduct additional tests required by authorities having jurisdiction. Unless required by authorities having jurisdiction, perform testing without the use of smoke or products that simulate smoke.

H. Prepare a complete report of observations, measurements, and deficiencies.

3.14 PROCEDURES FOR INDOOR-AIR QUALITY MEASUREMENTS

A. After air balancing is complete and with HVAC systems operating at indicated conditions, perform indoor-air quality testing.

B. Observe and record the following conditions for each HVAC system:

1. The distance between the outside-air intake and the closest exhaust fan discharge, flue termination, or vent termination.

2. Specified filters are installed. Check for leakage around filters.

3. Cooling coil drain pans have a positive slope to drain.

4. Cooling coil condensate drain trap maintains an air seal.

5. Evidence of water damage.

6. Insulation in contact with the supply, return, and outside air is dry and clean.

C. Make measurements at multiple locations served by the system if required to satisfy the following:

1. At least one test location per air handling unit.

2. Where air handling units serve multiple rooms conduct tests for a minimum of three spaces per air handling unit.

D. Measure and record the following indoor conditions for each location specified two times at two-hour intervals, and in accordance with ASHRAE 113:

1. Temperature.

2. Relative humidity.

3. Air velocity.

4. Concentration of carbon dioxide (ppm).

5. Concentration of carbon monoxide (ppm).

6. Nitrogen oxides (ppm).

7. Formaldehyde (ppm).

3.15 FACILITY MANAGEMENT SYSTEM VERIFICATION

A. Verify that controllers are correctly wired, calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

D. Check free travel and proper operation of control devices such as damper and valve operators.

E. Check the sequence of operation of control devices in all modes of operation. Note device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

F. Check the interaction of electrically operated switch transducers.

G. Check the interaction of interlock and lockout systems.

H. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or non-grounded power supply.

I. Note operation of electric actuators using spring return for proper fail-safe operations.

J. Upon completion of the Building Control System completely check out and field test hardware and software to assure that the complete system performs in accordance with the approved sequences of operation. Test all equipment and control functions for proper automatic and manual activation. Test each system and zone for proper operation through its complete heating and cooling cycles.

K. Include the specific tests and control functions listed below:

1. Full point check.

2. Smoke extract strategy.

3. Manual activation of each fan and smoke and fire/smoke damper.

4. System priorities and overrides.

5. Trouble, monitoring and annunciation capability.

6. Power resumption response.

7. System failure response, including emergency power operation.

8. All user notification messages.

9. All controls loops shall be verified as operating in a stable manner with no hunting prior to the start of the commissioning process.

3.16 TOLERANCES

A. Set HVAC system airflow and water flow rates within the tolerances specified above.

3.17 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.18 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:

1. Fan curves with operating points.

2. Manufacturers' test data.

3. Field test reports prepared by system and equipment installers.

4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.

2. Name and address of TAB firm.

3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Fan drive settings including settings and percentage of maximum pitch diameter.
    e. Settings for supply-air, static-pressure controller.
    f. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.

4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:
   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Sheave make, size in inches, and bore.
   i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
   j. Number of belts, make, and size.
   k. Number of filters, type, and size.
2. Motor Data
   a. Make and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data
   a. System identification.

b. Location.

c. Make and type.

d. Model number and size.

e. Manufacturer's serial number.

f. Arrangement and class.

g. Sheave make, size in inches, and bore.

h. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data

a. Make and frame type and size.

b. Horsepower and rpm.

c. Volts, phase, and hertz.

d. Full-load amperage and service factor.

e. Sheave make, size in inches, and bore.

f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

g. Number of belts, make, and size.

h. Test Data (Indicated and Actual Values):

i. Total airflow rate in cfm.

j. Total system static pressure in inches wg.

k. Fan rpm.

l. Discharge static pressure in inches wg.

m. Suction static pressure in inches wg.

H. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data

a. System and air-handling unit number.

b. Location and zone.

c. Traverse air temperature in deg F.

d. Duct static pressure in inches wg.

e. Duct size in inches.

f. Duct area in sq. ft.

g. Indicated airflow rate in cfm.

h. Indicated velocity in fpm.

i. Actual airflow rate in cfm.

j. Actual average velocity in fpm.

k. Barometric pressure in psig.

I. Air-Terminal-Device Reports:

1. Unit Data

a. System and air-handling unit identification.

b. Location and zone.

c. Test apparatus used.

d. Area served.

e. Air-terminal-device make.

f. Air-terminal-device number from system diagram.

g. Air-terminal-device type and model number.

h. Air-terminal-device size.

i. Air-terminal-device effective area in sq. ft.

2. Test Data (Indicated and Actual Values)

a. Airflow rate in cfm.

b. Air velocity in fpm.

c. Preliminary airflow rate as needed in cfm.

d. Preliminary velocity as needed in fpm.

e. Final airflow rate in cfm.

f. Final velocity in fpm.

g. Space temperature in deg F.

J. Vibration Measurement Reports

1. Date and time of test.
2. Vibration meter manufacturer, model number, and serial number.
3. Equipment designation, location, equipment, speed, motor speed, and motor horsepower.
4. Diagram of equipment showing the vibration measurement locations.
5. Measurement readings for each measurement location.
6. Calculate isolator efficiency using measurements taken.
7. Description of predominant vibration source.

K. Sound Measurement Reports: Record sound measurements on octave band and dBA test forms and on an NC or RC chart indicating the decibel level measured in each frequency band for both "background" and "HVAC system operating" readings. Record each tested location on a separate NC or RC chart. Location shall be noted and keyed to plans. Record the following on the forms:

1. Date and time of test. Record each tested location on its own NC curve.
2. Sound meter manufacturer, model number, and serial number.
3. Space location within the building including floor level and room number.
4. Diagram or color photograph of the space showing the measurement location.
5. Time weighting of measurements, either fast or slow.
6. Description of the measured sound: steady, transient, or tonal.
7. Description of predominant sound source.

L. Indoor-Air Quality Measurement Reports for Each HVAC System:

1. HVAC system designation.
2. Date and time of test.
3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
4. Room number or similar description for each location.
5. Measurements at each location.
6. Observed deficiencies.

M. Instrument Calibration Reports

1. Report Data
   a. Instrument type and make.
   b. Serial number.

c. Application.

d. Dates of use.

e. Dates of calibration.

N. Smoke Exhaust System Reports

1. Smoke Exhaust zone and all fans used in extract and make-up.

2. Date and time of test.

3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.

4. Air volume removed from zone, above ceiling and below ceiling.

5. Make-up air volume delivered by active make-up air systems.

6. Fan speed, amp draw for each fan.

7. Damper positions for all dampers, in zone being extracted and other zones.

8. Make-up air door position.

9. Correct functioning of smoke extract control panel for interlocks for each zone activation.

O. Outside Air Volume and Space Pressurization Reports

1. Report by HVAC zone, i.e. air handling unit area served including all exhaust fans.

2. Outside air volumes used in the system in each operating mode specified to be tested.

3. Exhaust air volumes of each fan operated in test.

4. Positive pressurization achieved in each operating mode with each exhaust fan operating with sequential starts.

3.19 INSPECTIONS

A. Initial Inspection

1. After testing and balancing are complete, and the 72-hour test has been successfully completed, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report. Advise Owner 5 days in advance of check tests.

2. Randomly check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.

b. Measure water flow of at least 5 percent of terminals.

c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.

d. Measure sound levels at 15 locations.

e. Measure space pressure of at least 10 percent of locations.

f. Verify that balancing devices are marked with final balance position.

g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner.

2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.

3. Owner shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to 15 percent of the total measurements recorded in the TAB process.

4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 15 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

6. Tab firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.

7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.20 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.21 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.

4. Submit executed Warranties.

END OF SECTION

SECTION 230713 - DUCT INSULATION

PART 1 PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Materials

2. Piping Insulation

3. Generator related insulation

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

2. Other Related Sections:

a. Section 230529 – HANGERS AND SUPPORTS FOR HVAC.

b. Section 230553 – IDENTIFICATION FOR HVAC.

c. Section 233100 – HVAC DUCTS AND CASINGS.

1.2 DESCRIPTION

A. Provide and install complete systems of insulation for all new piping and equipment as shown and specified.

1.3 QUALITY ASSURANCE

A. Insulation materials and accessories furnished and installed hereunder shall, where required, be accompanied by manufacturers' current submittal or data sheets showing compliance with applicable specifications.

B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.

C. Insulation materials, including all weather and vapor barrier materials, closures, hangers, fitting covers and other accessories, shall be furnished and installed in strict accordance with project drawings, plans and specifications. Work not in accordance with these Specifications, damaged, or incorrectly installed shall be removed and/or repaired and replaced as directed.

D. Mockups:

1. Before installing piping systems, build mockups representing primary and secondary chilled water systems in steel, copper, and PP piping with insulation for the following:

    a. Horizontal piping in individual hangers, trapeze hanger, metal framing system, and thermal hanger shield inserts.

    b. Vertical piping.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

1.4 REFERENCE STANDARDS:

A. Thermal insulation materials shall meet the property requirements of one or more of the following specifications as applicable to the specific product or use:

1. American Society for Testing of Materials Specifications:

    a. ASTM C 547, "Standard Specification for Mineral Fiber Pipe Insulation"

    b. ASTM C 553, "Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications"

    c. ASTM C 585, "Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)"

    d. ASTM C 612, "Standard Specification for Mineral Fiber Block and Board Thermal Insulation"

    e. ASTM C 795, "Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel"

    f. ASTM C 1136, "Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation"

    g. ASTM C 1290, "Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts"

    h. ASTM G 21, "Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi" (fungi resistance section only)

    i. ASTM G 22, "Practice for Determining Resistance of Plastics to Bacteria (bacteria resistance section only)

    j. ASTM - American Society for Testing and Materials E-84 Standard Test Method for Surface Burning Characteristics of Building Materials.

2. Federal Specification: a. HH-I-558B, "Insulation Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type" (Obsolete)

3. ASC - Adhesive and Seal Council
    a. ASC-A-7001C Standards for Adhesives for Duct Liner.
4. SMACNA - Sheet Metal and Air Conditioning Contractors National Association Inc.
    a. Duct Liner Application Standard.
    b. Mechanical Fastener Standard HF-1.
5. UL - Underwriters Laboratories Inc.
    a. 723 Tunnel Test.
6. NAIMA - North American Insulation Manufacturer's Association "Fibrous Glass Duct Linear Standard"
7. Requirements of Regulatory Agencies:
    a. NFPA - National Fire Protection Association
        1). 90A, Air Conditioning and Ventilating Systems.
        2). 90B, Warm Air Heating and Air Conditioning Systems.

B. Insulation systems shall include:
1. Piping insulation, jacketing and accessories.
2. Equipment insulation and jacketing and coating and accessories.
3. Ductwork insulation and jacketing lining and accessories.
4. Firestopping
5. Accessories

1.5 SUBMITTALS

A. Manufacturer's Data indicating product description and installation instructions.
1. Insulation Materials.
2. Adhesives.
3. Fastening Devices.
4. Vapor Barriers.
5. Jackets.

B. Submit schedules of types, thickness, jacketing and accessories for application and location.

C. Submit materials safety sheets for all adhesives.

1.6 DEFINITIONS

A. The term "mineral fiber" as defined by the above specifications includes fibers manufactured of glass, rock, or slag processed from a molten state, with or without binder.

1.7 SYSTEM PERFORMANCE

A. Insulation materials furnished and installed under this specification should meet the minimum requirements of ASHRAE 90.1-2004. However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor).

B. Insulation materials furnished and installed hereunder shall meet the fire hazard requirements of any one of the following specifications:

1. American Society for Testing of Materials ASTM E 84

2. Underwriters' Laboratories, Inc UL 723

3. National Fire Protection Association NFPA 255

C. Show ratings on products, cartons, labels, etc. or verify by report from an approved independent testing laboratory.

1. Flamespread: Minimum 25

2. Fuel contributed and smoke developed: Maximum 50

D. Flame proofing treatments subject to deterioration due to moisture or humidity are not acceptable.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Maintain manufacturer’s recommend temperatures and conditions for tapes, adhesives, and cements.

1.9 DELIVERY AND STORAGE OF MATERIALS

A. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.

B. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.

C. If any insulation material has become wet because of transit or job site exposure to moisture or water, the contractor shall not install such material, and shall remove it from the job site.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Fiberglass Insulation:

1. The Manville Corp.
2. Owens-Corning Fiberglass Corp.
3. Certain-Teed

B. Flexible Elastomeric Insulation:

1. The Manville Corp.
2. Armstrong
3. Halstead

C. Calcium Silicate Insulation:

1. The Manville Corp.
2. Owens-Corning Fiberglas Corp.
3. Pabco.

D. Cellular Foam Glass Insulation:

1. Pittsburgh Corning Corporation.

E. Styrofoam Insulation: Dow FR or FB.

F. Fire Wrap:

1. Unifrax.
2. 3M.
3. Thermal Ceramics.

G. Fiberglass Pre-molded Pipe Fitting Covers Insulation:

1. Insul-Coustic/Birma Products Co.
2. Childers Products Co.
3. Speedline
4. Zeston

H. Adhesives

1. Benjamin Foster
2. Insul-Coustic

3. 3M

4. Childers Products Co.

5. Miracle

I. Weld Pins:

1. Nelson Stud Welding Div. TRW Inc.

2. Duro-Dyne Corporation

3. Miracle

4. Tuff-Weld

5. Grip Nail

J. Jacketing

1. All service jacketing by insulation manufacturer

2. PVC jacketing by insulation manufacturer.

2.2 MATERIALS

A. Jackets and Coverings:

1. 0.016-inch stainless steel smooth surface with moisture barrier.

2. 0.016-inch aluminum smooth surface with moisture barrier.

3. All service jacket laminate (ASJ):

a. Paper free vapor retarder jacket.

b. Double adhesive longitudinal jacket lap seal, two component butt strip seal. (SSL)

4. PVC Plastic Jacket

a. Jacket: (ASTM C921). One piece molded type fitting covers and sheet material, off white color (Manville Zeston 2000)

b. Minimum Service Temperature: -40 degrees F.

c. Maximum Service Temperature: 150 degrees F.

d. Moisture Vapor Transmission: ASTM E96; 0.002 perm inches

e. Maximum Flame Spread: ASTM E84; 25.

f. Maximum Smoke Developed: ASTM E84; 50.

g. Thickness: 20 mil

h. Connections of brush-on welding adhesive or pressure sensitive color matching vinyl tape.

5. Canvas Jacket: UL listed fabric, 6 oz/sq yd (220g/sq m), plain weave cotton treated with dilute fire retardant lagging adhesive.

B. Adhesives and Coatings:

1. Foster Product Names and Figure Numbers or equal as follows:

a. Lagging Adhesive: 30-36 UL label.

b. Vapor-Barrier Coating: Tite-fit 30-35 UL label.

c. Vaporseal Adhesive: Spark-fas 85-20 UL label.

d. Duct Adhesive: Spark-fas 85-20 UL label.

e. Outdoor Mastic: Monolar mastic 60-38 UL label.

C. Wire, Banding, and Fastening Devices:

1. Manufacturers: Pabco, Marathon, Vimesco, Ideal or Venture.

2. Tie Wire: 18 gauge stainless steel with twisted ends on maximum 12 inch centers.

3. Bands: 3/4-inch nominal width wing seals, of minimum thickness as follows:

a. Aluminum: 0.007 inch indoors. Where exposed to weather, 0.020 inch.

b. Stainless Steel: 0.010 inch.

4. Staples: Outward clinching type of corrosion-resistant steel.

5. Weld pins to Support and Fasten Duct Insulation: Minimum 1/8- speed washer or integral flange of minimum 1-3/8 inches diameter.

D. Piping Insulation: Refer to types below and schedule.

1. Where type is not shown, provide: Type P-1 for service up to 350 degrees F.

2. Type P-1: Fiberglass:

a. Molded: Heavy density fiberglass, maximum 0.23 K factor at 75 degrees F mean temperature. 0.02 perms, maximum 500 degrees F. Paper free vapor barrier all service jacket (ASJ), self-seal double adhesive lap (SSL), vapor sealed.

3. Type P-2: Fiberglass:

a. As Type P-1 and with aluminum or stainless steel jacketing

4. Type P-3:

a. As Type 1 and with PVC jacketing

5. Type P-4: Calcium silicate:

    a. Rigid, molded asbestos free, 0.40 K factor at 300 degrees F. Maximum service 1200 degrees F, all service jacket (ASJ), 14 PCF, not damaged by water compressive strength of 100 psi to produce 5% compression, 100 psi.

6. Type P-5: Flexible elastomeric insulation:

    a. K=0.28 at 75 degrees F mean temperature, 6 PCF density, 0.20 perm-in. maximum, water absorption one percent volume, ten percent weight.

7. Type P-6: Trap and riser protection:

    a. Polyurethane 1-inch Dow TrymEr 2000 styrofoam, all service or all purpose jacket, vapor-sealed.

8. Type P-7: Cellular glass:

    a. ASTM C552.

    b. Inorganic, incombustible, cellulated glass with annealed, rigid, hermetically sealed cells.

    c. Two-piece, rigid preformed closed cell foamglass pipe insulation with fire resistant jacket.

    d. 7.5pcf density, 0.00 perm-in, water absorption 0.2% volume, 90psi compressive strength

    e. Thermal conductivity

        1). 0.29 btu-in/hr-sf-ºF @ 75ºF

        2). 0.28 btu-in/hr-sf-ºF @ 50ºF

    f. Foster 81-84 Cellular Glass and Urethane Adhesive/Sealant or equal.

9. Insulation for fittings and valves:

    a. Pre-molded PVC fiberglass fitting covers or radial mitered sections of pipe insulation type specified.

    b. For piping insulated with materials other than fiberglass use radial mitered sections of pipe insulation or built-up pipe insulation and finishing cement.

E. Ductwork, Casings, Housings and Plenums Insulation: Type as scheduled for services listed.

1. Type DW: Flexible fibrous glass blanket with vapor barrier.

    a. 1-DW: Manville "Standard" Microlite, 1-1/2 inch thick duct wrap. Thermal conductivity at 75 degrees F mean, K=0.26 BTU/hr.-degrees F/inch installed "R" 4.5, 1 pcf.

    b. 2-DW: Manville "Standard" Microlite, 2 inch thick duct wrap, thermal conductivity at 75 degrees F mean, K=0.26 BTU/hr-degrees F/inch installed "R" 6.0, 1 pcf.

c. 3-DW: Manville "Spin-Glass" 1-1/2 inch thick rigid board duct wrap, 4.25 pounds per cubic foot, glass cloth and mastic. Thermal conductivity at 75 degrees F mean, K=0.23 BTU/hr.-degrees F/inch.

d. 4-DW: Manville "814 Spin-Glass" 2 inch thick rigid board duct wrap, 4.25 pounds per cubic foot, glass cloth and mastic, aluminum paint. Thermal conductivity at 75 degrees F mean, K=0.23 BTU/hr.-degrees F/inch.

e. Factory applied jacket on each of the above:

1). Foil-scrim-kraft laminate (FSK):

2). Aluminum foil facing.

3). Glass scrim reinforcing.

4). Kraft paper backing.

5). Maximum vapor permanence: 0.02 perms.

6). One 2 inch flange, vapor sealed.

f. Minimum insulation as noted above and to comply with local energy code. In the absence of more stringent requirements: minimum R-value R-6 for ductwork indoors and R-8 for ductwork outdoors.

2. Type AL: Flexible acoustic and thermal duct liner

a. CertainTeed ToughGard Duct Liner, Schuller Permacote Linacoustic Standard coated flexible acoustic duct liner or equivalent, complying with N.B.F.U. Pamphlet 90-A requirements and ASTM C 1071 Type I requirements.

b. Density: 1.35 lb./cu.ft. minimum to 3.3 lb./cu.ft. maximum; as per ASTM C 1071 Type 1 requirement.

c. Thickness: 1 1/2" or more as indicated.

d. Have a potential heat value not exceeding 3500 btu/lb when tested in accordance with NFPA 259 and meeting the classification of "Limited Combustible" as defined by NFPA 90A.

e. Maximum rated air velocity not less than 5000 FPM when tested in accordance with ASTM C 1071.

f. Resistant to microbial growth using a "no growth criteria" when tested in accordance with ASTM C 1138, G 21 and G22.

g. Sound absorption coefficients and NRC shall meet or exceed the following when tested in accordance with ASTM C 423 using an "A" mounting.

h. Fire retardant adhesive: As recommended by lining manufacturer and complying with ASTM C 916.

3. Absorption Coefficients at Octave Band Frequencies:

Thickness	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	NRC
1”	.07	.28	.72	.90	.93	.93	.70
2"	.17	.76	1.00	1.00	.95	.96	.95

4. Type AW: Flexible Acoustic Duct Wrap (Lagging)
   a. Sound control lagging material shall be
      1). Kinetics Noise Control, Inc. Model KNM-100ALQ
      2). All Noise Control, Model ANC-WB21
      3). eNoise Control Model DL-10-LAG
      4). Noise S.T.O.P. Model B-10 Lag/NS QFA-9

   b. The duct wrap acoustical barrier shall be constructed of 0.12” thick mass loaded, limp vinyl sheet bonded to a thin layer of reinforced aluminum foil on one side. The barrier shall have a nominal density of 1.0-psf and shall have a minimum STC rating of 28.

   c. The barrier shall exhibit minimum flammability ratings of 0.0-seconds for flame-out and after-glow, and 0.2” for char length when tested in accordance with Federal Test Std. No. 191-5903. When tested for Surface Burning Characteristics per ASTM E84, the barrier will have a Flame Spread Index of no more than 10 and a Smoke Development Index of no more than 40.

   d. The barrier shall have a minimum thermal conductivity (K) value of 0.29 and a rated service temperature range of -40°F to 220°F.

   e. The decoupling layer shall be a combination of 1.0” or 2.0” as indicated on drawings fiber glass batting, non-woven porous scrim-coated glass cloth, quilted together in a matrix of 4.0” diamond stitch pattern which encapsulates the glass fibers.

   f. The composite material shall be fabricated to include a nominal 6” wide barrier overlap tab extending beyond the quilted fiber glass to facilitate a leak-tight seal around field joints. Nominal barrier width 54”, nominal fiber glass batt decoupler width 48”.

   g. Resistant to microbial growth using a “no growth criteria” when tested in accordance with ASTM C 1138, G 21 and G22.

   h. Fire retardant adhesive or mastic: As recommended by lining manufacturer and complying with ASTM C 916.

   i. Sound absorption coefficients and NRC shall meet or exceed the following when tested in accordance with ASTM C 423 using an “A” mounting.

5. Absorption Coefficients at Octave Band Frequencies:

Thickness	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	STC

1”	3	6	7	18	24	27	28
2"	2	10	16	27	35	34	33

F. Equipment Insulation Types:

1. Type E-1:
    a. Fiberglass board.
    b. Thickness as scheduled.
    c. 3 pounds per cubic foot density.
    d. Foil-scrim-kraft facing.
    e. Vapor-sealed.
    f. K=0.23 at 75F mean.
    g. Aluminum jacket banded in place.
    h. Segmented or scored for curved surface.
2. Type E-2:
    a. Fiberglass board.
    b. Thickness as scheduled.
    c. 6-pound per cubic foot density.
    d. Segmented or scored for curved surfaces.
    e. K=0.22 at 75F mean.
    f. Foil-scrim-kraft facing.
    g. Vapor-sealed.
    h. Aluminum jacket banded in place.
3. Type E-3:
    a. Elastomeric closed cell.
    b. Thickness as scheduled.
    c. Aluminum or stainless steel jacket banded in place.
4. Type E-4:

a. Calcium-silicate blocks.

b. Thickness as scheduled.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. Provide insulation as required for all packaged equipment whether furnished with equipment or not.

2. Before applying insulation:

a. Test piping and ductwork for tightness; obtain review and acceptance.

b. Clean surfaces of dust, grease, rust, extra flux and foreign matter.

c. Ensure surface is clean and dry before application. Ensure insulation is dry before and during installation.

3. Insulation shall not be installed prior to the building being weather tight.

B. Piping:

1. Insulation to be continuous using full length sections of pre-molded insulation only. Multiple short length sections on straight piping shall not be accepted. Butt edges neatly, ASJ jacket with 3-inch minimum butt strips.

2. Fill voids with insulating cement.

3. Longitudinal Overlaps:

a. 2 inches minimum, self-sealing, double adhesive.

b. For exposed work: place overlap facing toward ceiling or wall.

4. Continuous insulation passing through sleeves or other openings, except underground sleeves.

5. Install Metal frames to protect edges of openings in insulation.

6. Valves, Fittings, Flanges and Accessory Insulation:

a. Unless otherwise shown or specified, insulate:

1). Valves, including bonnets.

2). Flanges.

3). Fittings.

4). Strainers.

5). Expansion joints.

6). All specialties.

b. Insulation for Strainers, Expansion Joints, Fittings, and Accessories Requiring Servicing or Inspection:

1). Insulation removable and replaceable without damage.

2). Enclose within two piece, No. 18 gauge aluminum covers fastened with cadmium-plated bolts and nuts.

c. Insulation of same thickness as that of adjacent piping insulation.

d. For piping systems insulated with fiberglass use wired-on pre-molded fiberglass fitting covers or mitered segments of pipe insulation. Vapor barrier shall be continuous.

e. For piping systems insulated with calcium silicate:

1). Wire on pre-molded sections of calcium silicate fittings covers.

2). Under 3-inch pipe size, built up coating of insulating and finishing cement to match thickness of adjoining pipe insulation may be used.

3). For exposed locations only, apply skim coat of finishing cement to smooth out surface of fitting insulation.

f. Flanges: Insulation sleeve of same material as pipe insulation, to cover flange and overlap insulation on adjacent piping. For calcium silicate insulation provide calcium silicate rings between sleeve and pipe insulation.

7. At pipe hangers:

a. Insulation protection saddles and shields specified in Section 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT.

b. Embed no hangers in insulation.

c. At saddles use 360 degree calcium silicate insulation of same length as saddle where fiberglass is used, or of type specified for service where rigid insulation is used.

8. At fire- and smoke-rated wall and floor penetrations:

a. Bare pipe: Use Pipe Shields Model "F" series. Encase pipe penetrating fire- or smoke-rated walls and floors in adjoining sheet metal cans, 24 gauge minimum, sized for maximum 1-inch space between pipe and can. Pack space on either end with Manville Cerra-felt positively fastened.

b. Insulated pipe: Use Pipe Shields Model "F2000" series for chilled water and refrigerant lines. All other insulated lines use PSI Model "F1000" series.

c. Encase all pipes penetrating fire- and smoke-rated walls and floors in adjustable or fixed length metal cans, 24 gauge minimum, sized for maximum 1-inch space between insulation and can. Insulation shall consist of a 360-degree waterproofed calcium silicate insert sized to extend to a minimum of 1 inch beyond wall of floor penetration. Calcium silicate insert shall be the same thickness as that of adjoining pipe insulation. Pack space between shield and can on either end with Manville Cerra-felt positively fastened. Extend insulation insert beyond sheet metal shield on all chilled-water refrigerant lines.

9. Insulation as specified herein shall be applied to all new piping and to existing piping being re-located where existing insulation is damaged.

C. CELLULAR-GLASS INSULATION INSTALLATION

1. Insulation Installation on Straight Pipes and Tubes:

   a. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

   b. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

   c. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.

   d. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

2. Insulation Installation on Pipe Flanges:

   a. Install preformed pipe insulation to outer diameter of pipe flange.

   b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

   c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.

   d. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

3. Insulation Installation on Pipe Fittings and Elbows:

   a. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

   b. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

4. Insulation Installation on Valves and Pipe Specialties:

a. Install preformed sections of cellular-glass insulation to valve body.

b. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

c. Install insulation to flanges as specified for flange insulation application.

D. Jackets and Facings:

1. Vapor sealed types: Continuous. Staples not permitted.

2. For piping:

a. Seal longitudinal laps.

b. Adhere 3-inch wide joint strip, of same material as facing, at center of each butt joint.

c. Adhesives:

1). Vaporsealed insulation: Vaporseal adhesive.

2). Heating service insulation: Vaporseal adhesive.

d. Exposed to weather: Metal and canvas jackets as specified.

3. For ducts, plenums, casings, housings, and equipment:

a. Vaporseal fibrous glass blanket:

1). 2-inch lap strip at one end.

2). Peel insulation for 2-inch lap strip along longitudinal joints.

3). Seal lap strips with vaporseal adhesive.

b. Fibrous glass board: Seal joints and breaks in facings with 4-inch wide tape to match facing and adhere with vapor seal adhesive.

E. Adhesives and Coatings:

1. Apply in accordance with manufacturer's recommendations.

2. Adhere jackets and facings with wet coat of adhesive.

3. Lap sealing: 4 inches.

4. Surfaces to be adhered: Completely coated with adhesive.

F. Wiring, Banding, and Fastening Devices:

1. Secure insulation to piping, ductwork and equipment in accordance with the following minimum requirements:

a. Piping insulation section 3 feet long.

1). Concealed vaporsealed insulation banded at ends and center.

2). Other concealed insulation banded and ends and center.

b. Piping fittings insulation:

1). Loops of wire to secure mitered segments of insulation and pre-molded fitting covers.

c. Outdoor piping:

1). Band weatherproof metal jackets at each circumferential joint and center of each

2). 3-foot section.

3). Set bands in mastic.

4). Caulk joints vaportight.

d. Ductwork mechanical fasteners:

1). Weld pins or grip nails.

2). Spacing: Minimum 12 inch centers and minimum 2 rows per side of duct.

3). Maximum permissible load:

4). 5 pounds for 2 inch by 2 inch baseplate.

5). 10 pounds for 2-3/4 inch by 2-3/4 inch baseplate.

6). Clip off pin penetrations flush with insulation surface or facing.

7). Seal pins and washers:

a). With 2 inch square pieces of vapor barrier material to match facing.

b). Adhere with vaporseal adhesive.

e. Where round ducts are specified to be lined, use prefabricated circular fiberglass lining inserts.

f. Equipment insulation:

1). General:

a). Apply insulation with edges tightly butted, joints staggered and secure in place by steel bands. Where necessary weld on suitable anchors.

b). Provide sufficient clearance around openings for normal operation.

c). Finish hot surface insulation with 1 inch galvanized hexagonal mesh and coat with hydraulic setting insulation cement.

d). Finish cold surface insulation joints with 4 inch wide strips of vapor barrier sealed with vapor barrier adhesive. Finish insulation with heavy coat of vapor barrier mastic applied over whole body.

e). Finish with final coat of cement containing 25 percent by weight of Portland cement.

f). Recover and provide extra coat of lagging adhesive.

2). Rigid board with vapor barrier:

a). Application:

1). Impale insulation on weld pins for flat surfaces.

2). Band in place on irregular surfaces with 16 gauge galvanized annealed wire on maximum 9 inch centers.

3). Apply 1/4-inch coat of insulating and finishing cement filling all voids.

4). Secure lightweight glass cloth with adhesive over cement.

3). Special considerations:

a). Chilled water pump volutes:

1). Construct box of minimum 22 gauge galvanized sheet metal angles.

2). Build in solid insulation panels with vapor barrier using adhesives and vapor barrier tape.

3). Provide insulated removable sheet metal covers above volute, for bearing replacement gasket and seal.

4). For split case pump section above top case of pump.

4). Calcium silicate blocks:

a). Application:

1). Securely band blocks, tightly butted, and joints evenly staggered with 16 gauge galvanized annealed steel wire on maximum 9 inch centers.

2). Provide weld pins, clips, and angles for anchors.

3). Stretch 2 inch hexagonal mesh wire on anchors.

4). Apply 1/4-inch coat insulating and finishing cement.

5). Apply heavyweight glass cloth with foster 30-36 adhesive.

6). Apply finish coat of adhesive.

g. Field quality control: Repair separation of joints or cracking of insulation due to thermal

movement or poor workmanship.

G. Thermal Hanger Shields:

1. Tape all butt joints where pipe insulation butts up against hanger shield. On hot piping, apply 3 inch wide canvas strip dipped in lagging adhesive over the butt joints.

H. Plenum and Duct Insulation:

1. Comply with published recommendations of manufacturer.
2. Unless otherwise shown, apply insulation externally.
3. Ensure insulation is continuous through inside walls.
    a. Pack around ducts with fireproof self-supporting insulation material. Properly seal.
4. Finish insulation neatly at hangers, supports and other protrusions.
5. Locate insulation cover seams in least visible locations.
6. Where ducts run in groups too close to be individually insulated and finished:
    a. Completely fill all spaces between ducts with rigid or flexible insulation material.
    b. Insulate and finish exterior surfaces of groups as specified for particular service.
7. Where ducts cannot be insulated after erection, insulate prior to installation.
8. Where specified thickness of insulation exceeds available thickness in single layer, provide insulation in 2 or more layers with joints staggered.
9. Finish with systems at operating conditions.
10. Wrap: Duct and plenum wrap.
    a. Application, rectangular, round and oval duct:
        1). Apply the duct wrap over clean, dry sheet metal ductwork that has been sealed airtight at all seams and joints.
        2). Install duct wrap to allow maximum fullness at corners. Avoid excessive compression. Minimum thickness at corners is 1 inch.
        3). Butt insulation tightly at joints.
        4). Secure with 4 inch strips of adhesive at 8 inches on center, 2 inch lap strip at one end.
        5). Apply with one hundred percent coverage of adhesive, similar to Foster's 85-15.
        6). Overlap vapor barrier facing a minimum of 2 inches. Remove insulation from lap prior to stapling.

7). Staple all vapor barrier seams approximately 6 inches on center with outward clinching staples, and seal lap strips with a foil vapor barrier tape, or vapor barrier mastic, such as 3M No. 35.

8). When ducts are over 24 inches in width, additionally secure the duct wrap to the bottom of rectangular ducts with mechanical fasteners spaced on 12-inch centers, but not less than 1 pin on each surface, to prevent sagging of insulation.

9). Seal penetration of facing to provide a vapor tight system.

b. Duct and plenum rigid board wrap:

1). In addition to above general requirements:

2). Score insulation to cover standing seams.

3). Secure with mechanical fasteners spaced 16 inches on centers or closer as required to hold insulation firmly to duct.

4). Seal all joints and pin penetrations with pressure sensitive aluminum foil tape. Reinforce all exposed edges with corner bead.

11. Duct liner:

a. Fiberglass duct liner - Application:

1). Completely cover all portions of duct designated to receive duct liner.

2). Neatly butt transverse joints with no interruptions or gaps.

3). Face black-coated surface or foil surface of duct liner to the air stream.

4). Apply with 100 percent coverage of Foster's 81-99 adhesive. Use held pins or gripnail fasteners at 12 inches on center, but not less than one pin on each surface of duct.

5). Comply with SMACNA Duct Liner Application Standard, published recommendations of manufacturer, and as specified. Also comply with NAIMA Fibrous Glass Duct Liner Standard

6). Cut duct liner to assure overlapped end compressed longitudinal corner joints to be per NAIMA standard.

7). Surface adjacent to air flow, including at joints, to be uniformly flat. Pin compression to be in accordance with NAIMA Standard.

8). Seal butt joints and exposed edges of liner to prevent erosion with Foster 60-50. Tape all seams and joints with Arabol and canvas.

9). Provide 24 gauge sheet metal Z Sections frames over edge of lining in rectangular ducts listed as follows: Frames shall fit tight to lining edge and surfaces.

10). Around access openings in ducts.

11). Around access door in plenums.

12). Along edges exposed to air flow.

13). At leading edges.

12. Insulation as specified herein shall be applied to all new ductwork, plenums, etc. and to existing ductwork, etc., where existing insulation is damaged.

13. Install fire wrap (Unifrax FyreWrap EZ 1.5) as specified by the manufacturer and in accordance with all stated directions. Fire wrap shall be no more than 1.5-inches thick to provide 1.5 hour rating.

I. Emergency Generator Exhaust and Flue Insulation:

1. 4 inches thick hydrous calcium silicate on pipe, fittings, and muffler.

2. 3 inches thick Temp Matt on flexible connections.

3. Fasteners: 14 gage galvanized iron wire on 9 inch centers.

4. Fittings: Fabricated from pipe insulation.

5. Finish: 1200 degree F. glass cloth.

6. Maximum thermal conductivity factor of 0.5 K at 500 degrees F. mean temperature and a density of 11 pounds per cubic foot.

J. Acoustical Insulation (Lagging)

1. The correct installation of the sound control lagging material is critical in order to achieve the desired noise reduction. Sound control lagging material shall be cut to length, wrapped around the outside of the pipe or duct, and fastened with mechanical fasteners or bands. Tape and adhesive can be used in conjunction with mechanical fasteners or bands. All sound control lagging materials must be installed per the manufacturer's installation guidelines.
2. Bare sheet metal ductwork to acoustically lagged, is to be coated with a heavy coating of mastic / adhesive over 100% of the surface area as a vibration dampening material (Kenetics Model KDD or KDC-E-162 or approved equal) before any acoustical treatment.

3.1 SCHEDULE: PIPES AND EQUIPMENT

Service	Type	Size (Inches)	Thickness (Inches)

A. Any pressure heating hot water 250 degrees and under (including ground water)

1. Mechanical rooms	P-3	1 and smaller	1
		1¼ through 2	1-1/2
		2 ½ through 6	2
		8 and larger	3-1/2
2. Other piping in building	P-1	1 and smaller	1
		1¼ through 2	1-1/2
		2 ½ through 6	2
		8 and larger	3-1/2
3. Exposed to weather	P-2	2 and smaller	1-1/2
		Larger than 2	2

B. Any pressure domestic hot water supply and return 105 degrees F to 140 degrees F

1. Mechanical Rooms	P-3	2 and smaller	1
		2-1/2 and larger	1-1/2
2. Other piping in building	P-1	2 and smaller	1
		2-1/2 and larger	1-1/2
3. Exposed to weather	P-2	2 and smaller	1-1/2
		2-1/2 and larger	2

C. Chilled Water 40 degrees F to 57 degrees F

1. Piping in building	P-7	1½ and smaller	1-1/2

	2 and larger	2

D. Horizontal & vertical leaders

P-1	1 and smaller	1/2
	1 ¼ through 2	3/4
	2 and larger	1

E. AC Unit drains, make-up water piping and other piping subject to sweating

P-5	All	¾

3.3 DUCT AND PLENUM INSULATION

A. Notes for Insulation Application Schedule:

1. Where duct lining is specified, no other insulation is required, except when required minimum conductance cannot be obtained by lining alone; apply additional wrap or lining as required. Also refer to drawings for location of duct lining.

2. Provide fire-rated duct wrap (Unifrax FyreWrap EZ 1.5) where specified on the drawing. Fire wrap shall be no more than 1.5-inches thick to provide 1.5 hour rating.

    a. Wrap may be used to extend rating to suitable fire damper location as required only where noted on the drawing or agreed with the Engineer.

B. Application Schedule: Ductwork shall be acoustically lined and/or insulated as follows:

Item	Supply	Return	Exhaust
All ductwork in the mechanical rooms	3-DW	3-DW	3-DW
Supply ductwork not in MERs-concealed	1-DW	-	-
Supply ductwork not in MERs-exposed	AL	-	-
Return ductwork not in MERs-concealed	-	1-DW	-
Return ductwork not in MERs-exposed	-	AL	-
Other return air ductwork	-	1-DW	-
Outside air ducts from louver for first 25 Ft. or when	4-DW	4-DW	4-DW

routed through unconditioned space.			
Exhaust air ducts from louver for first 25 Ft. or when routed through unconditioned space.	4-DW	4-DW	4-DW
Transfer Ducts	AL	AL	AL
All ducts shown on drawings as being acoustically lined	AL	AL	AL
All ducts or plenums shown on drawings as being acoustically lagged	AW	AW	AW
External ductwork	4-DW	4-DW	-
Outside air ducts except where exposed	4-DW	4-DW	4-DW
Outside air ducts where exposed in public areas	AL	AL	AL
Outside air plenums and exhaust air plenums in mechanical spaces between outside air connections and shut-off damper	4-DW	4-DW	4-DW

3.4 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.5 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.
2. Corrective Work:
    a. Remove, Repair and Reinstall, or Restore in Place damaged items.
    b. Replace damaged materials or items with New if repair not acceptable to Architect.
3. Provide product data to complete Operation & Maintenance Manuals.
4. Submit executed Warranties.

END OF SECTION

SECTION 230923 – DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All work of this Division shall be coordinated and provided by the single Technology System Contractor, and coordinated with the existing system at Miami International Airport.

B. The work of this Section shall be coordinated with and interfaced with the associated work of other trades. Reference the following Division Documents for details:

1. Division 01 – General Requirements
2. Division 08 – Openings
3. Division 23 – Mechanical
4. Division 26 – Electrical
5. Division 27 – Communications

C. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

PART 2 - PRODUCTS

2.1 SYSTEM OVERALL

A. This contract involves primarily the modification or alteration of the mechanical systems serving or merely crossing the demolition and remodeling of the affected areas and adjacent areas. The BMS is a Miami Airport-Wide communications system. The intent of the work is to provide a completely functional controls system for the relocated or affected portions of the work. Any equipment being demolished or affected by the work shall have its controls function, sensors and programming properly restored at work completion, partial or final.

B. Each independent system shall share the common high speed backbone network specified throughout these documents. Provide all adapters, nodes and the like to accomplish single seat user interfaces.

C. Provide a network of systems and equipment which are digitally and physically independent, yet software integrated via network interface devices.

D. Each application shall reside on the communication network to allow interoperability, flexibility and capability for expansion.

1. The FMS shall consist of a number of Nodes and associated equipment connected by industry standard network practices. All communication between Nodes shall be by digital means only.

E. The FMS network shall support both the use of copper and optical fiber communication media in the physical layer.

F. The supplier of the system must have a maintained service organization consisting of at least ten (10) competent servicemen, within 50 miles of the project site, for a period of not less than ten years.

G. The manufacturer shall provide documentation supporting compliance with ISO-9002 (Quality Assurance). System shall have a documented history of compatibility by design for a minimum of 15 years.

H. Submit system block diagram showing quantity and location of all affected devices, original smoke sequence, a plan view of location of all smoke exhaust fans, air handling units and fire/smoke dampers involved in the fire / smoke sequence for the areas of work.

I. Narrative description of operation for each such system, enumerating and describing the function of each component. Include alarm and emergency sequences and equipment interlocks.

J. Narrative description of manual override operations for each input and output point associated with the existing functionality of the area involved in the project.

K. Damper schedule: Provide identification numbers, location, system, dimensions and performance data.

L. Provide complete full size drawings, 24" x 36"

M. Programming: Provide a list of all VAV boxes, dampers and other devices in the areas of the work, present programming sequence, and reprogram at project completion.

N. Upon completion provide demonstration and training to owner.

O. Make technical personnel available for three smoke tests at each location of the work.

P. Acceptable manufacturers:

1. Honeywell Inc.

2.2 DEVICES

A. Building network shall be able to communicate via hardwire to the existing Honeywell Building network and shall be capable of monitoring and controlling HVAC system operation as well as monitoring and transmitting alarm inputs from existing fire/life-safety/security equipment. It shall also have the capability of controlling (on/off) lighting circuits on a pre-programmed time schedule. BMS components provided under this contract shall be interlocked with existing BMS components serving the existing areas of the Terminal

B. Complete temperature control system to be DDC with electronic sensors and pneumatic actuation of VAVs. Damper to be DDC controlled.

C. Complete lighting control system via integral switchable circuit breaker panel boards with time of day, occupancy, service, schedules, according to photocells, occupancy sensors and security panels. All work to be coordinated with MDAD security department.

D. Totally integrated with the existing fire alarm for a UL Listed System with priority control of all HVAC, Ventilation, Smoke Exhaust, Smoke Pressurization, Alarm and announcement functions. A partial listing will not be acceptable The complete integrated system installation shall conform to the applicable section of NFPA 72 and NEC. All control equipment shall be listed under UL

E. All power, control, line and low voltage wiring, conduit, panels and accessories necessary for a complete operational system shall be included in the scope. All power shall be derived from emergency power panels.

2.3 OPERATOR INTERFACE SOFTWARE

A. General

1. The BMS Operator Interface shall be updated with any software required for the operation of any new or relocated work, and all new or relocated devices shall be updated at the proper MIA head end equipment.

2. Operating system shall be as per current MDAD MIA software.

3. Provide standalone secondary control panels as required for terminal equipment.

B. Alarms

1. Designated functions shall annunciate alarms generated by the BMS. The alarm management portion of the software shall, at the minimum, provide the following functions

   a. Log date and time of alarm occurrence.
   b. Generate a “Pop-Up” window, with audible alarm, informing a user that an alarm has been received.
   c. Allow a user, with the appropriate security level, to acknowledge, or disable an alarm.
   d. Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.

2. The BMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions

3. The BMS shall annunciate application alarms at minimum, as required by Part 3 and the sequence of operations.

C. Reports

1. Reports shall be generated and directed to one or more of the following: OWS display, printer, or archive at the user's option.

D. Dynamic Color Graphics

1. Update all graphic displays shall be able to be generated and executed.

E. Schedules

1. Provide a spreadsheet-type schedule input form for automatic BMS time-of-day scheduling and override scheduling of FMS operations shall be provided. At a minimum, the following spreadsheet types shall be accommodated:

   a. Weekly schedules.
   b. Temporary override schedules.
   c. Special "Only Active If Today Is A Holiday" schedules.
   d. Monthly schedules.

F. Alarm Paging:

1. Provide automatic alphanumeric paging of personnel for user-defined FMS events.

   a. System shall support both numeric and alpha-numeric pagers, using Alphanumeric, PET, or IXO Protocol at the owner's option.
   b. Users shall have the ability to modify the phone number or message to be displayed on the pager through the system software.
   c. System shall utilize pager schedules to send pages to the personnel that are "on-call".
   d. Contractor shall be responsible for providing a modem for connection to the paging service.

2.4 APPLICATION NODES

G. General

1. The Application Nodes (AN) shall include all monitoring, control and information Nodes including field panels.

2. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, governing Radio Frequency Electromagnetic Interference and be so labeled. BMS shall comply with UL 916 PAZX and 864 UDTZ and be so listed at time of bid.

3. System devices utilized for smoke control shall have UL 864 (UUKL smoke control) and shall be so certified at time of bid.

H. HVAC Nodes

1. HVAC Node shall provide both standalone and networked direct digital control of HVAC systems.

2. Provide a means to prevent unauthorized personnel form accessing setpoint adjustments and equipment control functions.

3. The HVAC Node shall provide the ability to download and upload configuration data, both locally at the Node and via the FMS communications network.

4. The HVAC Node shall be provided with a permanently-mounted local graphic terminal where required in the sequences of this specification. The local graphic terminal shall provide dynamic graphical representation of the associated system status, with the ability for the operator to enter commands with proper password protection.

5. Lighting zone assignments shall be stored in nonvolatile memory so that setup and assignments are not lost during power outages or brown outs.

I. Fire Alarm Nodes

1. Fire alarm system shall comply fully with Fire Alarm specifications, as well as plans and related sections in addition to requirements stated herein.

2. Provide the Fire Alarm Detection system which shall be 100% standalone, however, it shall be monitored by the FMS through BACnet IP and shall provide primary reporting through UDACT.

3. Each Fire Alarm Node shall be able to retain program, , and history information for at least 72 hours in the event of a power failure, and shall return to normal operation upon restoration of power

4. Each Fire Alarm Node shall report its communication status to the BMS. The BMS shall provide a system advisory upon communication failure and restoration.

5. Provide a means to prevent unauthorized personnel from accessing sensitivity, pre-alarm adjustments and equipment control functions

2.5 APPLICATION SOFTWARE

J. BMS Application Software

1. Provide as part of the contract scope any software and software updates which are available for the existing system and any that are necessary for the proper operation of the system in the project area.

2. Prior to any demolition work, review the existing devices in the project area and demonstrate via remote software actuation, all functionalities.

3. Reports: The report feature shall provide access to all data in the system from entire data base to specific system transactions or configurations

4. Smoke Control Modes: The system shall provide means to perform FSCS mode Smoke Control to meet NFPA-92A and 90B and HVAC mode to meet NFPA 90A.

2.2 FIELD DEVICES

A. Input Devices

1. Air Low Differential Pressure Switch

a. Rating: NEMA 1

b. Mounting: Duct Insertion

c. Range: 0.05” to 5.0” WC, complete with field adjustable set-point.

d. Protection: Overpressure to 1 PSIG

e. Output: Form C Contact, minimum 50VA

f. Special: Automatic reset, provide complete installation kit including static pressure tips, tubing, fittings, and air filters.

2. Air Low Differential Pressure Sensor

a. Rating: NEMA 1

b. Mounting: Duct Insertion

c. Range: 0.05” to 5.0” WC,

d. Protection: Overpressure to 1 PSIG

e. Output: 0-10vDC, 4-20mA

f. Special: Provide complete installation kit including static pressure tips, tubing, fittings, and air filters.

3. Air Flow Measuring Station

a. Materials: Anodized Aluminum with stainless steel brackets

b. Rating: +30°F to 120°F & 0-99%RH (Non-condensing)

c. Mounting: Duct Mount

d. Range: 400-5000FPM

e. Accuracy: +/- 3% of reading over operating range

f. Protection: NEMA 1, NEMA 4 (outdoor use)

g. Input/Output: 24VAC power, 0-10vDC, 4-20mA

4. Air High Differential Pressure Switch

a. Rating: NEMA 1

b. Mounting: Duct Insertion

c. Range: 1" to 10" WC, complete with field adjustable set-point.

d. Protection: Overpressure to 1 PSIG

e. Output: 2 Form C Contacts, minimum 360VA

f. Special: Manual reset, provide complete installation kit including static pressure tips, tubing, fittings, and air filters.

5. Current Switch

a. Materials: Encased copper

b. Rating: 600vAC

c. Mounting: Split Core

d. Range: 1.5amps to 50 amps

e. Action: Trip point adjustment

f. Output: SPST, N.O.

g. Special: Status LED

3 Override Request Switch

a. Materials: Bakelite

b. Rating: 10 amps @ 120vAC

c. Mounting: Wall

d. Output: SPDT Momentary Contact

e. Special: Provide with cover plate

4 Space Temperature Sensors

a. Materials: Nickel or Platinum element.

b. Mounting: Room

c. Range: 32ºF to 104ºF

d. Accuracy: 1ºF

e. Output: Resistive 1000ohms @ 70ºF

f. Special: Duct Element Holder, Brass Well Assembly, Room Mounting Bracket and Cover

5 Current Sensors

a. Provide and install split core current sensors to interface with the DDC system as described in Sequence of Operations and as shown on Control Drawings.

b. Units shall be UL listed.

c. Each sensor shall be two wire, loop powered and sized for expected amperage.

d. Analog Output Current Transducer

1. Typical installations used for the determination of current consumption of fan and pump motor in remote starter enclosures.

2. Power requirements: Self powered, 0-60 Amp rating

3. Output: 0-5 VDC

4. Accuracy +/-2.0% Full scale

5. Manufacturer: Veris - Hawkeye H922

6 Occupancy Sensors

a. Occupancy sensors shall be provided to interface with the DDC system for lighting control

b. Occupancy Switch can be combined with space temperature sensor. Sensor shall use either passive infrared or ultrasonic technology with sensitivity adjustment

c. Power requirements: 24 VDC

d. Output: 2 Form C contacts; 1 A rating at 24VDC

B. Output Devices

1. Remote Alarm Lamps

a. Materials: Plastic Cover

b. Rating: UL, NFPA

C. Controlled Devices

2. Electric Damper/Valve Actuators.

a. Rating: NEMA 1 Enclosure

b. Mounting: Direct mount

c. Control Input: Continuous 0-10 VDC or 0-20 mADC

d. Power: Nominal 24 VAC

e. Protection: Stall protection

f. Torque: Size for minimum 150% of required duty

g. Special: Output position feedback, manual override, field selectable direction, field adjustable zero and span. For spring return provide field selectable spring return direction.

3. Automatic Control Dampers

a. Mounting: Field

b. Normal Position: Closed

c. Blade Configuration: Opposed

d. Blade/Frame: Extruded Aluminum

e. Bearing/Seal: Acetal/Santoprene, synthetic

D. Field Equipment Cabinets:

1. All transformers, electric relays, manual override switches, etc., shall be mounted in an NEMA 1 enclosure (minimum, see NEMA rating for enclosures within this specification) and factory wired to terminal strips.

L. Test and Calibration Equipment

1. All necessary calibration and testing equipment shall be provided to perform the testing, commissioning and acceptance testing as part of the deliverable.

M. Component Tags

1. Sensor Tags:

a. All sensors/instruments shall be identified with 1"x 3" black lamacoid labels with engraved white lettering. Lettering shall be 1/4" high. Provide sensor number, Air handling unit number/pump/source equipment (as relevant), part number and sensor range on tag.

PART 3 – EXECUTION

3.1 BUILDING MANAGEMENT SYSTEM - GENERAL

A. Space mounted devices are to be identical in appearance. All devices shall be mounted under the same style cover.

B. Provide all relays, switches, sources of electricity and all other auxiliaries, accessories and connections necessary to make a complete operable system in accordance with the sequences specified.

C. Install controls so that adjustments and calibrations can be readily made.

D. Mount surface-mounted control devices on brackets to clear the final finished surface on insulation.

E. Conceal control conduit and wiring in all spaces except in the Mechanical Equipment Rooms and in unfinished spaces. Install control conduit and wiring in parallel banks with all changes in directions made at 90 degree angles.

F. Install control valves horizontally with the power unit up. Installation of control valves will be by the Division 23 Contractor.

G. Unless otherwise noted, install wall mounted sensors, thermostats and humidistats at 5'-0" above the finished floor measured to the centerline of the instrument. Submit device locations, mounting heights and details for approval.

H. Install outdoor thermostats in perforated tube and sun shield or engineer approved installation assembly designed for application.

3.2 ELECTRICAL INSTALLATION

A. General

1. For conduit support and installation of wires and cables see applicable paragraphs of the latest edition of the NEC.

2. Wire splices within conduit are prohibited under any circumstances.

3. No plenum rated cables are to be used.

4. All wiring shall be in accordance with this specification and Division 26, including tagging,

labeling and identification.

5. All smoke control wiring shall be in conduit.

B. Raceway

6. Percent fill EMT shall not exceed maximum NEC allowable fill.

7. Use liquid tight flexible metal conduit for making connections at instruments and devices mounted on piping or vessels or on equipment subject to vibration.

C. Wiring

8. All wiring shall be in approved raceways (conduit, EMT, etc.)

9. Cables for 120/24 VAC wiring and low level signal wiring shall always be run in separate raceways.

D. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements.

3.3 SEQUENCE OF OPERATIONS

A. VAV Box Control (Cooling)

1. The local controller shall modulate the airflow to each VAV terminal box. Each box shall be programmed for a minimum and maximum flow setpoint as measured by a flow sensor.

2. On a rise in space temperature the flow setpoint shall be reset upward to a maximum setting such that the flow to the VAV zone is increased to provide additional cooling.

3. On a drop in space temperature below setpoint the flow setpoint shall be reset downward to a minimum setting such that the flow to the VAV zone is decreased to reduce cooling.

4. VAV box damper shall be designed to fail in place on failure of power to the VAV box controller. VAVs to fail open. In fire mode, VAVs shall open to full.

5. When the AHU serving the VAV terminal box is off the VAV box damper shall be at minimum open position.

B. Fire Smoke Dampers

1. Fire smoke dampers (FSD) shall be controlled by the FMS.

2. The controls contractor shall monitor a minimum of two damper end switches (open & closed) per FSD. See description in Product Devices for additional information.

3.4 COMMISSIONING, TESTING AND ACCEPTANCE

A. Refer to Section 230593 for requirements of controls system testing to be carried out by an independent testing contractor.

B. The installation contractor shall perform a three-phase commissioning procedure consisting of field I/O calibration and commissioning, system commissioning and integrated system program commissioning. Document all commissioning information on commissioning data sheets as contained in this specification or alternatively on commissioning data sheets as provided by the independent controls testing contractor and submitted for review prior to the work being carried out. Commissioning work, which requires shutdown of system or deviation from normal function, shall be performed when the operation of the system is not required. The commissioning must be coordinated with the Owner and construction manager to ensure systems are available when needed. Notify the operating personal in writing of the testing schedule so that authorized personnel from the Owner and construction manager are present throughout the commissioning procedure.

C. Field I/O Calibration and Commissioning

1. Prior to system program commissioning, verify that each control panel has been installed according to plans, specifications and approved shop drawings. Test, calibrate and bring on line each control sensor and device. Commissioning to include, but not be limited to:

   a. Sensor accuracy at 10, 50 and 90% of range.

   b. Sensor range.

   c. Verify analog limit and binary alarm reporting.

   d. Point value reporting.

   e. Binary alarm and switch settings.

   f. Actuator and positioner spring ranges.

   g. Fail safe operation on loss of control signal, electric power, network communications, etc.

2. Record calibration and test data on commissioning data sheets. Sufficient space should be provided near each point name for sign off.

D. System Program Commissioning

1. After control devices have been commissioned (i.e. calibrated, tested and signed off), each DDC program shall be put on line and commissioned. The contractor shall, in the presence of the Owner demonstrate each programmed sequence of operation and compare the results in writing. In addition, each control loop shall be tested to verify proper response and stable control, within specified accuracies. System program test results shall be recorded on commissioning data sheets and submitted for record. Any discrepancies between the specification and the actual performance will be immediately rectified and retested.

E. System Commissioning:

1. After all DDC programs have been commissioned, the contractor shall verify the overall system performance as specified. Tests shall include, but not be limited to the following:

2. Data communication, both normal and failure modes.

3. Fully loaded system response time.

4. Impact of component failures on system performance and system operation.

5. Time/Date changes.

6. End of month/ end of year operation.

7. Season changeover.

8. Global application programs and point sharing.

9. System backup and reloading.

10. System status displays.

11. Diagnostic functions.

12. Power failure routines.

13. Battery backup.

F. Acceptance Testing

1. Submit for approval, a detailed acceptance test procedure designed to demonstrate step by step testing of all FMS related sequences, systems and equipment, integration with external systems and compliance with contractual requirements. This Acceptance test procedure will take place after the commissioning procedure, in addition to the testing described above the testing will verify that sensors and control devices maintain specified accuracies and the system performance does not degrade over time.

2. Using the commissioning test data sheets, the contractor shall demonstrate all paint types as required by Owner/engineer. The contractor shall supply all instruments for testing and turn over same to the Owner after acceptance testing.

    a. All test instruments shall be submitted for approval.

G. Test instrument accuracy

1. Temperature: 1/4ºF or 1/2% full scale, whichever is less.

2. High Pressure (psi): 1/2 psi or 1/2% full scale, whichever is less.

3. Low Pressure (in w.c.): 1/2% of full scale

4. Humidity: 2% RH

5. Electrical: 1/4% full scale

H. Verification Testing

1. System verification testing is part of the Commissioning Process. Verification testing shall be performed by the contractor and witnessed and documented by the Engineer. The commissioning process requires detailed O&M documentation.

END OF SECTION

SECTION 230923.11 – CONTROL COMPRESSED AIR SYSTEM

PART 1 GENERAL

1.1 SCOPE

A. It is the intent of this specification and plans to provide for a complete and operational compressed air control system properly interfaced with the Building Management System, the HVAC equipment, accessories, and appurtenances and coordinated with the existing compressed air system. The work contained within the scope of this section shall include furnishing and installing all of the compressed air controls system, valves, piping, fittings, tubing, and pressure reducing stations terminating at each pneumatic valve, damper, operator, control, and device in coordination with the mechanical contractor, equipment manufacturers, and BMS contractor.

1.2 SECTION INCLUDES

A. Pipe and Pipe Fittings.

B. Valves.

C. Pressure reducing station.

1.1 RELATED SECTIONS

A. Section 2320500 – Common Work Results of HVAC

B. Section 2303529 – Hangers and Supports for HVAC

C. Section 230553 - Identification of HVAC Systems

D. Section 230923 – Direct Digital Control (DDC) System for HVAC

1.2 SUBMITTALS FOR REVIEW

A. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.

B. Shop Drawings: Indicate piping system schematic with electrical characteristics and connection requirements.

1.3 SUBMITTALS AT PROJECT CLOSEOUT

A. Project Record Documents: Record actual locations of equipment and components. Modify shop drawings to indicate final locations.

B. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name

and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable ASME code for installation of pressure vessels.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Incas suitable for the purpose specified and indicated.

1.6 WARRANTY

A. Provide one-year manufacturer warranty for all equipment.

PART 2 PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. No airlines are to be hidden within duct insulation. All piping and tubing shall be properly supported using straps, cleats, or hangers as approved. Use of wire will not be permitted. Where this specification permits the use of plastic tubing (inside control panel) virgin polyethylene tubing, with a molecular weight of not less than 25,000 and a melt index of not more than .3 dg. /min., shall be supplied. Pressure rating: 160 psi/72 degrees F. Ambient temperature rating: 175 degrees F. Tubing shall be supported with pipe rests or other supporting methods as to prevent the lines from stress conditions.

1. Air tubing shall be hard drawn copper.

2. Air tubing in finished areas shall be run concealed.

B. Copper Tubing: ASTM B88 (ASTM B88M), Type K drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints: ASTM B32, solder, Grade 95TA.

C. Copper Tubing: ASTM B88 (ASTM B88M), Type K, annealed.
   1. Fittings: ASME B16.26, cast bronze.
   2. Joints: Flared.

2.2 UNIONS AND COUPLINGS

A. Unions
   1. Ferrous Pipe: 150-psi malleable iron threaded unions.

2. Copper Tube and Pipe: 150 psi bronze unions with soldered joints.

B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, and water impervious isolation barrier.

C. Flexible Connector: Stainless steel with brass threaded connectors.

PART 3 EXECUTION

3.1 INSTALLATION

A. Connect condensate drains to nearest floor drain.

B. Install valved drip connections at low points of piping system.

C. Install compressed air couplings, female quick connectors, and pressure gages where outlets are indicated.

D. Install tees instead of elbows at changes in direction of piping. Fit open end of each tee with plug.

3.2 FIELD QUALITY CONTROL

A. Compressed Air Piping Leak Test: Prior to initial operation, clean and test compressed air piping in accordance with ANSI B31.1.

B. Repair or replace compressed air piping as required to eliminate leaks, and retest to demonstrate compliance.

C. Cap and seal ends of piping when not connected to mechanical equipment.

END OF SECTION

SECTION 230993 – SEQUENCE OF OPERATIONS - SMOKE MANAGEMENT SYSTEM (HVAC)

PART 1 GENERAL

1.1 RELATED WORK DESCRIBED IN OTHER SECTIONS.

A. Direct Digital Control (DDC) System for the HVAC of ticket counter: Section 230923.

B. Testing Adjusting and Balancing: Section 230593.

C. Fire Alarm System Digital Addressable: Section 283111.

1.2 SYSTEM OBJECTIVES

A The system objectives are:

1. Restrict the migration of smoke from the zone of fire origin (ZOFO) and between smoke zones.

2. Direct the movement of smoke from the ZOFO to the exterior of the building.

3. Provide smoke free exit passageways and stairs to the exterior of the building.

4. Coordinate the existing smoke control systems with the new or temporary smoke control systems.

5. Coordinate the demolition, alteration or modifications of the existing smoke control systems.

1.3 QUALITY ASSURANCE

A. Smoke Management System shall be tested to demonstrate that all components of the system respond as indicated in the sequence of operation.

B. Smoke testing shall only be performed if and when the Authority having Jurisdiction request it. If it is necessary it shall be performed according to the following parameters.

C. Prior to Smoke Evacuation System Testing, at the end of the project Architect/Engineer shall have:

1. Accepted a coordinated pre-test and balance report along with the Final Test and Balance Report, both reviewed and accepted by General Contractor.
2. Accepted the Final Test and Balance Report, reviewed and accepted by General Contractor.
3. Been notified in writing that Fire Alarm System is fully operational.
4. Been notified in writing that Control Subcontractor has completed all programming of Building Automation System and that control system is fully operational.

5. Been notified in writing that Building Automation system and Fire Alarm System have been properly and successfully interfaced.
6. Been notified in writing that the building automation system and fire alarm system have been properly and successfully interfaced with all of the new, existing, demolished, relocated and altered HVAC systems, including smoke control, pressurization, and ventilation.
7. Been notified in writing that all of the components of the smoke control systems have been tested and are fully operational.

PART 2 PRODUCTS

2.1 All instrumentation required to perform the testing shall be furnished by test and balance agency.

2.2. Mechanical subcontractor shall be responsible for furnishing the following:

A. All protective equipment required by all personnel participating in the test.

B. The smoke candles, tin buckets, respirator to all participants and communication devices, during the test.

PART 3 EXECUTION

3.1 The following shall be performed under the coordination and verification phase:

A For each component in each smoke control zone, including but not limited to smoke exhaust fans, make up air units, pressurization fans, fire smoke dampers, relief dampers, verify that each is fully functional in smoke mode.

B Verify that no “orphan” systems or zones were left as part of the demolition or alterations.

C Coordinate the existing and new building management system integration.

D Verify that each component in smoke control zone responds correctly to the appropriate signal form the building management system of fire alarm as required.

E Verify that adjacent smoke zones are properly designated by the building management system of the fire alarm.

3.2 The following shall be performed under “Sequence and Verification Phase” of the test, by compartment or floor:

A. Fire alarm subcontractor shall set each compartment in the alarm mode.

B. Verification of the smoke mode of operation of all equipment and appurtenances.

C. Verification that all VAV box damper operators have failed open in pressurized compartments.

D. Verification that Fire Alarm Signal overrides "OFF" cycles, control safeties, low limit controls, etc., of all air moving equipment involved in the smoke evacuation of the compartment.

E. Verification that the fire alarm signal at the mechanical room shuts down air handling units and operate the proper damper and smoke evacuation fan(s) per sequence of operation as indicated on Mechanical Plans.

F. Verification that activation of either supply or return smoke detectors or automatic alarm initiating device at all air handling units shuts down the AHU involved through the fire alarm system.

G. Verification that activation of the smoke control system shall be either by any water flow device serving a smoke control zone, manually at the central fire alarm (F/A) control station or through the annunciation of at least two (2) area-wide smoke detectors serving a smoke control zone. Operational sequence for the latter is as follows:

1. First Smoke Detector Annunciation: All VAV boxes serving the Zone of fire origin (ZOFO) modulate to 100% shut-off (no air supply or return to the sub-area within the ZOFO).
2. Second Smoke Detector Annunciation: Sub-area within the ZOFO is placed under smoke control sequence.

Initiation of any smoke control sequence shall simultaneously energize pressurization fans strictly serving exit egress stairwell and elevator shafts having openings into the ZOFO.

H. Any malfunction identified during the phase of the test shall be corrected by the responsible subcontractor. Once corrected, the particular condition under which the malfunction was identified shall be simulated to demonstrate proper operation of all components involved in the particular sequence.

I. Test and balance subcontractor shall measure and record the following during the Phase:

1. CFM quantities across exhaust fans or ducts used in evacuating the compartment or floor under conditions described.

3.3 The following shall be performed under the "Smoke Phase' of the test, by compartment at Control. Tower:

A. Smoke candle(s) of the type approved by the authority having jurisdiction or building official, as required to obtain a smoke density satisfactory to the Fire Marshall, shall be placed at a location selected by the authority having jurisdiction.

B. Upon automatic activation of the Smoke Evacuation System, the time sequence shall be as follows:

SMOKE TEST CHRONOLOGY

Time (min)	Event
0:00	Ignition
0:30	Activation smoke control system. Monitor smoke zone boundaries for any smoke migration prior to activation.
3:00	Verify movement of smoke in the fire zone. Monitor smoke zone boundaries for migration prior to activation.
13:00	Determine whether an exit sign in the test zone is visible from a height of 5 feet at a distance of 20 feet.

The test shall be conducted using the largest smoke zone as the simulated zone of fire origin.

C. Should the system or any part thereof fail to satisfy the requirements set forth by the Fire Marshall, the following steps shall be performed:

1. Control and mechanical subcontractors shall inspect, repair or replace at no expense to the Owner, all automatic dampers used in connection with the Smoke Evacuation System found not in compliance with performance specified in approved submittals.
2. Subcontractor shall take any necessary steps to seal all openings, penetrations, cracks, etc. to insure tightness of compartments and evacuation shafts.
3. Subcontractor shall provide notice as to when the test can be repeated as specified herein.

END OF SECTION

SECTION 233100 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Duct materials.
2. Flexible ducts.
3. Single wall spiral round ducts.
4. Single wall spiral flat oval ducts.
5. Glass fiber reinforced plastic ducts.
6. Sealant and gasket materials.
7. Duct and fitting fabrication.
8. Special duct applications.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 General Requirements Specification Sections, apply to this Section.
2. Other Related Sections:
   a. Section 033000 – CAST-IN-PLACE CONCRETE.
   b. Section 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT.
   c. Section 230548 – MECHANICAL SOUND AND VIBRATION CONTROL AND SEISMIC RESTRAINTS.
   d. Section 230593 – TESTING, ADJUSTING, AND BALANCING FOR HVAC.
   e. Section 230700 – HVAC INSULATION.
   f. Section 233300 – AIR DUCT ACCESSORIES.

1.2 REFERENCES

A. ASTM International:

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

C. ASTM A90/A90M - Standard Test for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

D. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

E. ASTM A480 - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

G. ASTM A1008/ A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

I. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

J. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.

K. ASTM C168 - Standard Terminology Relating to Thermal Insulation

L. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

M. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

N. Standard Specification for Elastomeric Joint Sealants.Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

O. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

P. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

Q. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

3. NFPA 91 - Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids.

4. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

5. NFPA 45 - Standard on Fire Protection for Laboratories using Chemicals.

R. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Air Duct Leakage Test Manual.

2. SMACNA - HVAC Duct Construction Standard – Metal and Flexible.

3. SMACNA - Balancing and Adjustment Manual.

4. SMACNA - Seismic Restraint Manual.

S. American Conference of Governmental Industrial Hygienists (ACGIH):

1. Industrial Ventilation - A Manual of Recommended Practice

T. Factory Mutual (FM) Standard 7-78 Industrial Exhaust Systems

U. National Bureau of Standards (NBS) Voluntary Product Standard 15-69

V. North American Insulation Manufacturers Association (NAIMA):

1. Fibrous Glass Duct Liner Standard.

W. Underwriters Laboratories Inc.:

1. UL 181 - Factory-Made Air Ducts and Connectors.

2. UL 723 - Test for Surface Burning Characteristics of Building Materials

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Duct system design, as indicated in the Drawings, has been used to select size and type of air-moving and distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure or fan external static pressure.

B. Duct system construction in compliance with SMACNA HVAC Duct Construction Standard as constrained by pressure class and sealant class definitions in Part 3 of this Section.

C. Duct system support and anchorage design per local code requirements and the SMACNA Seismic Restraint Manual and HVAC Duct Construction Standard.

D. Sealing of duct system to achieve required leakage test performance results. Where leakage test methods only are defined under SMACNA HVAC Air Duct Leakage Test Manual, and leakage class is listed in Part 3 of this section.

E. Construction of self-supporting casings with anchorage and supports per local code requirements.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Refer to Section 033000 CAST IN PLACE CONCRETE.

C. Coordinate size and location of holes in walls, floors, roofs, and ceilings, taking into account the relevant air duct accessories and firestopping or caulking that is required.

D. Coordinate installation of duct mounted or duct connection equipment specified in other sections.

1.6 SUBMITTALS

A. Section 01340 – SUBMITTAL PROCEDURES and Section 230500 – COMMON WORK RESULTS FOR HVAC. Where conflicts occur between divisions, the more stringent requirement shall apply.

B. Shop Drawings: CAD-generated and drawn to 1/4 inch equals 1 foot scale. Show fabrication and installation details for metal ducts. Shop drawings to be submitted in PDF format.

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.

2. Duct layout indicating sizes and pressure classes.

3. Elevations of top and bottom of ducts.

4. Dimensions of main duct runs from building grid lines.

5. Fittings.

6. Reinforcement and spacing.

7. Seam and joint construction.

8. Penetrations through fire-rated and other partitions.

9. Equipment installation based on equipment being used on Project.

10. Duct accessories, including access doors and panels, volume dampers, fire & smoke dampers, and turning vanes.

11. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints. Submit structural calculations.

12. Casing access doors, including frames, hinges, and latches.

13. Filter, coil, humidifier and other apparatus.

14. Casing Interior lighting, including switches.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.

2. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout. Unless otherwise noted, duct sizes shown on the contract drawings are clear internal airway dimensions, and allowance shall be made for internal lining as appropriate.

3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.

4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

5. Structural members to which duct will be attached.

6. Size and location of initial access modules for acoustical tile.

7. Penetrations of smoke barriers and fire-rated construction.

8. HVAC piping runs.

9. Required openings in structural and architectural systems.

10. Location of supports for suspension systems.

11. Locations and critical dimensions of structural steel,

12. Major electrical conduit and cable tray routes,

13. Dimensions of actual equipment to be installed.

14. All conflicts between trades should be resolved prior to submission to the Architect/Engineer.

15. Location of walls and partitions, doors, door swings, lighting and all other information required to assure complete coordination among the various trades.

D. Product Data: For factory-fabricated casings, signed by product manufacturer.

1. Show sound-absorption coefficients in each octave band lower than those scheduled when tested according to ASTM C 423.

2. Show airborne sound transmission losses lower than those scheduled when tested according to ASTM E 90.

E. Test Reports:

1. Flamespread of resins (refer to UL-723).

2. Air Leakage (see Section 230593 also).

F. Welding certificates.

G. Field quality-control test reports.

1.7 QUALITY ASSURANCE

A. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

E. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

1.8 QUALIFICATIONS

A. Welding Qualifications: Quality procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.

3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

1.9 PRE-INSTALLATION MEETINGS

1. Refer to Division 01 GENERAL REQUIREMENTS.

2. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 – PRODUCT REQUIREMENTS.

B. Ductwork

1. All ductwork shall be delivered to the job site in a dry and clean state.

2. All ductwork shall be stored in a manner and location to minimize physical damage to any part of the ductwork (including internal lining), and stored in a dry and clean location.

3. All ductwork shall be stored in a clean and dry environment and protected from dust and dirt ingress.

4. All ductwork shall be delivered to the job site with shop-installed caps on all openings. Caps shall be made of heavy gauge polythene sheets securely taped to duct on all sides. Any ductwork not protected in this manner will be rejected and removed from the jobsite and replaced at no increase in the Contract Sum.

5. Ductwork that has been contaminated by dust shall be cleaned in accordance with proper standards. All lined ductwork shall be cleaned using the methodology outlined in the NAIMA booklet “Cleaning Fibrous Glass Insulated Air Duct Systems.”

6. Ductwork with lining that has been contaminated by liquids shall have lining removed and replaced prior to installation.

7. Installation of any damaged or refurbished ductwork shall not be accepted by the Engineer.

PART 2 PRODUCTS

2.1 IN OTHER PART 2 ARTICLES WHERE SUBPARAGRAPH TITLES BELOW INTRODUCE LISTS, THE FOLLOWING REQUIREMENTS APPLY FOR PRODUCT SELECTION:

A. Manufacturers: Subject to compliance with requirements and manufacturer’s offerings, products that may be incorporated into the Work include, but are not limited to, manufacturers specified. The first manufacturer listed represents the basis of design as scheduled and drawn in the Construction Documents.

2.2 DUCT MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. PVC-Coated Galvanized Steel: Acceptable by authorities having jurisdiction for use in fabricating ducts with UL 181, Class 1 listing. Lock-forming-quality, galvanized sheet steel complying with ASTM A 653/A 653M and having G90 coating designation. Factory-applied PVC coatings shall be 4 mils (0.10 mm) thick on sheet metal surfaces of ducts and fittings exposed to corrosive conditions and 2 mils (0.05 mm) thick on opposite surfaces.

D. Carbon-Steel Sheets: ASTM A 1008/A 1008M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

E. Stainless Steel: ASTM A 480/A 480M, Type 304.

F. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for

concealed ducts and standard, 1-side bright finish for exposed ducts.

G. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

H. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

I. Hangar Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.3 FLEXIBLE DUCTS

A. Manufacturers:

1. Thermaflex MKE.

2. Flexmaster U.S.A., Inc.

3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

4. Thermaflex, S-LD.

B. Noninsulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire.

1. Pressure Rating:4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.

2. Maximum Air Velocity: 4000 fpm (20.3 m/s).

3. Temperature Range: Minus 20 to plus 175 deg F (Minus 28 to plus 79 deg C).

C. Insulated, Flexible Duct: UL 181, spiral formed with 3003 bright reflective finished aluminum alloy, mechanically locked.

1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.

2. Maximum Air Velocity: 4000 fpm (20.3 m/s).

3. Temperature Range: Minus 20 to plus 175 deg F (Minus 28 to plus 79 deg C).

4. Water Vapor Permeance: 0.17 grains per sq. ft. per hour per inch of Hg. (Test Method: ASTM E 96, Procedure A)

5. Insulation R-Value: R-6.0 minimum at 75°F.

D. Flexible Duct Connectors:

1. Clamps: Mechanically locked, stainless-steel band with cadmium-plated hex screw to tighten band with a wormgear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

E. Regenerative Noise:

1. Noise due to air turbulence within the duct shall not exceed the following sound power levels for a 12-inch diameter duct with an air speed of 1,000 feet per minute.

Octave band center frequency (Hz)	125	250	500	1000	2000
Sound power levels (dB) referenced to 10-12 watts	30	31	30	22	20

2.4 SINGLE WALL SPIRAL ROUND DUCTS

A. Manufacturers:

1. McGill AirFlow Corporation.
2. SEMCO Incorporated.
3. Tangent Air Corp.
4. Spiral Mfg. Co., Inc.
5. Shop fabricated by mechanical contractor, upon approval of fabrication methodology statement.

B. Product Description: UL 181, Class 1, round spiral lockseam duct constructed of material to match adjacent ductwork.

C. Construct duct with the following minimum gages:

Diameter	**Gauge**
3 inches to 14 inches	26
15 inches to 26 inches	24
28 inches to 36 inches	22
38 inches to 50 inches	20
52 inches to 84 inches	18

D. Construct fittings with the following minimum gages:

Diameter	**Gauge**

3 inches to 14 inches	24
15 inches to 26 inches	22
28 inches to 36 inches	20
38 inches to 50 inches	20
52 inches to 60 inches	18
62 inches to 84 inches	16

2.5 SINGLE WALL SPIRAL FLAT OVAL DUCTS

A. Manufacturers:

1. McGill AirFlow Corporation.
2. SEMCO Incorporated.
3. Tangent Air Corp.
4. Spiral Mfg. Co., Inc.
5. Shop fabricated by mechanical contractor, upon approval of fabrication methodology statement.

B. Product Description: Machine made from round spiral lockseam duct constructed of material to match adjacent ductwork.

C. Joints: Either fully welded or bolted flange with gasket material in accordance with manufacturer's recommendations.

D. Construct duct with the following minimum gauges:

Major Axis Dimension	**Gauge**
7 inches to 24 inches	24
25 inches to 48 inches	22
50 inches to 70 inches	20
72 inches to 82 inches	18
84 inches and larger	16

E. Construct fittings with the following minimum gauges:

Major Axis Fitting Dimension	Gauge
7 inches to 36 inches	20
38 inches to 60 inches	18
62 inches and larger	16

2.6 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals. The application of this standard shall be contingent on the pressure class and sealant class defined in Part 3 of this Section.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for the pressure class defined in Part 3 of this Section.

2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Manufacturers:

a. Ductmate Industries, Inc.

b. Nexus Inc.

c. Ward Industries, Inc.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

1. Manufacturers:

a. Ductmate Industries, Inc.

b. Lockformer.

2. Duct Size: Maximum 30 inches (750 mm) wide and up to 2-inch wg (500-Pa) pressure class.

3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of nonbraced

panel area unless ducts are lined.

2.7 ROUND AND FLAT-OVAL DOUBLE WALL DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct. References are to interior sizes.

B. Insulation (inner cavity) to be 1-1/2" thick fiberglass insulation R6. No insulation in contact with airstream

C. Inner liner to be acoustical K27 galvanized sheet metal

D. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

E. Flat-Oval, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."[Fabricate ducts larger than 72 inches (1830 mm) in diameter with butt-welded longitudinal seams.]

1. Manufacturers:

   a. McGill AirFlow Corporation.

   b. SEMCO Incorporated.

   c. Lindab, Inc.

F. Duct Joints:

1. Ducts up to 20 Inches (500 mm) in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.

2. Ducts 21 to 72 Inches (535 to 1830 mm) in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.

3. Ducts Larger Than 72 Inches (1830 mm) in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.

4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

   a. Manufacturers:

      1). Ductmate Industries, Inc.

      2). Lindab Inc.

      3). Ward Industries, Inc.

5. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

a. Manufacturers:

1). Ductmate Industries, Inc.

2). McGill AirFlow Corporation.

3). SEMCO Incorporated.

4). Durodyne

G. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

H. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

I. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

2. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinalseam flat-oval duct.

3. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.

4. Round Elbows 8 Inches (200 mm) and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

5. Round Elbows 9 through 14 Inches (225 through 355 mm) in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

6. Round Elbows Larger Than 14 Inches (355 mm) in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.

7. Die-Formed Elbows for Sizes through 8 Inches (200 mm) in Diameter and All Pressures 0.040 inch (1.0 mm) thick with 2-piece welded construction.

8. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.

9. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.

10. Pleated Elbows for Sizes through 14 Inches (355 mm) in Diameter and Pressures through

10-Inch wg (2500 Pa): 0.022 inch (0.55 mm).

2.8 RECTANGULAR DUCT FITTING FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals. The application of this standard shall be contingent on the pressure class and sealant class defined in Part 3 of this Section.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for the pressure class defined in Part 3 of this Section.

2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Turning Vanes

1. Manufacturers:

a. Ductmate Industries, Inc.

b. Duro Dyne Inc.

c. METALAIRE, Inc.

d. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

C. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

D. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

E. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

F. Vane Construction:

1. Single wall

a. For use with lower than 3 inch wg (750 Pa) pressure classification system, except as noted.

b. ¾ inch (19mm) trailing edge and 2 inch (50mm) radius.

c. Type Y blades for ducts 36 inches (915mm) or less in width.

d. Type Z blades for ducts greater than 36 inches (915mm) in width.

2. Double wall

   a. For use with 3 inch wg (750Pa) and higher pressure classification systems.

   b. Small double thickness vanes with 2 inch (50mm) inside radius.

   c. Vane length not to exceed 36 inches (915mm). Provide separate equal size section for greater lengths.

2.9 SPECIAL DUCT APPLICATIONS

A. Duct Exposed to Outdoors or in overhang areas

   1. Type 304 or 316 Stainless Steel

   2. Joining method per particular system requirement (see above).

B. Fire Rated ductwork

   1. Scope

      a. Provide 2-hour Fire Resistant ductwork systems where space does not allow installation of standard duct with fire wrap

      b. 2 hour fire resistant ducts shall be UL listed for a minimum 2-hour Fire Resistance rating when tested to ISO Standard 6944. Ducts shall be constructed and installed following the requirements of UL Assemblies No. V-15, V-25 or V-28 and bear the UL mark.

   2. Prefabricated flanged duct sections with an overall wall thickness of 16.52 mm with a galvanized or stainless liner determined by the nature of the installed environment.

   3. The duct assembly shall be listed by UL and have achieved a 2-hour Fire Resistance rating when tested to ISO 6944. Each duct section shall bear the UL Listing mark.

   4. Product Trade Names :

      a. DuraDuct GNX - 2 hour Listed/Impact Resistance

2.10 SHOP- AND FIELD-FABRICATED CASINGS

A. Fabricate casings according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Shop fabricate casings, to greatest extent possible, with a minimum number of joints and to minimize field fabrication and assembly.

C. Fabricate casings with standing seams and angle reinforcements. Fabricate close-off sheets from casing sides, top, and bottom to damper, coil, and filter frames. Fabricate close-off sheets at joints between stacked coils. Bolt close-off sheets to frame flanges and housings. Support coils on stands fabricated from galvanized-steel angles or channels.

D. Reinforce casings with galvanized- or painted-steel angles.

E. Seal joints with liquid-type, high-pressure duct sealant to eliminate air leakage.

F. Fabricate drain pans for outside air intake louvers, cooling coils, humidifiers, and eliminator blade sections in casings with external connections. Provide vented deep-seal traps for drainage piping with 3/4-inch (20-mm) pipe connections. Fabricate and reinforce drain pans of same material and thickness as housing, 2 inches (50 mm) deep with rolled edges. Solder seams.

G. Fabricate casings with reinforced openings for access doors at least 20 inches (500 mm) wide by 48 inches (1200 mm) high and located for access to each item of equipment housed. Refer to Section 233300 – AIR DUCT ACCESSORIES for access doors.

H. Fabricate casings to receive flexible or hard ducted connections. Refer to Section 233300 – AIR DUCT ACCESSORIES for flexible connections.

I. Static-Pressure Classifications: Unless otherwise indicated, fabricate HVAC casings according to the following:

1. Before Fans: 2-inch wg

2. After Fans: 4-inch wg

PART 3 EXECUTION

3.1 EXAMINATION

A. Refer to Section 013300 – SUBMITTAL PROCEDURES.

B. Verify sizes of equipment connections before fabricating transitions.

C. Examine concrete bases and roof curbs for compliance with requirements for conditions affecting installation and performance of HVAC ducts and casings.

D. Examine wall, floor, roof, and ceiling penetrations for compliance with the requirements for conditions affecting installation and performance of HVAC ducts and casings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards—Metal and Flexible," unless otherwise indicated.

B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 3 inch plus allowance for insulation and lining thickness, except at penetrations of construction where small annular spaces are required to allow caulking and firestopping.

H. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

I. After each piece has been placed, duct section shall be wiped down with a clean rag. Provide a plastic cap, taped the full perimeter, for every open ended piece not having an immediate extension to be installed that day.

J. During construction, at the end of each day and at every open piece of duct, install temporary closures of metal or full-perimeter taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

K. Use mechanical locked joints with or without bead or beaded sleeve couplings for joining round duct sizes 8 inch and smaller.

L. Install duct hangers and supports in accordance with Section 230529.

M. Connect flexible ducts to metal ducts with mechanically locked connections.

N. Electrical and IT Equipment Spaces: Route ducts to avoid passing through transformer vaults, electrical equipment spaces and enclosures, and IT rooms.

O. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Section 233300 – AIR DUCT ACCESSORIES. Firestopping materials and installation methods are specified in Section 078400 FIRESTOPPING

P. PVC-Coated Duct, Special Installation Requirements

1. Repair damage to PVC coating with manufacturer's recommended materials.

Q. Aluminum Ductwork

1. Aluminum sheets: One gage heavier than galvanized steel as tabulated.

2. Joints and seams made watertight by:

a. Continuous soldering

b. Continuous aluminum welding

c. Apply epoxy adhesive (Not for dishwasher exhaust)

1). Scotch-Welt Structural Adhesive No. 2216 or equal.

2). Apply epoxy adhesive to seams and joints before fabrication

d. Grilles on aluminum ductwork: Aluminum.

e. Separate aluminum ducts, casing, plenums, housings and louvers from direct contact with concrete by resilient gasketing or caulking compound.

R. Installation of Exposed Ductwork

1. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

2. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

3. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

4. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

5. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring

B. Connect diffusers to low pressure ducts or with 6 feet maximum length of flexible duct.

C. In concealed ceilings, connect air outlets to supply ducts with eight foot maximum length of flexible duct. Connect air inlets directly to return duct, except where flexible duct is explicitly shown in the Drawings. If shown on return, provide maximum length of 8 feet. Connect exhaust inlets directly to exhaust ducts with flexible duct connectors. In situations where there are no ceilings, all diffusers shall be directly connected to ductwork.

D. Flexible ducts shall be supported by a 2 inch wide, 28 gauge steel collar hanger at or near mid-length.

E. A maximum of one bend shall be permitted per length of flexible ductwork. Where bends are used centerline radius shall be not less than one duct diameter.

F. Make connections with clamps as recommended by SMACNA duct construction standards. Clamp per SMACNA S3.33 and S3.34 with one clamp on the core duct and one on the insulation jacket.

G. Where a side-wall type grilles and registers are directly mounted to the open end of the duct, flange perimeter shall match external duct perimeter in size and the contractor shall provide the necessary folded lip to accept the grille’s screwed attachment.

3.4 CASING INSTALLATION

A. Install casings according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with recommended spacing of sheet metal screws and with requirements for casing sealing and trim positioning.

B. Apply sealant to joints, connections, and mountings.

C. Field-cut openings for pipe and conduit penetrations; insulate and seal according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

D. Support casings on floor or foundation system. Secure and seal to base.

E. Support components rigidly with ties, braces, brackets, seismic restraints, and anchors of types that will maintain housing shape and prevent buckling.

F. Align casings accurately at connections, with 1/8-inch (3-mm) misalignment tolerance and with smooth interior surfaces.

G. Maintain duct seal class integrity throughout casings.

H. Install floor mounted casings on 6 inch high concrete curbs. Refer to Section 033000 – CAST-IN-PLACE CONCRETE. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, furnish liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields

3.5 FIELD QUALITY CONTROL

A. All ductwork (in particular the exposed ductwork in the front of the house) shall:

1. Be constructed, assembled, installed, and hung level, square, with perpendicular walls, plumb and true.

2. All joints shall be square and perpendicular and each section shall be in the same vertical and horizontal plane.

3. Be stiff with minimal deflection in either plane, with no racking, sagging, oil canning, or rumbling.

4. Have mastic applied at each joint neatly with minimum over spread or dripping.

5. Be properly insulated (where applicable) with the insulation neatly attached with edges overlapped, sealed and mastic applied with no dripping, sagging, or ballooning.

6. Each label and arrow shall be applied square to the wall of the duct and centered.

7. The duct supports whether rods, saddles, or angles shall be plumb and perpendicular with each support in the same horizontal plane.

B. Perform duct cleanliness test as noted in this Section.

C. Perform duct leakage test as noted in this Section.

D. Inspect fibrous-glass duct systems according to “Inspection Checklist for Fibrous Glass Duct System Installation” in NAIMA AH116. Prepare a written report using the format of this

checklist.

E. The Architect / Engineer shall be the final arbiter of the quality of the installation and may require that any section or sections be replace that are not to his satisfaction.

3.6 DUCT SYSTEM CLEANLINESS TESTS:

A. Visually inspect duct system to ensure that no visible contaminants are present.

B. Test sections of duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

1. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

2. Duct system will be considered defective if it does not pass tests and inspections.

a. If duct system does not the tests all ductwork shall be cleaned completely as New Systems

3.7 CLEANING NEW SYSTEMS

A. Refer to Section 017300 – EXECUTION, Section 017700 – CLOSEOUT PROCEDURES, and Division 01 GENERAL REQUIREMENTS.

B. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

C. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Create other openings to comply with duct standards.

2. Install access doors for future cleaning purposes. See Section 233300 – AIR DUCT ACCESSORIES.

3. Disconnect flexible ducts as needed for cleaning and inspection.

4. Remove and reinstall ceiling sections to gain access during the cleaning process.

D. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

E. Clean the following metal duct systems by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.

3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.

4. Coils and related components.

5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.

6. Supply-air ducts, dampers, actuators, and turning vanes.

F. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.

3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.

4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.

5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

G. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.

2. Where contaminants are discovered, re-clean and reinspect ducts.

3.8 DUCT PRESSURE AND LEAKAGE TESTS

A. Test all ducts in accordance with the schedule in Part 3 of this section

B. Engage the testing agency specified in Section 230593 to verify the leakage tests of all ducts and submit a certification attesting to the results obtained.

C. Test Equipment: Use equipment arranged as recommended by the testing and balancing agency specified in Section 230593

D. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports.

E. Tested sections of ductwork to be visually marked by agency with certification sticker and initials of field test inspector. A master copy of the shop drawings shall be annotated to denote extent of ductwork that has been tested and has passed. Tests shall be made before duct sections are concealed.

F. Field Test Procedures

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and

for compliance with test requirements.

2. Seal all openings in duct section to be tested.
3. Connect test apparatus to test section of duct, using a flexible duct connection or hose.
4. Close damper or blower suction side to prevent excessive build up of pressure.
5. Start blower and gradually open damper on suction side of blower.
6. Build up pressure in duct test section. Conduct tests at static pressures equal to the pressure class of system or section being tested. Do not pressurize systems above the pressure class rating. Negatively pressurized ducts shall be tested under negative pressure.
7. Record indicated pressure or instrument that is connection to section of duct under test.
8. Maintain this pressure for ten minutes and check for audible leaks. Mark location of each leak.
9. Reduce pressure to 0 inch wg and repair all visual and audible leaks. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.
10. Leakage CFM to be read by consulting chart calibrated with orifice diameter. If no leakage exists, zero pressure differential shall be indicated. Leakage CFM shall not exceed the value derived from the SMACNA calculation given the leakage class definitions in this part 3 of this Section.

3.9 SCHEDULES

A. Ductwork Material Schedule:

Air System	**Material**
Supply Air except as noted below	Galvanized Steel
Outside Air except as noted below	Galvanized Steel
Return and Relief except as noted below	Galvanized Steel
General Exhaust (toilet, kitchenette, janitor closet, copier room)	Galvanized Steel
Outside Air Intake (including plenums/ casings) within 10 feet of louver	Stainless steel
Supply air in locations without ceilings	Internally lined Galvanized Steel

B. Ductwork Pressure and Sealant Class Schedule

1. Seal Classes are intentionally more stringent than SMACNA standards to reduce leakage.

Air System	Pressure Class	Seal Class
Outside Air Suction Side	1 inch wg250	A
Supply or Outside Air (downstream of VAV boxes,or dampers)	1 inch wg regardless of velocity.	A
On Floor Supply or Outside Air (upstream of VAV boxes)	2 inch wg (500 Pa)	A
Supply or Outside Air in Risers	4 inch wg	A
Return or Relief in Risers	2 inch wg	A
Return and Relief on Floor	1 inch wg regardless of velocity.	A
General (toilet, kitchenette, janitor closet, copier room)	2 inch wg regardless of velocity.	A
Exhaust		
Smoke Exhaust	5 inch wg	A

C. Leakage Test Requirement Schedule

1. The following portions of systems are required to have leakage tests.

System	Location	Notes
Supply	In risers	With SFDs and access panels installed.
Supply	On floors, upstream of	Blocked before VAV box

	VAV boxes, or dampers	or balancing device, with access panels installed.
Return and Relief	Risers and horizontal mains larger than 2 square feet in cross-sectional area	With SFDs and access panels installed.
General Exhaust	Risers	With SFDs and access panels installed.
Product-conveying, Pressurization-critical Exhausts	Entire system as a whole	With SFDs and access panels installed. Blocked at diffuser connections.

2. The maximum leakage allowed in cfm/sf is to be referenced against the seal class listed above and the definitions of seal class from Table 4-1 of the SMACNA HVAC Air Duct Leakage Test Manual.

Seal Class	**Leakage Class Allowed**
A	6
B	12
C	24
Round Duct, all classes	3

3.10 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.11 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.

4. Submit executed Warranties.

END OF SECTION

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Back-draft dampers.

2. Barometric relief dampers.

3. Fire and smoke dampers

4. Manual control dampers.

5. Cable-driven Bowden-type remote control on volume dampers.

6. Duct access doors.

7. Flexible duct connections.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

2. Other Related Sections:

a. Section 230500 – COMMON WORK RESULTS FOR HVAC.

b. Section 233100 – HVAC DUCTS AND CASINGS.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. ASTM International:

1. ASTM E1 - Standard Specification for ASTM Thermometers.

C. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

2. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

3. NFPA 92A - Recommended Practice for Smoke-Control Systems.

D. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

E. Underwriters Laboratories Inc.:

1. UL 33 - Heat Responsive Links for Fire-Protection Service.

2. UL 555 - Standard for Safety for Fire Dampers.

3. UL 555C - Standard for Safety for Ceiling Dampers.

4. UL 555S - Standard for Safety for Smoke Dampers.

1.3 SUBMITTALS

A. Refer to Section 01340 – SUBMITTAL PROCEDURES and Section 230500 – COMMON WORK RESULTS FOR HVAC. Where conflicts occur between divisions, the more stringent requirement shall apply.

B. Shop Drawings Refer to Section 01340 – SUBMITTAL PROCEDURES and Division 01. Shop drawings to be provided in PDF Format.:

1. For duct accessories. Include plans, elevations, sections, details, product data and attachments to other work, include with ductwork shop drawings

2. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.

b. Manual volume damper installations.

c. Concealed volume damper operators, with locations shown on the ductwork shop drawings, and details/method of installation to finished surfaces.

d. Control damper installations.

e. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators. Include installation details for angles, sleeves, breakaway connections, out-of-wall installations, and factory insulation.

f. Duct security bars.

g. Wiring Diagrams: For power, signal, and control wiring.

h. Duct access doors

C. Product Data:

1. Submit data for shop fabricated assemblies, hardware and devices used.

2. Submit scheduled list of devices for the following. Include where applicable electrical characteristics and connection requirements.

    a. Fire dampers including locations and required ratings cross-referenced against plan.

    b. Smoke dampers including locations and ratings cross-referenced against plan.

    c. Backdraft dampers.

    d. Flexible duct connections.

    e. Volume control dampers and concealed remote controllers.

    f. Duct access doors, including location, size, device served cross-referenced against plans.

3. For fire dampers, smoke dampers, combination fire and smoke dampers submit the following:

    a. Include UL ratings, dynamic ratings, leakage, pressure drop and maximum pressure data.

    b. Indicate materials, construction, dimensions, and installation details.

    c. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500 for each size of damper.

    d. Size of internal clear dimensions at opening versus external duct dimensions.

D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

E. Source quality-control reports.

F. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

G. Manufacturer's Installation Instructions

1.4 CLOSEOUT SUBMITTALS

A. Refer to Section 017300 – EXECUTION, Section 017700 – CLOSEOUT PROCEDURES and Division 01 GENERAL REQUIREMENTS.

B. Project Record Documents:

1. Record actual locations of access doors and devices.

2. Location of concealed operator screwdriver access and types.

C. Operation and Maintenance Data: Submit for Smoke and Combination Smoke and Fire Dampers.

1.5 QUALITY ASSURANCE

A. Provide evidence of the UL listing and California State Fire Marshall approval for all Fire Dampers and combination smoke and Fire Dampers, including explicit identification of approval for horizontal or vertical mounting configuration as appropriate.

B. Damper pressure drop ratings versus duct size and clear opening size based on tests and procedures performed in accordance with AMCA 500, for each size of damper.

C. Coordination Shop Drawings: Refer to Division 1 Section 013100 for requirements for Coordination Shop Drawing.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.7 PRE-INSTALLATION MEETINGS

A. Refer to Section 01340 – SUBMITTAL PROCEDURES.

B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 – PRODUCT REQUIREMENTS.

B. Protect dampers from damage to operating linkages and blades.

C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

D. Storage: Store materials in a dry area indoor, protected from damage, stored off the floor on pallets.

E. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 COORDINATION

A. Refer to Section 01340 – SUBMITTAL REQUIREMENTS and DIVISION 01 GENERAL REQUIREMENTS.

B. Coordinate Work where appropriate with building control Work.

1.11 WARRANTY

A. Refer to Section 017300 – EXECUTION and 017700 – CLOSEOUT PROCEDURES.

B. Furnish five year manufacturer warranty for duct accessories.

1.12 EXTRA MATERIALS

A. Refer to Section 017300 – EXECUTION, 017700 – CLOSEOUT PROCEDURES, and Division 01 GENERAL REQUIREMENTS.

B. Furnish two of each size and type of fusible link.

C. Furnish two spare cable-driven volume controller drivers.

D. Furnish two spare special tools for concealed volume damper operator.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with requirements and manufacturer's offerings, products that may be incorporated into the Work include, but are not limited to, manufacturers specified. The first manufacturer listed represents the basis of design as scheduled and drawn in the Construction Documents.

2.2 BACK-DRAFT DAMPERS

A. Manufacturers:

1. Greenheck.

2. Ruskin.

3. Nailor.

4. Air Balance.

5. American Warming.

B. Provide damper material of the same material as ductwork. Provide stainless steel dampers in stainless steel ducts.

C. Description: Adjustable gravity balanced.

D. Maximum Air Velocity: 3000 fpm .

E. Maximum System Pressure: 2-inch wg.

1. sheet steel or 0.063-inch- (1.6-mm-) thick extruded aluminum, with welded corners and mounting flange.

2. Blades: Multiple single-piece blades, parallel-action, center-pivoted, maximum 6-inch (150-mm) width, 16 gauge galvanized steel or extruded aluminum, with felt or vinyl foam sealed edges. Blades linked together in rattle-free manner

3. Blade Axles:

a. Material: Plated steel.

b. Diameter: 0.20 inch (5 mm).

4. Tie Bars and Brackets: Aluminum or Galvanized steel per the blade construction.

5. Return Spring: Adjustable tension.

6. Bearings: Steel ball.

7. Accessories:

a. Adjustment device to permit setting for varying differential static pressure.

b. Counterweights and spring-assist kits for vertical airflow installations.

c. Electric actuators.

d. Chain pulls.

e. Screen Mounting: Front mounted in sleeve.

1). Sleeve Thickness: 20-gage (1.0-mm) minimum.

2). Sleeve Length: 6 inches (152 mm) minimum.

f. Screen Mounting: Rear mounted.

g. Screen Material: Galvanized steel or Aluminum.

h. Screen Type: Bird.

i. 90-degree stops.

2.3 BAROMETRIC RELIEF DAMPERS

A. Manufacturers:

1. Greenheck.

2. Ruskin.

3. Nailor.

4. Air Balance.

5. American Warming.

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 2000 fpm (10 m/s).

D. Maximum System Pressure: 4-inch wg (0.5 kPa).

E. Construction

1. Frame: 0.064-inch- (1.6-mm-) thick, galvanized sheet steel welded corners and mounting flange.

2. Blades:

    a. Multiple, 0.050-inch- (1.2-mm-) thick aluminum sheet.

    b. Maximum Width: 6 inches (150 mm).

    c. Action: Parallel.

    d. Balance: Gravity.

    e. Eccentrically pivoted.

3. Blade Seals: Neoprene.

4. Blade Axles: Galvanized steel.

5. Tie Bars and Brackets:

    a. Material: Galvanized steel.

    b. Rattle free with 90-degree stop.

6. Return Spring: Adjustable tension.

7. Bearings: Stainless steel.

8. Accessories:

    a. Flange on intake.

    b. Adjustment device to permit setting for varying differential static pressures.

2.4 FIRE AND SMOKE DAMPERS

A. General

1. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S. Provide evidence of UL Approved use in both horizontal and vertical air flow applications. Internal clear opening shall match or be greater than that of adjacent ductwork, taking into account internal angles associated with frame or sleeve. Where this requires a larger external duct size, transition shall be provided.

2. All fire and smoke dampers UL 555S listed and listed in the latest California State Fire Marshal's Bulletins and Listings under Guide No. 3225. Install in accordance with their requirements. Submit listing numbers.

3. Submit substantiation of California State Fire Marshal damper approval and acceptance of installation details and assembly in accordance with the requirements of Section 230500 – COMMON WORK RESULTS FOR HVAC.

4. Fire-damper installation is required for all ductwork which penetrates fire rated walls, floors

and ceilings. Smoke dampers required in all smoke rated partitions. Every effort has been made to show all dampers on the Mechanical Drawings. The Architectural Drawings indicate by symbol all such rated partitions. The Contractor shall verify all locations and provide dampers which are required but not shown on the Mechanical Drawings at no increase in Contract Sum.

5. Provide dampers for rectangular or round duct connections as required.

6. Provide duct access panel at each damper, suitably sized and located for inspection and resetting. Ceiling or wall access doors as specified in General Mechanical Section.

B. Combination Fire and Smoke Dampers

1. Manufacturers:

   a. Greenheck.

   b. Ruskin.

   c. Nailor.

   d. Air Balance.

2. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

3. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000- fpm (10-m/s) velocity.

4. Fire Resistance: 1-1/2 hours and 3 hours, as required by the Building Code to match allowable resistance for each penetrated construction's fire rating.

5. Leakage: Class I, (less than 8cfm (3.7L/s) at 4 inch wg (1000 Pa) differential pressure).

6. Rated pressure and velocity to exceed design airflow conditions.

7. Mounting: vertical or horizontal.

8. Mounting Sleeve: Factory-installed, 20 gauge, galvanized sheet steel; length to suit wall or floor application, minimum 17 inches (430mm) with factory-furnished silicone calking to comply with leakage rating requirements.

9. Frame: 5 inches (127mm) 16 gauge hat shaped channel; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners, structurally equivalent to 13 gauge U-channel type frame.

10. Finish - Mill galvanized.

11. Linkage concealed in frame.

12. Blades: Opposed blade; airfoil shaped, single piece, double skin; horizontal; minimum 14 gauge galvanized steel; maximum 6 inch (150mm) width.

13. Bearings: Stainless steel sleeve pressed into frame.

14. Seals: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of 450 degrees F (232 degrees C) and blade edge overlap for flame seal to 1900 degrees F (1038 degrees C); glue-on or grip type seals are not acceptable. Stainless steel flexible metal compression type jamb.

15. Minimum ½ inch (13mm) plated steel hex stock shaft mechanically attached to blade.

16. Breakaway Connections: Provide breakaway connections are required on all installations unless the damper sleeve is at least 16 gauge galvanized steel.

17. Smoke Detector: Integral, factory wired for single-point connection, refer to accessories below.

18. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

19. Temperature Release Device: Heat-Actuated, Quick Detect.

    a. Close (in a controlled manner) and lock damper during test, smoke detection, power failure, or fire conditions through actuator closure spring. At no time shall actuator disengage from damper blades.

    b. Allow damper to be automatically and remotely reset after test or power failure conditions. After exposure to high temperature or fire, inspect damper before reset to ensure proper operation.

    c. Controlled closing and clocking of damper in 7 - 15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable.

    d. Release Temperature: 250 degrees F.

20. Actuator: Actuator shall be selected such that the combined actuator/damper assembly is UL listed, and approved by the AHJ.

    a. Type: Electric 120 volt, 60 hertz, two-position, fail close

    b. Mounting: external or internal as required for access.

21. Release Device: Close in controlled manner and allow damper to be automatically reset remotely.

22. Master control panel for use in dynamic smoke-management systems.

23. Provide dual indicating switches for indication of full open and full closed position. At dampers with multiple sections, provide one factory mounted end switch per damper section. Provide for acceptance of remote open and close signals from fire alarm panel.

24. Fire Stat: (factory installed):

    a. UL classified controlling device to allow dampers to be reopened after the initial closure as part of a smoke purge system.

    b. At temperatures in excess of 250 degrees F the damper will close and lock into position.

c. The damper shall remain closed until the override signal from a remote command station is present and the duct temperature is not above the high limit specified below.

d. A high limit temperature sensor shall prevent the damper from being opened if the duct temperature is above 350 degrees F.

e. Device shall also include a manual reset button for local opening of damper.

f. Position indicating switches are required to prove damper position.

25. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.

a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

c. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.

d. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).

e. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).

f. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).

g. Electrical Connection: 115 V, single phase, 60 Hz.

C. Dynamic Fire Dampers

1. Manufacturers:

a. Greenheck.

b. Ruskin.

c. Nailor.

d. Air Balance.

2. Fabricate in accordance with NFPA 90A and UL 555. Internal clear opening shall match or be greater than that of adjacent ductwork, taking into account internal angles associated with frame or sleeve. Where this requires a larger external duct size, transition shall be provided.

3. Fire Resistance: 1-1/2 hours and 3 hours as required by the Building Code to match allowable resistance for each penetrated construction's fire rating.

4. Dynamic Closure Rating: Dampers classified for dynamic closure to 2000 fpm (10 m/s) and 4 inches wg (1 kPa) static pressure.

5. Construction:

    a. Integral Sleeve Frame: Minimum 20 gage (0.9 mm) roll formed galvanized steel.

    b. Length: 16 inches (406 mm).

    c. b. Blades:

    d. Style: Curtain type with blades outside airstream.

    e. Action: Spring or gravity closure upon fusible link release.

    f. Material: Minimum 24 gage (0.6 mm) roll formed, galvanized steel.

6. Fusible Link Release Temperature: 250°F.

7. Mounting: Vertical or horizontal as indicated on Drawings. For horizontal dampers include blade lock and 301 stainless-steel closure spring.

8. Finish: Mill galvanized.

D. Static Fire Dampers

1. Manufacturers:

    a. Greenheck.

    b. Ruskin.

    c. Nailor.

    d. Air Balance.

2. Fire Rating: UL 555 classified and labeled as a 1-1/2 and 3 hour static fire damper as required by the Building Code to match allowable resistance for each penetrated construction's fire rating.

3. Air Flow Rating: UL approved for dual directional air flow.

4. Integral Sleeve Frame: Minimum 20 gage (0.9 mm) by 12 inches (305 mm) roll formed, galvanized steel.

    a. Factory Sealant: Apply to dampers in HVAC systems with pressures to maximum 4 inches wg (1 kPa).

5. Blades:

    a. Style: Curtain type with blades outside airstream.

b. Action: Spring or gravity closure upon fusible link release.

c. Orientation: Horizontal.

d. Material: Minimum 24 gage (0.6 mm) roll formed, galvanized steel.

6. Closure Springs: Stainless steel, constant force type, if required.

7. Temperature Release Device:

a. Fusible link, 250°F.

b. Mounting: Vertical.

8. Finish: Mill galvanized.

9. Picture Frame Mounting Angles:

a. One-piece, roll formed retaining angles 1-1/2 x 1-1/2 inches (38 x 38 mm).

b. Factory matched and shipped attached to damper.

E. Ceiling Dampers

1. Manufacturers:

a. Greenheck.

b. Ruskin.

c. Nailor.

d. Air Balance.

2. General Requirements:

a. Labeled according to UL 555C by an NRTL.

b. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

3. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction. 3 inch (75mm) 20 gauge minimum for rectangular, 3-1/2 inch (89mm) 20 gauge minimum for circular galvanized steel with roll formed ridge for blade stop.

4. Blades: Galvanized sheet steel with refractory insulation.

a. Style: Two-piece, single-thickness with blade insulation, hinged in center, and held open with fusible link.

b. Action: Butterfly.

c. Orientation: Horizontal.

d. Material: Minimum 20 gage galvanized steel.

5. Heat-Responsive Device: Replaceable, 212 deg F rated, fusible links.

6. Fire Rating: 3 hours.

7. Thermal Insulation Blanket: Mineral wool.

8. Hinge: Spring stainless steel, mechanically attached to blades.

9. Mounting: Horizontal.

10. Finish: Mill galvanized.

11. Assembly: Factory-assembled damper and accessories and furnish as a single unit conforming to UL 555C.

12. Dampers shall be suitable for use in dynamic systems. Classified for dynamic closure to a minimum of 2000fpm (10m/s) and 4 inches wg (1000 Pa) differential pressure for air flow direction as installed.

F. Smoke Dampers

1. Manufacturers:

a. Greenheck.

b. Ruskin.

c. Nailor.

d. Air Balance.

2. Fabricate in accordance with NFPA 90A and UL 555S. Provide evidence of UL Approved use in both horizontal and vertical applications. Internal clear opening shall match or be greater than that of adjacent ductwork, taking into account internal angles associated with frame or sleeve. Where this requires a larger external duct size, transition shall be provided.

3. Fire Resistance: 1-1/2 hours and 3 hours as required by the Building Code to match allowable resistance for each penetrated construction's fire rating..

4. Leakage Rating: Class II, maximum of 20 cfm (9.4 L/s) at 4 inches wg (1 kPa) differential pressure.

5. Damper Temperature Rating: 250°F (121°C).

6. Frame: 16 gage (1.5 mm), galvanized steel.

7. Blades:

a. Style: Airfoil-shaped, single piece, double skin.

b. Action: Opposed.

c. Orientation: Horizontal.

d. Material: Minimum 14 gage (1.8 mm) equivalent thickness, galvanized steel.

e. Width: Maximum 6 inches (150 mm).

8. Bearings: Stainless steel pressed into frame.

9. Seals: Silicone blade edge seals and flexible stainless steel jamb seals.

10. Linkage: Concealed in frame.

11. Actuator:

a. Type: Electric 120 volt, 60 hertz, two-position, fail close.

b. Mounting: External wherever possible when maintenance access can be assured, Internal otherwise (must identify actuator position in Shop Drawings to clarify).

12. Sleeve: Factory installed 20 gage (0.9 mm) sleeve, minimum 12 inches (305 mm) long.

13. Finish: Mill galvanized.

2.5 MANUAL VOLUME DAMPERS

A. Manufacturers:

1. Ruskin.

2. Air Balance.

B. Provide where required to provide complete air balance and where shown on drawings. Coordinate with air balance firm. Not all dampers are shown.

C. In ducts greater than 9 inches high, provide opposed-blade-type dampers.

D. In ducts 9 inches high or less, provide single-blade dampers.

E. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

F. General requirements for all volume dampers

1. Stainless steel rod and fasteners

2. End bearings and gaskets

3. Locking indicating quadrants

4. Factory-supplied integral sleeve

5. Provide a groove in the end of the blade shaft parallel to the blade to indicate blade angle.

6. Suitable for horizontal or vertical applications.

7. Single blade dampers with center “V” break. Single blade round dampers shall be double beaded.

8. Multiple blade rectangular dampers shall have hat channel frame with interlocking corner gusset and 1” (13mm) frame. Blades shall be interconnected.

G. Bearings: Stainless steel oiltite.

H. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch (200 x 1825 mm). Assemble center and edge crimped blades in frame channel with suitable hardware.

I. End Bearings: Except in round ductwork 12 inches (300 mm) and smaller, furnish close end bearings. On multiple blade dampers, furnish oil-impregnated nylon or sintered bronze bearings. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less and greater than 18 inches (450mm) shall have axles full length of damper blades and bearings at both ends of operating shaft.

J. Material thickness

Damper Type	Frame Gauge per Duct Type			Blade Gauge per Duct Type		
	Galvanized Steel	Aluminum	304 Stainless Steel	Galvanized Steel	Aluminum	304 Stainless Steel
Single Blade Rectangular	22	22	20	22	22	22
Single Blade Round	22	22	20	22	22	22
Multiple Blade Rectangular	16	16	16	16	16	16

K. Damper Regulators

1. General:

   a. All steel components zinc plated.

   b. Provide elevated dial or shaft extension for use on insulated ducts.

   c. Provide only one handle per multi-blade volume damper regardless of size.

2. Shaft length 12 inches (300mm) or less:

    a. 1/4 inch (6mm) dial regulator. Die cast steel with heavy gauge dial. 3/32 inch (2.5mm) steel handle. 3/4 inch (19mm) hexagonal nut.

3. Shaft length greater than 12 inches (300mm) and less than 20 inches (500mm):

    a. 3/8 inch (9.5mm) dial regulator. Die cast steel with heavy gauge dial. 3/32 inch (2.5mm) steel handle. 3/4 inch (19mm) hexagonal nut.

4. Shaft length 20 inches (500mm) or greater:

    a. Die-cast steel. Self-locking regulator with locking nut. Heavy steel stamped handle. Serrated teeth to prevent slippage with flat spring between the two pieces. Gasket.

2.6 CABLE DRIVEN BOWDEN-TYPE REMOTE CONTROL VOLUME DAMPER OPERATOR

A. Manufacturers

1. Young's Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment. Provide controller package for a complete workable system for damper operation, including (but not limited to): gear drives and controller, mounting brackets, connecting operator wire and casing, and wrenches.

C. Cable: Stainless steel, 50ft maximum.

D. Wall-Box Mounting: Recessed,

E. Wall-Box Cover-Plate: Zinc plated, for use with flush ceiling/wall installation, not exceeding 7/8 inch (22mm) in diameter.

F. Provide concealed volume damper operator for all volume dampers located above inaccessible ceilings. An inaccessible location is defined as a location where there is insufficient access (or no access panel shown on architect's drawings) to operate a manual volume damper.

1. Exposed shaft for plenum mount to be located with diffuser plenum.

2. Tamper-proof flush mounted screw head for exposed head for ceiling mount or flush with diffuser flange.

2.7 MOTORIZED DAMPERS

A. Manufacturers

1. Ruskin

2. Greenheck

3. American Warming

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal

for both air performance and air leakage. Less than 10cfm/sqft at 4 inches WG.

C. Frames:

1. Hat shaped, galvanized-steel channels, 16 gauge, mitered and welded corners.

2. Flanges for attaching to walls and flangeless frames for installing in ducts.

3. Dampers less than 12 inches (300mm): 4½ inches (115mm) wide.

4. Dampers 12 inches (300mm) and larger: minimum 5 inches (89mm) wide.

5. Stainless steel jamb seals.

D. Blades:

1. Multiple blade, opposed-blade, maximum blade width of 6 inches (150 mm), galvanized steel, 16 gauge.

2. Blade Edging: PVC.

E. Blade Axles: 1/2-inch- (13-mm-) diameter; plated steel extending minimum 6 inches (150mm) beyond frame; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. ½ inch (13mm) jackshaft for multisection dampers for single-sided actuation. Operating Temperature Range: From minus 25 to plus 180 deg F (minus 32 to plus 83 deg C).

F. Bearings:

1. Molded synthetic.

2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less and greater than 18 inches (450mm) shall have axles full length of damper blades and bearings at both ends of operating shaft.

3. Thrust bearings at each end of every blade.

G. Actuators:

1. Refer to Division 25 for information regarding motorized damper actuator requirements.

2.8 DUCT ACCESS DOORS

A. Manufacturers:

1. American Warming.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

C. Wherever possible, install doors so that air pressure differential tends to keep door closed. On doors of systems where fan is scheduled for 4 inches S.P. or greater, provide painted signs appropriately worded as follows:

1. “CAUTION – DOOR CLOSES WITH AIR PRESSURE”

2. “CAUTION – DOOR OPENS WITH AIR PRESSURE”

D. Hinged Rectangular Duct Access Door

1. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Frame duct opening for each door with a continuous 1 inch by 1 inch (25mmx25mm) by 12 gauge sheet metal angle, of the same material as the duct in which installed, riveted to the exterior surface of the duct opening. Min. 24 gauge steel frame. Galvanized steel for galvanized ductwork. 304 stainless steel for stainless steel ductwork.

3. Door: Min. 26 gauge steel double-wall with 1 inch fiberglass insulation. Design lock edge of doors with a bevel of 1/8-inch (3mm) in 1 inch (25mm) and fill interior hollow space with insulation, thermally equivalent to the ductwork insulation. Lap inner face of door over duct opening, a minimum of 1/4-inch (6mm) on all four edges of the free duct opening. Galvanized steel for galvanized ductwork. 304 stainless steel for stainless steel ductwork.

4. Hinge: Continuous piano type hinge. Galvanized steel for galvanized ductwork. 304 stainless steel for stainless steel ductwork.

5. Gaskets: Foam gasket at door-to-frame and frame-to-duct.

6. Casement fasteners: Steel or cast aluminum with a galvanized or aluminized finish.

7. Door latches: operable rustproof zinc/aluminum alloy latch accessible from inside and outside duct. Steel and sponge rubber washers to prevent leakage. Beveled flange to work against frame to achieve compression. Sash locks: Up to 18” (25mm) square: Furnish two locks. Above 18” (25mm) square: Furnish three locks.

E. Removable CAM type Rectangular Duct Access Door

1. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: 22 gauge steel frame. Galvanized steel for galvanized ductwork. 304 stainless steel for stainless steel ductwork.

3. Door: 26 gauge steel double-wall with 1 inch fiberglass insulation. Galvanized steel for galvanized ductwork. 304 stainless steel for stainless steel ductwork.

4. Gaskets: Foam gasket at door-to-frame and frame-to-duct.

5. Lock: CAM type latches. Up to 14 inches square: Furnish two locks. Above 14 inches square: Furnish four locks.

F. Hinged Circular Duct Access Door

1. Fabricate doors airtight and suitable for duct pressure class.

2. Door: 20 gauge steel roll formed.

3. Hinge: Continuous zinc plated steel.

4. Gaskets: 1/2 inch thick neoprene gasket at door-to-duct.

5. Lock: Spring bolt type. Furnish two locks.

2.9 GREASE DUCT ACCESS DOORS

A. Manufacturers:

1. Ductmate Industries.

2. Flame Gard.

3. 3M.

B. Labeled according to UL.

C. Door shall meet NFPA 96 standards.

D. Panel and Frame: Minimum 22 gauge stainless steel.

E. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

F. Gasket: grease-tight, high-temperature ceramic fiber, rated for minimum 2300 deg F (1260 deg C).

G. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

H. Provide external chain where access door may fall into vertical duct.

2.10 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers

1. Ventfabrics.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.

C. Connector: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd (1.0 kg/sq m).

2. Net Fabric Width: Approximately 6 inches (150 mm) wide.

3. Sewn and cemented seams.

4. Metal: 3 inch (75 mm) wide, 24 gage (0.6 mm thick) galvanized steel.

5. Maintain not less than 4” (100mm) metal-to-metal separation with fabric folds to allow for flexibility.

D. Connections shall be of fireproof material and manufactured for temperatures and pressures involved. Connections shall be flanged for attachment to fans and adjacent ductwork. Material

shall be as follows:

1. External Locations: Heavy glass fabric, double-coated with Hypalon (chlorosulfurated polyethylene). Resistant to sunlight, ozone and temperatures –10 to 275 deg. F. Shall comply with UL Standard 214. Ventfabrics, Ventlon.

2. All Corrosion Resistant Applications: Glass fabric coated with Teflon fluorocarbon resins. Resistant to temperatures –20 to 500 deg. F. Shall comply with UL Standard 214 and NFPA 102. Ventfabrics, Ventel.

3. All Other Locations: Heavy glass fabric, double-coated with Neoprene. Resistant to temperatures –20 to 200 deg. F. Shall comply with UL Standard 214. Ventfabrics, Ventglas.

E. Install flexible connectors to connect ducts to motorized equipment. Install also in ducts at structural expansion joints.

1. Secure fabric connectors tightly to fans, casings and ducts as follows:

a. Secure round connectors with 12 gauge by 1 inch (25mm) wide galvanized steel draw bands. Secure bands with bolts and nuts.

2. Secure rectangular connectors with 1 inch by 1/8-inch (25mmx3mm) thick flat galvanized steel bars, with screws or bolts on 8 inch (200mm) centers maximum, or with sheet metal slip joints. Tightly crimp fabric into sheet metal joint and secure complete joint with sheet metal screws on 6-inch centers maximum.

3. Allow at least 3 inch (76mm) slack in connections.

F. Leaded Vinyl Sheet: Minimum 0.55 inch (14 mm) thick, 0.87 lbs. per sq ft (4.2 kg/sq m), 10 dB attenuation in 10 to 10,000 Hz range.

PART 3 EXECUTION

3.1 EXAMINATION

A. Refer to Section 013300 – SUBMITTAL PROCEDURES.

B. Verify rated walls are ready for fire damper installation.

C. Verify ducts and equipment installations are ready for accessories.

D. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 INSTALLATION – GENERAL

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in

galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

D. Provide wire mesh screens on all duct openings that do not contain grilles or access panels.

3.3 INSTALLATION – DAMPERS

A. Install back-draft dampers on exhaust discharges and outside air intakes. Coordinate with Section 233400 to determine if backdraft dampers are already provided at the fan unit. In addition to required back-draft dampers, exhaust and outside air intakes must also be provided with motorized dampers that automatically shut when systems are not in use per requirements of ASHRAE 90.1. Refer to Division 25 for information regarding motorized dampers and sequence of operations.

B. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.

2. Install aluminum volume dampers in aluminum ducts.

C. Set dampers to fully open position before testing, adjusting, and balancing.

D. Provide concealed remote volume damper operators for all volume dampers in inaccessible locations. Operator shall be installed within the ceiling or wall such that the unit is flush with the finished surface. Operators for diffusers shall not be located in active supply portions of the diffuser, but may be installed in blank-off locations and/or return diffusers. Coordinate location of operator with the Architect.

E. Provide fire and smoke dampers, fire dampers at locations where ducts and outlets pass through fire rated components taking into account the matching of fire area to that of the adjacent duct. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

1. Install fire, smoke, and combination fire and smoke dampers according to UL listing.

2. Install all dampers in accordance with SMACNA fire damper guide and manufacturer's instructions.

3. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92A.

4. Install dampers square and free from racking with blades running horizontally.

5. Do not compress or stretch damper frame into duct or opening.

6. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jack

shaft.

7. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

3.4 INSTALLATION – FLEXIBLE CONNECTORS

A. Provide ductwork connected to air-handling equipment or air inlet and outlet devices, with all necessary transformation pieces, flexible fabric connections, as required.

B. Do not paint fabric connectors.

C. For fans developing static pressures of 5-inch (1250 Pa) and more, cover flexible connectors with leaded vinyl sheet held in place with metal straps. For large fan connections, provide structural angle on flexible connection to match fan angle according to SMACNA figure 2-17.

D. Connect terminal units to supply ducts directly. Do not use flexible ducts to change directions.

E. Connect flexible ducts to metal ducts with draw bands. Duct collars exceeding 12” dia. Shall have draw bands positioned behind a bead on the metal collar, per SMACNA.

3.5 INSTALLATION – ACCESS DOORS

A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 233100 for duct construction and pressure class.

B. Install ductwork accessories in accordance with the manufacturer’s printed instructions.

C. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

Equipment	Location	Minimum Size Inches (mm)
Control damper	Upstream or Downstream	18x18 (450x450)
Control devices requiring inspection	Upstream or Downstream	18x18 (450x450)
Backdraft damper	Upstream or Downstream: Ensure visibility of damper	18x18 (450x450)
Inline fans	Inlet and Outlet	18x18 (450x450)
Fire dampers	Upstream or Downstream: Ensure visibility of damper	8x8 (200x200)
Combination fire and smoke dampers	Upstream or Downstream: Ensure visibility of damper	18x18 (450x450)
Filters	Upstream and Downstream	18x18 (450x450)
Duct Mounted Cooling coil	Upstream and Downstream	8x8 (200x200)
Duct Mounted Heating coil	Upstream and Downstream	8x8 (200x200)
Humidifiers	Upstream and Downstream	8x8 (200x200)
Duct Mounted Drain pans and seals	Upstream and Downstream	18x18 (450x450)
Outdoor intakes and mixed air plenums	One location per plenum	18x18 (450x450)
Full height plenum	One location per plenum	24 W x 60 H (600W x 1500 H)
Duct Silencers	Upstream	8x8 (200x200)
Manual volume dampers	Upstream	8x8 (200x200)
Change in direction	Upstream	8x8 (200x200)
Turning vanes	Upstream	8x8 (200x200)
Maximum 50-foot (15-m) spacing. Maximum 10 foot (3m) spacing for lined ductwork.	N/A	8x8 (200x200)

D. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.

E. Access Door Sizes:

1. One-Hand Access: 8 x 8 inches (200 x 200 mm).

2. Two-Hand Access: 12 x 12 inches (300 x 300 mm).

3. Head and Shoulders Access: 18 x 18 inches (450 x 450 mm).

4. Body Access: 25 x 14 inches (635 x 355 mm).

5. Body plus Ladder Access: 25 x 17 inches (635 x 430 mm).

F. Label access doors according to Section 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT to indicate the purpose of access door.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

B. Operate dampers to verify full range of movement.

C. Inspect locations of access doors and verify that purpose of access door can be performed.

D. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.

E. Inspect turning vanes for proper and secure installation.

F. Operate remote damper operators to verify full range of movement of operator and damper.

3.7 DEMONSTRATION

A. Refer to Section 017300 – EXECUTION and Section 017700 – CLOSEOUT PROCEDURES.

B. Demonstrate resetting of fire dampers / fire & smoke dampers to the AHJ.

C. Demonstrate re-setting of all damper types to Owner's representative.

3.8 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project’s Waste Management Plan.

3.9 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.

4. Submit executed Warranties.

END OF SECTION

SECTION 233600 - AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Shutoff, single-duct air terminal units.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

2. Other Related Sections:

a. Section 230513 – COMMON MOTOR REQUIREMENTS FOR HVAC.

b. Section 250200 - FACILITY MANAGEMENT SYSTEM

c. Section 233100 - HVAC DUCTS AND CASINGS

d. Section 233300 - AIR DUCT ACCESSORIES

1.2 SUBMITTALS

A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.

1. Air terminal units.

2. Liners and adhesives.

3. Sealants and gaskets.

B. Shop Drawings: For air terminal units. 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. Wiring Diagrams: For power, signal, and control wiring.

3. Hangers and supports, including methods for duct and building attachment**,** and vibration isolation.

4. Coil data including water flow rate, air and water pressure drop, and capacity.

5. Sound power ratings per ASHRAE Standard 130 and ARI Standard 880, rated in NC levels with 10-dB room factor.

C. Delegated-Design Submittal:

1. Materials, fabrication, assembly, and spacing of hangers and supports.

2. Design Calculations: Calculations**,** including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.

D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.

2. Size and location of initial access modules for acoustic tile.

3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

E. Field quality-control reports.

F. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition, include the following:

1. Instructions for resetting minimum and maximum air volumes.

2. Instructions for adjusting software set points.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

C. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

1.4 WARRANTY

A. The manufacturer shall provide the parts warranty for equipment manufactured and all vendor supplied components. The said warranty shall cover replacement of all defective parts for a period of 12 months from equipment start up.

1.5 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.

PART 2 PRODUCTS

2.1 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

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

1. MetalAire

2. Titus.

3. Trane

B. Configuration: Pressure independent volume-damper assembly inside unit casing with control components inside a protective metal shroud. Field adjustable maximum and minimum air quantities from maximum catalog airflow rate to zero with taps for air flow readings.

C. Casing:

1. Minimum 22 gauge single wall.

2. Casing lining: Adhesive attached, 1-inch- (25-mm-) thick, coated, fibrous-glass duct liner complying with ASTM C 1071, 4lb density, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84. All exposed insulation edges sealed from the airstream using mechanically bonded metal barrier strips.

a. Cover liner with nonporous foil such that 100% of the insulation is not in contact with the airstream.

3. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.

4. Air Outlet: S-slip and drive connections, transition ductwork to size shown on drawing as appropriate.

5. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

7. Casing leakage:

a. Shall not exceed 1% at 1 inch wg (250Pa).

b. Shall not exceed 2% at 3 inch wg (750Pa).

D. Volume Damper:

1. Galvanized steel with peripheral neoprene gasket and self-lubricating bearings.

2. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg (750-Pa) inlet static pressure.

3. Damper Position: Normally open.

E. Electronic Controls: Bidirectional damper operator and microprocessor-based thermostat with integral airflow transducer. Control devices shall be compatible with temperature controls specified in and shall have the following features:

1. Damper Actuator: pneumatic, fail open, preferably installed in the factory, same manufacturer as controls. Controls may be field installed due to small quantity.

2. Multipoint flowcross center averaging velocity sensor at air inlet. Non-center averaging sensors are not acceptable.

3. Provide NEMA 1 controls enclosure.

4. Provide transformers and transfucer as required, coordinate with FMS.

F. Direct Digital Controls: Single-package unitary controller and actuator. Controls shall be furnished by BAS/BMS Contractor.

2.2 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Steel Cables: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to ARI 880 and ASHRAE Standard 130.

1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

2. Factory coil leak test up to 300psi under water.

3. Coil capacities tested under ARI Standard 410.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

C. Install wall-mounted thermostats.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete. Drill inserts into finished concrete.

2. Do not use powder-actuated concrete fasteners.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

A. Install piping adjacent to air terminal unit to allow service and maintenance.

B. Connect ducts to air terminal units according to Section 233100 – HVAC DUCTS AND CASINGS.

C. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 – AIR DUCT ACCESSORIES.

3.4 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.

2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Air terminal unit will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.

3. Verify that controls and control enclosure are accessible.

4. Verify that control connections are complete.

5. Verify that nameplate and identification tag are visible.

6. Verify that controls respond to inputs as specified.

7. Refer to “Owner’s Commissioning Requirements” for additional requirements.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units. Refer to Division 01 for additional requirements.

3.8 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project’s Waste Management Plan.

3.9 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.
2. Corrective Work:
    a. Remove, Repair and Reinstall, or Restore in Place damaged items.
    b. Replace damaged materials or items with New if repair not acceptable to Architect.
3. Provide product data to complete Operation & Maintenance Manuals.
4. Submit executed Warranties.

END OF SECTION

SECTION 233713 - AIR DIFFUSERS AND GRILLS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grilles and registers.

2. Linear outlets.

3. Ceiling diffuser outlets.

4. Thermally powered VAV diffusers

5. Laminar flow diffusers.

6. Displacement diffusers.

7. High velocity outlets.

8. Fabric air dispersion system.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

2. Other Related Sections:

a. Section 230529 – HANGERS AND SUPPORTS FOR HVAC.

b. Section 087100 – DOOR HARDWARE.

c. Section 233300 – AIR DUCT ACCESSORIES.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.

C. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

D. Air Diffusion Council:

1. Equipment Test Code 1062-GRD Test Codes for Grilles, Registers and Diffusers.

E. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

A. Refer to Section 01340 – SUBMITTAL PROCEDURES and Section 230500 – COMMON WORK RESULTS FOR HVAC. Where conflicts occur between divisions, the more stringent requirement shall apply.

B. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings at design conditions.

2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.

2. Method of attaching hangers to building structure.

3. Size and location of initial access modules for acoustical tile.

4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

5. Duct access panels.

D. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes. Submit one of each required air outlet and inlet type. Maintain on site for review by Owner’s Representative at next site meeting. Do not ship or mail.

E. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

F. Test Reports: Rating of air outlet and inlet performance.

1.4 CLOSEOUT SUBMITTALS

A. Refer to Division 01.

B. Project Record Documents: Record actual locations of air outlets and inlets, their types and TAB-balanced flows.

1.5 QUALITY ASSURANCE

A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.

B. Test and rate louver performance in accordance with AMCA 500.

C. Fabric ductwork to be UL Rated and marked for proof of flame spread and smoke developed to meet NFPA 90A.

D. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.7 PRE-INSTALLATION MEETINGS

A. Refer to Section 01340 – SUBMITTAL PROCEDURES.

B. Convene minimum one week prior to commencing work of this section.

1.8 EXTRA MATERIALS

A. Refer to Division 01 GENERAL REQUIREMENTS.

PART 2 PRODUCTS

2.1 IN OTHER PART 2 ARTICLES WHERE SUBPARAGRAPH TITLES BELOW INTRODUCE LISTS, THE FOLLOWING REQUIREMENTS APPLY FOR PRODUCT SELECTION:

A. Manufacturers: Subject to compliance with requirements and manufacturer's offerings, products that may be incorporated into the Work include, but are not limited to, manufacturers specified. The first manufacturer listed represents the basis of design as scheduled and drawn in the Construction Documents.

2.2 GENERAL DIFFUSER AND GRILLE REQUIREMENTS

A. Units shall have been tested in accordance with Air Diffuser Council (ADC) Code and ASHRAE Standard 36-72, with ratings certified by the ADC.

B. Provide all diffusers, registers and grilles to match the performance, noise criteria and size requirements as scheduled on Drawings.

C. Units shall have a factory applied finished, color as selected by the Owner's Representative.

D. Diffuser, register and grille frames shall be compatible with the ceiling suspension systems. For types of ceiling suspension systems refer to the Architectural Drawings.

E. Provide factory plenum box for linear diffusers.

F. Provide factory round duct neck transition for diffusers with square neck connections.

G. Furnish frames complete with felt or sponge rubber gaskets, except when they are used as plaster stops on all four sides.

2.3 GRILLES AND REGISTERS

A. Wall Grilles

1. Manufacturers:

a. MetalAire

b. Titus.

c. Krueger.

d. Nailer

2. Fabrication: Steel, unless otherwise scheduled, with 20 gage minimum frames and 22 gage minimum blades

3. Frame: Countersunk screw mounting and gasket.

4. Supply grilles:

a. Provide adjustable, double-deflection type, consisting of a heavy formed face, with rear bars and vanes.

b. Install face bars and rear bars or vanes spaced 3/4 inch (19 mm) apart, individually adjustable.

5. Exhaust or return grilles:

a. Provide 40-degree or 45-degree fixed single deflection type, consisting of a heavy formed face with horizontal face bars spaced 3/4 inch (19 mm) apart.

2.4 LINEAR OUTLETS

A. Slot Diffuser

1. Manufacturers:

a. MetalAire

b. Titus.

c. Krueger.

d. Nailer

2. Type: Continuous slot (number of slots and width of slots per plan or schedule), with adjustable discharge vanes for left, right or vertical discharge.

3. Fabrication: Aluminum extrusions with factory baked white enamel finish.

4. Frame: Plaster installation with flanges completely covered by taping, end cap.

5. Plenum: Galvanized steel, insulated, low height.

2.5 CEILING DIFFUSER OUTLETS

A. Cone Type Diffuser

1. Manufacturers:

a. Titus.

b. Anemostat.

c. Krueger.

d. Price Industries.

2. Type: Round or square, steel (unless otherwise scheduled), baked white enamel finish, adjustable pattern, stamped or spun, multi-core diffuser to discharge air in 360 degree pattern, with sector baffles where indicated.

3. In gypsum ceilings, furnish plaster ring and ceiling plaque.

4. Insulated backpan.

B. Modular Core Diffuser

1. Manufacturers:

a. Titus.

b. Anemostat.

c. Krueger.

d. Price Industries.

2. Type: Square and rectangular, steel (unless otherwise scheduled), white baked enamel finish, adjustable pattern, modular core diffuser to discharge air in 360 degree one way, two-way, three-way or four-way pattern as indicated in the Drawings.

3. In gypsum ceilings, furnish plaster ring and ceiling plaque.

4. Insulated backpan.

5. Provide factory square to round neck transitions.

C. Louver Face Diffuser

1. Manufacturers:

a. MetalAire

b. Titus.

c. Krueger.

d. Nailer

2. Type: Square, steel (unless otherwise scheduled), white baked enamel finish, .

3. In gypsum ceilings, furnish plaster ring and ceiling plaque.

4. Insulated backpan.

5. Provide factory square to round neck transitions.

PART 3 EXECUTION

3.1 EXAMINATION

A. Refer to Section 01340 – SUBMITTAL PROCEDURES.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Verify inlet and outlet locations.

D. Verify ceiling, roof and wall systems are ready for installation

3.2 INSTALLATION

A. Locate grilles, registers, and diffusers indicated on the reflected ceiling plan drawings and submit Shop Drawings before installation in suspended ceiling systems or surface mounted in gypsum ceilings as scheduled. Locate all ceiling grilles and diffusers symmetrically. Provide inactive segments and blank-offs as required for linear diffuser installations.

B. For aesthetic quality, provide continuous diffusers and locate active plenum boxes above ceiling as noted on the Drawings. Provide “dummy” diffuser blank-off caps where plenums do not exist.

C. Provide all branch ducts to grilles and diffusers complete with volume dampers.

D. Install diffusers, registers, and grilles level and plumb.

E. Install diffusers to ductwork with airtight connection.

F. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly.

G. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Division 9 - PAINTING.

H. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate

units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

I. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

J. Registers and Grilles Installed in Exposed Ductwork:

1. Frames are not required for registers and grilles installed directly in exposed ductwork.

2. Cut and form openings in ducts, so that there shall be a double thickness of metal, to attach the registers or grilles to the ductwork, with sheet metal screws. Bend back edges of the openings into the duct, on all four sides, a minimum of 1 inch to provide the thickness of metal stated above. Provide felt or sponge rubber gasketing, all four sides of duct openings, for supply grilles and supply registers.

K. Air Diffusers Installed in Exposed Ductwork:

1. Frames are not required for registers and grilles installed directly in exposed ductwork.

2. Cut and form openings in ducts, to accommodate the specified volume control damper and adjustable equalizing grid assembly. Reinforce opening as required. Provide felt or sponge rubber gasketing, around duct opening, for supply diffuser assemblies.

L. Install inclined blade return and exhaust grilles and registers so that blades obstruct vision by inclining blades as follows:

1. Ceiling outlets: Incline toward nearest wall.

2. Wall outlets near ceiling: Incline toward ceiling.

M. Adjust throw-patterns of all supply air outlets to result in uniform, draft free room air distribution at minimum and maximum air flows. Coordinate throw patterns with drawings where throw patterns are indicated.

N. Work among the different trades for shared services in single slot diffuser shall be divided as follows:

1. All continuous linear slot diffusers shall be provided and installed by Division 23 mechanical contractor. Diffuser shall be supported in such a way that allows “clip-on” addition of other trades.

2. All supply diffuser plenums shall be provided and installed and ducted by Division 23 mechanical contractor. All blank-off plates and lighthoods explicitly shown on mechanical plans shall be provided by the Division 23 contractor.

3. All hole-plates for sprinkler head installation shall be provided by Division 23 mechanical contractor for use and installation by the Fire Sprinkler contractor.

4. Division 26 shall fabricate a light housing that can be supported by the linear slot diffuser. Division 26 shall mount the light fixtures within the light housing. Division 26 shall install the light housing above the linear diffuser and shall be responsible for wiring the light

fixture.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.4 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.5 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.6 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.
2. Corrective Work:
    a. Remove, Repair and Reinstall, or Restore in Place damaged items.
    b. Replace damaged materials or items with New if repair not acceptable to Architect.
3. Provide product data to complete Operation & Maintenance Manuals.
4. Submit executed Warranties.

END OF SECTION

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SUMMARY

A. Work of this Section includes but is not limited to the following:

1. Building wires and cables rated 600 V and less.

2. Connectors, splices, and terminations rated 600 V and less.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

2. Other Related Sections:

a. Section 271500, "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.2 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

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. Comply with NFPA 70.

D. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

PART 2 PRODUCTS

2.1 CONDUCTORS AND CABLES

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

1. Southwire Company

2. American Insulated Wire Corp.; a Leviton Company.

3. General Cable Corporation.

4. Alcan Products Corporation; Alcan Cable Division.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and XHHW.

D. Multiconductor Cable: Comply with NEMA WC 70 for armored cable, Type AC, metal-clad cable, Type MC, mineral-insulated, metal-sheathed cable, Type MI, nonmetallic-sheathed cable, Type NM with ground wire.

2.2 CONNECTORS AND SPLICES

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

1. AFC Cable Systems, Inc.

2. O-Z/Gedney; EGS Electrical Group.

3. 3M; Electrical Products Division.

4. Tyco Electronics Corp.

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 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders Under 100A: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Feeder Over 100A: Stranded Aluminum.

C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW, single conductors in raceway or bus duct.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway

E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHNTHWN, single conductors in raceway.

I. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainlesssteel, wire-mesh, strain relief device at terminations to suit application.

K. Class 1 Control Circuits: Type THHN-THWN, in raceway.

L. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

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 Section 260529, "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

3.4 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. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260500, “Common Work Results for Electrical.”

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.

   a. UPS equipment.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. 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. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

    a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

    b. 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.

D. 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.

E. Remove and replace malfunctioning units and retest as specified above.

3.8 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.9 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

    a. Remove, Repair and Reinstall, or Restore in Place damaged items.

    b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.

4. Submit executed Warranties.

END OF SECTION

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Work of this Section includes but is not limited to the following:

1. Hangers and supports for electrical equipment and systems.

2. Construction requirements for concrete bases.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

2. Other Related Sections:

a. Section 260548, "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details for the following:

1. Trapeze hangers. Include Product Data for components.

2. Steel slotted channel systems. Include Product Data for components.

3. Nonmetallic slotted channel systems. Include Product Data for components.

4. Equipment supports.

5. Provide calculations that are signed and sealed by a qualified professional engineer for all supports of equipment weighing in excess of 200 lbs.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

C. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

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:

a. Allied Tube & Conduit Corporation

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. ERICO International Corporation.

d. Thomas & Betts Corporation.

e. Unistrut; Tyco International, Ltd.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

5. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch diameter holes at a maximum of 8 inches o.c., in at least 1 surface.

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:

a. Allied Tube & Conduit Corporation

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. Seasafe, Inc.

d. Fabco Plastics Wholesale Limited.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.

3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.

4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Provide products by one of the following:

1). Hilti Corporation.

2). ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

3). MKT Fastening, LLC.

4). Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Manufacturers: Provide products by one of the following:

1). Cooper B-Line, Inc.; a division of Cooper Industries.

2). Empire Tool and Manufacturing Co., Inc.

3). Hilti Corporation.

4). ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

5). MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70, or as scheduled in NECA 1, where its table 1 lists maximum spacing less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater.

Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.

6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or beam clamps (MSS type 19,21,23,25 or 27) complying with MSS SP-69.

7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements, if required.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for sitefabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.7 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.
2. Corrective Work:
    a. Remove, Repair and Reinstall, or Restore in Place damaged items.
    b. Replace damaged materials or items with New if repair not acceptable to Architect.
3. Provide product data to complete Operation & Maintenance Manuals.
4. Submit executed Warranties.

END OF SECTION

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Work of this Section includes but is not limited to the following:

1. Raceways
2. Fittings
3. Boxes
4. Enclosures
5. Cabinets for electrical wiring.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.3 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.

2. For handholes and boxes for underground wiring, including the following:

a. Duct entry provisions, including locations and duct sizes.

b. Frame and cover design.

c. Grounding details.

d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

e. Joint details.

C. Samples for Initial Selection: For wireways and surface raceways with factory-applied texture and color finishes.

D. Samples for Verification: For each type of exposed finish required for wireways and surface raceways, prepared on Samples of size indicated below.

E. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

3.

F. Qualification Data: For professional engineer and testing agency.

G. Source quality-control test reports.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

1. Contractor shall additionally provide detailed, dimensioned, fully coordinated shop drawings for the A/E's review prior to rough in of all floor, ceiling, and wall boxes and devices. Provision of these exact locations is mandatory on this project and most conditions are based on precise dimensions that the owner and A/E wish to control. Contractor shall make adjustments as required by the A/E comments at no additional cost.

PART 2 PRODUCTS

2.1 METAL CONDUIT AND TUBING

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

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Co-Operative Industries Aerospace & Defense
6. Electri-Flex Co.
7. Manhattan/CDT/Cole-Flex.
8. Maverick Tube Corporation.
9. O-Z Gedney; a unit of General Signal.
10. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. EMT: ANSI C80.3.

E. FMC: Zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket.

G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel set screw type.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

H. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

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

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

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

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters,

holddown straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Flanged-and-gasketed type.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.

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

a. Thomas & Betts Corporation.

b. Walker Systems, Inc.; Wiremold Company (The).

c. Wiremold Company (The); Electrical Sales Division.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.

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

a. Butler Manufacturing Company; Walker Division.

b. Enduro Systems, Inc.; Composite Products Division.

c. Hubbell Incorporated; Wiring Device-Kellems Division.

d. Lamson & Sessions; Carlon Electrical Products.

e. Panduit Corp.

f. Walker Systems, Inc.; Wiremold Company (The).

g. Wiremold Company (The); Electrical Sales Division.

2.5 BOXES, ENCLOSURES, AND CABINETS

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

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.

2. EGS/Appleton Electric.

3. Erickson Electrical Equipment Company.

4. Hoffman.

5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.

F. Nonmetallic Floor Boxes: Nonadjustable, round.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.

J. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.6 RECESSED CONCRETE CAST FLOOR BOXES:

A. Provide watertight construction, cast iron body. Provide gasketed, mop-tight cover plate with individual outlet covers, finish as selected by architect. Raco 6200 series or approved equal from above manufacturers.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Green.

2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.

3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

5. Cover Legend: Molded lettering as indicated for each service.

6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

7. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

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

a. Armorcast Products Company.

b. Carson Industries LLC.

c. CDR Systems Corporation.

d. NewBasis.

C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.

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

a. Armorcast Products Company.

b. Carson Industries LLC.

c. Christy Concrete Products.

d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.

D. Flush Wall Boxes (For All Areas Exposed to Exterior Weather Conditions):

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

a. FSR Metal Products Group

1). Provide OWB "Weather Box" Series with flush mount cover, in custom box size. Dimension and color to be determined by architect.

2). Coordinate exact locations with architectural elevations prior to rough-in.

E.

PART 3 EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit or RTRC conduit.

2. Concealed Conduit, Aboveground: PVC Schedule 40.

3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or RTRC conduit.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

6. Application of Handholes and Boxes for Underground Wiring:

a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Fiberglass enclosures with polymer-concrete frame and cover, SCTE 77, Tier 15 structural load rating.

b. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglassreinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.

7. PV System Flexible Conduit Crossing From Canopy to Bar North/West: Braided Stainless Steel Flexible Conduit.

a. Co-Operative Industries Aerospace & Defense CAB-3SS or approved equal

1). Product shall be liquid-tight, corrosion resistant, and rated for outdoor use.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: RNC.

2. Exposed, Not Subject to Severe Physical Damage: RNC identified for such use.

3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:

    a. Loading dock.

    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

    c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

6. Damp or Wet Locations: Rigid steel conduit, RTRC conduit and Schedule 80 PVC.

7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

    a. LSS Rooms to have fiberglass boxes and enclosures.

8. LSS Rooms exposed runs shall be schedule 80 PVC.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hotwater pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Section 260529, "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).

2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).

M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where otherwise required by NFPA 70.

N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-

run length that exceeds 25 feet (7.6 m).

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.

   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.

   c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.

3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

O. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

Q. Set metal floor boxes level and flush with finished floor surface.

R. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom for pipe less than 6 inches (150 mm) in nominal diameter.

2. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.

3. Install manufactured duct elbows for stub-ups at poles and equipment and at building

entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.

4. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above directburied conduits, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of conduit.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G.

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping.

3.6 FLOODPROOFING

A. Conduits shall be routed in a manner that avoids penetrations through the flood-proofed structure wherever possible. Conduit that must be contained within the flood-proofed slabs and walls up and above elevation +21'-8" before entering into or out of the flood proofed structure. FIRE ALARM DEVICE THAT MUST BE MOUNTED ON THE EXTERIOR OF THE "BATH TUB" WALL, SHALL NOT PENETRATE TO THE INTERIOR SIDE OF THE BATHTUB. THE CONDUITS SHALL REMAIN WITHIN THE BATHTUB WALL AND BE ROUTED UP ABOVE ELEVATION +21'-8".

3.7 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.8 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.9 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.

4. Submit executed Warranties.

END OF SECTION

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Work of this Section includes but is not limited to the following:

1. Identification for raceways.

2. Identification of power and control cables.

3. Identification for conductors.

4. Underground-line warning tape.

5. Warning labels and signs.

6. Instruction signs.

7. Equipment identification labels.

8. Miscellaneous identification products.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, 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 ACCEPTABLE MANUFACTURERS

A. W. H. Brady or Westline products.

B. Seaton

C. Allen Systems

D. Industrial Safety Supply Co.

E. 3M, Electrical Markets Division

F. Ideal Industries, Inc.

2.2 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.

2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.

2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high letters on 20-inch centers.

D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pre-tensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pre-tensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

I. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.3 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.

2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.

2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high letters on 20-inch centers.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.4 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

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. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

D. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

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

2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

E. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands: Slit, pre-tensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.5 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

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 sleeve, 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 sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

F. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.6 JUNCTION AND PULLBOX IDENTIFICATION

A. Junction boxes, pullboxes and their covers shall be distinctively painted to identify their service as follows:

Red	Emergency Power Systems
Orange	Fire Alarm Systems
Dark Blue	Security Systems
Light Blue	Network Systems
Green	CCTV Systems
Brown	5 KV Power Systems
Black	15 KV Power Systems
Purple	480/277 V. Power and Lighting Systems
Yellow	120/208 V. Power and Lighting Systems
White	Any other system, with system type (such as "intercom" or "public address") marked on covers in black.

2.7 FLOOR MARKING TAPE

A. 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.8 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.

2. Printing on tape shall be permanent and shall not be damaged by burial operations.

3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.

2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.

3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag: Type I:

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.

2. Thickness: 4 mils.

3. Weight: 18.5 lb/1000 sq. ft.

4. 3-Inch Tensile According to ASTM D 882: 30 lbf and 2500 psi.

D. Tag: Type II:

1. Multilayer laminate consisting of high-density polyethylene scrim coated with pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility,

compounded for direct-burial service.

2. Thickness: 12 mils.

3. Weight: 36.1 lb/1000 sq. ft.

4. 3-Inch Tensile According to ASTM D 882: 400 lbf, and 11,500 psi.

2.9 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.

2. 1/4-inch grommets in corners for mounting.

3. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.

2. 1/4-inch grommets in corners for mounting.

3. Nominal size, 10 by 14 inches.

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 36 INCHES."

2.10 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.

2. Punched or drilled for mechanical fasteners.

3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process.

Minimum letter height shall be 3/8 inch.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.11 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.12 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.

3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.

3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.

3. UL 94 Flame Rating: 94V-0.

4. Temperature Range: Minus 50 to plus 284 deg F.

5. Color: Black.

2.13 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine

screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.1 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. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding 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 maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

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. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.

2. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous undergroundline warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inchwide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is

in contact with earth or is framed above unexcavated space.

2. Wall surfaces directly external to raceways concealed within wall.

3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 30-foot (10-m) maximum intervals.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot maximum intervals.

D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.

2. Power.

3. UPS.

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

b. Colors for 208/120-V Circuits:

1). Phase A: Black.

2). Phase B: Red.

3). Phase C: Blue.

4). Neutral: White

5). Ground: Green

c. Colors for 480/277-V Circuits:

1). Phase A: Brown.

2). Phase B: Orange.

3). Phase C: Yellow or Purple.

4). Neutral: Grey with White Tracer

5). Ground: Green

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches 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. Locate bands to avoid obscuring factory cable markings.

F. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesivebacked phase tags, and a separate tag with the circuit designation.

G. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal 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 the Operation and Maintenance Manual.

J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.

2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Selfadhesive warning labels.

1. Comply with 29 CFR 1910.145.

2. Identify system voltage with black letters on an orange background.

3. Apply to exterior of door, cover, or other access.

4. For 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.

M. Operating Instruction Signs: 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.

N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the 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. Indoor Equipment: Self-adhesive, 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 two lines of text are required, use labels 2 inches (50 mm) high.

b. Outdoor Equipment: Engraved, laminated acrylic or melamine label. Stenciled legend 4 inches high.

c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.

b. Enclosures and electrical cabinets.

c. Access doors and panels for concealed electrical items.

d. Switchgear.

e. Switchboards.

f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

g. Substations.

h. Emergency system boxes and enclosures.

i. Motor-control centers.

j. Enclosed switches.

k. Enclosed circuit breakers.

l. Enclosed controllers.

m. Variable-speed controllers.

n. Push-button stations.

o. Power transfer equipment.

p. Contactors.

q. Remote-controlled switches, dimmer modules, and control devices.

r. Battery-inverter units.

s. Battery racks.

t. Power-generating units.

u. Monitoring and control equipment.

v. UPS equipment.

w. PDU equipment

x. Fire Pump Controller

y. Fire Alarm Fuse Cut Out

z. Lighting Control Panels

3.3 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.4 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.
4. Submit executed Warranties.

END OF SECTION

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. Work of this Section includes but is not limited to the following:

1. Time switches.

2. Photoelectric switches.

3. Switch-box occupancy sensors.

4. Indoor occupancy sensors.

5. Outdoor motion sensors.

6. Multipole contactors.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

1.2 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Shall be per Division 1, Section 01340 and submitted in PDF format. Show installation details for occupancy and light-level sensors.

1. Lighting plan showing location, orientation, type and coverage area of each sensor.

2. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

E. The architect must review and approve all device locations and installation methods prior to rough-in.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

1.5 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Wherever possible, all devices must be sourced from the same manufacturer.

2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.3 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers:

1. Intermatic, Inc.

2. Lithonia Lighting.

3. Square D.

4. Crestron

5. Lutron

B. Description: Solid state, with SPST dry contacts rated for 1800-VA or 1000-VA inductive, to operate connected relay, contactor coils, microprocessor input, and complying with UL 773A.

1. 1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.

2. Time Delay: 15-second minimum, to prevent false operation.

3. Surge Protection: Metal-oxide varistor type, complying with IEEE C62.41 for Category A1 locations.

4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.

C. Description: Solid state, with SPST dry contacts rated for 1800 VA to operate connected load, relay, or contactor coils; and complying with UL 773.

1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.

2. Time Delay: 15-second minimum, to prevent false operation.

3. Lightning Arrester: Air-gap type.

4. Mounting: Twist lock complying with IEEE C136.10, with base. Provide with stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.

2.4 INDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers:

1. Intermatic, Inc.

2. Lithonia Lighting.

3. Square D.

4. Crestron

5. Lutron.

B. Ceiling-Mounting Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit mounted on luminaire, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.

2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.

3. Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.

4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.

5. Indicator: Two LEDs to indicate the beginning of on and off cycles.

C. Skylight Photoelectric Sensors: Solid-state, light-level sensor; housed in a threaded, plastic fitting for mounting under skylight, facing up at skylight; with separate relay unit mounted on luminaire, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.

2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.

3. Light-Level Monitoring Range: 1000 to 10,000 fc, with an adjustment for turn-on and turn-off levels within that range.

4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.

5. Indicator: Two LEDs to indicate the beginning of on and off cycles.

2.5 SWITCH-BOX OCCUPANCY SENSORS

A. Manufacturers:

1. Hubbell Lighting Inc.

2. Leviton Mfg. Company Inc.

3. Lithonia Lighting.

4. Crestron.

5. Lutron.

B. Description: PIR type with integral power-switching contacts rated for 800 W at 120-V ac, suitable for incandescent light fixtures, flourescent light fixtures with magnetic or electronic ballasts, or 1/6-hp motors; and rated for 1000 W at 277-V ac, suitable for flourescent light fixtures with magnetic or electronic ballasts, or 1/3-hp motors, minimum.

1. Include ground wire.

2. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keeps lighting off when selected lighting level is present.

2.6 INDOOR OCCUPANCY SENSORS

A. Manufacturers:

1. Hubbell Lighting Inc.

2. Leviton Mfg. Company Inc.

3. Lithonia Lighting.

4. Crestron

5. Lutron

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.

4. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.

b. Relay: Externally mounted though a 1/2-inch knockout in a standard electrical enclosure.

c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

6. Bypass Switch: Override the on function in case of sensor failure.

7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keeps lighting off when selected lighting level is present.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of at least 36 sq. in..

2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.

D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Detector Sensitivity: Detect a person moving at least 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on an 8-foot- high ceiling.

4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.

5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.

E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of at least 36 sq. in., and detect a person of average size and weight moving at least 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

2.7 OUTDOOR MOTION SENSORS (PIR)

A. Manufacturers:

1. Hubbell Lighting Inc.

2. Lithonia Lighting.

3. Crestron

4. Lutron.

B. General Description: Suitable for operation in ambient temperatures ranging from minus 40 deg F to 130 deg F, UL 773A rated as raintight.

1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

2. Sensor Output: Suitable for switching 300 W of tungsten load at 120- or 277-V ac. Lampholders shall comply with UL for wet locations.

3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

4. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.

5. Mounting:

   a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.

   b. Relay: Internally mounted in a standard weatherproof electrical enclosure.

   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

7. Bypass Switch: Override the on function in case of sensor failure.

8. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc; keeps lighting off during daylight hours.

C. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of at least 36 sq. in.

D. Detection Coverage: Up to 35 feet, with a field of view of 180 degrees.

2.8 MULTIPOLE CONTACTORS

A. Manufacturers:

1. ASCO Power Technologies, LP; a division of Emerson Electric Co.

2. Cutler-Hammer; Eaton Corporation.

3. GE Industrial Systems; Total Lighting Control.

4. Hubbell Lighting Inc.

5. Lithonia Lighting.

6. Crestron

7. Lutron.

8. Square-D.

B. Description: Electrically operated and mechanically held, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).

2. Control-Coil Voltage: Match control power source.

C. Square-D powerlink panelboards may be used as an alternate for multi pole contractors.

2.9 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG.

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 18 AWG.

C. Class 1 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 16 AWG.

PART 3 EXECUTION

3.1 GENERAL DEVICE INSTALLATION

A. All controllers, interfaces, contactors, and other devices not required to be exposed for sensing or manual control purposes shall be concealed from view in all front of house spaces. Contractor shall locates this and other similar items above ceilings or in IT and electrical rooms as appropriate for manufacturer's recommendations.

B. Wall mounted devices, sensors, and controllers to have custom color and finish to be selected by the architect during the CA phase. Additionally, engraving is to be selected by the owner during CA/Closeout.

3.2 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated.

B. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 WIRING INSTALLATION

A. Minimum conduit size shall be ½-inch.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

D. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

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

3.4 IDENTIFICATION

A. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time lighting control devices, and after electrical circuitry has been energized, adjust and test for compliance with requirements.

2. Operational Test: Verify actuation of each sensor and adjust time delays.

B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 ADJUSTING / PROGRAMMING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

B. Programming: Coordinate time switch schedules with Owner representative and program initial schedules to Owner’s requirements.

3.7 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project’s Waste Management Plan.

3.8 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.

4. Submit executed Warranties.

END OF SECTION

SECTION 262213 - LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SUMMARY

A. Work of this Section consists of types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

1.2 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Qualification Data: For testing agency.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

D. 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.

E. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

F. Coordination Shop Drawings: Refer to Division 1 Section 013100 for requirements for Coordination Shop Drawing.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.5 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchorbolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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

1. Eaton Electrical Inc.; Cutler-Hammer Products.

2. General Electric Company.

3. Siemens Energy & Automation, Inc.

4. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.

2. Coil Material: **Aluminum**.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: ANSI 49 gray.

E. Taps for Transformers up to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 1**50** deg C rise above 40 deg C ambient temperature.

H. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.

2. Tested according to NEMA TP 2.

I. Wall Brackets: Manufacturer's standard brackets.

J. Fungus Proofing: Permanent fungicidal treatment for coil and core.

K. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553, "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526, "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Section 260548, "Vibration and Seismic Controls for Electrical Systems.

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions**,** seismic codes applicable to Project, and requirements in Section 260548, "Vibration and Seismic Controls for Electrical Systems."

3.3 CONNECTIONS

A. Ground equipment according to Section 260526, "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519, "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Remove and replace units that do not pass tests or inspections and retest as specified above.

E. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.

2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.

3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

F. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.7 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.8 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.
4. Submit executed Warranties.

END OF SECTION

SECTION 262416 - PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

A. Work of this Section consists of, but is not limited to the following:

1. Distribution panelboards.

2. Lighting and appliance branch-circuit panelboards.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

1.2 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.

b. Bus configuration, current, and voltage ratings.

c. Short-circuit current rating of panelboards and overcurrent protective devices.

d. UL listing for series rating of installed devices.

e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Qualification Data: For testing agency.

D. Field quality-control test reports including 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.

E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition, include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated.

D. 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.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

G. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2000 m).

H. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet (2000 m).

I. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

1.5 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

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. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:

a. Eaton Corporation; Cutler-Hammer Products.

b. General Electric Co.; Electrical Distribution & Protection Div.

c. Siemens Energy & Automation, Inc.

d. Square D.

2.2 MANUFACTURED UNITS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in

Section 260548, "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface mounted cabinets. NEMA PB 1, Type 1.

1. Rated for environmental conditions at installed location.

a. Outdoor Locations: NEMA 250, Type 3R.

b. Kitchen Areas: NEMA 250, Type 4X, stainless steel.

c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.

5. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.

6. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.

C. Phase and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

3. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

4. Split Bus: Vertical buses divided into individual vertical sections.

D. Conductor Connectors: Suitable for use with conductor material.

1. Main and Neutral Lugs: Mechanical type.

2. Ground Lugs and Bus Configured Terminators: Compression type.

3. Feed-Through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

4. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for

future installation of devices.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. UL label indicating series-connected rating with integral or remote upstream overcurrent protective devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 DISTRIBUTION PANELBOARDS

A. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.

B. Main Overcurrent Protective Devices: Circuit breaker.

C. Branch Overcurrent Protective Devices:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.

2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

3. Fused switches.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.6 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:

a. Instantaneous trip.

b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.

d. Ground-fault pickup level, time delay, and I2t response.

4. GFCI Circuit Breakers: Single- and two-pole configurations.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

4. Shunt Trip: 120-V trip coil energized from separate circuit.

5. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuitbreaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

6. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.

C. Fuses are specified in Section 262813, "Fuses."

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Furnish portable test set to test functions of solid-state trip devices without removal from panelboard.

C. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Comply with mounting and anchoring requirements specified in Section 260548, "Vibration and Seismic Controls for Electrical Systems."

C. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.

D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

E. Install overcurrent protective devices and controllers.

1. Set field-adjustable switches and circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 260553, "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526, "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519, "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

C. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.

4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement. Where the maximum load on one phase is less than 50% of the feeder conductor rating, tolerance may be increased to 40 percent.

E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 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 panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.6 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.7 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

B. Provide product data to complete Operation & Maintenance Manuals.

C. Submit executed Warranties.

END OF SECTION

SECTION 262726 - WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. Work of this Section consists of but is not limited to the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.

2. Twist-locking receptacles.

3. Wall-switch.

4. Cord and plug sets.

5. Floor service outlets, poke-through assemblies and multioutlet assemblies.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

2. Section 271500, "Communications Horizontal Cabling" for workstation outlets.

1.2 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. UTP: Unshielded twisted pair.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

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. Comply with NFPA 70.

D. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

1. Contractor shall additionally provide detailed, dimensioned, fully coordinated shop drawings for the A/E's review prior to rough in of all floor, ceiling, and wall boxes and devices. Provision of these exact locations is mandatory on this project and most conditions are based on precise dimensions that the owner and A/E wish to control. Contractor shall make adjustments as required by the A/E comments at no additional cost.

1.5 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

1.6 EXTRA MATERIALS

A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Service/Power Poles: One for every 10, but no fewer than one.

2. Floor Service Outlet Assemblies: One for every 10, but no fewer than one.

3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names:

1. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).

3. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).

4. Leviton Mfg. Company Inc. (Leviton).

5. Crestron

6. Lutron

B. Devices are to be similar in appearance to Leviton Decora Series. Color selected by the architect.

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Basis of Design Product: Leviton 16352

B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Basis of Design Product: Leviton TDR-20

2.3 USB CHARGING RECEPTACLES

A. Convenience Receptacles, 125V, 20A; Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Basis of Design Product: Topgreener TU22048A-W

2.4 DETENTION GRADE RECEPTACLES

A. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

B. Receptacles to be Industrial Grade

1. Basis of Design Product: Cooper AH5352 or equal

2.5 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Basis of Design Product: Leviton N7899

2.6 WEATHER-RESISTANT RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498. Receptacle shall be weather-resistant.

1. Basis of Design Product: Leviton W7899

2.7 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD

6 configuration L5-20R, and UL 498.

1. Basis of Design Product: Leviton 2310

2.8 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.

2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.9 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.

2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.10 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

b. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).

c. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).

d. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).

e. Crestron equivalent.

f. Lutron equivalent.

C. Pilot Light Switches, 20 A

1. Products: Subject to compliance with requirements, provide one of the following:
    a. Pass & Seymour; PS20AC1-PLR for 120 V.
    b. Cooper; 2221PL for 120 V and 277 V.
    c. Hubbell; HPL1221PL for 120 V and 277 V.
    d. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
    e. Crestron equivalent.
    f. Lutron equivalent.
2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
    a. Pass & Seymour; PS20AC1-L.
    b. Cooper; 2221L.
    c. Hubbell; HBL1221L.
    d. Leviton; 1221-2L.
    e. Crestron equivalent.
    f. Lutron equivalent.
2. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Fan Speed Control Switch, 120V, 3-speed
1. Pass & Seymour; LSSC5W.
2. Leviton equivalent.
3. Cooper equivalent.

F. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
1. Products: Subject to compliance with requirements, provide one of the following:
    a. Pass & Seymour; 1251.
    b. Cooper; 1995.
    c. Hubbell; HBL1557.

d. Leviton; 1257.

e. Crestron equivalent.

f. Lutron equivalent.

G. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pass & Seymour; 1251L.

b. Cooper; 1995L.

c. Hubbell; HBL1557L.

d. Leviton; 1257L.

e. Crestron equivalent.

f. Lutron equivalent.

2.11 WALL PLATES

A. Single and combination types to match corresponding wiring devices (Leviton Decora Series or similar).

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Front of House (all areas visible to the public) Spaces: Satin-finished stainless steel.

3. Material for Unfinished Spaces: Galvanized steel.

4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

5. Material for Detention-Grade Receptacles: Security Wall Plates for Correctional Facilities, Cooper: SSB/SPC series or equal.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

1. Leviton 6196-VFS or approved equivalent.

2.12 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, solid brass or stainless steel as selected by Architect, with

satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 6 jacks for UTP cable.

F. Floor boxes shall have mop tight covers.

G. Manufacturer: Wiremold

1. 6-Gang: Evolution Series Floor Box, 6-Gang EFB6S

2. 4-Gang: EFB4

2.13 POKE-THROUGH ASSEMBLIES

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

1. Pass & Seymour/Legrand; Wiring Devices & Accessories.

2. Hubbell Incorporated; Wiring Device-Kellems.

3. Square D/ Schneider Electric.

4. Thomas & Betts Corporation.

5. Wiremold Company (The).

B. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.

1. Service Outlet Assembly: Flush type with two simplex receptacles and space for two RJ- 45 jacks.

2. Size: Selected to fit nominal 4-inch (100-mm) cored holes in floor and matched to floor thickness.

3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

4. Closure Plug: Arranged to close unused 4-inch (100-mm) cored openings and reestablish fire rating of floor.

5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two 4-pair, Category 5e voice and data communication cables.

2.14 MULTIOUTLET ASSEMBLIES

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

following:

1. Hubbell Incorporated; Wiring Device-Kellems.

2. Wiremold Company (The).

B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with manufacturer's standard finish.

D. Wire: No. 12 AWG.

2.15 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Provide weather resistant type receptacles in all wet and damp areas. Provide weather-proof cover as indicated on the plans and specifications.

C. Provide detention-grade receptacles within Violator Area in Customs & Border Patrol Area and at Embark Interview Room on second floor.

D. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

E. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or

terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

4. Existing Conductors:

   a. Cut back and pigtail, or replace all damaged conductors.

   b. Straighten conductors that remain and remove corrosion and foreign matter.

   c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

F. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.

2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

G. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

H. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

I. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

J. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Section 260553, "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.

2. Test Instruments: Use instruments that comply with UL 1436.

3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.

2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.

4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

3.4 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project’s Waste Management Plan.

3.5 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.
2. Corrective Work:
    a. Remove, Repair and Reinstall, or Restore in Place damaged items.
    b. Replace damaged materials or items with New if repair not acceptable to Architect.
3. Provide product data to complete Operation & Maintenance Manuals.
4. Submit executed Warranties.

END OF SECTION

SECTION 262813 - FUSES

PART 1 GENERAL

1.1 SUMMARY

A. Work of this Section consists of, but is not limited to the following:

1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, panelboards, switchboards, enclosed controllers, and motor-control centers.

2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches, fuseholders and panelboards.

3. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.

4. Spare-fuse cabinets.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.

b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

3. Current-limitation curves for fuses with current-limiting characteristics.

4. Time-current coordination curves and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

5. Coordination charts and tables and related data.

6. Fuse sizes for elevator feeders and elevator disconnect switches.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition, include the following:

1. Ambient temperature adjustment information.

2. Current-limitation curves for fuses with current-limiting characteristics.

3. Time-current coordination curves and current-limitation curves (instantaneous peak letthrough current) for each type and rating of fuse.

4. Coordination charts and tables and related data.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

F. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

1.4 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.5 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.6 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.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

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. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 PLUG FUSES

A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.4 PLUG-FUSE ADAPTERS

A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

2.5 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and keycoded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class L, fast acting, Class L, time delay, Class RK1, fast acting, Class RK1, time delay, Class J, fast acting, Class J, time delay and Class T, fast acting.

2. Feeders: Class L, fast acting, Class L, time delay, Class RK1, fast acting, Class RK1, time delay, Class RK5, fast acting, Class RK5, time delay, Class J, fast acting, and Class J, time delay.

3. Motor Branch Circuits: Class RK1 and Class RK5, time delay.

4. Other Branch Circuits: Class RK1, time delay, Class RK5, time delay, Class J, fast acting and Class J, time delay.

5. Control Circuits: Class CC, fast acting and time delay.

B. Plug Fuses:

1. Motor Branch Circuits: Edison-base type, dual, Edison-base type, single, Type S, dual, Type S, single-element time delay.

2. Other Branch Circuits: Edison-base type, single-element fast acting, Edison-base type, dual element time delay, Edison-base type, single-element time delay, Type S, dual element time delay and Type S, single-element time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.

C. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553, "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

3.5 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.6 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.

4. Submit executed Warranties.

END OF SECTION

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SUMMARY

A. Work of this Section consists of, but is not limited to the following:

1. Fusible switches.

2. Nonfusible switches.

3. Receptacle switches.

4. Shunt trip switches.

5. Molded-case circuit breakers (MCCBs).

6. Molded-case switches.

7. Enclosures.

B. Related Documents and Sections: Examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to the following:

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

1.2 DEFINITIONS

A. GD: General duty

B. HD: Heady duty

C. NC: Normally closed.

D. NO: Normally open.

E. SPDT: Single pole, double throw.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.

2. Current and voltage ratings.

3. Short-circuit current ratings (interrupting and withstand, as appropriate).

4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: Wiring diagrams for power, signal, and control wiring. Include plans, elevations, sections, details, and attachments to other work.

C. Qualification Data: For qualified testing agency.

D. Field quality-control reports.

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.

E. Manufacturer's field service report.

F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

2. Time-current coordination curves for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of NETA or an NRTL and that is acceptable to authorities having jurisdication.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. 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.

E. Comply with NFPA 70.

F. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for Coordination Shop Drawing.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2010 m).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than seven days in advance of proposed interruption of electric service.

2. Indicate method of providing temporary electric service.

3. Do not proceed with interruption of electric service without Construction Manager's and / or Owner's written permission.

4. Comply with NFPA 70E.

1.6 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.7 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.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

2. Fuse Pullers: Two for each size and type.

3. Indicating Lights: Six of each type installed.

PART 2 PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers

offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type GD, Single Throw, 600-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with fuse interiors to accommodate indicated fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contacts, arranged to activate before switch blades open.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Compression type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.

9. Accessory Control Power Voltage: Remote mounted and powered; 24-V ac or 120-V ac

2.2 NONFUSIBLE SWITCHES

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. Type GD, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contacts, arranged to activate before switch blades open.

5. Hookstick Handle: Allows use of a hookstick to operate the handle.

6. Lugs: [Mechanical] [Compression] type, suitable for number, size, and conductor material.

7. Accessory Control Power Voltage: Remote mounted and powered; 24-V ac or 120-

V ac

2.3 RECEPTACLE SWITCHES

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. Type HD, Single-Throw Fusible Switch: 600-V ac, 30, 60, 100 A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Type HD, Single-Throw Nonfusible Switch: 600-V ac, 30, 60, 100 A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

E. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

2.4 SHUNT TRIP SWITCHES

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

1. Cooper Bussmann, Inc.

2. Ferraz Shawmut, Inc.

3. Littelfuse, Inc.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position. Fusible power switch with shun trip and fire safety interface shall be Cooper Bussmann PS or similar.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer source of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:

1. Oiltight key switch for key-to-test function.

2. Oiltight red ON pilot light.

3. Isolated neutral lug; 100 percent rating.

4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.

5. Form C alarm contacts that change state when switch is tripped.

6. Three-pole, double-throw, fire-safety and alarm relay; 24-V dc coil voltage.

7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.5 MOLDED-CASE CIRCUIT BREAKERS

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuitbreaker frame sizes 250 A and larger. Thermal magnetic with interchangeable trip unit for circuit-breaker frame sizes smaller than 250A.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, fieldadjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.

2. Long- and short-time pickup levels.

3. Long- and short-time time adjustments.

4. Ground-fault pickup level, time delay, and I2t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

J. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.

2. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.

3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

5. Communication Capability: Circuit-breaker-mounted communication module with functions and features shall be compatible with power monitoring and control system.

6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

8. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.

10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

11. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking

ground-fault protection function.

12. Electrical Operator: Provide remote control for on, off, and reset operations.

13. Accessory Control Power Voltage: Integrally mounted, self-powered; 24-V ac or 120-V ac.

2.6 MOLDED-CASE SWITCHES

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.

2. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.

3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.

7. Alarm Switch: One NO contact that operates only when switch has tripped.

8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.

9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.

10. Electrical Operator: Provide remote control for on, off, and reset operations.

11. Accessory Control Power Voltage: Integrally mounted, self-powered; 24-V ac or 120-V ac.

2.7 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

2. Outdoor Locations: NEMA 250, Type 3R.

3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.

4. LSS Areas: NEMA 250, Type 4X, fiberglass.

5. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

6. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

7. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7 or Type 9.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553, "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.

c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed

switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges.

3.6 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damages finishes.

3.7 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.8 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.

2. Corrective Work:

a. Remove, Repair and Reinstall, or Restore in Place damaged items.

b. Replace damaged materials or items with New if repair not acceptable to Architect.

3. Provide product data to complete Operation & Maintenance Manuals.

4. Submit executed Warranties.

END OF SECTION

265100 LUMINAIRES

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, equipment and services necessary to complete the lighting fixture installation work, and as indicated on the drawings and as specified herein.

B. All materials shall be listed by an OSHA approved National Recognized Testing Laboratory (NRTL).

C. Related Sections:

1. 092000 – Drywall-Plaster Suspension System.
2. 095113 - Acoustical Panel Ceiling
3. 260519 – Low-Voltage Electrical Power Conductors and Cables.
4. 260533 - Raceways and Boxes for Electrical Systems.

1.2 SYSTEM DESCRIPTION

A. Explosion-proof, shielded, and vapor tight and wet location fixtures shall bear a NRTL label appropriate for the type of application.

1.3 SUBMITTALS

A. Submit, shop drawings, manufacturer's literature and technical product data as required.

B. Shop drawings shall include but not be limited to:

1. Manufacturer's dimensioned scale drawings showing in complete detail the fabrication of all luminaires including finished, metal thickness, fabrication methods, support method, ballasts, sockets type of shielding, reflectors, provisions for re-lamping and all other information to show compliance with the Contract Documents.
2. Submit shop drawings and samples as requested of luminaires for approval before fabrication. Luminaire details may vary slightly from those shown on drawings provided the changes do not adversely affect size of installation, durability of luminaire, luminaire performance or appearance. Submitted samples may be subjected to photometric testing at an independent testing laboratory, refer to Section, “Submittals”.

C. Furnish certified photometric data for every fixture specified.

D. Upon request, a sample of each fixture proposed for every use and specified unit shall be submitted to the A/E for review.

E. Lighting calculations shall comply with Florida Building Code (FBC) and IES minimum foot-candle level when required.

1.4 QUALITY ASSURANCE

A. Materials, equipment and appurtenances as well as workmanship provided under this section shall conform to the highest commercial standard and as specified and as indicated on drawings. Luminaire parts and components not specifically identified or indicated: made of materials most appropriate for their use or function and as such resistant to corrosion, thermal, and mechanical stresses encountered in the normal application and functioning of the luminaires.

B. All cast parts, including die-cast members: of uniform quality, free from blow holes, pores, hard spots, shrinkage defects, cracks or other imperfections that affect strength and appearance, or are indicative of inferior metals or alloys. Exterior surfaces, which do not otherwise receive a finishing coating: machined, sanded or similarly treated areas, such as extruded metal parts. All such finished castings: given a minimum of one coat of baked-on clear methacrylate lacquer unless a painted finish is specified.

C. Comply with Florida Building Code (FBC).

D. Luminaries and components shall be built under provisions of the N.E.C.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Surface mounted fixtures outdoors shall be vandal resistant, with 10-year lens warranty. Fixture bases shall be metal and fastened to mounting locations with metal components.

B. Exterior fixture shall be of aluminum or plastic construction.

C. Lighting Fixtures:

1. Provide lighting fixtures as indicated on the drawings and as specified.
2. The schedule and details of lighting fixtures, appearing on the drawings, indicate the type, construction, appearance, quality and performance of the fixtures required.

    a. Any proposed deviation from the fixtures specified shall equal or be superior to the item specified under these headings.
    b. Proposed substitute lighting fixtures will be judged on overall quality on construction.
    c. The fixture manufacturers products scheduled are considered acceptable, based on the equivalency of individual units as determined by the A/E.

3. Materials used in the manufacture of fixtures shall be new and the best of their respective kind, and shall be formed and assembled in a neat, accurate, and professional manner.

    a. Sheet metal shall be of sufficient thickness or shall be ribbed, flanged, or otherwise reinforced so that lighting fixtures and their component parts will withstand the stresses of normal handling and installation and service without undue distortion of shape.
    b. Plastering or other installation procedures shall not be relied on to reinforce lighting fixtures or their component parts.
    c. Fixture bases shall be metal and fastened to mounting location with metal components.

4. Finishes:

    a. Painted steel sheet shall be processed with Bonderize or equal phosphate treatment or shall be Paintlok or Galvanneal.
    b. Unpainted sheet steel shall be Galvanneal, by Republic Steel or accepted equivalent.
    c. Springs shall be of full hard temper stainless steel.
    d. Fasteners of ferrous metal shall be cadmium plated or zinc plated with chromate.
    e. Screws mounting fixture housing in plaster ring shall be minimum #8, pointed to facilitate installation.
    f. Plaster frame rings shall be of sufficient strength to withstand deformation during installation, and of suitable materials or finish to prevent corrosion from ceiling plasters and mortars.

        1) The contractor shall furnish the fixture manufacturer a complete list of fixtures that will be installed in acoustical plaster ceilings with types and quantities.

    g. Painted finishes shall be baked epoxy, polyester powder coated, acrylic or accepted equivalent finish suitable for the service required including temperature and accepted by the A/E. Finish shall be applied after fabrication.

5. Fixtures shall be complete with canopies, suspensions of proper lengths, hickeys, casing, sockets, holders, reflectors, hardware, and shall be completely wired and assembled. Each troffer shall have positive enclosed spring-loaded catches and safety hinges.
6. Furnish suitable plaster rings or plaster stops for fixtures set in plaster ceilings. Consult the "Finish Schedules" on drawings for locations and extent of plaster ceilings. Coordinate the mounting methods of recessed fluorescent lighting fixtures with ceiling suspension system and ceiling trades.

D. REFLECTORS

1. Reflectors and reflecting cones or baffles: fabricated from #12 aluminum reflector sheets, 0.57: (15 gage) or heavier, all absolutely free of any tooling marks including spinning lines, and free of any marks or indentations caused by riveting or other assembly techniques. No rivets, springs or other hardware will be visible after installation.
2. Reflectors and baffles: of first quality polished, buffed and anodized finish, "Alzak", and of specular finish color as selected by the A/E. Reflector and baffles: modified elliptical contour and produce no apparent brightness from nadir to 40 degrees above nadir, nor the lamp image nor any part of the lamp be visible from nadir to 40 degrees above nadir.
3. Submit samples of colored aluminum finished (black, brass, bronze, etc.) for approval before fabrication.

E. LENSES

1. Plastic lenses and diffusers used on LED fixtures shall be 100 percent prime virgin acrylic KSH K-12 or accepted equivalent, minimum unpenetrated thickness of 0.125" and be furnished with anti-static treatment. Injection molded lenses shall be as manufactured by Holophane or accepted equivalent.

2. Exposed fixture housings or frames shall have a continuous smooth surface with no visible seams and a neat and finished quality appearance. Hinges and fastening devices shall be fully concealed unless otherwise specifically approved by the A/E.
3. The thickness of visible edges of mounting frames and rings at the ceiling line shall be between 0.035" and 0.050". Light leaks around trim frame or lens or between any of these are unacceptable.
4. Where fixture type is not indicated on drawings, fixture type used in similar locations shall be provided, as accepted by the A/E.
5. Components of the same type, size, rating, functional characteristics, and make of similar interior lighting fixtures shall be interchangeable.
6. Fixture stems shall be furnished by the manufacturer of the fixture specified or as shown on the drawings.
7. Fixtures for use outdoors or in wet areas shall be suitably gasketed to prevent access of moisture or insects into fixture or diffuser.
8. Metal parts of fixtures for use in damp locations, specified as requiring painting, shall be painted with suitable weather and moisture resistant paints exhibiting moisture resisting qualities equal to epoxy based coatings.
9. Aluminum parts of fixtures for use in damp locations specified as requiring an unpainted finish shall be anodized.

F. Lamps:

1. LED:

a. Shall be Reduction of Hazardous Substance (RoHS) compliant, and shall comply with FCC 47 CFR Part 15, IES LM-79 & 80.
b. Minimum CRI of 80 with a color temperature of 3000-3500ºK for interior fixtures and 4000-4500ºK for exterior fixtures, unless otherwise noted in the Contract Documents.
c. Minimum rated life of 60,000 hours at 25ºC ambient temperature.
d. LED driver shall have a THD of <20% and a power factor of 0.95 or higher with integral short circuit, open circuit and overload protection.
e. LED driver and LED module shall be accessible and replaceable from below.
f. LED lighting fixtures shall be assembled in the USA with minimum 80% materials content from the USA.
g. All LED fixtures located within instructional spaces shall have factory installed dimmable control modules built right into the fixture.
h. LED fixtures shall be provided with a minimum 10-year warranty on entire fixture (all components).
i. Approved LED fixtures:

1) Size: 2'-0" x 2'-0": Model #ZR22 by Cree or other A/E approved equivalent by Lithonia or Kenall.
2) Size 2'-0" x 4'-0": Model #ZR24 by Cree or other A/E approved equivalent by Lithonia or Kenall.
3) Other LED fixtures of size and type as indicated in Contract Documents: Fixtures shall be as manufactured by Cree, Lithonia or Kenall, and as approved by A/E.

2.2 MARKING OF LUMINAIRES

A. Mark luminaires designed for voltages other than 110-125 volts circuits.

2.3 SOUND TRANMISSION

A. It is the intent of this Specification that sound transmission through the luminaire units, when spaced as indicated on drawings, shall be sufficiently attenuated to maintain speech privacy between adjoining spaces.

2.4 LUMINAIRE TRIMS

A. Luminaires shall have finish trim designed for the following types of ceiling systems:

1. LED Luminaires:

	Ceiling Type	Trim Type
a.	Plaster	F - Flanged with Plaster Frame
b.	Metal pan	M - Modular - Fit-In
c.	Mineral Tile	F - Flanged
d.	Drywall	F - Flanged
e.	Lay-In	G - Grid

B. Each trim detail shall be as shown on the drawings, which are indicative of appearance and dimensional requirements. The manufacturer's trim finish and dimensions: subject to the approval of the A/E. Flush mounted ceiling trims for rectangular or square recessed luminaires shall include mitered corners continuously welded and smoothed before shop finish is applied. No lapping of trim metal is permitted.

C. Trim of luminaires installed in metal shall match the color of that deck.

2.5 EXIT LIGHTS

A. LED lamps shall have 6-inch red letters on white background.

B. Field convertible mounting-end, back or top.

C. Field convertible directional arrows.

D. Each LED exit light shall have a total connected load of less than 2 watts.

2.6 LIGHTING CONTACTOR

A. Electrically operated, mechanically held, double break silver alloy contacts. Fully rated for tungsten lamp loads, when used as a back-up for HID luminaires, fluorescent lamp loads and general use loads. Interrupting capacity: 300 percent of rated current. NEMA I enclosure except otherwise specified.

B. As manufactured by: Asco-920RC, Square 'D' - Class 8903, General Electric - CR160MB, Westinghouse A202.

2.7 LIGHTING CONTROL

A. Provide a motion detector(s) in each enclosed space.

B. Motion sensors shall be installed following manufacturer's recommendations.

C. Motion sensors and their power packs must be of the same manufacturer.

D. Motion sensor failure shall leave lights on.

E. Motion sensors shall be provided with a 5-year warranty.

2.8 ILLUMINANCE COMPUTER ANALYSIS

A. Provide illuminance computer analysis for all indoor space.

B. For indoor analysis the initial light loss factor shall be taken as the product of the voltage drop factor (0.97) times the ballast factor.

PART 3 EXECUTION

3.1 INSPECTION

A. Do not proceed with the work of this section until conditions detrimental to the proper and timely completion of the work have been corrected in an acceptable manner.

3.2 INSTALLATION

A. Install fixtures according to manufacturer's recommendations and in compliance with the NEC.

B. Install "Lay-In" type fixtures with 6-foot lengths of flexible conduit to enable fixture relocation with minimum inconvenience. Fixture shall be securely fastened to ceiling frame members by mechanical means as per the NEC.

C. Luminaire locations as indicated on the drawings are generalized and approximate. Carefully verify future locations with architectural floor plans, reflected ceiling plans and other reference data prior to installation. Check for adequacy of headroom and non-interference with other equipment, such as ducts, pipes or openings

D. Upon completion of the installation, the luminaires and lighting equipment must be in first class operating order and free from defects in condition and finish. At time of final inspection, all luminaires and equipment shall be fully lamped, and be complete with required lenses of diffusers, reflectors, side panels, louvers or other components necessary for the functioning of the luminaires. Luminaires and equipment shall be clean and free from dust, plaster or paint spots. Any reflectors, lenses, diffusers, side panels or other parts damaged prior to the final inspection shall be replaced by the Contractor.

E. The housings of recessed luminaires shall be adequately protected during installation by internal blocking or framing to prevent distortion of sides or dislocation of threaded lugs which, upon completion, shall be in perfect alignment and match the corresponding holes in frames or rims. Holding screws shall be inserted freely without forcing and remain easily removable for servicing. Threads intended to receive holding screws shall be chased after plating and finished to ensure easy installation and removal of knurled headed screws.

F. Housings shall be rigidly installed and adjusted to neat flush fit with the ceiling or other finished mounting surface. No light leaks will be permitted at the ceiling line or from any visible part or joints of the luminaires.

G. Housings installed directly in concrete shall be fabricated of hot dip galvanized steel or cast aluminum. Where cast aluminum housings are used, provide two coats of asphaltum paint prior to installation.

H. Provide 1/8 inch thick x 2 inch diameter solid neoprene grommets at every mounting point for all luminaires surface mounted to concrete structure to prevent direct contact of housing to concrete.

I. Adjust all directional luminaires to obtain the most uniform distribution. Orient all similar luminaires consistently. Coordinate luminaires with speakers, air grilles, pipes and ductwork.

J. Luminaire bottoms, edges and ends of rows shall be even. Rows shall be straight, aligned and equally spaced in distinct areas. Clean all luminaires of debris and fingerprints and adjust trim to fit surface snug.

K. Provide all necessary hangers and mounting accessories for a complete installation.

L. Locate the fluorescent luminaires in the equipment rooms to best illuminate the equipment installed. Use chains or rods to support below ducts and pipes as required. Install after pipes and ducts are in.

M. Test all luminaires, switches and controls for operation. Replace all lamp burnout's if their estimated operating period is less than 80 percent rated lamp life prior to final acceptance.

3.3 Exit lights:

A. Install wall or ceiling mounted as shown on drawings.

B. Provide directional arrows required to show correct path to exit.

C. Install exit lights at a location and height to ensure a clear line of sight from the egress passageway.

D. Relocate exit lights that are not readily visible at no additional cost to MDAD.

E. Internally illuminated exit signs shall have LED light source on normal power.

3.4 SUPPORTS

A. Fixture Supports:

1. Fixtures shall be supported according to manufacturer's recommendations and the NEC.
2. Where pendant fixtures are mounted in continuous rows, the number of hangers shall equal the number of 4-foot lengths, plus 1.
3. Do not support fixtures to plaster or gypsum board ceilings.
4. Furnish and install steel members and supports to fasten and suspend fixtures.

B. Install lighting fixtures on ceilings or walls of mechanical and electrical equipment rooms after piping, ductwork, and equipment are installed therein.

1. Exact location and switching for such fixtures will be determined at the job site during the work.
2. Fixtures shall be located to give maximum illumination to items of equipment requiring servicing and moving machinery.
3. Any lighting fixtures blocked, inaccessible or improperly located shall be relocated at no extra cost.
4. Where fan rooms are used as an air plenum, provide suitable gasketed vapor-tight lighting fixtures.

C. Plaster frames for lighting fixtures shall be furnished under this Section and installed by others under this Contract. Frames shall be finished matte white baked enamel unless otherwise noted.

D. Recessed luminaires shall be provided complete with mounting devices and accessories and constructed and mounted as to permit access to wiring.

E. Attachment devices shall be fabricated of formed, rolled or cast metal shapes with the requisite rigidity and strength to maintain continuous alignment of the installed luminaires.

F. Contractor shall be responsible for necessary adjustments in ceiling required to install luminaires.

G. Contractor shall verify all ceiling conditions from the architectural plans and provide appropriate mounting details for each luminaires.

H. Reflectors shall be attached to housing by means of a length of chain, which will prevent reflector from falling. Ensure that no part of chain is visible after installation when viewed from any angle below 45 degrees from the horizontal.

I. Pendant or surface mounted luminaires shall be provided with required mounting devices and accessories, including hickeys, stud-extensions, ball-aligners, canopies and stems. Coordinate locations of luminaires in mechanical areas. Mounting stems of pendant luminaires shall be of the correct length to uniformly maintain the luminaire heights shown on the drawings or established in the field.

3.5 ADJUSTMENTS

A. Upon the completion of the installation of all luminaires, turn on for a continuous period of 48 hours and during that time, replace any burned-out lamps, defective ballasts or fuses, etc.

END OF SECTION

SECTION 270500 – COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the basic requirements for communications and low voltage installations as indicated or required, and includes requirements common to more than one specification section of this Division (such as related documents, related sections, definitions, governing requirements, contractor requirements, warranty requirements, submittal requirements/procedures, and project closeout requirements/procedures, as well as other requirements).

1.2 RELATED DOCUMENTS

A. The general provisions of the Contract, including General, Supplementary and other conditions, Division 01, and the requirements of other Divisions apply to the work of this Division Related Requirements.

B. Examine the Contract Documents in their entirety (including Drawings and Specification Sections in the other Divisions) for requirements or work which may affect work under this Section, regardless of whether such requirements or work are specifically indicated in this Section

1.3 RELATED SECTIONS

A. All Division 27 Specification Sections in this Bid Package.

B. The applicable portions of the Governing Requirements (see Part 1 - General: Governing Requirements, herein) shall be incorporated by reference into each related Specification Section.

C. Other Division Sections referencing this Section

1.4 QUALIFICATIONS

A. See Division 01 requirements for contractor general qualifications.

B. Where manufacturer supports an authorized distributor program, products shall be purchased through an authorized distributor. Provide manufacturer’s letter of authorization.

C. Where manufacturer supports a certified installer program, products shall be installed by a certified installer company using certified installers. Provide certification documents.

1.5 INTENT AND INTERPRETATION

A. It is the intent of the Construction Documents that the Contractor shall include all items necessary for the proper execution and completion of the Work by the Contractor, resulting in complete and fully operational system(s) ready for the Owner's use, in full compliance with all applicable standards, codes and ordinances.

1. Work or product not specifically indicated in the Construction Documents, but which are necessary to result in complete and fully operational system(s) ready for the Owner's use, shall be provided.
2. The specification of certain products in the Construction Documents shall not be construed as a release from furnishing such additional products and materials necessary to furnish complete and fully operational system(s) ready for the Owner's use.

B. In the event that discrepancies exist or required items or details have been omitted in the Construction Documents, You shall notify the Consultant in writing prior to the bid date. Failure to do so shall be construed as willingness to provide a complete and fully operational system within the amount of your bid. Where such discrepancies are not brought to the attention of the Consultant, the most stringent requirements shall be construed to be the basis for your bid.

C. Prior to bidding the project, you shall visit the site to determine all existing conditions affecting the work, the type of construction to be used, and the nature and extent of work provided by other trades. Failure to do so shall be construed as willingness to provide complete and fully operational system(s) within the amount of your bid. Site visit to be coordinated with Owner/general contractor.

D. Drawings and Specifications are complementary. Items required by either are binding as though they are required by both. In the event of conflict between or within the requirements of the Drawings and the Specifications:

1. With regards to the preparation of proposals and/or bids, the Contractor shall assume the more stringent (costly) condition shall prevail. The Contractor shall notify the Consultant of such prior to the bid date.

2. With regards to actual construction, the Contractor shall notify the Consultant and await the Consultant's instruction prior to proceeding with procurement and installation.

E. The Construction Documents include certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions include:

1. Abbreviated Language: Language used may be abbreviated. Implied words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpreted as the sense requires. Singular words shall be interpreted as plural and plural words interpreted as singular where applicable and where the full context so dictates.
2. Imperative and Streamlined Language: Imperative and streamlined language is used generally. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the text, for clarity, subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.

3. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where abbreviations and acronyms are used, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context.
4. Words used in the singular shall also mean the plural, wherever the context so indicates, and likewise words in the plural shall also mean the singular, wherever the context so indicates.
5. Unless otherwise stated, words which have well known technical or construction industry meanings are used in accordance with such recognized meanings.
6. The terms "directed", "required", "permitted", "ordered", "designated", or "prescribed", as well as similar words shall mean the direction, requirement, permission, order, designation or prescription of the Consultant.
7. The terms "approved", "acceptable", "satisfactory", and similar words shall mean approved by, acceptable, or satisfactory to the Consultant.
8. The terms "necessary", "reasonable", "proper", "correct" and similar words shall mean necessary, reasonable, proper, or correct in the judgment of the Consultant.

F. Assignment of Specialists: The individual Specification Sections may require that certain specific construction activities be performed by specialists who are recognized experts in the operations to be performed. The specialists must be engaged for those activities, and such assignments are requirements over which the Contractor has no choice or option. Nevertheless, the ultimate responsibility for fulfilling the contract requirements shall remain with the Contractor.

G. Drawings:

1. Drawings are diagrammatic and approximate in character, are not intended to show all features of required work, and do not necessarily indicate every required component.
2. Symbols used on the Drawings are defined in the legend on the Drawings. Some symbols indicated on the legend may not necessarily be required.

1.6 DEFINITIONS

A. The definitions below are applicable to this Division. These definitions supplement the definitions specified in Division 01. In the event of discrepancies between these definitions and those defined in Division 01, the definitions in Division 01 shall take precedence.

1. Accepted/Acceptable: Work or materials conforming with the intent of the project, and in general, conforming to the pertinent information in the Construction Documents in the opinion of the Consultant or other designated Owners' Representative.
2. Approved/Approval: The written approval of the Consultant.
3. Accessible: Easy access. Access attained without requiring extensive removal of other materials to gain access, and additionally as prescribed by governing requirements.
4. Accessible Ceiling: Acoustical tile hanging ceilings. "Hard-lid" ceilings (concealed spine or sheetrock/gypsum ceilings), specialty architectural ceilings and any ceiling larger than 2 ft. x 4 ft. (even when provided with access panels) are not considered an Accessible Ceiling.
5. Agreement: The contractual agreement between the General Contractor or Owner and the Contractor or as indicated in Division 01.

6. Concealed: Hidden from sight in interstitial building spaces, chases, furred spaces, shafts, crawl spaces, etc.
7. Construction Documents: Collective term for the entire set of bound or unbound material describing the construction and services required, including all Drawings, Specifications, addenda issued prior to execution of the contract, and modifications issued after execution of the Contract (such as change orders, construction change directives, supplemental instructions, etc.).
8. Contract Documents: The Agreement (including other documents listed in the Agreement), Conditions of the Contract (General, Supplementary and other conditions), and the Construction Documents.
9. The Contract: The Contract Documents form the Contract. The Contract represents the entire and integrated agreement between the Owner and the Contractor and supersedes any prior negotiations, representations or agreements, either written or oral. The Contract shall not be construed to create a contractual relationship of any kind (1) between the Consultant and the Contractor, (2) between the Owner and a Subcontractor, or (3) between any persons or entities other than the Owner and Contractor.
10. Contractor: The party (or parties) responsible for providing the system(s) as indicated herein.
11. Drawings: The graphic and pictorial portions of the Contract Documents, wherever located and whenever issued, showing the design, location and dimensions of the Work, generally including (but not limited to) plans, elevations, sections, details, schedules and/or diagrams.
12. Engineer/Consultant: The party responsible for producing the communications system(s) Construction Documents.
13. Exposed: Not concealed (see above) and not installed underground
14. Final Completion: The date when the Consultant or other designated Owners' Representative confirms in writing that the Contractor has completed the work in accordance with the Construction Documents, including completion of all punch list items, cleanup work and delivery of all required guarantees, warranties, licenses, releases and other required deliverables.
15. Furnish: To purchase, supply, and deliver to the project materials in new and operable condition, ready for installation.
16. Governing Requirements: Collective term for regulations, laws, ordinances, codes, rules, standards, requirements, and guidelines that govern the installation and inspection of the work defined in the Contract Documents. See Part 1 – General: Governing Requirements herein.
17. Governing Authorities: Entities or their representatives charged with formation and/or enforcement of Governing Requirements, such as the Authority Having Jurisdiction (AHJ).
18. Install: To place in final position in fully operable, tested condition.
19. Inside Plant (ISP): Infrastructure within a building.
20. Or Equal, Or Approved Equal, Or Equivalent, Or Approved Equivalent: Materials that are deemed, in the opinion of the Consultant or other designated Owner representative, to be dimensionally suitable, the same in appearance, and are operationally identical, to the specified item.
21. Outside Plant (OSP): Infrastructure exterior to a building.
22. Owner: The Owner and the Owner's designated representative(s).
23. The Project: The total construction of which the Work performed under the Contract Documents may be the whole or a part, and which may include construction by the Owner and/or separate contractors.

24. Provide: To furnish and install, complete, tested and ready for intended use.
25. Substantial Completion: The date when all work required by the Construction Documents shall be designated in writing as complete (subject to the final punch list to be prepared by the Consultant or other designated Owners' Representative) and on which the applicable jurisdictional authorities have issued a temporary certification of occupancy.
26. Section: An individual section of the Specifications.
27. Shown on Drawings: Noted, indicated, scheduled, detailed, or any other written reference made on the Drawings.
28. Specifications: The portion of the Contract Documents consisting of the written requirements for materials, equipment, construction systems, standards and workmanship for the Work and performance of related services.
29. Specification Section(s): One or more sections of the Specifications.
30. Section(s): An abbreviated form of Specification Section(s).
31. The Work: The construction and services required by the Contract Documents, whether completed or partially completed, and all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project

1.7 ABBREVIATIONS

A. Refer to the individual Specification Sections and Drawings for abbreviations and their definitions.

1.8 GOVERNING REQUIREMENTS

A. All work shall be executed in compliance with the latest version and applicable portions of the codes, regulations, standards, guidelines, and/or recommendations of the following (hereinafter referred to as Governing Requirements):

1. General

a. ACI: American Concrete Institute (www.aci-int.org)
b. AHJ: Authority Having Jurisdiction
c. ANSI: American National Standards Institute (www.ansi.org)
d. ASTM: American Society for Testing and Materials (www.astm.org)
e. ASME A17.1: Safety Code for Elevators and Escalators
f. BICSI: A Telecommunications Association (www.bicsi.org)
g. IBC: International Building Code
h. IFC: International Fire Code
i. ICEA: Insulated Cable Engineers Association (www.icea.net)
j. IEEE: Institute of Electrical and Electronic Engineers (www.ieee.org, standards.ieee.org)
k. IES: Illuminating Engineering Society of North America (www.iesna.org)
l. FCC: Federal Communications Commission Rules and Regulations
m. NAB: National Association of Broadcasters
n. NFPA: National Fire Protection Association (www.nfpa.org)
o. NEC: National Electrical Code (NFPA Article 70) (www.nfpa.org, www.necdirect.org)

p. NESC: National Electrical Safety Code (http://standards.ieee.org/nesc/)
q. NEMA: National Electrical Manufacturers Association (www.nema.org)
r. OSHA: Occupational Safety and Health Administration (www.osha.gov)
s. TIA: Telecommunications Industry Association (www.tiaonline.org)
t. UL: Underwriters Laboratories, Inc. (www.ul.com, ulstandardsinfonet.ul.com)
u. State and local codes, ordinances, and regulations
v. Requirements and guidelines of local utility companies
w. Applicable state, local and/or federal requirements
x. Seismic requirements applicable to this location
y. Manufacturer installation guidelines and recommendations

2. Communications Specific:

a. TIA-568-C: Commercial Building Telecommunications Cabling Standard
b. TIA-569-B: Commercial Building Standard for Telecommunications Pathways and Spaces
c. TIA-606-B: Administration Standard for Commercial Telecommunications Infrastructure
d. TIA-607-C: Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
e. TIA -758-B: Customer-Owned Outside Plant Telecommunications Infrastructure Standard
f. TIA: Technical Service Bulletins (TSBs) (related to the above TIA standards)
g. IEEE 802.3: Local Area Network Ethernet Standard, including the IEEE 802.3z Gigabit and 802.3ae and 802.3an 10 Gigabit Ethernet Standard
h. BICSI: BICSI Customer Owned Outside Plant Design Manual
i. BICSI: BICSI LAN and Internetworking Design Manual
j. BICSI: BICSI Telecommunications Distribution Methods Manual
k. BICSI: BICSI Telecommunications Cabling Installation Manual
l. NEC: NFPA 70
m. NFPA 75: Standard for the Fire Protection of Information Technology Equipment
n. NFPA 780: Standard for the Installation of Lightning Protection Systems
o. FCC Part 68: Connection of Terminal Equipment to Telephone Network.
p. FCC Title 47: Telecommunication
q. FCC 76.611: Cable Television Basic Signal Leakage Performance Criteria.

B. Work shall comply with the Governing Requirements in effect at the time of construction, including all addenda, errata, annexes, and technical service bulletins (TSBs), etc., except where a specific date or version is otherwise indicated, or where otherwise mandated by a Governing Authority.

C. In the event of conflict within the Governing Requirements and/or conflict between the Governing Requirements and the Construction Documents:

1. With regards to the preparation of proposals and/or bids, the Contractor shall assume the more stringent (costly) condition shall prevail. The Contractor shall notify the Consultant of such prior to the bid date.
2. With regards to actual construction, the Contractor shall notify the Consultant and await the Consultant's instruction prior to proceeding with procurement and/or installation.

3. In the event of conflict between a code and a non-code Governing Requirement, or between a code and the Construction Documents, the code shall govern. However, compliance with code requirements shall not be construed as relieving the Contractor from complying with any requirements of the non-code Governing Requirement or Construction Documents which may be in excess of code requirements and not contrary to same.
4. If the requirements of this section or the Project Drawings exceed those of the governing codes and regulations, then the requirements of this section and the Drawings shall govern. However, nothing in this section or the Drawings shall be construed to permit work not conforming to all governing codes and regulations.
5. Errors or omissions in the Construction Documents do not relieve the Contractor from executing the work in accordance with the Governing Requirements.

D. The Governing Requirements are incorporated by reference into these Specifications.

1.9 PERMITS AND FEES

A. Permit and Fee requirements shall be in accordance with the applicable portions of 01 40 00 Regulatory Requirements sections. The requirements below supplement the requirements in Sections 01 40 00. In the event of discrepancies between these requirements and those defined in Sections 01 40 00, the more stringent requirements shall take precedence.

B. Obtain and pay for all licenses, permits and inspections required by the laws, ordinances and rules governing work specified herein. Such fees shall be included in the bid amount.

C. Schedule and coordinate all inspections of the work as required, and shall provide all assistance as required by the inspector(s) during their inspection(s).

D. Pay all fees, including but not limited to fees for local utility service installation, connection charges, etc. Such fees shall be included in the bid amount.

1.10 SUBSTITUTIONS AND DEVIATIONS

A. Substitutions and deviations shall be in accordance with the applicable portions of Section 01 25 00 Substitution Procedures. The requirements below supplement the requirements in Section 01 25 00. In the event of discrepancies between these requirements and those defined in Section 01 25 00, the more stringent requirements shall take precedence.

B. Prior to award of contract:

1. Bids shall be based on products and methods of construction as specified.

a. Substitution of product and deviations from the methods of constructions specified which are used in the Contractor's bid shall be at the sole risk of the Contractor, and as such are subject to rejection without consideration during submittal review, should the Contractor be awarded the contract.

C. After award of contract:

1. Proposed substitution and deviation requests shall be reviewed during the time of Submittal review.

    a. Conditions for Consideration: Substitution and deviation requests will be received and considered only when one or more of following conditions are satisfied:
        1) The specified product or method of construction cannot be provided within the contract period.
        2) The specified product or method of construction cannot receive necessary approval by a Governing Authority, and the requested substitution can be approved.
        3) The specified product or method of construction cannot be provided in a manner that is compatible with other materials.
        4) A substantial advantage is offered to the Owner, in terms of cost, time, or other considerations of merit.
        5) The product as specified includes the statement "Or Equal/Equivalent."

    b. Conditions for Rejection: Substitution and deviation requests will be rejected for the following reasons, among others:
        1) The conditions for consideration (see above) have not been met.
        2) Extensive revisions to the Construction Documents are required to support the proposed changes.
        3) The proposed changes do not comply with the general intent of the Construction Documents.
        4) The substitution request is for product which does not include the statement, "Or Equal/Equivalent", or is specified as "no substitute", "substitutions are not acceptable", "provide as specified" or similar.
        5) The proposed change is solely for the convenience or economic gain of the Contractor.

2. Approval of substitution and deviation requests

    a. Do not proceed with a substitution or deviation without written approval.
    b. The Contractor shall be responsible for fees incurred by the Consultant for any redesign resulting from the proposed changes, and for the updating of the Construction Documents to reflect such changes.

1.11 SUBMITTALS

A. Submittals shall be in accordance with the applicable portions of Section 01 33 00 Submittal Procedures. The requirements below supplement the requirements in Section 01 33 00. In the event of discrepancies between these requirements and those defined in Section 01 33 00, the most stringent requirements shall take precedence.

B. General:

1. Submittal review is a courtesy extended to the Contractor for the limited purpose of checking for general conformance with the design concept and the information shown in the Construction Documents.

2. In the event of discrepancies or conflict between Submittals and the Construction Documents, either prior to or after review, the requirements of the Construction Documents shall prevail.
3. Submission of material for review, regardless of the outcome of the review, does not alter the Contractor's obligation to follow the intent of the Construction Documents, nor the Contractor's responsibility to comply with the Construction Documents.
4. Submittals will not be reviewed and will be returned to the Contractor without review for the following reasons:

    a. Submittal is partial or incomplete.
    b. Submittal contains information concerning the proposed implementation of means, methods, procedures, sequences or techniques, temporary aspects of the construction process, or other items, which are the sole responsibility of the Contractor.
    c. Submittal was not carefully reviewed by the Contractor prior to submission, as evidenced by poor organization, obvious or numerous errors, lack of correlation or cross-referencing, lack of clarity in presentation, or containing Shop Drawings which do not meet the standard of the Construction Drawings.
    d. Submittal cut sheets covering multiple products and options that do not have arrows or highlights indicating which product or option is being submitted.
    e. Submittal was submitted directly from the Contractor's subcontractor(s) or vendor(s).
    f. Subcontractor and/or vendor submittal information was not carefully reviewed and/or approved by the Contractor.
    g. Submittal does not bear the Contractor's approval stamp, and/or contains subcontractor and/or vendor submittal information which does not bear the Contractor's approval stamp.
    h. Submittal contains substitution and/or deviation requests, which are not clearly identified as substitution or deviation requests in a separate "Substitution and Deviation Requests" section of the Submittal.

C. Submittal Format:

    1. Electronic PDF format

D. Product Data: Submit Product Data information as called for in the individual Specification Sections. Product Data shall include:

    1. For all products provide the following product information (as applicable):

        a. Specification Section to which the product applies.
        b. Catalog cut sheets, manufacturer data sheets, and/or specification sheets detailing the product, item, assembly and installation. Note: Cut sheets covering multiple products and options shall have arrows or highlights indicating which product or option is being submitted and cross out of non-applicable information.
        c. Highlighted details within the product data that identifies compliance with the Construction Documents or the intent of the Construction Documents.
        d. Highlighted details within the product data that identifies deviations from the Construction Documents or the intent of the Construction Documents.
        e. When the specifications include product descriptions, model numbers, part numbers, etc. that have been superseded, changed, or discontinued, the Contractor shall submit

a comparable substitution for review with a note indicating purpose of substitution (not to be used for Substitutions and Deviations as indicated in paragraph below.)

2. For products for which the Contractor is proposing a substitution, include the product as specified in the submittal per the above requirements and list the reference to the proposed substitution in the "Substitution and Deviation Requests" section of the submittal (see below).
3. Do not provide product quantities (except where requested in RFP as backup) – quantities are the sole responsibility of the Contractor, are not part of the contract, and may not be reviewed.

E. Shop Drawings: Submit Shop Drawings as called for in the individual Specification Sections. Shop Drawings shall include:

1. Shop drawings shall be provided in PDF format and in form, format and size identical to that of the Construction Drawings (the Construction Drawings set the standard). Note: Shop drawings that are prepared at a resolution making them unreadable when zoomed in to a normal reading size are not acceptable. Shop Drawings that do not meet these standards shall be rejected without review.
2. For methods of construction for which the Contractor is proposing a deviation, include the method of construction as specified per the above requirements and list the reference to the proposed deviation in the "Substitution and Deviation Requests" section of the submittal (see below).

F. Technical Drawings: Submit Technical Drawings as called for in the individual Specification Sections.

G. Samples: Submit Samples as called for in the individual Specification Sections.

1. Samples shall be indexed and identified in this section. Product samples shall be clearly labeled and correlated to the descriptions in each section.

H. Substitution and Deviation Requests: For each substitution and/or deviation request, include the following:

1. Whether the request is for substitution of product or deviation from a construction method.
2. The Specification Section(s) or Drawing to which the request applies.
3. Reason for the request (Note: the reason must conform to the requirements of Part 1 – General: Substitutions and Deviations herein)
4. If a substitution, provide:

    a. Specified product to which the proposed substitution applies.
    b. Product Data for the substituted product.
    c. Notation of differences between the proposed substitution and the specified item.
5. If a deviation, provide:

    a. Specified method of construction to which the proposed deviation applies.
    b. Shop Drawing data for the deviation.
    c. Notation of differences between the proposed deviation and the specified construction method.

6. Written statement signed by the Contractor stating that the proposed substitution or deviation is equivalent or superior in function, appearance, and quality to the specified product or construction method and that the proposed substitution or deviation will be at no additional cost to the Owner.

I. Other information:

1. Submit Other Information as called for in the individual Specification Sections.

J. Submittal review:

1. The submittal review will not include review of the accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes, construction means or methods, coordination of work with other trades, or construction safety precautions, all of which are the sole responsibility of the Contractor.
2. Corrections or comments made on the Submittal by the reviewer during the submittal review do not relieve the Contractor from compliance with the requirements of the Construction Documents.
3. Review of a specific item shall not indicate that the reviewer has reviewed the entire assembly of which the item is a component.
4. Review does not relieve the Contractor from responsibility for errors, which may exist in the submitted data.
5. Review of substitutions and deviations:

    a. The reviewer shall not be responsible for review of substitutions and/or deviations that were not brought to the attention of the reviewer by specific inclusion of the substitution and/or deviation in the Substitution and Deviation Requests section of the Submittal.
    b. Where a substitution and/or deviation is not included in the Substitution and Deviation Requests section of the Submittal, the procurement and installation of the substitution and/or deviation is at the sole risk of the Contractor.
    c. If the Reviewer does not specifically note substitutions and/or deviations, it remains the Contractor's responsibility to comply with the Construction Documents.
6. After review, submittals shall be returned together with review comments and specific actions (if required) to be taken by the Contractor. Typical comments and actions will be:

    a. "No exceptions taken." The submittal appears complete and accurate per the contract documents. Do not re-submit.
    b. "Make corrections noted." The submittal appears complete per the contract documents but includes minor variances from the contract documents. Make the changes noted but do not re-submit.
    c. "Amend and resubmit." The submittal appears substantially complete per the contract documents, but has significant variances from the contract documents. You must re-submit.
    d. "Rejected." indicates the submittal is incomplete per the contract documents. Rejected submittals are not reviewed by the Consultant. You must re-submit.
    e. "Submit specified item." The submittal appears substantially complete and accurate per the contract documents, but is missing an item that the Consultant needs to review. Re-submit only the specified item.

7. Perform no portion of the Work requiring a submittal until the respective submittal has been approved by the Architect/Consultant/general contractor. Such Work shall be in accordance with the approved submittal.
8. Re-submission of submittals:

    a. Submittals shall continue to be re-submitted and reviewed until all submitted items are marked by the Consultant as "No Exceptions Taken" or "Make Corrections Noted (Re-submittal Not Required)."
    b. Re-submittals shall be clearly identified as a re-submittal and shall identify changes on a separate Revisions page inserted after the Table of Contents page(s).
    c. The Contractor shall be responsible for fees incurred by the Consultant resulting from subsequent review of re-submittals that fail to meet the requirements herein. Such fees will be incurred after the Consultant has reviewed the original submission and one re-submission.

1.12 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products in full compliance with the manufacturer's recommendations and/or instructions, using means and methods that will prevent damage, deterioration, and loss (including theft).

B. Protect product until final acceptance.

C. Protection of product is the sole responsibility of the Contractor. Replace damaged, deteriorated, or lost product at no additional cost to the Owner.

D. Products subject to damage by the elements shall be stored above ground, under cover, in a weather tight enclosure, with ventilation adequate to prevent condensation. Temperature and humidity shall be maintained within the manufacturer's recommendations.

E. Make provisions for receiving and storing product, including Owner furnished product to be installed by the Contractor as part of the work.

F. Carefully inspect for damage upon delivery. Defective or damaged product shall be marked "Rejected", removed from the site, and shall not be installed.

G. Arrange product deliveries in accordance with the construction schedule. Deliveries shall be scheduled to maintain the progress of work, to avoid conflict with the work of other Trades, and to accommodate site conditions.

H. Product shall be delivered to the site in the manufacturer's original containers, complete with labels and instructions for the proper handling, storage, unpacking, protection and installation.

I. Ensure that product to be installed is not temporarily used as steps, ladders, platforms, scaffolds, or for storage by the Contractor or by other Trades during the construction process. Equipment found to be used in such a manner will be considered "damaged", shall not be installed, and shall be replaced at no additional cost to the Owner.

1.13 PROJECT CONDITIONS

A. Environmental Rating: Equipment shall be rated for continuous operation under the ambient environmental temperature, humidity and vibration conditions encountered at the installation location. For devices located in harsh environments such as interior uncontrolled or exterior environments, the Contractor shall provide the necessary housings or enclosures to ensure proper equipment operation and performance. The equipment shall meet the following requirements based upon installed location:

1. Interior, controlled environment: 60 to 82 degrees F dry bulb and 20 to 90 percentage relative humidity, non-condensing.
2. Interior, uncontrolled environment: 32 to 140 degrees F dry bulb and 10 to 95 percentage relative humidity, non-condensing.
3. Exterior environment: 14 degrees to 122 degrees F dry bulb and 5 to 100 percentage relative humidity, condensing. Rate equipment for continuous operation where exposed to rain and winds up to 85 mi/h.

1.14 WARRANTY

A. Contractor Warranty: Provide a Contractor endorsed and backed warranty against all defects in materials and workmanship, in compliance with the applicable requirements of Division 1.

1. All labor and materials attributable to the fulfillment of the warranty (including Contractor administrative costs) shall be provided at no cost to the Owner.
2. Defects in materials and workmanship shall be remedied within 72 hours of discovery and Contractor notification.
3. The Warranty period shall be a minimum of 1 year and shall commence upon Final Completion of the work.

B. Manufacturer Warranty: Provide Manufacturer Warranty(s) (per system type) as follows:

1. Communications Cabling System: Provide a minimum 20-year Manufacturer extended product, performance/application, and labor warranty:

a. Provide a communications cabling system Manufacturer extended product, performance/application, and labor warranty that shall warrant all passive components used in the communications cabling system. Additionally, this warranty shall cover all components not manufactured by the Manufacturer, but approved by the Manufacturer for use in the communications cabling system (i.e. “Manufacturer Approved Alternative Products”). The Manufacturer warranty shall warrant:
   1) That the products will be free from manufacturing defects in materials and workmanship.
   2) That all cabling products of the installed system shall exceed the specification of TIA -568-C performance standards.
   3) That the installation shall exceed the specification of TIA -568-C installation standards.

4) That the system shall be application independent and shall support both current and future applications that use the TIA -568-C component and link/channel specifications for cabling.
5) That all labor (including administrative) and required product attributable to the fulfillment of this warranty shall be provided at no cost to the Owner.

2. Other Systems: Provide a minimum 2-year Manufacturer extended product, performance/application, and labor warranty UNLESS a different time period is provided within the specific specifications.

C. The Manufacturer warranty period shall commence upon a Warranty Certificate being issued by the manufacturer.

1. The Warranty Certificate shall be included with the O&M Manual submission. O&M Manual's submitted without the Manufacturer's Warranty Certificate will be rejected without review.

1.15 COORDINATION

A. Thoroughly examine the Construction Documents, including Drawings and specification Sections of other Divisions, for construction details and methods that are dependent upon or will affect the work of other trades. The Contractor is responsible for identifying coordination issues and dependencies, and for preparing Shop Drawings, work plans and schedules to accommodate and/or mitigate coordination issues and dependencies before they arise.

B. Changes necessitated by the failure of the Contractor to coordinate with the work of other trades shall be at no additional cost to the Owner.

C. Confer and cooperate with the other trades, throughout the entire construction process, in order to coordinate the work in the proper sequence. Typical coordination issues include but are not limited to:
1. Electrical work, including electrical receptacles, power panels, transformers, telecommunications grounding system, and the installation of raceway, device boxes, conduits, and sleeves for the Communications Cabling System.
2. Mechanical work, including HVAC systems and ductwork, piping, and mechanical chases.
3. Ceiling cavity spaces.
4. Installation of acoustical ceiling tiles and similar finishes that may conceal the work.
5. Build-in of oversized equipment during structure construction.
6. Required separation distances.
7. Access routes for equipment through the construction
8. Cutting/coring of floor, ceiling or wall structures.

D. Coordinate communications service installations with the Owner and with the Service Provider(s).

E. Existing communications service outages shall be coordinated and scheduled in advance with the Owner at a time and duration acceptable to the Owner. Outages scheduled at times other than the normal working hours shall not entitle the Contractor to additional compensation beyond the

original amount bid. Outages without advance notice and prior approval by the Owner are not acceptable.

F. Review the Drawings and Specifications of other Divisions for locations of devices and equipment requiring communications connectivity not specified in this Division or shown on the Communications Drawings. Coordinate the locations of these items with the other trades, and shall verify locations with the Consultant and Owner prior to rough-in.

G. Verify that the physical dimensions of each item of equipment fit the available space, promptly notify the Consultant of any potential conflicts, and await the Consultant's direction prior to purchase and rough-in of the equipment.

H. Coordinate locations of devices, outlets, etc. with field conditions, unless such locations are specifically dimensioned or otherwise noted in the Construction Documents. If so noted, verify location with other affected trades and against existing field conditions, promptly notify the Consultant of any potential conflicts, and await the Consultant's direction prior to purchase and rough-in of the equipment.

I. Coordinate locations for chases, slots, sleeves, and openings in the building structure. For new concrete coordinate, locate and provide chases, slots, sleeves, and openings prior to the pouring of the concrete.

J. Coordinate communications installations' impact on code or manufacturer required access to equipment of other trades. Propose solutions to any conflicts prior to rough-in of communications equipment or support infrastructure.

1.16 RECORD DOCUMENTS

A. Maintain a set of Record Documents showing all additions, changes, and deletions that have been made to the original Drawings and Specifications throughout the course of construction, as well as reviewed Submittal data.

B. Items to be noted shall include but shall not be limited to:

1. Routing of concealed raceways/pathways;
2. Raceways/pathways located more than 2 feet from where shown on the original Contract Documents;
3. Raceways and main pathways (pathways with more than 30 cables) not shown on the Contract Documents;
4. Concealed equipment;
5. Stubouts; actual equipment locations, sizes and dimensions;
6. Building outline changes;
7. Addenda, accepted Alternates, Change Orders, other document revisions which occurred after the award of the Contract and/or the start of construction activities;
8. System component labels and identifiers for all major components.

C. Notations shall be handwritten in a neat and legible manner and shall be noted as follows:

1. Red – for additions and changes

2. Green – for deletions
3. Blue – for notes

D. The record drawings shall be submitted in accordance with the applicable portions of Section 017839 and as supplemented herein.

1.17 OPERATING AND MAINTENANCE (O&M) MANUALS

A. General

1. O&M Manuals shall be submitted in accordance with the applicable portions of Section 01 78 23 and as supplemented herein.
2. O&M Manuals shall be submitted as a single package and shall include subcontractor and vendor O&M information.
3. Catalog pages and data included in O&M Manuals shall be originals. Where not possible to obtain original copies in sufficient quantity, catalog pages and data shall be neat, clean copies of the originals.
4. O&M Manual Requirements: O&M Manuals shall include Product Data, Service, Spare Parts, Tests/Measurements/Calibration Settings, Record Drawings, Warranty information, and Other Information as required.

    a. Product Data: Include the product data provided in the Submittal reflecting product as supplied and installed, as well as additional information such as installation, operation, and routine maintenance information.
    b. Service: Assemble service information (cleaning, adjustments, frequency, etc.) for each device requiring service. For devices requiring qualified service, compile an index of qualified service providers (and their contact information) able to service these devices.
    c. Spare Parts: Assemble a list of spare parts. Compile an index of spare parts providers (and their contact information) able to provide the spare parts.
    d. Tests: Assemble all test documentation made for each system and/or device requiring testing.
    e. Record Drawings: Provide Record Drawings per the requirements of Part 1 – General: Record Documents herein.
    f. Warranty: Provide warranty documentation per the requirements of Part 1 – General: Warranty herein and the individual Specification Sections.
5. O&M Manual contents shall also be submitted in soft/electronic copy on a USB drive.

B. O&M Manual format:

1. Front cover of the O&M Manual shall indicate the name of the project, the project number, specification section the name of the Owner, year of completion, the title “Communications O&M Manual”, and the names of the Contractor, as well as the General Contractor.
2. O&M Manual shall include the following sections, indexed (with tab dividers) accordingly.

    a. Product Data
    b. Service
    c. Spare Parts
    d. Tests

e. Calibration/Configuration Settings
f. Record Drawings
g. Final Punchlist
h. Certificates of Inspection
i. Warranty
1) Contractor's Warranty Certificate
2) Manufacturer's Warranty Certificate (as applicable)
j. Other information (as applicable)

3. O&M Manuals shall include a table of contents identifying sections and page numbers.
4. Pages within each section shall be numbered.
5. Provide PDF format copies of all O&M Manuals

C. O&M Manual submission:

1. The Contractor shall submit one draft copy of the O&M Manual for review and approval by the Consultant in PDF format.

a. The submission will be reviewed for accuracy, completeness, and compliance to the requirements herein. A submission which fails to meet these requirements will be rejected and returned to the Contractor together with review comments and specific actions to be taken by the Contractor. The Contractor shall revise the O&M Manual and re-submit for review and approval.
b. The O&M Manual shall continue to be re-submitted and reviewed until such time as the O&M Manual is approved by the Consultant.
c. The Contractor shall be responsible for fees incurred by the Consultant resulting from subsequent review of O&M Manuals that fail to meet the requirements herein. Such fees will be incurred after the Consultant has reviewed the original submission and one re-submission.

2. Upon approval of the draft copy, the Contractor shall submit final copies in quantities per the requirements of Section 01 78 23.
3. Final payment to the Contractor will not be authorized until the final copies of the O&M Manuals (including Record Documents) have been received and approved by the Consultant.

1.18 CONSULTING FEES

A. The Specifications may identify work required of the Consultant due to various actions, lack of action, or deficiencies on the Contractor's part. Such instances will be identified in the individual Specification Sections (including this one) and the Contractor shall be responsible for these fees if they are incurred by the Consultant.

B. Fees charged to the Contractor will be at the Consultant's billing rates at the time the services are performed. Travel time will be included, if applicable. Mileage will be charged for required automobile travel at the standard IRS mileage rate in effect at the time the services were performed. Expenses will be billed at cost plus 10% markup.

C. Fees will either be paid directly to the Consultant or will be deducted directly from payments (or the final payment) to the Contractor.

PART 2 - PRODUCTS

2.1 GENERAL

A. Where products from several manufacturers are listed under a specified component:

1. The products list shall be listed by manufacturer name
2. Products not listed first shall be considered equal and there is no manufacturer preference of those listed as acceptable.

B. If no product manufacturer is listed, then any manufacturer able to meet the listed specifications is acceptable.

C. Where product is specified without the statement “or equal” and/or “or equivalent”, substitutions will not be entertained.

2.2 MATERIALS

A. The Contractor is responsible for providing all incidental and/or miscellaneous tools, scaffolding, consumable items, testing equipment appliances, and other hardware not explicitly specified or shown on the Drawings required for the installation of a complete and operable telecommunications infrastructure system ready for the Owner’s use.

B. Products shall be:

1. New (except as otherwise indicated) and free from defects.
2. Standard products of manufacturers regularly engaged in the production of such products.
3. Of the manufacturer’s latest standard design.
4. Designed to ensure satisfactory operation and life in the environmental conditions that prevail in their installation location.
5. For products of similar type, provide products manufactured by a single manufacturer.
6. Where systems are indicated, provide component products manufactured by a single system manufacturer.

C. Prior to ordering and delivery of equipment:

1. Verify that the equipment shall adequately pass through building openings and passageways with unobstructed access to the final equipment location. When building openings and passageways will not permit the equipment to pass through unobstructed, equipment shall be manufactured and shipped in sections for final assembly at the equipment location. Submittals shall indicate sectionalized manufacturing of equipment.
2. Verify that the equipment shall properly fit the space allocated, that required clearances can be maintained, and that the equipment can be located without interference from other systems, structural elements, or the work of other trades.

PART 3 - EXECUTION

3.1 GENERAL

A. All contractor personnel shall be clearly identified by uniform and/or company badge with photo ID, employee's name, and company name. Contractor vehicles shall be equipped with signs on both sides of vehicle identifying the Contractor's company name.

B. All Owner provided Contractor IDs shall be returned at or before project closeout.

C. Installation shall be in a neat and workmanlike manner employing workers skilled in the trade, familiar with the particular techniques and methods of construction applicable to the work of the trade.

D. Completed work shall present a neat and professionally installed appearance. The appearance of the work shall be of equal importance to its operation. Failure to present a neat and professionally installed appearance shall be considered sufficient reason for rejection of the system in part or in whole.

E. Completed work shall demonstrate quality workmanship. Quality workmanship shall be of equal importance to its operation. Failure to demonstrate quality workmanship shall be considered sufficient reason for rejection of the system in part or in whole.

F. Order and install materials and equipment with long lead times and/or those having a major impact on work by other trades so as not to jeopardize the project or project schedule.

G. The Contractor is solely responsible for the safety of the public and workers in accordance with all applicable rules, regulations, building codes and ordinances, and Governmental Requirements, including but not limited to employee training and Safety Program development, documentation and execution.

3.2 PERMITS AND FEES

A. Make arrangements to obtain and pay for necessary permits, licenses, and inspections.

B. No work shall be started prior to obtaining necessary permits and payment of required fees. Work installed prior to obtaining proper permits shall, if required by the Governing Authority (AHJ), be redone in compliance with requirements at no additional cost to the Owner.

3.3 INSTALLATION

A. Install product according to manufacturer recommendations, except where local codes or regulations take precedence.

B. Installation shall comply with the applicable portions of the Governing Requirements (see Part 1 – General: Governing Requirements).

C. Dimensions and clearances:

1. Equipment dimensions and dimensions indicated for the installation of equipment are restrictive dimensions. Verify that the equipment will fit within the indicated locations and spaces.
2. Maintain, at a minimum, code required clearances.
3. Promptly notify the Consultant of any potential dimension or clearance conflicts, and await the Consultant's direction prior to purchase and rough-in of the equipment.

D. Access:

1. Install equipment such that it is readily accessible for operation and maintenance.
2. Access to equipment shall not be blocked or concealed by conduits, supporting devices, boxes, or other items.
3. Do not install equipment such that it interferes with the normal operation or maintenance requirements of other equipment.
4. Equipment shall be installed level, plumb, parallel, and perpendicular to building structures and to other building systems and components, except where otherwise indicated.
5. Equipment shall be securely fastened. Select fasteners so that the load applied to any one fastener does not exceed 25 percent of the proof-test load.
6. Place equipment labels and/or other identification where the label and/or identification can be easily seen and read without difficulty.

E. Attachment of hanger rods, support cables, diagonal wall bracing, and any other connections made to the building structure after the fireproofing contractor has completed his work, shall be made with minimal impact to the existing fireproofing. The Contractor making such connections is responsible for (a) removal of firestopping where attachment is required and (b) scorings and over-cut as required for connection only. Contractor shall be held responsible for costs associated with the patch back of excessively removed firestopping material.

3.4 REFERENCES AND STANDARDS

A. Work shall comply with the Governing Requirements listed in Governing Requirements herein.

3.5 SUPERVISION

A. Appoint a Project Manager who will be the single point of contact for all work accomplished under this Project and will be vested by the Contractor with the authority to make decisions on behalf of the Contractor.

B. The Project Manager will be responsible to represent the Contractor and coordinate all aspects of this Project, including but not limited to:

1. Overall and specific project responsibility
2. Thorough knowledge of Project Specifications and Drawings
3. Creation and maintenance of a project schedule, including milestones, task definitions and resource allocations
4. Attendance at all Project Management meetings

5. Supervision and direction of all Contractor personnel
6. Documentation, including submittals and change orders
7. Quality assurance of Project

C. The Project Manager initially assigned to the Project shall be assigned to the Project for the duration of the Project. Once assigned by the Contractor, the Project Manager shall not be changed by the Contractor without Consultant and Owner approval.

D. Assign a qualified Foreman to the Project and shall keep the Foremen on site and in charge of the work at all times. The Foreman shall be equipped with a mobile phone during project working hours.

E. The Foreman initially assigned to the Project shall be assigned to the Project for the duration of the Project. Once assigned by the Contractor, the Foreman shall not be changed by the Contractor without Consultant and Owner approval.

3.6 DRAWINGS

A. Drawings shall not be scaled for rough-in measurements or equipment locations. Field verification of dimensions, locations, and levels to suit field conditions is required. Final placement of devices, outlets, equipment, etc. shall be coordinated with field conditions.

B. Unless specifically dimensioned or detailed, Drawings indicate approximate locations, arrangement, and general character. To avoid interference with structural members and equipment of other trades, or for the convenience of the Owner, it may be necessary to adjust the locations shown on the Drawings prior to installation. Unless specifically dimensioned or detailed, and with the exception of locations of equipment and raceway in Telecommunications Rooms, the Contractor may make minor location adjustments without obtaining the Consultant's prior approval. All other adjustments require prior approval from the Consultant.

C. Minor adjustments are defined as distances not to exceed:

1. 1 foot at grade, floor ceiling, and roof level in any direction in the horizontal plane.
2. 1 foot on walls in a horizontal direction within the vertical plane.

D. Particular attention shall be paid to door swings, piping, ductwork, and structural steel:

1. In general, waste and vent lines, large pipe mains, and ductwork shall be given priority for the locations and spaces shown.
2. In general, electrical lighting fixtures shall be given priority for ceiling space.

E. Where minor location adjustments are required, such adjustments shall be made at no cost to the Owner.

3.7 PENETRATIONS, PATCHING AND PAINTING

A. Penetrations (openings, holes, chases, sleeves, slots, cuts, etc.):

1. Properly size and locate penetrations required as construction progresses. For new concrete or masonry the Contractor shall coordinate, locate and provide required openings prior to the pouring of concrete or construction of masonry.
2. Obtain written approval from the Structural Consultant/Architect for penetration of structural elements prior to penetration.
3. Penetration of concrete and structural elements shall be avoided where possible. Where not possible, penetrations shall be performed in a manner that will not reduce structural element load-carrying capacity or load-deflection ratio.
4. Penetrations shall be performed by workers qualified and skilled in the trades involved.
5. Penetrations shall not be exposed on the exterior or in occupied spaces in a manner that would, in the Consultant's opinion, reduce the aesthetic qualities of the structure or result in visual evidence of penetration and patching.
6. Penetrations shall be constructed using methods least likely to damage elements to be retained or adjoining construction.

    a. Provide temporary support for the work to be penetrated.
    b. In general, where cutting is required, use hand or small power tools designed for sawing or grinding, not for hammering or chopping. Cut holes and slots neatly to required size with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
    c. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring of existing finished surfaces.
    d. Cut through concrete and masonry using a cutting device such as a Barborundum saw or diamond core drill.
7. Voids around penetrations shall be properly sealed, caulked or grouted as required.
8. Existing elements:

    a. The Contractor shall be responsible for identifying, locating, and protecting existing embedded conduits, pipe, ductwork, etc. when penetrating existing structures.
    b. Cap, valve, plug or seal remaining portions of cut pipes or conduit to prevent entrance of moisture or other foreign matter.
    c. The Contractor shall be responsible for repairing and/or replacing existing conduits, pipe, ductwork, etc. damaged by the Contractor during construction of penetrations. Repair and/or replacement shall be at no additional cost to the Owner.
9. Penetrations (and subsequent patching) resulting from the Contractor's failure to properly coordinate penetrations shall be at no additional cost to the Owner.

B. Patching:

1. Patching in every instance consists of completing the work to match and blend with the adjoining existing work insofar as methods, materials, colors, and workmanship are concerned
2. Patching shall be performed by workers qualified and skilled in the trades involved.
3. The Contractor shall be responsible for replacing improperly matched, blended, or poorly constructed patches at no additional cost to the Owner.

C. Painting:

1. Painting shall consist of cleaning, surface preparation, painting (primer, intermediate, and finish) and finishing surfaces and items, new and existing, affected by the work of the Contractor.

    a. Surface painting shall match and blend with existing adjoining surfaces.
    b. Scratched, chipped, or otherwise marred equipment shall be repainted to match original finish.
    c. The areas around penetrations, once sealed, shall be painted.
2. Painting shall be performed by workers qualified and skilled in the trades involved.
3. The Contractor shall be responsible for refinishing and repainting improperly matched, blended, or poorly painted surfaces and items at no additional cost to the Owner.

3.8 HOUSEKEEPING

A. General

1. Comply with General Contractor and Owner requirements for site operations including work area cleaning and debris removal.

B. During the course of construction

1. At the conclusion of each day's work, remove empty boxes, crates, and other debris, and sweep clean all work areas affected by the Contractor's work of the day.

C. At project completion:

1. Remove all tools and scaffolding.
2. Equipment and facilities shall be thoroughly cleaned inside and out and residue removed.
3. Remove temporary labels and adhesives.
4. Thoroughly vacuum the interior of enclosures to remove debris.
5. Surplus product, materials and debris shall be cleared from the job site.
6. The Contractor is solely responsible for the appropriate disposal of all surplus product, materials and debris.

3.9 SUBSTANTIAL COMPLETION

A. Pre-Substantial Completion Submittal: Three weeks prior to Substantial Completion, the Contractor shall prepare and submit the following:

B. Known Exceptions/Deviations List:

1. A thorough list of known exceptions/deviations (in materials, construction, and/or workmanship) from that specified in the Contract Documents, and for which there was not associated documentation in the form of Change Orders (CO), Construction Change Directives (CCD), Architects Supplemental Instructions (ASI), or responses to a Request for Information (RFI).

2. The Contractor shall submit the list to the Consultant for review. The Consultant shall review each item and mark as either Accepted or Not Approved.

    a. Items marked "Not Approved" shall be corrected by the Contractor to conform with the intent of the Contract Documents at no additional cost to the Owner.
    b. Perform corrective action for "Not Approved" items prior to notifying the Consultant that the work is Substantially Complete.

C. Notice of Substantial Completion: When the Work nears Substantial Completion, notify the Consultant in writing the date that the work will be Substantially Complete and ready for review by the Consultant.

3.10 PROJECT CLOSE-OUT

A. Punchlist:

1. Once notice of Substantial Completion is received, the Consultant shall visit the site to review the Work, and shall prepare a punchlist of items determined to be incomplete, deficient or otherwise not in compliance with the intent of the Contract Documents.

    a. During the review of the Work, if the Consultant finds that the Known Exceptions/Deviations List provided by the Contractor was insufficiently thorough, that the Work is not Substantially Complete, or that deficiencies in the work are excessive, the Consultant will cease review and inform the Contractor that the work is not Substantially Complete. The Contractor shall be responsible for fees incurred by the Consultant for this partial review.

2. Perform corrective action for each item noted in the punchlist. When complete, the Contractor shall submit the original punchlist with each item initialed attesting to the fact that the item was corrected.

    a. If necessary, the Consultant will perform a subsequent review after receipt of the Contractor initialed punchlist.

3. Should additional reviews beyond the original punchlist review be required of the Consultant due to the Contractor's failure to correct all incomplete, deficient, or non-compliant work, the Contractor shall be responsible for fees incurred by the Consultant for the additional reviews.

B. Provide O&M Manuals per the requirements of Part 1 – General: Operating & Maintenance (O&M) Manuals.

3.11 FOLLOW UP

A. After the system(s) and facility have been placed in operation and are in use by the Owner, provide technical assistance for the first two weeks of operation on a standby basis for troubleshooting, education, and problem solving.

END OF SECTION 270500

SECTION 270526 – GROUNDING AND BONDING FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. The primary purpose of the Grounding and Bonding for Communication Systems is to improve personnel safety and decrease risk from equipment fire by facilitating operation of over current devices.

B. Contractor shall provide all Labor, Materials, Contractor's Equipment and Plant to fully execute the requirements to deliver, configure, install and commission the Works as shown on the Drawings and described in this section. Further requirements are that the provisions of this section shall be complementary to and shall be correlated with, the requirements of the Contract.

C. Section Includes:

1. Grounding and bonding conductors.
    a. Alternating Current Equipment Ground (ACEG).
    b. Telecommunications Bonding Conductor (TBC).
    c. Backbone Bonding Conductor (BBC).
    d. Rack Bonding Conductor (RBC).
    e. Telecommunication Bonding Backbone (TBB).
    f. Telecommunications Bonding Jumper (TBJ).
    g. Telecommunication Equipment Bonding Conductor (TEBC).
    h. Unit Bonding Conductor (UBC).
2. Grounding connectors, taps, and splices.
3. Primary Bonding Busbar (PBB).
4. Secondary Bonding Busbar (SBB).
5. Rack Bonding Busbar (RBB).
    a. Horizontal (HRBB).
    b. Vertical (HRBB).
6. Maintenance holes and handholes.
7. Grounding rods.
8. Grounding system accessories

1.2 SCOPE OF WORKS

A. Provide a complete grounding and bonding system for communications systems as described in this Section. The grounding system includes additional requirements beyond the minimum NFPA 70 requirements.

B. Grounding and Bonding for Communication Systems shall function in concert with the provided cabling topology, pathways, administrative labeling, outside plant, and comply with all referenced codes and standards.

C. The Contractor shall provide all Enabling and Preparatory Works for the installation of System Equipment as described in this Section, including but not limited to:

1. Coordination: Coordinate pathway requirements and connectivity to grounding with the Electrical Contractor.

1.3 RELATED DOCUMENTS

A. Section 27 05 00 Common Work Results for Communications

B. Section 27 05 28 Pathways for Communications Systems

C. Section 27 05 36 Cable Trays for Communications Systems

D. Section 27 05 44 Sleeves and Sleeve Seals for Communications Pathways and Cabling

E. Section 27 05 53 Identification for Communications Systems

F. Section 27 11 00 Communications Equipment Room Fittings

G. Section 27 13 00 Communications Backbone Cabling

H. Section 27 15 00 Communications Horizontal Cabling.

1.4 DEFINITIONS

A. Abbreviations

1. ac – Alternating Current
2. ACEG – Alternating Current Equipment Ground
3. AWG – American Wire Gauge
4. BBC – Backbone Bonding Busbar
5. TBC – Telecommunications Bonding Conductor
6. BET – Building Entrance Terminal
7. dc – Direct Current
8. EF – Entrance Facility
9. ER – Equipment Room
10. RBB – Horizontal Rack bonding busbar
11. NEC – National Electric Code
12. RBB – Rack Bonding Busbar
13. RBC – Rack Bonding Conductor
14. RU – Rack Unit
15. TBB – Telecommunications Bonding Backbone
16. TBJ – Telecommunications Bonding Jumper

17. TEBC – Telecommunications Equipment Bonding Conductor
18. SBB – Secondary Bonding Busbar
19. PBB – Primary Bonding Busbar
20. TR – Telecommunications Room
21. UBC – Unit Bonding Conductor
22. UL – Underwriters Laboratories
23. VRBB – Vertical Rack bonding busbar

B. Definitions

1. American Wire Gauge (AWG) – A standardized logarithmic stepped wire gauge system used for the diameters of round, solid, nonferrous, electrically conducting wire.
2. Bonding – The connection intended to equalize safely and effectively the potential differences between two metallic items.
3. Grounding – The establishment of a reference for the electrical power source, the electrical equipment, or both.
4. Impedance – The total opposition of electrical current in ac circuits or an ac waveform imposed upon a dc or ac circuit or conductor.

1.5 APPLICABLE LAWS, CODES RULES REGULATIONS AND STANDARDS

A. All equipment, materials, construction and installation of the system to be in compliance with the applicable requirements as mentioned in Section 27 05 00 "Common Work Results for Communications" and following codes and standards:

1. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire
2. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
3. ASTM B187/B187M - Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes
4. NFPA 70 - National Electrical Code (NEC)
5. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment
6. TIA 607-C - Generic Telecommunications Building Grounding (Earthing) for Customer Premises
7. BICSI Telecommunications Methods Manual (TDMM)
8. UL 467 - Grounding and Bonding Equipment
9. UL 910 - Plenum Test
10. UL 1666 - Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

1.6 SUBMITTALS

A. The following paragraphs define the submittal requirements for this Section in addition to those described in Section 27 05 00 "Common Work Results for Communications."

B. Initial Submittals – Comply with applicable requirements as described in Section 27 05 00 "Common Work Results for Communications."

C. Each product submittal shall include a summary listing each manufacturer, model, part number and cut sheet reference page(s).

D. Contractor shall provide the following documentation:

1. Final grounding and bonding as-built drawings in approved CAD formats.
2. Digital copies and full-size color drawings copies.
3. Physical system topology documentation.
4. Communications room layout documentation.
5. Mark-ups of the Contract drawings showing the actual installed conditions.

1.7 QUALITY ASSURANCE

A. The Quality Assurance as described in Section 27 05 00 "Common Work Results for Communications" applies to this Section.

1.8 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall comply with the Delivery, Storage and Handling requirements as described in Section 27 05 00 "Common Work Results for Communications."

1.9 PROJECT CONDITIONS

A. The Project Conditions as described in Section 27 05 00 "Common Work Results for Communications" apply to this Section.

1.10 WARRANTY

A. The Warranty Conditions as described in Section 27 05 00 "Common Work Results for Communications" apply to this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The Manufacturers requirements as described in Section 27 05 00 "Common Work Results for Communications" apply to this Section.

2.2 GENERAL REQUIREMENTS

A. Contractor shall provide all necessary components to meet all requirements and recommendations specified under TIA-607 C "Generic Telecommunications Building Grounding (Earthing) for Customer Premises" and NFPA-70 Article 250.

B. Provide all grounding and bonding hardware necessary to connect all metallic components to an appropriate ground.

C. Conductor General Requirements:

1. Grounding wire shall be insulated copper American Wire Gauge (AWG) wire following ASTM-B3, ASTM-B8 and ASTM-B33.
2. Ground wire shall be 16mm² (No. 6 AWG) or larger physical size. Use of 16mm² (No. 6 AWG) ground wire shall be limited to 30.5 m (100 ft) in length.
3. Ground wire shall be Green with Yellow stripe insulated copper wire
4. Braided cable shall not be used
5. Plenum-rated grounding and bonding conductors:

    a. Installed in plenums or air-handling spaces shall meet UL 910.
    b. Shall be marked CMP (communications multipurpose plenum) in accordance with the NEC.
6. Non-plenum riser-rated grounding and bonding conductors:

    a. Shall meet UL 1666.
    b. Shall be marked CMR (communications multipurpose riser) in accordance with the NEC.

D. Communications Grounding and Bonding Conductors: Insulated copper American Wire Gauge (AWG) wire following ASTM-B3, ASTM-B8 and ASTM-B33, of following types:

1. Alternating Current Equipment Ground (ACEG):

    a. Function: Connects Secondary Bonding Busbar (SBB) or Primary bonding busbar (PBB) to a local panelboard when located in the same room or space as the SBB or PBB.
    b. Conductor: Shall be minimum 16mm² (No. 6 AWG) green insulated stranded copper ground wire.
2. Telecommunications Bonding Conductor (TBC):

    a. Function: Main ground source feed from the building ground system to the Primary bonding busbar (PBB)
    b. Conductor: Shall be minimum 70mm² (No. 2/0 AWG) green insulated stranded copper ground wire.
3. Backbone bonding busbar (BBC):

    a. Function: Bonds together Telecommunications Bonding Backbones (TBBs) at SBBs on every third floor and the top floor of multi-level buildings
    b. Conductor: Shall be green insulated stranded copper ground wire sized at a minimum, the same as the largest Telecommunications Bonding Backbone (TBB).
4. Rack Bonding Conductor (RBC):

    a. Function: Connects Telecommunications Equipment Bonding Conductor (TEBC) to Rack bonding busbar (RBB).
    b. Conductor: Shall be minimum 16mm² (No. 6 AWG) green insulated stranded copper ground wire.

5. Telecommunications Bonding Backbone (TBB):

    a. Function: Connects the PBB to the SBBs
    b. Conductor: Shall be minimum 70mm² (No. 2/0 AWG) green insulated stranded copper ground wire.

6. Telecommunications Bonding Jumper (TBJ):

    a. Function: Bonds the following to the SBB or PBB
        1) Electrically conductive materials including metallic cable, vents, dampers, conduit, cable raceway, cable junction boxes, etc. within telecommunication spaces
        2) Telecommunication pathways
    b. Conductor: Shall be minimum 16mm² (No. 6 AWG) green insulated stranded copper ground wire.

7. Telecommunications Equipment Bonding Conductor (TEBC):

    a. Function: Connects PBB or SBB to equipment, cabinets, racks, and frames via RBCs to each RBB.
    b. Conductor: Conductor: Shall be minimum 16mm² (No. 6 AWG) green insulated stranded copper ground wire.

8. Unit Bonding Conductor (UBC):

    a. Function: Connects equipment in cabinets, racks, and frames to rack bonding busbar (RBB).
    b. Conductor: The UBC shall be provided by active equipment manufacturer/contractor per manufacturer's equipment grounding requirements.

E. Additional communications grounding and bonding conductor requirements include:

1. The TBB originates at the PBB and shall extend from the PBB to each SBB within the TR and throughout the building using the telecommunications backbone pathways, to the SBB(s) in the communication rooms.
2. The TBB connections shall be exothermically welded at connecting ends.
3. All grounding and bonding components including conductor wire, busbars, ground rods and conduit shall be UL listed. Connectors shall be UL listed for the application.
4. Grounding and Bonding conductor sizing shall comply with BICSI TDMM Sizing of Bonding Conductors per size of the building AC electrical service ground conductor and required conductor length.

F. Grounding Connectors, Taps, and Splices

1. General:

    a. All connectors shall be listed by an NRTL for the intended purpose and as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Connectors shall comply with UL 486A-486B.
    b. Conduit grounding bushings or ground clamps shall be provided for ground wire connection.

2. Irreversible Compression Connectors, Taps, and Splices: Electroplated tinned copper irreversible Crimp-and-compress connectors that bond to the conductor when the

connector is compressed around the conductor. Comply with UL 467. Provide matching clear covers. C and H Taps shall have a minimum of two clamping elements. I-Beam clamps shall have a minimum of one clamping element.

3. Two-hole Lugs: Electroplated tinned copper solderless compression or exothermic-type, mechanical connector; with a long barrel, inspection window, minimally two clamping elements for compression connectors, and two holes sized and spaced for a two-bolt connection to the busbar.
4. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

G. Grounding busbars shall be provided in lengths to meet the equipment connectivity requirements and spare capacity defined herein, minimum lengths are stated for each busbar type below.

H. Secondary Bonding Busbars (SBB): Each SBB shall comply with the following:

1. Predrilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors to be used.
2. Sized for the immediate requirements and allow for 50% growth. The minimum dimensions shall be 6.3 mm (0.25 in) thick by 50 mm (2 in) wide by 300mm (12 inches) long.
3. Electroplated tinned copper plated for reduced contact resistance.
4. Contain pre-drilled holes, which shall support a minimum of one tier of eight 16mm² (No. 6 AWG) copper two-hole compression lugs.
5. ASTM-B187-C11000 Copper bar suitable for use with two-hole compression-type copper lugs.
6. Provide insulated standoff bracket that provides a 100mm (4 inch) clearance for access to the rear of the busbar.
7. Plexiglas cover with “SBB” in black lettering.

I. Equipment Cabinet and Rack Ground Busbar (RBB):

1. The RBB shall include ground bar, abrasive pad, joint compound, label, and mounting hardware.
2. The RBB shall be suitable for use with two-hole compression-type copper lugs.
3. Horizontal Mounted Busbar: Designed for mounting in 19- or 23-inch equipment racks. Minimum cross-section dimension of 1-1/2 inch by 1/4 inch. Include a copper splice bar for transitioning to an adjoining rack. Busbars shall be pre-drilled or tapped minimally with fifteen pairs of 5/16 inch holes.
4. Vertical-Mounted Busbar: 72 or 36 inches long, minimum cross-section dimension of 5/8 inch by 1/4 inch. Busbars shall be pre-drilled or tapped minimally with fifteen pairs of 5/16 inch holes.

J. Maintenance Holes and Handholes:

1. Manhole and Handhole grounding connections shall be minimum 16mm² (No. 6 AWG) ground wire.
2. Provide a ground busbar in each manhole and handhole

    a. Minimum dimensions shall be 19mm in width by 5mm in thickness
    b. Provide insulated standoff bracket for busbar mounting.

3. Underground grounding conductors shall be bare tinned-copper No. 2 AWG minimum.

K. Grounding System Accessories:

1. Cable Tray Grounding Jumper:

a. Shall have minimum size of 16mm² (No. 6 AWG) and not longer than 300mm (12 inches).
b. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps.
c. If jumper is a flexible braid, it shall have a one-hole ferrule.
d. Jumper shall attach with grounding screw or connector provided by cable tray manufacturer.

2.3 PERFORMANCE REQUIREMENTS

A. The Grounding and Bonding system shall:

1. Maintain zero volts to all equipment enclosures during normal operation.
2. Provide a zero-voltage reference for end use power supplies.
3. Provide a maximum ac current value on any bonding conductor of less than 1 ampere and a maximum dc current value on any bonding conductor of less than 500 milliamperes.

B. Bonding connections between the nearest available grounding electrode and the busbar in the EF or TR shall have a maximum resistance of 0.1 ohms.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Comply with the requirements of Section 27 05 00 “Common Work Results for Communications”.

3.2 PREPARATION

A. The Preparation as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

3.3 CONTRACTORS RESPONSABILITY

A. The Contractors Responsibility as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

3.4 INSTALLATION

A. Refer to Section 27 05 00 “Common Work Results for Communications” in addition to the following requirements Equipment Cabinets and Racks

B. General

1. Install work following specification requirements, drawings, manufacturer’s instructions and approved submittal data.
2. The communications ground system shall be independent from all power grounding.
3. Power grounding and/or bonding shall not be allowed to interfere or provide any back feed or be a conductor to the separate communications ground system source or to any communications bonded materials or equipment.
4. Labeling shall be provided in compliance with Section 27 05 53 Identification for Communication Systems.

C. Conductors

1. Bonding conductors shall be installed in one continuous length without splices unless using exothermic connections or listed irreversible compression-type connectors. Bonding conductors shall be routed as short and straight as practical. Bends in the conductor shall be made toward the ground location.
2. Do not connect ground wire in power cable assemblies to the communications ground system.
3. The BBC between the SBBs on the same floor on the first, top, and every third floor in a multistory building shall be continuous copper conductor that shall be sized no less than No. 6 AWG. The BBC shall be, as a minimum, the same size as the largest TBB.

D. Conductor Connections

1. Bonding connections should be made by using compression copper lugs or, within the ground electrode system, exothermic welding for parts of a grounding system that are subject to corrosion, that must carry high currents reliably or for locations that require minimum maintenance.
2. The 70mm² (No. 2/0 AWG) green insulated stranded copper ground wire connections shall be exothermically welded at connecting ends.
3. Make connections to dry surfaces only. Remove paint, rust, oxides, scales, grease and dirt from surfaces before making connection. Sand clean a one square inch area, drill, tap, and bolt conductor and connector to sanded area. Ensure proper conductivity.
4. The 70mm² (No. 2/0 AWG) insulated ground wire weld ends shall have a minimum amount of wire exposure from the conduit to each weld and a minimum amount of insulation removed at weld.
5. The 16mm² (No. 6 AWG) insulated ground wire connecting ends shall have a minimum amount of insulation removed at ground lug.
6. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
7. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

    a. Use crimping tool and the die specific to the connector.
    b. Pre-twist the conductor.

c. Apply an antioxidant compound to all bolted and compression connections.

8. Conductor Connector Applications:

   a. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   b. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   c. Connections to Ground Rods at Test Wells: Bolted connectors.
   d. Connections to Structural Steel: Welded connectors

9. Provide Telecommunications Equipment Bonding Conductor (TEBC) sized at #6 AWG and not to exceed 100 feet in length, from the nearest PBB or SBB to all telecommunications pathways, enclosures, and lightning protection devices located within or entering the room area and provided under this contract, including:

   a. Equipment cabinets.
   b. Racks.
   c. Enclosures.
   d. Consoles.
   e. Conduits.
   f. Cable tray and raceways.
   g. Building Entrance Terminals (BET).
   h. Metallic cable shield, sheath and strength members.
   i. Splice cases.
   j. Lightning arrestors.
   k. Vertical steel columns

10. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each SBB and PBB to the vertical steel of the building frame
11. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each SBB to the ground bar of the panelboard.
12. Shielded Cable: Bond the shield of shielded cable to the SBB in communications rooms and spaces. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, balanced, twisted-pair cables.
13. Bond the shield of coaxial cables to the grounding bus bar in communications rooms and spaces.
14. Bond patch panels for overall screened or foiled twisted pair cables to the grounding bus bar.
15. Ground bonding is not required for short sections of wall and floor sleeves less than 3 feet in length.
16. Ground bond connection to electrical ground bus within electrical panels shall performed by a licensed electrician

E. Conductor Routing

1. Bonding conductors shall be routed parallel and at right angles to architectural components using minimum wire lengths, bends and changes in direction. Terminations shall be made directly to the points being bonded.
2. The bend radius shall not be smaller than eight times the diameter of the conductor, or exceed the manufacturer's minimum bend radius. No single bend may exceed 90 degrees.
3. Secure grounding and bonding conductors at intervals of not less than 36 inches.

4. Route ground bond conductors under raised floor where available, following designated telecom pathways.
5. Avoid placement of ground bond wire in conduit. Where ground wire is placed in a metallic conduit section in excess of 3 feet in length, the ground wire shall be bonded to both ends of the conduit.

F. Grounding Busbars

1. The PBB shall be installed at the bottom of the backboard near the building entrance conduits in the Entrance Facility.
2. Each SBB shall be installed near where the TBB enters or passes through each TR.

G. Equipment Cabinets and Racks

1. Provide and install a ground busbar to be used as an equipment grounding bus in all equipment cabinets and racks. The ground bar shall be installed consistently along either the entire elevation of the equipment cabinet or rack.
2. All cabinets and racks shall be provided with a 16mm² (No. 6 AWG) insulated RBC ground wire H-Tapped to a 16mm² (No. 6 AWG) insulated TEBC which provides connection to the PBB or SBB. Provide one TEBC per every six (6) cabinets or racks.
3. To bond each cabinet and rack to ground, sand clean a one square inch area, drill, tap, and bolt conductor and connector to sanded area.
4. Provide one RBB for each cabinet, rack and enclosure containing standard EIA-310-D mounting rails or brackets.

    a. Where no raised floor is provided and a horizontal RBB is used, mount RBB at the highest RU position at the back, or at the front where the back is not accessible.

H. Cable Raceway and Support System Grounding

1. Provide and install 16mm² (No. 6 AWG) insulated ground wire to one end of each cable tray/runway system and home run to the PBB or SBB.
2. Provide continuous grounding path between cable tray/runway sections with grounding strap.
3. To bond each cable tray section, sand and clean a one square inch area, drill, tap, and bond conductor and connector to sanded area. Provide cable tray grounding jumper between every cable tray section.
4. Provide and install 16mm² (No. 6 AWG) insulated ground wire from the end of each new telecommunications conduit and sleeve to the PBB using grounding bushings for ground clamps.

I. Maintenance Holes and Handholes

1. Provide separate ground wire connections from the maintenance hole busbar to the earth ground connection and to all exposed metallic components of the maintenance hole, pathways and cable infrastructure.
2. Provide ground rods as required to achieve maximum 5-ohm electrical earth ground. Do not place ground rods where electrical grounding electrode systems are provided.

3.5 COORDINATION

A. The Coordination as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

3.6 ON-SITE RESPONSABILITIES

A. The On-Site Responsibilities as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

3.7 PROTECTION

A. The Protection as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

3.8 QUALITY CONTROL AND TESTING

A. Comply with the requirements of Section 27 05 00 “Common Work Results for Communications.”

B. Performance Testing

1. Comply with the requirements of Section 27 05 00 “Common Work Results for Communications.”
2. Upon completion of the electrical system, including all grounding, the Contractor shall test the system for stray currents, ground shorts, etc. Approved instruments, apparatus, services, and qualified personnel shall be utilized. If stray currents, shorts, etc., are detected, eliminate or correct and/or coordinate with the Electrical Contractor as required. The maximum allowable AC current shall be less than one ampere and the maximum allowable DC current shall be less than 0.5 ampere. The maximum allowable potential voltage difference shall not exceed 1 volt between electrical power and telecommunications ground references for screened/shielded cabling applications.
3. Upon completion of the electrical system, including all grounding, the Contractor shall test the Telecommunications Grounding System using the Three-Point method to confirm an acceptable low impedance bond has been provided to Earth. The maximum allowable value is 5 ohms to Ground.
4. Upon completion of the electrical system, including all grounding, the Contractor shall test the PBB using the Two-Point method to confirm an acceptable low impedance bond has been provided to the building ground grid. The maximum allowable value for bonding resistance is 0.1 ohms.

3.9 DEMONSTRATION, TRAINING AND INSTRUCTION

A. The Demonstration, Training and Instruction as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

B. Project Qualifications:

1. Successful installation completion of at least three similar and comparable Telecommunications Grounding and Bonding Systems as indicated for this project, within the most recent three-year period.

END OF SECTION 270526

SECTION 270528 – PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor shall provide all Labor, Materials, Contractor's Equipment and Plant to fully execute the requirements to deliver, configure, install and commission the Works as shown on the Drawings and described in this section. Further requirements are that the provisions of this section shall be complementary to and shall be correlated with, the requirements of the Contract.

B. Section Includes:

1. Metal conduits and fittings.
    a. RMC
    b. IMC
    c. PVC-coated galvanized RMC
    d. EMT
    e. FMC
    f. LFMC
2. Nonmetallic conduits and fittings.
    a. RNC.
    b. Rigid HDPE.
    c. Continuous HDPE.
    d. RTRC.
3. Boxes and enclosures.
    a. Pull boxes.
    b. Device boxes.
    c. Floor boxes.
    d. Wall boxes.
    e. Enclosures.
4. Hangers and supports.
5. Innerduct.
6. Measured pull tape.
7. Hooks.

C. Refer to Section 27 05 36 "Cable Trays for Communications Systems" for cable tray outside of telecommunications rooms.

1.2 SCOPE OF WORKS

A. Pathways for communications systems shall be provided to complete the overall Premises Wiring Distribution System (PWDS) in accordance with ANSI/TIA 569-D Telecommunications

Pathways and Spaces and the BICSI Telecommunications Distribution Methods Manual (TDMM).

B. All other work, equipment and accessories required to provide a complete and fully operational system.

C. Scope Exclusions:
   1. Poke through, cast-in-place and raised access telecommunications floor back boxes shall be combination type with electrical power as provided by Electrical Contractor.

1.3 RELATED DOCUMENTS

A. Section 07 84 00 Firestopping

B. Section 27 05 00 Common Work Results for Communications

C. Section 27 05 26 Grounding & Bonding for Communication Systems

D. Section 27 05 36 Cable Trays for Communications Systems

E. Section 27 11 00 Communications Equipment Room Fittings

F. Section 27 13 00 Communications Backbone Cabling

G. Section 27 15 00 Communications Horizontal Cabling

1.4 DEFINITIONS

A. Abbreviations

1. EMT Electrical Metallic Tubing
2. EQ Equal
3. FMC Flexible Metal Conduit
4. HDPE High Density Polyethylene
5. JB Junction Box
6. LFMC Liquid Tight Flexible Metallic Conduit
7. LFNC Liquid Tight Flexible Nonmetallic Conduit
8. LSZH Low Smoke Zero Halogen
9. OC On Center
10. RTRC Reinforced Thermosetting Resin Conduit
11. TE Telecommunications Enclosure
12. WAP Wireless Access Point

1.5 APPLICABLE LAWS, CODES, RULES, REGULATIONS, AND STANDARDS

A. All equipment, materials, construction and installation of the system to be in compliance with the applicable requirements as mentioned in Section 27 05 00 "Common Work Results for Communications" and following codes and standards:

1. ANSI/TIA 569-D - Telecommunications Pathways and Spaces
2. NFPA 70 - National Electrical Code for Industrial Business Owners
3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel
4. ANSI C80.1 - Electrical Rigid Steel Conduit
5. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
6. UL-6 - Electrical Rigid Metal Conduit – Steel
7. ANSI C80.6 – Electrical Intermediate Metal Conduit
8. UL-1242 – Electrical Intermediate Metal Conduit – Steel
9. ANSI C80.3 – Electrical Metallic Tubing - Steel
10. UL-797 - Electrical Metallic Tubing – Steel
11. NEC Article 300.22 – Wiring in Ducts Not Used for Air Handling, Fabricated Ducts for Environmental Air, and Other Spaces for Environmental Air (Plenums)
12. UL-360 - Standard for Liquid-Tight Flexible Metal Conduit
13. NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, EMT, and Cable
14. UL-514B – Conduit, Tubing, and Cable Fittings
15. UL-1203 – Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous Locations
16. UL-467 – Grounding and Bonding Equipment
17. NEMA TC 2 –Selection and Installation of Underground Nonmetallic Raceways
18. UL-651 – Schedule 40, 80, Type EB, and A Rigid PVC Conduit and Fittings
19. UL-1684A – Safety Reinforced Thermosetting Resin Conduit and Fittings
20. NEMA TC 14 – Reinforced Thermosetting Resin Conduit and Fittings
21. UL-1773 – Standard for Termination Boxes
22. UL-514A – Metallic Outlet Boxes
23. UL-50 – Enclosures for Electrical Equipment, Non-Environmental Considerations
24. UL-2024 - Standard for Cable Routing Assemblies and Communications Raceways
25. UL-870 - Standard for Wireways, Auxiliary Gutters, and Associated Fittings
26. UL-94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
27. MFMA-4 - Metal Framing Standards Publication
28. MSS SP-58 - Pipe Hangers and Supports
29. ASTM A 325 - Standard Specification for Structural Bolts
30. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT)
31. NECA 105 - Standard for Installing and Maintaining Cable Tray Systems
32. NECA 1 - Standard for Good Workmanships in Electrical Construction
33. NECA/BICSI 568 - Standard For Installing Commercial Building Telecommunications Cabling
34. NEMA FB 2.10 - Selection and Installation Guidelines For Fittings for Use With Non-Flexible Metallic Conduit or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, and Electrical Metallic Tubing)

35. MSS SP-69 - Pipe Hangers and Supports

1.6 SUBMITTALS

A. The following paragraphs define the submittal requirements for this section in addition to those described in Section 27 05 00 "Common Work Results for Communications."

B. Initial Submittals – Comply with applicable requirements as described in Section 27 05 00 "Common Work Results for Communications."

C. Product data for the following:

1. Wireways and fittings.
2. Boxes, enclosures, and cabinets.
3. Hooks.

D. Shop Drawings: For custom enclosures and cabinets and custom underground handholes and boxes. Include plans, elevations, sections, and attachment details.

E. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
3. Underground ducts, piping, and structures in location of underground enclosures and handholes.

F. Source quality-control reports.

1.7 QUALITY ASSURANCE

A. The Quality Assurance as described in Section 27 05 00 "Common Work Results for Communications" applies to this Section.

1.8 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall comply with the Delivery, Storage and Handling requirements as described in Section 27 05 00 "Common Work Results for Communications."

1.9 PROJECT CONDITIONS

A. The Project Conditions as described in Section 27 05 00 "Common Work Results for Communications" apply to this Section.

1.10 WARRANTY

A. The Warranty Conditions as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

1.11 INTELLECTUAL PROPERTY

A. The Intellectual Property requirements as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The Manufacturers requirements as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

2.2 PATHWAYS GENERAL REQUIREMENTS

A. All pathways provided, including conduits, fittings, and pull boxes shall be listed by an NRTL and comply with ANSI/TIA 569-D and the NEC.

1. Hot Dip Galvanized finishes shall be applied after fabrication in accordance with ASTM A123.

B. Provide long-radius manufactured conduit sweeps to make bends.

C. All conduits, fittings and pull boxes intended for telecommunications structured cabling system shall provide for minimum cable bend radius as follows:

1. Conduits larger than 2" (50 mm): Inside bend radius shall be at least 10 times the internal diameter of the conduit.
2. Conduits 2” (50 mm) and smaller: Inside bend radius shall be at least 6 times the internal diameter of the conduit.
3. For fiber optic cable, regardless of conduit size, the inside bend radius shall be at least 10 times the internal diameter of the conduit.

2.3 HARDWARE

A. Metal Conduits and Fittings:

1. General Requirements for Metal Conduits and Fittings:

a. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

b. Comply with ANSI/TIA-569-D.
c. The term "Galvanized Rigid Metal Conduit (Galvanized RMC)" shall also refer to "Galvanized Rigid Conduit (GRC)".

2. Requirements for RMC:

a. Comply with ANSI C80.1 and UL-6.
b. Conduit to be seamless with threads on one end and a coupling on the other end.
c. Provide an enamel lubricating coating on the inside of the conduit.
d. Requirements for Galvanized RMC
   1) Hot dipped galvanized rigid steel.
   2) Threads to be cut and ends chamfered prior to galvanizing.
   3) Galvanizing to provide zinc coating fused to inside and outside walls of conduit.
e. Requirements for PVC-Coated RMC:
   1) Comply with NEMA RN 1.
   2) Coating Thickness: 0.040 inch (1 mm), minimum.

3. Requirements for IMC:

a. Comply with ANSI C80.6 and UL-1242.
b. Conduit to be seamless, hot dipped galvanized rigid steel.
c. Galvanizing to provide zinc coating fused to outside walls of conduit.
d. Provide an enamel lubricating coating on the inside of the conduit.

4. Requirements for EMT:

a. Comply with ANSI C80.3, UL-797, and conform to NEC Article 300.22.

5. Requirements for FMC:

a. Comply with UL 1; zinc-coated steel

6. Requirements for LFMC:

a. Flexible steel conduit with PVC jacket and complying with UL 360

7. Fittings for Metal Conduit:

a. Comply with NEMA FB 1 and UL-514B.
b. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL-1203 and NFPA 70.
c. Fittings for EMT:
   1) Material: Formed steel.
   2) Type: Compression.
d. Fittings and connectors utilizing set screws shall not be permitted.
e. Conduit bodies shall not be permitted.
f. Fittings and connectors for IMC, RMC, and PVC-Coated Galvanized RMC conduit shall be threaded type.
g. Couplings for RMC and IMC to be single piece threaded, cadmium plated malleable iron.

8. Expansion Fittings:

a. PVC-Coated or steel to match conduit type, complying with UL-467
b. Rated for environmental conditions where installed.
c. Shall allow for a minimum of four" of movement

d. Shall be complete with bonding jumpers and hardware.

9. Hubs:

    a. Hubs for box connection to be two-piece with outer internally threaded hub to receive conduit and inner locking ring with bonding screw.
    b. Raintight Sealing Hubs:
        1) Two-piece type with outer internally-threaded hub to receive conduit.
        2) Inner locking ring with bonding screw.
        3) Insulated throat.
        4) V shaped ring or O-ring.

10. Coating for Fittings for PVC-Coated Conduit:

    a. Minimum thickness of 0.040" (1 mm)
    b. Overlapping sleeves protecting threaded joints

B. Joint Compound for IMC or RMC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

C. Nonmetallic Conduits and Fittings:

1. General Requirements for Nonmetallic Conduits and Fittings:

    a. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
    b. Comply with ANSI/TIA-569-D.

2. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL-651 unless otherwise indicated.
3. Rigid HDPE: Comply with UL-651A.
4. Continuous HDPE: Comply with UL-651B
5. RTRC: Comply with UL-1684A and NEMA TC 14.
6. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.
7. Solvents and Adhesives: As recommended by conduit manufacturer.

D. Boxes and Enclosures

1. General Requirements for Boxes and Enclosures:

    a. Comply with ANSI/TIA-569-D.
    b. Boxes and enclosures installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
    c. All boxes and enclosures shall be sized to maintain minimum bend radius per cabling manufacturer's requirements.
    d. The term "device box" shall also refer to "backbox" and "outlet box" when used for telecommunications.
    e. All pull boxes shall be provided with a hinged cover. Where clearances do not allow full opening of hinged cover, bolt on covers with captive nuts shall be provided.

2. Steel Pull Boxes:

    a. Comply with NEMA OS 1.

b. Provide factory applied painted enamel finish color metallic grey.
c. Minimum Dimensions: Refer to ANSI/TIA 569-D for minimum pull box sizing
d. Material: Minimum 14-gauge steel

3. Galvanized Steel Pull Boxes:

a. Comply with NEMA 250 Type 12 (IP52).
b. Minimum Dimensions: Refer to ANSI/TIA 569-D for minimum pull box sizing
c. Material: Minimum 14-gauge steel

4. Cast-Metal Pull Boxes:

a. Comply with NEMA FB 1 and UL-1773
b. Minimum Dimensions: Refer to ANSI/TIA 569-D for minimum pull box sizing
c. Material: Cast aluminum with gasketed cover.

5. Metal Device Boxes:

a. Comply with NEMA OS 1 and UL-514A.
b. Device box extensions used to accommodate new building finishes shall be of same material as recessed box.
c. Minimum dimensions: 4" square by 2-1/8" deep.
d. Material: Minimum 16-gauge welded steel

6. Floor Boxes:

a. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
b. Floor box shall be equipped with corrosion resistant paint applied by the manufacturer when installed on grade.
c. Refer to Electrical drawings and specifications for floor box types and sizes.
d. Cover: Coordinate with architect finish color and to ensure correct cover type based on floor type.
e. Device plates, spacers, blanks and other accessories such as grommets and wire ties shall be provided and installed as required by contractor to ensure a complete assembly with protection for cabling preventing jacket damage and excessive bend radius.

7. Wall Boxes:

a. Metal wall boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
b. Shall provide a minimum depth of 3 ½".
c. Refer to electrical drawing and specifications for wall box types and sizes.
d. Cover:
    1) Shall be provided and installed by contractor after all cabling and faceplates have been installed.
    2) Shall be capable of opening 180° and shall be equipped with egress door for allowing cables to pass through when door is closed.
    3) Shall be equipped with integrated handle with lock and key set.
    4) Coordinate finish color with architect.

8. Enclosures:

a. Provide hinged cover, except where obstructions require use of screw on cover for access. Provide retaining strap with screw on cover.

b. Metal barriers to separate wiring of different systems and voltage.
c. Enclosure shall have ground lug hole. Contractor to provide ground lug kit.
d. When installed in interior environment:
    1) Comply with UL-50 and NEMA 250, Type 1 (IP10)
    2) Material shall be steel
    3) Finish shall be manufacturer's standards enamel inside and out.
e. When installed in exterior environment:
    1) Comply with UL-50 and NEMA 250, minimum Type 4 (IP66)
    2) Material shall be stainless steel.
f. Hinged:
    1) Provide lockable continuous-hinge cover with flush latch unless otherwise indicated.
g. Screw-on Cover:
    1) Screw holes for cover shall be keyhole slots to allow removal of cover without removing screws.

E. Hangers and Supports

1. General Requirements for Hangers and Supports:

    a. Hangers and supports shall be listed and labeled by NRTL acceptable to the local code and marked for intended use.
    b. Provide only materials and equipment of new stock meeting ANSI, NEC, NEMA (IP) and NRTL requirements and approved by the Engineer.
2. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8" on center (o.c.) in at least one surface.

    a. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
    b. Material for Channel, Fittings, and Accessories: Galvanized steel.
    c. Channel Width: 1-5/8".
    d. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
    e. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
    f. Channel Dimensions: Selected for applicable load criteria.
3. Aluminum Slotted Support Systems: Extruded aluminum channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8" o.c. in at least one surface.

    a. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
    b. Channel Width: 1-5/8".
    c. Channel Material: 6063-T6 aluminum alloy.
    d. Fittings and Accessories Material: 5052-H32 aluminum alloy.
    e. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
    f. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
    g. Channel Dimensions: Selected for applicable load criteria.
4. Conduit and Cable Support Devices: Steel clamps, hangers, and associated fittings, designed for types and sizes of raceway or cable to be supported.

5. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored communications conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
6. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
7. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

    a. Powder-Actuated Fasteners: Threaded-steel stud for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    b. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    c. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP 58.
    d. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
    e. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
    f. Toggle Bolts: All-steel springhead type.
    g. Hanger Rods: Threaded steel.

F. Innerduct

1. Plenum Rated

    a. Shall be a flexible textile material rated for use in plenum spaces as per UL-2024.
    b. Shall be low smoke zero halogen (LSZH)
    c. Shall provide 3 cells in a 4” (100mm) conduit.
2. Riser Rated

    a. Shall be a flexible textile material rated for use in non-plenum spaces and risers.
    b. Shall be LSZH.
    c. Shall provide 3 cells in a 4” (100mm) conduit.

G. Measured Pull Tale

1. Pre-lubricated, woven polyester, low friction, and high abrasion resistant yarn.
2. Minimum average tensile strength shall be 1250 lbs. for 2 inch and smaller conduits and innerduct.
3. Minimum average tensile strength shall be 1800 lbs. for conduits larger than 2”.
4. Marked in accurate and sequential minimum one-meter increments.

H. Hooks

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

2. Comply with ANSI/TIA-569-D.
3. Galvanized steel.
4. J shape.

2.4 SPARE PARTS

A. The spare parts requirements as described in Section 27 05 00 “Common Work Results for Communications” apply to this section.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The Examination as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

B. Contractor’s RCDD supervisor shall review and approve all shop drawings, coordination drawings, and record drawings.

C. Verify conduit system is properly sized for cables (minimum 1-inch, unless otherwise noted in Drawings).

D. Verify general conduit route following Drawings.

E. Verify substrates to which work is connected and determine detail requirements for proper support.

F. Verify proper location and type of rough-in for conduit terminations.

3.2 PREPARATION

3.3 CONTRACTORS RESPONSABILITY

A. The Contractors Responsibility as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

3.4 PATHWAY APPLICATION

A. Minimum Pathway Size: 1-inch trade size (100mm) unless noted otherwise.

B. Length of FMC and LFMC shall be limited to 6 feet (1800mm) unless noted otherwise.

C. Refer to Section 27 05 00 “Common Work Results for Communications” for environmental ratings.

D. Indoors: Shall comply with interior, controlled environment rating as specified in Section 27 05 00 “Common Work Results for Communications”. Apply pathway products as specified below unless noted otherwise:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: RMC. Pathway locations include but are not limited to the following:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric-Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: IMC
7. Connection from Junction Box to CCTV or WAP Device Box: EMT or FMC.
8. Connection from Junction Box to Modular Furniture: EMT or FMC
9. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT
10. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: IMC
11. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT or cable tray.
12. Boxes and Enclosures: NEMA 250, Type 1 (IP10).

E. Outdoors: Shall comply with exterior environment rating as specified in Section 27 05 00 “Common Work Results for Communications”. Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: Galvanized RMC, IMC, EMT, RNC, Type EPC-40-PVC.
3. Underground Conduit: RNC, Type EPC-40-PVC or RNC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Connection from Junction Box to VSS or WAP Device Box: LFMC.
6. Boxes and Enclosures, Aboveground: NEMA 250 Type 4 (IP66).

3.5 INSTALLATION

A. General

1. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

    a. NECA 1.
    b. NECA/BICSI 568.
    c. TIA-569-D.

d. NECA 101
e. NECA 105.

2. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
3. Ground communications pathways according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 27 05 26 "Grounding and Bonding for Communications Systems."
4. Identifiers depicted within the drawings are provided for reference only. All final labeling shall be per 27 05 53 “Identification for Communications Systems” and 27 05 00 “Common Work Results for Communications”.
5. Comply with requirements in Section 07 84 00 "Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
6. Comply with requirements in Section 27 05 44 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.
7. Keep pathways at least 6” (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
8. Install all pathways concealed in public spaces.
9. Complete pathway installation prior to installation of cabling.
10. Remove all burrs and sharp edges from all pathways prior to cable installation.
11. Install work following drawings, manufacturer’s instructions and approved submittal data.

B. Clearances: Comply with the following minimum clearances:

1. Conduits and pull boxes: 12” (300 mm) from any parallel electrical metallic cable tray or conduit.
2. Conduit and pull boxes: 6” (152 mm) from any perpendicular electrical conduit crossing.
3. Conduit and pull boxes: 6” (152 mm)from fluorescent lighting
4. Provide minimum clearance of 48” (1194 mm) from electrical motors and transformers.
5. Comply with ANSI/TIA-569-D Separation From Power Wiring Table for Balanced Twisted-Pair Cabling.
6. Provide additional clearance or approved heat shielding and/or insulation from heat sources as required to prevent conduit, pull box or cable temperature from exceeding 113 degrees Fahrenheit (F) (45 degrees Celsius (C)).
7. Avoid installation above steam lines, or below water or steam lines.

C. Conduit Routing and Installation:

1. Conduit fill shall comply with NEC fill requirements.
2. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
3. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).
4. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
5. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12” (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
6. Do not install conduit or other raceways in interference with equipment placement or operation; piping; structural members; maintenance access; indicated future equipment.
7. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

8. Support conduit within 12” (300 mm) of enclosures to which attached.
9. Conduits shall not pass through riser sleeves associated with cable tray pathways.
10. Conduit Stubs:

    a. Bushings shall be installed on the ends of all conduit stubs.
    b. Grounding of conduit stubs shall follow Section 27 05 26 “Grounding and Bonding for Communications Systems.”
    c. Conduits stubbed at cable trays: Conduits at sides or at ends of cable tray shall be stubbed between 8” (200 mm) and 20” (500 mm) from cable tray to allow cable bend radius and vertical supports as required to prevent cable pinch points at conduit lip and cable tray edges.
    d. Conduit embedded in a slab: Arrange stub-ups so curved portions of bends are not visible above finished slab.
    e. Conduit stubbed into a telecommunications space other than an Entrance Facility:
        1) Conduit shall be stubbed into a telecommunications space a minimum of one inch and a maximum of 3” (75mm) regardless of whether conduit is penetrating a wall, floor, or ceiling.
    f. Conduit stubbed into an Entrance Facility:
        1) Below grade entrance: Conduits shall be stubbed up 4” (100mm) above finished floor.
        2) Ceiling entrance: Conduits shall be stubbed down 4” (100mm) below finished ceiling.
        3) Wall Entrance: Conduits shall be stubbed 4” (100mm) out of wall.
11. Conduit Pathways Embedded in Slabs:

    a. Run conduit larger than 1” (27mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10’ (3m) intervals.
    b. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
    c. Arrange pathways to keep a minimum of 1” (25 mm) of concrete cover in all directions.
    d. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
    e. Change from nonmetallic conduit and fittings to galvanized RMC and fittings before rising above floor.
12. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
13. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
14. Changes in direction shall be accomplished with sweeping bends observing minimum bend radius requirements above.
15. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
16. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.

17. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.
18. Cut conduit perpendicular to the length. For conduits of 2" (50mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
19. Install measured pull tape in empty pathways. Leave at least 12" (300mm) of slack at each end of pull tape. Secure pull tape, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
20. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

D. Fittings and Seals

1. Pathway Fittings: Compatible with pathways and suitable for use and location.

    a. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
    b. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
    c. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
2. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.
3. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

    a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    b. Where an underground service pathway enters a building or structure.
    c. Where otherwise required by NFPA 70.
4. Fittings used for penetration of IP-rated enclosures shall not compromise the IP rating of the enclosure.
5. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
6. Flexible Conduit Connections: Comply with NEMA RV 3. Use maximum of 72" (1800mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

    a. Use LFMC in damp or wet locations subject to severe physical damage.
    b. Use LFMC in damp or wet locations not subject to severe physical damage.
7. Expansion-Joint Fittings:

    a. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25' (7.6 m). Install in each run of aboveground galvanized RMC that is

located where environmental temperature change may exceed 100 deg F (55 deg C), and that has straight-run length that exceeds 100’ (30 m).

b. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   1) Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   2) Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   3) Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   4) Attics: 135 deg F (75 deg C) temperature change.

c. Install fitting(s) that provide expansion and contraction for at least 0.00041” per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078” per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

d. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

e. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

8. Material Transition Fitting

   a. Provide fitting at all transitions of different conduit materials.

E. Pull Boxes

1. Minimum pull box sizing shall comply with ANSI/TIA 569-D. Where site conditions do not allow for pull box sizing compliant with ANSI/TIA 569-D, contractor shall obtain written approval from the CLIENT and AHJ for deviation from ANSI/TIA 569-D standards.
2. Provide pull boxes to limit each conduit segment to 100’ (30m) length and 180 degrees of total bend.
3. Provide additional pull boxes where additional conduit bends are provided and not indicated on the Drawings, and as required.
4. Orient pull boxes with sides parallel or perpendicular to structural beams and building column lines.
5. Conduits shall only enter opposite ends of pull boxes. Pull boxes shall not be used to change directions.
6. Conduits entering pull boxes shall be aligned with exiting conduits.
7. Provide maintenance access to each pull box.
8. Locate to comply with minimum conduit bend radius.
9. Support pull boxes from building structure using minimum four (4) mounting attachment points. Do not support boxes by conduit.
10. A pull box shall be installed inside the building at the entrance point for cable pulling and splicing when:

    a. The building conduit is extended from the entrance conduit; or

b. Warranted by excessive conduit length; or
c. The quantity of bends exceeds the equivalent of two 90-degree bends.

F. Device Boxes

1. Mount device boxes at heights coordinated with adjacent electrical outlet boxes.
2. Provide a backbox for every telecommunications outlet, unless otherwise noted.
3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
4. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
5. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

G. Floor Boxes

1. Set metal floor boxes level and flush with finished floor surface.
2. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

H. Hangers and Supports

1. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4" in diameter.
2. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   a. Secure raceways and cables to these supports with two-bolt conduit clamps.
3. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
4. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications items and their supports to building structural elements by the following methods unless otherwise indicated by code:

   a. To Wood: Fasten with lag screws or through bolts.
   b. To New Concrete: Bolt to concrete inserts.
   c. To Masonry: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   d. To Existing Concrete: Use expansion anchor fasteners.
   e. Instead of expansion anchors, powder-actuated-driven threaded studs, provided with lock washers and nuts, may be used in existing standard-weight concrete 4” thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4” thick.
   f. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.

g. To Light Steel: Sheet metal screws.
h. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

5. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

I. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6" (150 mm) of slack. The lowest point of the cables shall be no less than 6" (150 mm) adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 5' (1.5 m) on center.
5. Provide a hook at each change in direction.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 27 05 44 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

B. Seal conduit ends during construction to prevent entry of debris.

3.7 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 00 "Firestopping".

3.8 COORDINATION

A. The Coordination as described in Section 27 05 00 "Common Work Results for Communications" applies to this Section.

B. The Contractor shall coordinate with the Electrical Contractor to:

1. Confirm all combination type floor back boxes support minimum required cable bend radius and quantity of ports required per floor back box as indicated in the Drawing Schedules. Refer to manufacturer's bend radius specification for the cable provided.
2. Confirm floor box covers are hinged and notched to allow exit of all mounting cords with cover closed.

3. Provide telecommunications outlet ports and mountings that are compatible with floor boxes provided by the Electrical Contractor

C. Refer to Submittals section in this document as well as Section 27 05 00 "Common Work Results for Communications" for coordination document requirements.

3.9 ON-SITE RESPONSABILITIES

A. The On-Site Responsibilities as described in Section 27 05 00 "Common Work Results for Communications" apply to this Section.

3.10 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.11 QUALITY CONTROL AND TESTING

A. See Section 27 05 00 "Common Work Results for Communications".

B. Visually inspect to confirm all required clearances and maintenance access is provided.

C. Visually inspect for mechanical continuity.

D. Visually inspect for proper hanger and supports connections.

E. Clear any debris found in ducts and test entire duct with ball mandrel. If ball mandrel does not pass, clean, brush, sweep and rod as necessary to remove all obstructions.

F. Report results in writing.

3.12 DEMONSTRATION, TRAINING AND INSTRUCTION

A. The Demonstration, Training and Instruction as described in Section 27 05 00 "Common Work Results for Communications" apply to this Section.

END OF SECTION 270528

SECTION 270536 – CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor shall provide all Labor, Materials, Contractor's Equipment and Plant to fully execute the requirements to deliver, configure, install and commission the Works as shown on the Drawings and described in this section. Further requirements are that the provisions of this section shall be complementary to and shall be correlated with, the requirements of the Contract.

B. Section Includes:

1. Wire-mesh cable tray.
2. Cable tray accessories.
3. Cable tray supports.
4. Warning signs.

C. Refer to Section 27 11 00 "Communications Equipment Room Fittings" for ladder rack within the telecommunications rooms and where shown on drawings.

1.2 SCOPE OF WORKS

A. The overall Cable Tray system Scope of Work shall include:

1. Coordination and planning.
2. Overhead cable tray.
3. As- built documentation.
4. All other work, equipment, and accessories required to provide a complete and fully operational system.

1.3 RELATED DOCUMENTS

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

B. Section 07 84 00 "Firestopping"

C. Section 27 05 00 "Common Work Results for Communications"

D. Section 27 05 26 "Grounding and Bonding for Communications Systems"

E. Section 27 05 28 "Pathways for Communications Systems".

1.4 DEFINITIONS

A. Abbreviations

1.	EMI	Electromagnetic interference
2.	IP	International Protection Marking
3.	NEC	National Electrical Code
4.	NEMA	National Electrical Manufacturers Association
5.	NFPA	National Fire Protection Association
6.	NRTL	Nationally recognized testing laboratory
7.	TEBC	Telecommunications equipment bonding conductor
8.	TIA	Telecommunications Industry Association
9.	UL	Underwriters Laboratories

B. Definitions

1. Concentrated Load A load applied at midpoint of span and centerline of tray.
2. Appurtenances Something subordinate to another, more important thing.

1.5 APLICABLE LAWS, CODES, RULES, REGULATIONS AND STANDARDS

A. The following paragraphs define the standards for this Section in addition to those described in Section 27 05 00 “Common Work Results for Communications.”

B. All equipment, materials, construction and installation of the system to be in compliance with the applicable requirements as mentioned in Section 27 05 00 “Common Work Results for Communications“ and following codes and standards:

1. ANSI/TIA-569-D - Telecommunications Pathways and Spaces
2. NEMA VE 1 - Metal Cable Tray Systems
3. NEMA VE 2 – Cable Tray Installation Guidelines
4. ASTM B 633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
5. ASTM A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
6. ASCE/SEI 7 - Minimum Design Loads For Buildings and Other Structures
7. ASTM A 510/A 510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel
8. NFPA 70 – National Electrical Code.

1.6 SUBMITTALS

A. The following paragraphs define the submittal requirements for this Section in addition to those described in Section 27 05 00 “Common Work Results for Communications.”

B. Initial Submittals – Comply with applicable requirements as described in Section 27 05 00 “Common Work Results for Communications.”

C. Contractor shall provide the following documentation for Action Submittals:

1. Product Data: For each type of cable tray.

    a. Include data indicating dimensions and finishes for each type of cable tray indicated.
2. Shop Drawings: For each type of cable tray.

    a. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

D. Contractor shall provide the following documentation for Information Submittals:

1. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

    a. Scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
    b. Vertical and horizontal offsets and transitions.
    c. Clearances for access above and to side of cable trays.
    d. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
2. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. The Quality Assurance as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

1.8 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall comply with the Delivery, Storage and Handling requirements as described in Section 27 05 00 “Common Work Results for Communications”.

1.9 PROJECT CONDITIONS

A. The Project Conditions as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

1.10 WARRANTY

A. The Warranty Conditions as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

1.11 INTELECTUAL PROPERTY

A. The Intellectual Property requirements as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The Manufacturers requirements as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

2.2 CABLE TRAY GENERAL REQUIREMENTS

A. Cable Trays and Accessories:

1. Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
2. Comply with ANSI/TIA-569-D.

B. Source Limitations: Obtain cable trays and components from single manufacturer.

C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:

1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
2. Load and Safety Factors: Applicable to both side rails and rung capacities.

D. Cable tray inside edge radius shall be a minimum of 12” (300mm).

E. All straight sections shall be supplied in standard lengths, except where shorter lengths are required to facilitate tray assembly lengths as shown on drawings.

F. Fabricate cable tray products with rounded edges and smooth surfaces.

2.3 WIRE-MESH CABLE TRAY

A. General:

1. Configuration: Continuous, rigid, welded steel wire mesh cable management system, with NRTL listed splices where tray acts as Telecommunications Equipment Bonding Conductor (TEBC).
2. All fittings shall be field formed, from straight sections in accordance with the manufacturer’s instructions.

3. Wire-basket cable tray that is 6-inches wide or wider and splicing assemblies shall be UL classified for suitability as an equipment grounding conductor.
4. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
5. Refer to Section 27 05 00 "Common Work Results for Communications" for environmental ratings.

B. Materials:

1. High-strength-steel longitudinal wires with no bends. Shall be made from electro-plated zinc galvanized carbon steel and plated to ASTM B 633, Type III SCI-1.

C. Finishes**:**

1. Interior, controlled environment: Electrodeposited Zinc Plating: ASTM B 633, Type III, SC-1.
2. Exterior and Interior, uncontrolled environment spaces: Hot-Dip Galvanizing After Fabrication: ASTM A 123.

D. Dimensions:

1. Width: As indicated on Drawings.
2. Minimum Usable Load Depth: 4 inches (100 mm) unless otherwise indicated on Drawings.
3. Straight Section Lengths: 10 feet (3.0 m), except where shorter lengths are required to facilitate tray assembly.
4. Wire diameter shall be 0.195-inches (5mm) minimum on all mesh sections up to 16 linear inches. Wire diameter shall be 0.234-inches (6mm) minimum on all mesh sections in excess of 16 linear inches.

E. Performance Requirements

1. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.

    a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
3. Class Designation: Comply with NEMA VE 1, Class 10A.

2.4 CABLE TRAY ACCESORIES

A. General:

1. Provide all necessary cable tray supporting hardware, transitions and connectors, including bonding jumpers listed with an NRTL, as recommended by cable tray manufacturer.
2. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
3. Barrier Strips: Same materials and finishes as for cable tray.

4. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

B. Wire-Mesh Cable Tray Accessories.

1. Hardware and Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
2. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
3. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.5 CABLE TRAY SUPPORTS

A. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

B. Cable trays installed adjacent to walls shall be supported on wall mounted brackets.

2.6 WARNING SIGNS

A. Comply with requirements for identification in Section 27 05 53 "Identification for Communications Systems."

B. Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

PART 3 - EXECUTION

3.1 EXAMINATION

A. The Examination as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

3.2 PREPARATION

A. The Preparation as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

3.3 INSTALLATION

A. A Refer to Section 27 05 00 “Common Work Results for Communications” in addition to the following requirements

B. Installation of Cable Tray:

1. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

   a. TIA-569-D
   b. NEMA VE 2.
   c. NFPA 70
2. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
3. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
4. Remove burrs and sharp edges from cable trays.
5. Cable trays shall be planned for an initial maximum calculated fill of 25%. The maximum fill of any cable tray shall be 50%.
6. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.
7. Fasten cable tray supports to building structure and install seismic restraints.
8. Provide lateral restraint to minimize likelihood of injuring building occupants during seismic activity.
9. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb (90 kg).
10. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
11. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
12. Support bus assembly to prevent twisting from eccentric loading.
13. Locate and install supports according to manufacturer’s minimum requirements or NEMA EV 2, whichever is the more stringent requirement. Do not install more than one cable tray splice between supports and utilize splice plates that allow full rated load as Mid Span.
14. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
15. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
16. Make changes in direction and elevation using manufacturer's recommended fittings.
17. Make cable tray connections using manufacturer's recommended fittings.
18. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 07 84 00 "Firestopping."
19. Comply with requirements in Section 27 05 44 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.

20. Provide provisions for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
21. Cable tray routing shall conform to the following clearance and separation requirements:

    a. Minimum Clearance Above Side Rails: 12 inches (300mm)
    b. Minimum Side Clearance: 8 inches (200mm)
    c. Minimum Distance Between Suspended Ceiling and Bottom of Cable Tray: 8 inches (200mm)
    d. Comply with ANSI/TIA-569-D Separation From Power Wiring Table for Balanced Twisted-Pair Cabling.
    e. Balanced twisted-pair cabling shall be separated from fluorescent lamps and associated fixtures by a minimum of 5 inches (125 mm).
22. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.
23. Clamp covers on cable trays installed outdoors with heavy-duty clamps.
24. Install warning signs in visible locations on or near cable trays after cable tray installation.
25. Seal penetrations through fire and smoke barriers according to ANSI/TIA-569-D, Annex A, "Firestopping."
26. If cable trays are sized for future cables, specify provisions for penetrations with sleeves through fire-rated partitions or use "repairable" firestop-sealing material.
27. Exterior cable tray supports shall not penetrate roof, impact the roof covering or invalidate the roof covering warranty. Secure cover to reduce damage from wind.

C. Cable Tray Grounding:

1. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 27 05 26 "Grounding and Bonding for Communications Systems."
2. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with bonding jumpers listed by an NRTL.
3. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
4. Grounding Connections:

    a. Ground cable trays according to manufacturer's written instructions.
    b. Install an insulated equipment grounding conductor attached to each cable tray section and fitting as necessary to comply with NFPA 70.
    c. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
    d. Connect pathways to cable trays according to requirements in NEMA VE 2.

D. Installation of Cables:

1. Install cables only when each cable tray run has been completed and inspected.
2. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

3. Fasten cables on vertical runs to cable trays every 18 inches (450 mm). Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
4. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).
5. In existing construction, remove inactive or dead cables back to source.
6. Install covers after installation of cable is completed.

3.4 COORDINATION

A. The Coordination as described in Section 27 05 00 "Common Work Results for Communications" applies to this Section.

3.5 ON-SITE RESPONSABILITIES

A. The On-Site Responsibilities as described in section 27 05 00 "Common Work Results for Communications" apply to this section.

3.6 PROTECTION

A. Protect installed cable trays and cables.

B. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.

C. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.

D. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

3.7 QUALITY CONTROL AND TESTING

A. See Section 27 05 00 "Common Work Results for Communications".

B. Perform the following tests and inspections:

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.

3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and re-torque in suspect areas.
7. Measure clearances to verify proper distances are provided from obstructions and sources of EMI per clearances and separation requirements in this section.
8. Measure cable tray temperature near heat sources to verify compliance with cable operating temperature requirements.
9. Check for improperly sized or installed bonding jumpers.
10. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
11. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

C. Prepare test and inspection reports

3.8 DEMOSTRATION, TRAINING AND INSTRUCTION

A. The Demonstration, Training and Instruction as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

END OF SECTION 270536

SECTION 270544 – SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants

1.2 RELATED DOCUMENTS

A. Section 07 84 00 Firestopping

B. Section 27 05 00 Common Work Results for Communications

C. Section 27 05 26 Grounding and Bonding for Communications Systems

D. Section 27 05 28 Pathways for Communications Systems

E. Section 27 14 00 Outside Plant Infrastructure

1.3 SUBMITTALS

A. The following paragraphs define the submittal requirements for this Section in addition to those described in Section 27 05 00 “Common Work Results for Communications.”

B. Initial Submittals – Comply with applicable requirements as described in Section 27 05 00 “Common Work Results for Communications.

1.4 QUALITY ASSURANCE

A. The Quality Assurance as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

1.5 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall comply with the Delivery, Storage and Handling requirements as described in Section 27 05 00 “Common Work Results for Communications”.

1.6 PROJECT CONDITIONS

A. The definitions below are applicable to this Division. These definitions supplement the definitions specified in Division 01. In the event of discrepancies between these definitions and those defined in Division 01, the definitions in Division 01 shall take precedence.

1.7 WARRANTY

A. The Warranty Conditions as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURES

A. The Manufacturers requirements as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

2.2 SLEEVE AND SLEEVE SEAL GENERAL REQUIREMENTS

A. Comply with Section 07 84 00 “Firestopping” for product requirements.

B. Sleeves:

1. Wall Sleeves:

   a. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

2. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
3. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
4. Sleeves for Rectangular Openings:

   a. Material: Galvanized-steel sheet.
   b. Minimum Metal Thickness:
      1) For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

2) For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

5. Sleeve-Seal Systems

a. Description: Modular self-sealing device, designed to allow cables to penetrate fire-rated walls and floors without the need for firestopping. Device shall have a built-in fire and smoke sealing system that automatically adjusts to the amount of cables installed. Device shall allow cables to be easily added or removed at any time without the need to remove or reinstall firestopping materials.
b. UL Classified and/or FM Systems Approved and tested to the requirements of ASTM E814 (UL1479) & CAN/ULC-S115.
c. Component Specifications: Provide accessories and brackets from same manufacturer of sleeve seal system and install based on their instructions.
d. Pressure Plates: Carbon steel.
e. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

C. Sleeve-Seal Fittings:

1. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

D. Grout:

1. Description: Nonshrink; for interior and exterior sealing openings in non-fire-rated walls or floors.
2. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
3. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

E. Silicone Sealants:

1. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
   a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The Examination as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

3.2 PREPARATION

A. The Preparation as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

3.3 CONTRACTORS REPONSABILITY

A. The Contractors Responsibility as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

3.4 GENERAL INSTALLATION REQUIREMENTS

A. Comply with Section 07 84 00 “Firestopping” for installation requirements.

3.5 SLEEVE INSTALLATION FOR NON-FIRE RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

    a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint.
    b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe 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.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.6 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements required by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.8 COORDINATION

A. The Coordination as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

3.9 ON-SITE RESPONSABILITIES

A. The On-Site Responsibilities as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

3.10 PROTECTION

A. The Protection as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section’

3.11 QUALITY CONTROL AND TESTING

A. The Quality Control and Testing as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section in addition to the following.

3.12 DEMOSTRATION, TRAINING AND INSTRUCTION

A. The Demonstration, Training and Instruction as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

END OF SECTION 270544

SECTION 270553 – IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor shall provide all Labor, Materials, Contractor's Equipment and Plant to fully execute the requirements to deliver, configure, install and commission the Works as shown on the Drawings and described in this section. Further requirements are that the provisions of this section shall be complementary to and shall be correlated with, the requirements of the Contract.

B. Section Includes:

1. Color and legend requirements for labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes.
5. Signs.
6. Cable ties.
7. Fasteners for labels and signs.

1.2 RELATED DOCUMENTS

A. Section 27 05 00 Common Work Results for Communications

B. Section 27 05 26 Grounding and Bonding for Communications Systems

C. Section 27 05 28 Pathways for Communications Systems

D. Section 27 05 36 Cable Trays for Communications Systems

E. Section 27 11 00 Communications Equipment Room Fittings

F. Section 27 13 00 Communications Backbone Cabling

G. Section 27 15 00 Communications Horizontal Cabling

1.3 DEFINITIONS

1.4 APPLICABLE LAWS, CODES, RULES, REGULATIONS, AND STANDARDS

A. All equipment, materials, construction and installation of the system to be in compliance with the applicable requirements as mentioned in Section 27 05 00 "Common Work Results for Communications" and following codes and standards:

1.5 SUBMITTALS

A. The following paragraphs define the submittal requirements for this Section in addition to those described in Section 27 05 00 “Common Work Results for Communications.”

B. Initial Submittals – Comply with applicable requirements as described in Section 27 05 00 “Common Work Results for Communications.”

C. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for communications identification products.

D. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

E. Identification Schedule:

1. Outlets: Scaled drawings indicating location and proposed designation.
2. Backbone Cabling: Riser diagram showing each communications room, backbone cable, and proposed backbone cable designation.
3. Racks: Scaled drawings indicating location and proposed designation.
4. Patch Panels: Enlarged scaled drawings showing rack row, number, and proposed designations.

1.6 QUALITY ASSURANCE

A. The Quality Assurance as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

1.7 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall comply with the Delivery, Storage and Handling requirements as described in Section 27 05 00 “Common Work Results for Communications.”

1.8 PROJECT CONDITIONS

A. The Project Conditions as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

1.9 WARRANTY

A. The Warranty Conditions as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

1.10 INTELLECTUAL PROPERTY

A. The Intellectual Property requirements as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURES

A. The Manufacturers requirements as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

2.2 IDENTIFICATION SYSTEM GENERAL REQUIREMENTS

A. Comply with NFPA 70 and TIA 606-B.

B. Comply with ANSI Z535.4 for safety signs and labels.

C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969 performance metrics, including visual inspection, rub test, scrape test and adhesion test.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Color and Legend Requirements:

1. Equipment Identification Labels:
   a. Black letters on a white field.

F. Labels:

1. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, polyester flexible labels with acrylic pressure-sensitive adhesive.
2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating protective shields over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
3. Marker for Labels: Permanent, waterproof black ink marker recommended by tag manufacturer.
4. Marker for Labels: Machine-printed, permanent, waterproof black ink recommended by printer manufacturer.

G. Underground-Line Warning Tape:

1. Tape:

    a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground communications utility lines.
    b. Printing on tape shall be permanent and shall not be damaged by burial operations.
    c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
2. Color and Printing:

    a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, and ANSI Z535.4.
    b. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL-FIBER CABLE".

H. Baked-Enamel Signs:

1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches (180 by 250 mm).

I. Cable Ties:

1. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

    a. Minimum Width: 3/16 inch (5 mm).
    b. Tensile Strength at 73 deg F (23 deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
    c. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
    d. Color: Black, except where used for color-coding.
2. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

    a. Minimum Width: 3/16 inch (5 mm).
    b. Tensile Strength at 73 deg F (23 deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
    c. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
    d. Color: Black.
3. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

    a. Minimum Width: 3/16 inch (5 mm).
    b. Tensile Strength at 73 deg F (23 deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
    c. UL 94 Flame Rating: 94V-0.
    d. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
    e. Color: Black.

J. Miscellaneous Identification Products:

1. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
2. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. See Section 27 05 00 “Common Work Results for Communications”

3.2 PREPARATION

A. Self-Adhesive Identification Products: Before applying communications identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.3 CONTRACTORS REPONSABILITY

A. The Contractors Responsibility as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

3.4 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of communications systems and connected items.

G. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

H. Self-Adhesive Wraparound Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Provide label 6 inches (150 mm) from cable end.

I. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. 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 two lines of text are required, use labels 2 inches (50 mm) high.

J. Underground-Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway 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.
2. Where optical fiber cable is placed underground without the presence of a detectable cable type such as twisted pair or coaxial cable, detectable tape containing metallic tracings is recommended.
3. Limit use of underground-line warning tape to direct-buried cables.
4. Install underground-line warning tape for direct-buried cables and cables in raceways.

K. Cable Ties: General purpose, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

L. Identification Schedule

1. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
2. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations with high visibility. Identify by system and circuit designation.
3. Accessible Fittings for Raceways and Cables within Buildings: Identify covers of each junction and pull box with self-adhesive labels containing wiring system legend.

M. Faceplates:

1. Label individual faceplates with self-adhesive labels. Place label at top of faceplate. Each faceplate shall be labeled with its individual, sequential designation, composed of the following, in the order listed:

    a. Wiring closet designation.

b. Colon.
c. Faceplate number.

N. Equipment Room Labeling:

1. Racks, Frames, and Enclosures: Identify front and rear of each with self-adhesive labels containing equipment designation.
2. Patch Panels: Label individual rows in each rack, starting at top and working down, with self-adhesive labels.
3. Data Outlets: Label each outlet with a self-adhesive label indicating the following, in the order listed.

O. Backbone Cables: Label each cable with a self-adhesive wraparound label indicating the location of the far or other end of the backbone cable. Patch panel or punch down block where cable is terminated should be labeled identically.

P. Horizontal Cables: Label each cable with a self-adhesive wraparound label indicating the following, in the order listed:

1. Room number.
2. Colon.
3. Faceplate number.

Q. Locations of Underground Lines: Underground-line warning tape for copper, coaxial, hybrid copper/fiber, and optical-fiber cable.

R. Instructional Signs: Self-adhesive labels.

S. Warning Labels for Indoor Cabinets, Boxes, and Enclosures: Baked-enamel warning signs.

1. Apply to exterior of door, cover, or other access.

T. Equipment Identification Labels:

1. Indoor Equipment: Baked-enamel signs.
2. Outdoor Equipment: Laminated-acrylic or melamine-plastic sign.
3. Equipment to Be Labeled:

a. Communications cabinets.
b. Uninterruptible power supplies.
c. Computer room air conditioners.
d. Fire-alarm and suppression equipment.
e. Egress points.
f. Power distribution components.

3.5 COORDINATION

A. The Coordination as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

3.6 ON-SITE RESPONSABILITIES

A. The On-Site Responsibilities as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

3.7 PROTECTION

A. The Protection as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

3.8 QUALITY CONTROL AND TESTING

A. The Quality Control and Testing as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section in addition to the following.

3.9 DEMOSTRATION, TRAINING AND INSTRUCTION

A. The Demonstration, Training and Instruction as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

END OF SECTION 270553

SECTION 271100 – COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor shall provide all Labor, Materials, Contractor's Equipment and Plant to fully execute the requirements to deliver, configure, install and commission the Works as shown on the Drawings and described in this section. Further requirements are that the provisions of this section shall be complementary to and shall be correlated with, the requirements of the Contract.

B. Section Includes:

1. Entrance protection hardware
2. Racks, frames, and enclosures
3. Cable management and ladder rack
4. Rack- and cabinet-mounted power strips
5. Rack- and cabinet-mounted UPS

    a. 3KVA
    b. 6KVA

C. Refer to Section 27 05 36 "Cable Trays for Communications Systems" for cable tray outside of telecommunications rooms

1.2 SCOPE OF WORKS

A. Pathways for communications systems shall be provided to complete the overall Premises Wiring Distribution System (PWDS) in accordance with ANSI/TIA 569-D Telecommunications Pathways and Spaces and the BICSI Telecommunications Distribution Methods Manual (TDMM).

B. All other work, equipment and accessories required to provide a complete and fully operational system.

1.3 RELATED DOCUMENTS

A. Section 27 05 00 Common Work Results for Communications

B. Section 27 05 26 Grounding & Bonding for Communications Systems

C. Section 27 05 28 Pathways for Communications Systems

D. Section 27 05 36 Cable Tray for Communications Systems

E. Section 27 05 44 Sleeves and Sleeve Seals for Communications Pathways and Cabling

F. Section 27 05 53 Identification for Communications Systems

G. Section 27 13 00 Communications Backbone Cabling

H. Section 27 15 00 Communications Horizontal Cabling

1.4 DEFINITIONS

A. Abbreviations

1. EMT Electrical Metallic Tubing
2. EQ Equal
3. FMC Flexible Metal Conduit
4. HDPE High Density Polyethylene
5. JB Junction Box
6. LFMC Liquid Tight Flexible Metallic Conduit
7. LFNC Liquid Tight Flexible Nonmetallic Conduit
8. LSZH Low Smoke Zero Halogen
9. OC On Center
10. RTRC Reinforced Thermosetting Resin Conduit
11. TE Telecommunications Enclosure
12. WAP Wireless Access Point

1.5 APPLICABLE LAWS, CODES, RULES, REGULATIONS, AND STANDARDS

A. All equipment, materials, construction and installation of the system to be in compliance with the applicable requirements as mentioned in Section 27 05 00 "Common Work Results for Communications" and following codes and standards:

1. ANSI/TIA 569-D - Telecommunications Pathways and Spaces
2. NFPA 70 - National Electrical Code for Industrial Business Owners
3. UL-467 – Grounding and Bonding Equipment
4. UL-50 – Enclosures for Electrical Equipment, Non-Environmental Considerations
5. UL-2024 - Standard for Cable Routing Assemblies and Communications Raceways
6. UL-870 - Standard for Wireways, Auxiliary Gutters, and Associated Fittings
7. UL-94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
8. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT)
9. NECA 105 - Standard for Installing and Maintaining Cable Tray Systems
10. NECA 1 - Standard for Good Workmanships in Electrical Construction
11. NECA/BICSI 568 - Standard For Installing Commercial Building Telecommunications Cabling.

1.6 SUBMITTALS

A. Provide submittal information for the following submittal sections as described below:

1. Product Data

1.7 QUALITY ASSURANCE

A. The Quality Assurance as described in Section 27 05 00 “Common Work Results for Communications” applies to this Section.

1.8 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall comply with the Delivery, Storage and Handling requirements as described in Section 27 05 00 “Common Work Results for Communications.”

1.9 PROJECT CONDITIONS

A. The Project Conditions as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

1.10 WARRANTY

A. The Warranty Conditions as described in Section 27 05 00 “Common Work Results for Communications” apply to this Section.

PART 2 - PRODUCTS

2.1 ENTRANCE PROTECTION

A. Provide primary protectors in accordance with NFPA 70 Article 800.

B. Service entrance protectors

1. Protection panels fully enclosed with hinged doors
2. 110 style input and output terminals
3. Complying with UL 497 Primary Protection Standards
4. Solid state 5-pin protection modules appropriate to circuit type
5. Circa #1880ECA1-*** or approved equal

C. Other cable protectors

1. Provide protectors complying with NFPA 70 and UL 497 fully compatible with Coax. Cat 6, Cat 6A, and PoE functionality.

2.2 RACKS, FRAMES, AND ENCLOSURES

A. Floor Mounted Equipment Racks

1. 7-foot high, by x 19-inch wide (23-inch wide where indicated)
2. Universal alternating hole patterns on both sides of the posts
3. RMU markings on both uprights (front and back)
4. 3-inch channels, 2 posts, top angles, self-supporting bases
5. Hardware for securing/bolting to floor using a minimum of four (4) anchors
6. 2-post: Panduit R2PS or approved equal.
7. 4-post: Panduit R4P or approved equal.

B. Accessories for Equipment Racks

1. Horizontal Cable Management Panels: Managers shall be 2 RMU and 4 RMU, single-sided and 19-inches wide.

    a. 4RU: Panduit NM4 or approved equal.
    b. 2RU: Panduit NM2 or approved equal.
2. Vertical Cable Managers: 7-feet, double sided, 10" W between and 6" wide on ends, complete with double-hinged section covers and slack spools:

    a. 10": Panduit PR2VD10 or approved equal.
    b. 6": Panduit PRV2D06 or approved equal.

C. Grounding for Cabinets and Racks

1. Provide rack bonding busbar (RBB) ground bus and tin plated connectors for each cabinet or rack indicated on the drawings. RBB shall comply with the EIA universal mounting hole spacing and mount to standard racks and cabinets
2. All components shall be bonded to the rails with paint piercing hardware.
3. Equipment shall be bonded to the RBB with a jumper and compression lugs.
4. Provide all the necessary parts and grounding cable interconects for a complete grounding system in compliance with TIA 607-C.
5. Acceptable Manufacturers: Panduit, Part No. RGRBN19 series or approved equal.

2.3 CABLE MANAGEMENT AND LADDER RACK

A. Cable Management

1. C-Rings: To route patch cables and jumpers on backboards in telecommunications rooms. Size shall be a minimum of 2 inches in diameter. C-rings shall be:

    a. CPI: Open Composite Distribution Ring 12035
    b. Approved Equal
2. D-Rings: To route cables on backboards in telecommunications rooms. Size shall be a minimum of 2 inches in diameter. D-Rings shall be:

    a. CPI: Composite: CPI 12127, 10812

b. CPI: Metallic: CPI 10941, 10942, 10943
c. Approved Equal

3. Cable Straps: Reusable Velcro hook-and-loop style straps to secure cable bundles to ladder rack and other supporting equipment.

B. Ladder Racks:

1. Provide ladder rack to affix tops of racks to walls, to route cable from walls to racks within telecommunications rooms, and in size and locations shown on the Drawings. Rack shall be complete with same finish fittings including but not limited to splice kits, cable radius drop-outs, radius bends, protective end caps, support brackets, foot kits, vertical wall brackets, wall angles, grounding hardware and other incidental and miscellaneous hardware required for a complete system.

   a. Finish shall be black
   b. UL listed for equipment ground
   c. CPI: 10250 series or approved equal.

2. Ladder Rack cable retaining posts shall be used to provide extra cabling depth, minimum size to match installed cable height or as noted on drawings:

   a. CPI: 10596 series or approved equal

3. Ladder Rack Corner Brackets shall be used to create radii for T-junctions and corners:

   a. CPI: 11959 series or approved equal.

4. The 90 degree Horizontal Radius Bends shall be provided for each 90 degree change in direction of cable runway angle as shown on Drawings:

   a. CPI: 10822 series or approved equal.

5. Cable Radius Drops shall be provided wherever cable is to drop from one section of cable runway to another lower section of cable runway, or is to drop from cable runway to equipment racks/frames:

   a. CPI: 12100 series or approved equal.

6. Ladder Rack Grounding kits shall be provided across cable runway:

   a. CPI: 40164 series or approved equal.

7. Alternate-spacing Ladder Rack shall be provided for supporting the cable transition between overhead cable runway and racks, and shall be designed for use over 19-inch wide racks and 6-inch or 10-inch wide vertical cable management sections. Alternate-spacing Ladder Rack shall have cross-members spaced on alternating centers of 12.5 inches and 13.81 inches:

   a. CPI: 31472 series or approved equal.

8. Channel Rack-To-Ladder Rack Mounting Plate: Provide to secure ladder rack to equipment racks and frames. Provide for each equipment rack and/or equipment frame shown on the drawings. Mounting plates shall be mounted either parallel or perpendicular, depending upon the orientation of the ladder rack:

   a. CPI: 10595 series or approved equal.

9. Ladder Rack Elevation Kit: Mount between rack mounting plate and ladder rack for connection to elevated ladder rack:
    a. CPI: 10506 series or approved equal.

2.4 RACK AND CABINET MOUNTED POWER STRIPS

A. Acceptable Manufacturers:

1. APC AP8841 or approved equal.

B. Provide (2) cabinet power strips per cabinet

1. Zero U vertical rack mount
2. 208V
3. 30A single phase
4. Metered for amps, voltage, KW (by phase)
5. Minimum (36) C-13 output receptacles
6. Minimum (6) C-19 output receptacles
7. Ethernet jack
8. DHCP, SNMP, web interface

2.5 RACK-AND CABINET-MOUNTED UPS

A. Acceptable Manufacturers:

1. 3KVA - APC SRT3000RMXLA-NC or approved equal
2. 6KVA – Eaton 9PX6KTF5 or approved equal

B. Provide minimum (1) UPS per rack with active equipment, coordinate locations and quantities with final rack layouts and equipment by others.

C. 3KVA UPS

1. Minimum 3000VA
2. Rack Height – 2RU
3. 120V Nominal output voltage
4. Output Connections:
    a. (8) NEMA 5-20R
    b. (1) NEMA L5-30R

D. 6KVA UPS

1. Minimum 6000VA
2. Rack Height – 6RU
3. 120V Nominal output voltage
4. Output Connections:

a. 18) NEMA 5-20R
b. (1) NEMA L5-30R
c. (2) NEMA L6-20R

5. Network card equipped with ethernet jack
6. Web interface with control console

PART 3 - EXECUTION

3.1 GENERAL

A. Equipment and installation shall strictly conform to requirements of the following:

1. TIA-569-B: Commercial Building Standard for Telecommunication Pathways and Spaces
2. TIA-606-B: Administration Standard for Commercial Telecommunications Infrastructure
3. J-STD-607-C: Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

3.2 ENTRANCE PROTECTION

A. Provide primary protectors for all circuits entering/exiting building in accordance with NFPA 70 Article 800 and additional circuits where indicated on the drawings.

3.3 CABINETS, RACKS, FRAMES, AND ENCLOSURES

A. General

1. Install equipment complete with all required incidental hardware and materials
2. Install equipment racks, frames, and enclosures in such a fashion to meet local code for seismic bracing requirements.
3. Bond each rack and cabinet to the grounding system.

B. Floor mounted Equipment Racks:

1. Using cable runway, horizontally affix the top of a given rack to the wall as shown on the Drawings. Bolt horizontal runway to rack and to walls. Bolt rack to floor using a minimum of four anchors.
2. When installing vertical cable management between racks, install management trough such that the management trough is as far back as possible between the racks.
3. When installing multiple equipment racks, bolt adjacent racks together per manufacturer's instructions.

C. Vertical Rack-mounted Power Strips

1. Use the offset mounting bracket and adjust, so the that power strips clear the vertical wire managers in the back

3.4 CABLE MANAGEMENT AND LADDER RACK

A. Cable Management

1. C-Rings: Mount at 6-inch intervals and as shown on the Drawings
2. D-Rings: Mount at 12-inch intervals and as shown on the Drawings
3. Cable Straps

a. Install reusable Velcro hook-and-loop style straps to secure cable bundles (see below) to ladder rack and other supporting equipment. The use of plastic tie wraps for this purpose is not acceptable.
b. Bundling:

1) Cables shall be bundled by application (patch, horizontal, backbone) and by cable type (Cat 3, Cat 6, MM Fiber, SM Fiber, etc.). Cable applications and types shall not be intermixed within a bundle.
2) Cable bundles (of a given application and cable type) shall be of even cable quantity.

c. Quantity of cable per cable bundle: See Part 2 Products for quantity
d. Provide excess cable straps to Owner.
e. Station cables in suspended cable runs shall be supported at varying intervals. Cable spans shall be limited to 5-feet or less, and the length of spans shall vary along the cable path (i.e., a given span should not be exactly the same length as the span preceding or following it - "exact" spans can degrade cable performance).

B. Ladder Rack:

1. Install at +96 inches A.F.F. with ends of ladder rack cut square, unless noted otherwise.
2. Ream cut ends to remove burrs and sharp edges.
3. Cap cut ends with manufacturer’s recommended caps.
4. Affix cable radius drop outs as required.
5. Install per manufacturer’s instructions with flat (rung) side up.
6. Meet local code for seismic bracing.

END OF SECTION 271100

SECTION 271300 – COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for the installation of a TIA/EIA standard interior (inside plant) communications cabling system.

B. Communications Backbone Cabling Description:

1. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

C. Contractor shall provide all Labor, Materials, Contractor's Equipment and Plant to fully execute the requirements to deliver, configure, install and commission the Works as shown on the Drawings and described in this section. Further requirements are that the provisions of this section shall be complementary to and shall be correlated with, the requirements of the Contract.

D. Section includes:

1. Cable
2. Cable assemblies (patch cords) and cross-connects
3. Copper termination frames and blocks
4. Fiber splicing hardware
5. Cable supports
6. Cable straps
7. Testing Equipment

1.2 RELATED DOCUMENTS

A. Section 27 05 00 Common Work Results for Communications

B. Section 27 05 26 Grounding & Bonding for Communications Systems

C. Section 27 05 28 Pathways for Communications Systems

D. Section 27 05 36 Cable Tray for Communications Systems

E. Section 27 05 44 Sleeves and Sleeve Seals for Communications Pathways and Cabling

F. Section 27 05 53 Identification for Communications Systems

G. Section 27 13 00 Communications Backbone Cabling

H. Section 27 15 00 Communications Horizontal Cabling

1.3 DEFINITIONS

A. Abbreviations

1. ANSI American National Standards Institute
2. BICSI Building Industry Consulting Service International
3. EIA Energy Information Administration
4. FOCIS Fiber Optic Connector Intermateability Standard
5. HVAC Heating, Ventilation and Air Conditioning
6. ICEA Insulated Cable Engineers Association
7. IDC Insulation displacement connector
8. LAN Local area network
9. NFPA National Fire Protection Association
10. NRTL Nationally Recognized Testing Laboratories
11. OFNP Optical fiber nonconductive plenum
12. OFNR Optical fiber nonconductive riser
13. RCDD Registered Communications Distribution Designer
14. TIA Telecommunications Industry Association

B. Definition

1. Cross-Connect -A facility enabling the termination of cable elements and their interconnection or cross-connection.

1.4 APPLICABLE LAWS, CODES, RULES, REGULATIONS, AND STANDARDS

A. ANSI/BICSI N1-19 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure

B. NECA 1 - Standard for Good Workmanship in Electrical Construction

C. NECA 301 - Installing and Testing Fiber Optics

D. TIA-568-B - Commercial Building Telecommunications Cabling Standard

E. TIA-568-C.0 - Generic Telecommunications Cabling for Customer Premises

F. TIE-568-C.1 – Commercial Building Telecommunications Cabling Standard

G. TIA - 568-C.2 - Balanced Twisted Pair Telecommunications Cabling and Components Standards

H. TIA-568-C.3 - Optical Fiber Cabling Components

I. TIA-492CAAA - Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers

J. TIA-492CAAD - Detail Specification for 850-nm Laser- Optimized, 50-µm Core Diameter/125-µm Cladding Diameter Class la Graded-Index Multimode Optical Fibers Suitable for Manufacturing OM4 Cabled Optical Fiber

K. TIA-492AAAE - Detail Specification for 50-µm Core Diameter/125-µm Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers with Laser-Optimized Bandwidth Characteristics Specified for Wavelength Division Multiplexing

1.5 SUBMITTALS

A. Provide submittal information for the following submittal sections as described below:

1. Product Data

2. Shop Drawings:

a. Cable Routing and Grouping Plan: Provide only if cable routing and grouping have not been shown on the Drawings, or if proposing a deviation.

3. Testing

a. Provide a list of proposed test equipment for use in verifying the installation of the communications cabling system.
   1) Provide for each testing device:
   2) Manufacturer and product number.
   3) Manufacturer documentation showing date and outcome of last re-calibration. Testing device shall have been re-calibrated within the manufacturer's recommended recalibration period.
   4) Manufacturer documentation showing software revision. Software revision shall be most current revision available for the device and shall be based upon the most current TIA/EIA testing guidelines.
   5) Patch cords and other specialized components.

b. Provide proposed test results forms.

c. Provide the calculated optical fiber cable loss budget for each optical fiber cable in the system.

1.6 QUALITY ASSURANCE

A. The Quality Assurance as described in Section 27 05 00 "Common Work Results for Communications" applies to this Section.

1.7 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall comply with the Delivery, Storage and Handling requirements as described in Section 27 05 00 "Common Work Results for Communications."

1.8 PROJECT CONDITIONS

A. The Project Conditions as described in Section 27 05 00 "Common Work Results for Communications" apply to this Section.

1.9 WARRANTY

A. The Warranty Conditions as described in Section 27 05 00 "Common Work Results for Communications" apply to this Section.

1.10 INTELLECTUAL PROPERTY

A. The Intellectual Property requirements as described in Section 27 05 00 "Common Work Results for Communications" apply to this Section.

PART 2 - PRODUCTS

2.1 GENERAL

A. Communication cabling system components shall be sourced (manufactured) by formally partnered Manufacturers (collectively referred to as the "Manufacturer"). Products shall not be intermixed between different manufacturers unless the Manufacturer of the chosen communications cabling system has listed (in writing) another manufacturer's component as an "Approved Alternative Product" and will warrant the "Approved Alternative Product" as part of the Manufacturer's extended Warranty.

1. Provide the same Manufacturer for this section as that for Division 27 Section 27 15 00 – Communications Horizontal Cabling unless otherwise noted.

B. For a given Manufacturer, all cabling products shall be part of a single product line – components shall not be intermixed between a Manufacturer's product lines. The product line shall be engineered "end-to-end" (i.e. the system and all of its components shall be engineered to function together as a single, continuous transmission path).

C. Physically verify the following materials on site, prior to purchase and delivery of the materials:

1. Lengths of conduit and/or pathway to be used for routing backbone cabling. Pre-cut materials of insufficient length shall not be installed.
2. Fill ratio and overall suitability of raceway for installation of inside plant cabling. Promptly notify the Engineer of potential overfill, potential for installation problems due to overfill, or raceway which may be otherwise deemed unsuitable for use, and shall await the Engineer's direction prior to purchase and delivery of the materials.

2.2 PERFORMANCE

A. Protocols/Services:

1. At a minimum, the communications cabling system shall support data network protocols/services at rates up to 10 Gbps. It shall support 10 Mb, 100 Mb, 1 Gb, and 10 Gb Ethernet and other network protocols.

B. Copper backbone components (cable, connectors, etc.) shall exceed the transmission requirements for connecting hardware as specified in the TIA standards for the Category for which they are rated. Copper components shall be rated, at a minimum, Category 3 unless otherwise noted.

2.3 CABLE

A. General: Cable shall be plenum (CMP, OFNP) rated. Cables shall be manufactured by the selected communications cabling Manufacturer. Provide cable in types, sizes, and quantities as shown on the Drawings. All cables of the same type (Cat 3, Cat 6, 50µm MM, SM, etc.) shall be of the same color – multiple colors of the same cable type are not acceptable.

B. Copper Backbone Cable:

1. Multi-pair copper backbone cable:

a. 24-AWG solid copper conductors insulated with color coded jacket
b. UL Verified to TIA-568 for Category 3 performance and shall be sized in pair counts as shown on the Drawings.

C. Fiber Cable:

1. Singlemode – Indoor/Outdoor:

a. Meet or exceed OS2 requirements
b. Shall be rated for installation in underground ducts
c. Color: Black

D. Manufacturer:

1. Commscope, Inc
2. General Cable
3. Systimax Solutions
4. Siemon Systems
5. Approved equal

2.4 CABLE ASSEMBLIES (PATCH CORDS) AND CROSS-CONNECTS

A. Copper Patch Cables: Provide per Division 27 Section 27 15 00 – Communications Horizontal Cabling.

B. Fiber Patch Cables: Provide fiber patch cables for fiber cross-connects. Fiber patch cables shall be pre-manufactured (factory-terminated) with a UL rating of OFNR. Fiber patch cables shall be manufactured by the selected communications cabling Manufacturer.

1. Single mode: Cable shall have duplex LC connectors on both ends and meet the requirements of 2.6.B

a. Quantities and lengths:
1) Provide (40) 1-meter duplex patch cables
2) Provide (40) 3-meter duplex patch cables
3) Provide (20) 5-meter duplex patch cables
b. Color: Yellow

C. Copper Patch Panels

1. Multi-pair copper riser panels:

a. Rack mountable in 19" rack
b. Terminate 4-pair, 22-26 AWG, 100 ohm unshielded twisted pair cables with a standard 110 punchdown tool
c. Support a universal (T568A and T568B) wiring pattern
d. Exceed the transmission requirements for connecting hardware as specified in the TIA/EIA standards for the Category for which they are rated
e. Bar strain relief
f. Complete with all incidental materials necessary for mounting
2. Analog phone getaways panels:

a. 1 RU 24 port angled [flat] rack mountable in 19" rack
b. (24) RJ45 ports with pins 4 and 5 active wired to (1) RJ21 Telco connector.
c. Installed with 25-pair RJ-21 male patch cord
3. Manufacturer:

a. Commscope, Inc
b. General Cable
c. Systimax Solutions
d. Siemon Systems
e. Approved equal
f.

D. Fiber Patch Panels

1. Enclosures:

a. Accept modules for the termination of multimode and/or single mode fiber backbone cables and shall be sized (port/fiber count and rack units) as shown on the Drawings.
b. Rack mountable with sliding doors and strain relief
c. Blank adapter panels for unused openings
d. Complete with fiber connectors and receptacle adaptors (see "Connectors" below) and with incidental materials necessary for mounting.
2. Connectors:

a. Accept modules for the termination of multimode and/or single mode fiber backbone cables and shall be sized (port/fiber count and rack units) as shown on the Drawings.
b. Rack mountable with sliding doors and strain relief
c. Blank adapter panels for unused openings
d. Complete with fiber connectors and receptacle adaptors (see "Connectors" below) and with incidental materials necessary for mounting.

3. Manufacturers

a. Commscope, Inc
b. General Cable
c. Systimax Solutions
d. Siemon Systems
e. Approved equal

2.5 COPPER TERMINATION FRAMES AND BLOCKS

A. 110-Style Blockss:

1. Exceed TIA-568-C Category 3 specifications for performance.
2. 300-pair (or as noted on drawings) connecting blocks, designation strips, and labels for each 25-pair strip.
3. Label colors per TIA standards.
4. UL listed blocks without legs as required for mounting on frames.
5. 66-style blocks are not acceptable.

B. Manufacturer:

1. Commscope, Inc
2. General Cable
3. Systimax Solutions
4. Siemon Systems
5. Approved equal

C. Products: Panduit P110BW300 series

2.6 FIBER SPLICING HARDWARE

A. OSP Fiber Splice Closure

1. Shall be rated for underground installation in manholes and handholes.
2. Hinged case with reusable seals for future access.
3. Shall contain modular splice trays with cable strain relief and slack spool.

2.7 CABLE SUPPORTS

A. Provide per Division 27 Section 27 05 28 – Communications Raceways and Pathways.

2.8 CABLE STRAPS

A. Reusable Velcro hook-and-loop style straps to secure cable bundles. Plastic tie wraps are unacceptable.

2.9 TESTING EQUIPMENT

A. Reusable Velcro hook-and-loop style straps to secure cable bundles. Plastic tie wraps are unacceptable.

1. For copper cables: Testing device shall be a ANSI/TIA-568-C Level 4 testing instrument re-calibrated within the calibration period recommended by the manufacturer, with the most current software revision based upon the most current TIA/EIA testing guidelines.
2. For fiber cables:

    a. Testing devices shall consist of a light source/power meter with a stabilized light source for end-to-end attenuation testing and an Optical Time Domain Reflectometer (OTDR) for testing on the reel, for continuity and quality testing, for accurately determining cable length, and for locating and correcting problems noted during attenuation testing. Testing equipment shall be calibrated and traceable to the National Institute for Standards and Technologies (NIST), with an operating range of 850 ±30 nm or 1300 ±20 nm in accordance with TIA/EIA-526-14 for multimode testing, and an operating range of 1310 ±10nm or 1550 ±20 nm in accordance with TIA/EIA-526-7 for single mode testing.
    b. To ensure quality connectorization/splicing, a microscope of not less the 200x magnification shall be used to visually inspect connectors and splices after installation.

PART 3 - EXECUTION

3.1 GENERAL

A. Pay particular attention to and comply with the applicable portions of the following:

1. TIA-568-C: Commercial Building Telecommunications Cabling Standard
2. TIA-606-A: Administration Standard for Commercial Telecommunications Infrastructure
3. J-STD-607-C: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
4. TIA-455: Fiber Optic Test Standards
5. TIA-526: Optical Fiber Systems Test Procedures
6. IEEE 802.3 (series): Local Area Network Ethernet Standard, including the IEEE 802.3z Gigabit and 802.3ae and 802.3an 10 Gigabit Ethernet Standard
7. BICSI: BICSI Telecommunications Cabling Installation Manual
8. Manufacturer Recommendations and Installation Guidelines
9. TIA-455: Fiber Optic Test Standards

3.2 CABLE

A. General (applicable to all cable types):

1. Cable shall be installed in strict compliance with the manufacturer's recommendations.
2. Maintain separation from other conductors (power, fire alarm, etc.) per NEC requirements and TIA/EIA standards.
3. The bending radius and pull strength requirements of all cable as detailed in the TIA/EIA standards and the manufacturer's installation recommendations shall be strictly observed during handling and installation.

    a. Pull cables simultaneously where more than one cable are being installed in the same raceway.
    b. Use pulling compound or lubricant where necessary. Use compounds that will not damage conductor or insulation (Polywater, or approved equal).
    c. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cable or raceway.
4. Cable jackets shall not be twisted during installation. Cables showing evidence of twisting shall be replaced at no additional cost to the Owner, regardless of the outcome of cable testing.
5. Cable shall be installed in a continuous (non-spliced) manner unless otherwise indicated.
6. Cable installed in conduit and/or ducts:

    a. Fill ratios shall not exceed NEC requirements.
    b. Cable shall not be pulled into conduit/ducts until the conduit/duct ends have been prepared for cable installation (i.e. reamed to eliminate sharp edges and insulated throat bushings installed). Cables pulled into conduit/ducts prior to conduit/duct end preparation shall be replaced at no additional cost to the Owner.
    c. Reinstate pull-wires in conduits and ducts after use to facilitate future addition of cables.
7. Cable installed in cable tray:

    a. Cable shall not be attached to the cable tray (i.e. cable shall be left "loose") with the exception of cable installed in cable tray (cable runway) within telecommunications rooms (see "Cable in telecommunications rooms" below).
    b. Cable shall be laid in tray in such a way as to present a neat and professional appearance.
    c. For cable tray serving both backbone (riser) and horizontal cabling, install cable in cable tray in such a manner that backbone cabling does not overlap with horizontal cabling – reserve approximately one-fourth of the space in the tray for backbone cabling and the remaining three-fourths for horizontal cabling.
    d. Where cables in cable trays are required to maintain specific distances between each other, they shall be firmly secured to maintain this distance at fire rated penetrations.
8. Cable not installed in conduit/ducts or cable tray:

    a. Cables shall be strapped or fastened with reusable Velcro hook and loop style cable straps/fasteners for support. Staples and tie-wraps are not acceptable:
        1) Straps and fasteners shall not be over-tightened. Cables showing evidence of over-tightening shall be replaced at no additional cost to the Owner, regardless of the outcome of cable testing.

2) Straps and fasteners installed in plenum spaces shall be plenum rated.
3) Cables shall be bundled by application (horizontal or backbone) and by cable type (Cat 3, Cat 6, MM Fiber, SM Fiber, etc.). Cable applications and types shall not be intermixed within a bundle.

b. Cables in suspended cable runs shall be supported at varying intervals. Cable spans shall be limited to 5 feet or less, and the length of spans shall vary along the cable path (i.e. a given span should not be exactly the same length as the span preceding or following it – "exact" spans can degrade cable performance). See Section 27 05 28 "Pathways for Communications Systems".

c. Cable installed on exposed surfaces or structural members shall be installed parallel and perpendicular to the surfaces. Surface contours shall be followed wherever possible. Cables shall be attached to surfaces at intervals not to exceed 3 feet.

d. Attaching cables to pipes, electrical conduit, mechanical items, existing cables, or the ceiling support system (grids, hanger wires, etc. – with the exception of ceiling support anchors) is not acceptable.

9. Cable in telecommunications rooms:

a. Cable straps: Install per Division 27 Section 27 11 00 – Communications Rooms.

b. Cable on backboards:
1) Lay and dress all cables to allow other cables to enter raceway (conduit or otherwise) without difficulty at a later time by maintaining a working distance from these openings.
2) Cable shall be routed as close as possible to the ceiling, floor, sides, or corners to insure that adequate wall or backboard space is available for current and future equipment and for cable terminations.
3) Lay cables via the shortest route directly to the nearest edge of the backboard from mounted equipment or blocks. Secure all similarly routed and similar cables together and attach to D-rings vertically and/or horizontally, then route over a path that will offer minimum obstruction to future installations of equipment, backboards or other cables.
4) See "Part 3 – Execution: Copper Termination Blocks" herein for details on routing copper cabling to termination blocks.

10. Cable Slack:

a. Provide cable slack (service loops) at cable ends (both ends) to accommodate future cabling system changes.

b. Provide slack length as follows:
1) For fiber: Provide a minimum of 25 feet.
2) For copper and coaxial: Provide a minimum of 25 feet.

B. Copper Cable

1. All pairs within a cable shall be terminated. Un-terminated cable pairs are not acceptable.
2. Provide strain relief at the patch panels to ensure durable connections.
3. For shielded/armored cable, bond both ends of the metallic shield (or metallic strength member) to the nearest TGB.

C. Fiber Cable:

1. All fiber strands within a fiber cable shall be spliced/connectorized. The installation of "dark fiber" is not acceptable.
2. Cable shall be tested on reel prior to installation.

3.3 CABLE ASSEMBLIES (PATCH CORDS) AND CROSS-CONNECTS

A. Provide cable assemblies to Owner.

3.4 CONNECTORS

A. Fiber connectors and splices:

1. Visually check fiber connectors/splices after splicing with a minimum 200x magnification microscope to ensure that no physical damage has occurred during the installation process.
2. Fiber splices shall be fusion and shall be required for all fiber strands. Mechanical splices are not acceptable. Each fusion splice shall be protected in a splice tray or similar protective device that is designed to mount within the enclosure. Bare/stripped optical fiber strands shall be protected with a heat shrink or silicon adhesive to prevent exposure to moisture.

3.5 COPPER TERMINATION BLOCKS

A. Cable shall be routed horizontally along base of backboard until it reaches the termination block column on which it is to terminate and then shall route vertically to the termination block.

B. Termination block punch downs shall be as follows:

1. Punch down cable sequentially across the termination strips.
2. Punch down cable using only the selected communication cabling system Manufacturer approved impact tool.

3.6 TESTING

A. General

1. Test devices shall be in calibration throughout the testing period. Tests performed on equipment without up to date calibration shall be rejected and shall be repeated at no additional cost to the Owner.
2. Notify the Consultant and Owner seven (7) days in advance of each type of test to be conducted. The Owner and/or Consultant may, at their discretion, witness all testing.

    a. The Owner and Consultant shall be invited to attend and inspect the first instance of each type of test to be conducted. Tests conducted prior to first inspection shall be at the sole risk of the Contractor, and as such are subject to rejection. Such tests will be repeated at no additional cost to the Owner.

B. Systems Specific Testing:

1. Communications Cabling System

a. All interior (inside plant) and exterior (outside plant) fiber cables shall be tested on the reel upon delivery to the job site prior to installation.
   1) Test results shall be permanently affixed to the reel and a copy given to the Owner and Consultant for review prior to installation.
   2) Testing shall demonstrate compliance with the factory test results as shipped with the reel. Cables that fail to pass shall not be installed, and replace the cable at no additional cost to the Owner. Repair of damaged cable is not acceptable.

b. Test the communications cabling system for compliance to the Governing Requirements and all applicable standards as follows:
   1) Visually inspect all labels at the station locations (faceplates/ports), patch panels/ports, and on each end of each cable to ensure that all cables and equipment are correctly identified.
   2) Copper Cable:
      a) For Backbone Distribution (inside and outside plant): Test each cable, all pairs, for length, shorts, opens, continuity, polarity reversals, transposition (wire map), and the presence of AC voltage.
         (1) Test entire channel, from termination block to termination block.
         (2) Test results shall demonstrate compliance with:
            (a) The criteria specified in TIA/EIA-568-C for Category 3 cables
   3) Fiber Cable:
      a. Prior to testing, calculate the cable loss budget for each optical fiber cable and shall be clearly shown on the test documentation. Maximum loss shall be calculated by the following formula, assuming no splices:
         (1) For Backbone Distribution:
            (a) Max Loss = (allowable loss/km) * (km of fiber) + (0.4 dB) * (# of connectors) + (0.3 dB) * (# of splices)
            (b) A mated connector-to-connector interface is defined as a single connector for the purposes of the above formula.
         (2) A given fiber cable shall not exceed its calculated maximum loss (per the above formula).
      b. Test all strands. Testing shall consist of a bi-directional end-to-end Optical Transmission Loss Test Instrument trace performed per ANSI/TIA-568-C, TIA/EIA-455-61 and/or a bi-directional end-to-end power meter test performed per ANSI/TIA-568-C and TIA/EIA-455-53A.
         (1) Loss numbers shall be calculated by taking the sum of the two bi-directional measurements and dividing that sum by two.
         (2) All backbone fiber cables shall be tested with an OTDR in addition to attenuation testing performed with a power meter.
            (a) The number of samples (averages) for each OTDR test shall be such that the noise amplitude is significantly less than the smallest loss of any component under test.
         (3) Multimode fiber testing shall incorporate use of a mandrel wrap of fiber jumper to induce macro bends in the fiber.
      c. Test measurements shall be provided as follows:

(1) For Multi-mode Cable: Test at both 850 and 1300 nm.
(2) For Single mode Cable: Test at both 1300 and 1550 nm.

d. Test results shall demonstrate compliance with:
(1) The criteria specified in TIA/EIA-568-C
(2) The calculated loss budget above.
(3) The criteria specified in IEEE 802.3z (1000Base-X Gigabit Ethernet) and IEEE 802.3ae (10GBase-X 10 Gigabit Ethernet)

c. In addition to the above, tests performed shall be both those recommended and mandated by the communications cabling system Manufacturer.

d. Cables and equipment that do not pass shall be identified to the Consultant. The source of the non-compliance shall be determined, corrected or replaced, and re-tested at no additional cost to the Owner. Provide new test results to the Consultant in the same manner as above.

1) If it is determined that a cable is at fault, remove the damaged cable and replace it with a new cable. Cable "repairs" are not acceptable. The procedure for removing the cable shall be as follows:
a. Prior to removal of the damaged cable and re-pull of the new cable:
(1) Any cables which are in the same conduit, duct or innerduct as the damaged cable shall be tested, regardless of whether or not they are new cables installed as part of this project or existing cables installed prior to this project.
(2) If the damaged cable is a backbone or outside plant cable:
(a) The Owner and Consultant shall be informed of the schedule for the removal and re-pull.
(b) The new cable shall be tested on the reel prior to installation.
(3) All test results shall be provided to the Consultant for approval.
b. The damaged cable shall be removed and the new cable shall be pulled in.
c. After the removal of the damaged cable and re-pull of the new cable:
(1) The new cable shall be tested.
(2) Any cables which are in the same conduit, duct or innerduct as the damaged cable shall be tested, regardless of whether or not they are new cables installed as part of this project or existing cables installed prior to this project.
(3) All test results shall be provided to the Consultant for approval
d. Existing cables which are in the same conduit, duct or innerduct as the damaged cable, and which are damaged by the extraction and re-pull process, shall be removed and replaced at no additional cost to the Owner.
(1) Existing damaged cables that are replaced shall be subject to the testing procedures of this section in its entirety.

END OF SECTION 271300

SECTION 271500 – COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for the installation of a TIA standard interior (inside plant) communications horizontal cabling system.

B. Horizontal Cabling Description:

1. Horizontal cabling system shall provide interconnections between Telecommunication Rooms and the equipment outlet. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
3. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

C. Contractor shall provide all Labor, Materials, Contractor's Equipment and Plant to fully execute the requirements to deliver, configure, install and commission the Works as shown on the Drawings and described in this section. Further requirements are that the provisions of this section shall be complementary to and shall be correlated with, the requirements of the Contract.

D. Section includes:

1. Cabling

    a. Category 6 twisted pair cable
2. Cable assemblies (patch cords) and cross-connects
3. Telecommunications outlets
4. Surge protection
5. Cable supports
6. Cable straps
7. Testing Hardware

1.2 RELATED DOCUMENTS

A. Section 27 05 00 Common Work Results for Communications

B. Section 27 05 26 Grounding & Bonding for Communications Systems

C. Section 27 05 28 Pathways for Communications Systems

D. Section 27 05 36 Cable Tray for Communications Systems

E. Section 27 05 44 Sleeves and Sleeve Seals for Communications Pathways and Cabling

F. Section 27 05 53 Identification for Communications Systems

G. Section 27 13 00 Communications Backbone Cabling

1.3 DEFINITIONS

A. Abbreviations

1. AC Above Counter
2. ASTM American Society for Testing and Materials
3. CAT Category Cable
4. F/FTP Overall Foil Screened Cable with Foil Screened Twisted Pair
5. F/UTP Overall Foil Screened Cable with Unscreened Twisted Pair
6. FO Fiber Optic
7. FTP Foil Twisted Pairs
8. ICEA Insulated Cable Engineers Association
9. IDC Insulation Displacement Connector
10. MUTOA Multiuser Telecommunications Outlet Assembly
11. NECA National Electrical and Communications Association
12. NEMA National Electrical Manufacturers Association
13. RFI Radio-Frequency Interference
14. S/FTP Overall Braid Screened Cable with Unscreened Twisted Pairs
15. S/UTP Overall braid screened cable with unscreened twisted pairs
16. SMFO Single-Mode Fiber Optic"
17. UTP Unshielded Twisted Pair

B. Definition

1. Cross-Connect - A facility enabling the termination of cable elements and their interconnection or cross-connection.
2. Jack Also commonly called an "outlet," it is the fixed, female connector.
3. Plug Also commonly called a "connector," it is the removable, male telecommunications connector.
4. Screen - A metallic layer, either a foil or braid, placed around a pair or group of conductors.
5. Shield - A metallic layer, either a foil or braid, placed around a pair or group of conductors.

1.4 APPLICABLE LAWS, CODES, RULES, REGULATIONS, AND STANDARDS

A. UL 1685 - Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

B. UL 1666 - Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

C. ICEA S-103-701 - Riser Cables Technical Requirements

D. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials

E. TIA-568-C.1 - Commercial Building Telecommunications Cabling Standard

F. TIA-569-D - Telecommunications Pathways and Spaces

G. TIA-607-D - Telecommunications Bonding and Grounding (Earthing) for Customer Premises

H. NEMA WC 66/ICEA S-116-732 - Standard for Category 6 and 6A, 100 Ohm, Individually Unshielded Twisted Pairs, Indoor Cables

I. TIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components

J. NECA 1 - Standard for Good Workmanship on Electrical Construction

K. NECA/BICSI 568 - Cabling Installation

L. TIA-568-C.0 - Generic Telecommunications Cabling for Customer Premises

M. ISO/IEC 11801 - Generic Cabling for Customer Premises

1.5 SUBMITTALS

A. Provide submittal information for the following submittal sections as described below:

1. Product Data

2. Shop Drawings:

a. Cable Routing and Grouping Plan: Provide only if cable routing and grouping have not been shown on the Drawings, or if proposing a deviation.

3. Testing

a. Provide a list of proposed test equipment for use in verifying the installation of the communications cabling system.
   1) Provide for each testing device:
   2) Manufacturer and product number.
   3) Manufacturer documentation showing date and outcome of last re-calibration. Testing device shall have been re-calibrated within the manufacturer's recommended recalibration period.
   4) Manufacturer documentation showing software revision. Software revision shall be most current revision available for the device and shall be based upon the most current TIA testing guidelines.
   5) Patch cords and other specialized components.

b. Provide proposed test results forms.

1.6 QUALITY ASSURANCE

A. The Quality Assurance as described in Section 27 05 00 "Common Work Results for Communications" applies to this Section.

B. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, cabling administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.7 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall comply with the Delivery, Storage and Handling requirements as described in Section 27 05 00 "Common Work Results for Communications."

B. Test cables upon receipt at Project site.

C. Test each pair of twisted pair cable for open and short circuits.

1.8 PROJECT CONDITIONS

A. The Project Conditions as described in Section 27 05 00 "Common Work Results for Communications" apply to this Section.

B. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.9 WARRANTY

A. The Warranty Conditions as described in Section 27 05 00 "Common Work Results for Communications" apply to this Section.

PART 2 - PRODUCTS

2.1 GENERAL

A. Communication cabling system components shall be sourced (manufactured) by formally partnered Manufacturers (collectively referred to as the "Manufacturer"). Products shall not be intermixed between different manufacturers unless the Manufacturer of the chosen communications cabling system has listed (in writing) another manufacturer's component as an

"Approved Alternative Product" and will warrant the "Approved Alternative Product" as part of the Manufacturer's extended Warranty.

1. The communications cabling system Manufacturer shall be:

    a. Commscope, Inc.
    b. General Cable
    c. Systimax Solutions; A Commscope Brand
    d. Siemon Systems
    e. Approved equal

B. For a given Manufacturer, all cabling products shall be part of a single product line – components shall not be intermixed between a Manufacturer's product lines. The product line shall be engineered "end-to-end" (i.e. the system and all of its components shall be engineered to function together as a single, continuous transmission path).

2.2 PERFORMANCE

A. Protocols/Services:

1. At a minimum, the communications cabling system shall support data network protocols/services at rates up to 1 Gbps, 10 Gbps for Cat. 6 outlets. It shall support 10Mb, 100Mb, and 1Gb Ethernet, (10Gbs for Cat. 6 outlets) and other network protocols up to a channel length of 100 meters.

B. Category Rating (for copper components):

1. Copper components (cable, connectors, etc.) shall exceed the transmission requirements for connecting hardware as specified in the TIA standards for the Category for which they are rated. Copper components shall be rated Category 6 or greater.
2. Copper components for wireless access points shall be rated Category 6 or greater.

2.3 CABLING

A. Environmental Ratings

1. Plenum rated
2. Cable installed in raceway below grade, in slab on grade or extending to the building from the exterior shall be indoor/outdoor with dry blocking and shall have the same indoor environment rating as the remainder of cabling in the facility.
3. Cable shall bear markings for the environment in which they are installed.

B. Manufactured by the selected communications cabling Manufacturer.

C. Provide station cable in types, sizes, and quantities as defined by the Symbol Schedule and as shown on the Drawings.

D. Category 6: Cable shall exceed category transmission requirements as specified in TIA -568-C, shall be 4-pair, UTP, 23/24 AWG, with solid copper conductors.

2.4 CABLE ASSEMBLIES (PATCH CORDS) AND CROSS-CONNECTS

A. Pre-manufactured (factory-terminated), stranded UTP, with 8-pin modular plugs.

B. Thin 28-gauge stranded

C. Manufactured by the selected communications cabling Manufacturer.

D. Category 6: Patch cables shall exceed Category 6 transmission as specified in TIA -568-C.2. Modular plugs shall be complete with snagless boots.

E. Quantities, Colors, and sizes shall be:

1. Provide 10-foot patch cables for bidding purposes
2. Color shall be blue
3. Provide for 100% of Category 6 ports. (include 2 patch cords for each cable) Coordinate exact lengths and colors prior to orderings with the owner.

F. UTP Patch Panels

1. Angled and rack mountable in 19" rack
2. 2 RU, 48-port modular
3. Terminate 4-pair, 22-26 AWG, 100 ohm unshielded twisted pair cable with a standard 110 punchdown tool
4. IDC connectors to support a universal (T568A and T568B) wiring pattern.
5. Rear cable support bar/strain relief (2 per patch panel)
6. Exceed the transmission requirements for connecting hardware as specified in the TIA standards for the Category for which they are rated, and shall be complete with pre-manufactured cable management for supporting cables behind the patch panel and with all incidental materials necessary for mounting.

2.5 TELECOMMUNICATIONS OUTLETS

A. The work area outlets shall be configured as detailed below for each type. The color cable associated with the outlets are specified under the station cable section.

1. Ticket Counter Outlet:

    a. 6-port faceplate
    b. Color: White
    c. UTP cables(s) and connector(s), quantity as shown on drawings
    d. Blank filler(s) for unused ports
2. LCD Outlet

    a. 2-port faceplate

b. Color: White
c. UTP cables(s) and connector(s), quantity as shown on drawings
d. Blank filler(s) for unused ports

3. Wireless Access Point/Above Ceiling Outlet/LED/Security Camera/Misc Equipment Outlet:

   a. Minimum 6" square device box
   b. Color: White
   c. UTP cable and connector
   d. Surface mounted 2-port biscuit jack with CAT6 ports

4. Direct Connect:

   a. Field terminated direct connector
   b. Color: Black
   c. Panduit TX6A or approved equal for Cat. 6 application
   d. Utilize angled version where required to maintain minimum bend radius per cabling manufacturer

5. Provide blank fillers for unused ports.

2.6 SURGE PROTECTION

A. Surge protection devices shall be provided for exterior mounted field devices exposed to lightning strikes.

B. Surge protection device shall be din rail mounted within Communications Interface Boxes (CIBs). Quantity based on number of field devices served by each CIB.

C. Surge protection device shall have the following minimum characteristics:

1. RJ45 connections with external grounding screws for UTP cabling connections
2. Compatible with CAT6 cabling
3. Allows for data speeds up to 10GbE without signal degradation
4. Compatible with PoE and PoE+ applications
5. Common Mode (L-G) Clamping Voltage: 75V
6. Differential Mode (L-L) Clamping Voltage: 72V
7. Surge Current Rating: 20kA/Pair
8. Maximum Continuous Current: 1.5 Amps

2.7 CABLE SUPPORTS

A. Provide per Division 27 Section 27 05 28 – Communications Raceways and Pathways, and Grounding.

2.8 CABLE STRAPS

A. Reusable Velcro hook-and-loop style straps to secure cable bundles. Plastic tie wraps are unacceptable.

2.9 TESTING HARDWARE

A. Testing Devices: Testing devices shall be capable of storing and printing test records for each cable within the system.

1. For copper cables: Testing device shall be a ANSI/TIA-568-C Level 4 testing instrument re-calibrated within the calibration period recommended by the manufacturer, with the most current software revision based upon the most current TIA/EIA testing guidelines.

PART 3 - EXECUTION

3.1 GENERAL

A. Pay particular attention to and comply with the applicable portions of the following:

1. TIA-568-C: Commercial Building Telecommunications Cabling Standard
2. TIA-606-A: Administration Standard for Commercial Telecommunications Infrastructure
3. J-STD-607-C: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
4. TIA-455: Fiber Optic Test Standards
5. TIA-526: Optical Fiber Systems Test Procedures
6. IEEE 802.3 (series): Local Area Network Ethernet Standard, including the IEEE 802.3z Gigabit and 802.3ae and 802.3an 10 Gigabit Ethernet Standard
7. BICSI: BICSI Telecommunications Cabling Installation Manual
8. Manufacturer Recommendations and Installation Guidelines

3.2 PATCH PANELS

A. Station Patch Panels: Ports shall be terminated sequentially, from left to right, from patch panel to patch panel.

3.3 CONNECTORS

A. Copper Connectors (modular jacks):

1. For station distribution:

a. The T568B wiring pattern shall be used at both ends of the cable.

3.4 CABLE

A. General (applicable to all cable types):

1. Cable shall be installed in strict compliance with the manufacturer's recommendations.

2. Maintain separation from other conductors (power, fire alarm, etc.) per NEC requirements and TIA standards.
3. The bending radius and pull strength requirements of all cable as detailed in the TIA standards and the manufacturer's installation recommendations shall be strictly observed during handling and installation.

    a. Pull cables simultaneously where more than one cable is being installed in the same raceway.
    b. Use pulling compound or lubricant where necessary. Use compounds that will not damage conductor or insulation (Polywater, or approved equal).
    c. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cable or raceway.
4. Cable jackets shall not be twisted during installation. Cables showing evidence of twisting shall be replaced at no additional cost to the Owner, regardless of the outcome of cable testing.
5. Cable shall be installed in a continuous (non-spliced) manner unless otherwise indicated.
6. Cable installed in conduit and/or ducts:

    a. Fill ratios shall not exceed NEC requirements.
    b. Cable shall not be pulled into conduit/ducts until the conduit/duct ends have been prepared for cable installation (i.e. reamed to eliminate sharp edges and insulated throat bushings installed). Cables pulled into conduit/ducts prior to conduit/duct end preparation shall be replaced at no additional cost to the Owner.
    c. Reinstate pull-wires in conduits and ducts after use to facilitate future addition of cables.
7. Cable installed in cable tray:

    a. Cable shall not be attached to the cable tray (i.e. cable shall be left "loose") with the exception of cable installed in cable tray (cable runway) within telecommunications rooms (see "Cable in telecommunications rooms" below).
    b. For performance reasons, station cable in tray shall not be combed.
    c. Cable shall be laid in tray in such a way as to present a neat and professional appearance.
    d. For cable tray serving both backbone (riser) and horizontal cabling, install cable in cable tray in such a manner that backbone cabling does not overlap with horizontal cabling – reserve approximately one-fourth of the space in the tray for backbone cabling and the remaining three-fourths for horizontal cabling.
    e. Where cables in cable trays are required to maintain specific distances between each other they shall be firmly secured to maintain this distance at fire rated penetrations.
8. Cable not installed in conduit/ducts or cable tray:

    a. Cables shall be strapped or fastened with reusable Velcro hook and loop style cable straps/fasteners for support. Staples and tie-wraps are not acceptable:
        1) Straps and fasteners shall not be over-tightened. Cables showing evidence of over-tightening shall be replaced at no additional cost to the Owner, regardless of the outcome of cable testing.
        2) Straps and fasteners installed in plenum spaces shall be plenum rated.
        3) Cables shall be bundled by application (horizontal or backbone) and by cable type (Cat 3, Cat 6, MM Fiber, SM Fiber, etc.). Cable applications and types shall not be intermixed within a bundle.

b. Cables in suspended cable runs shall be supported by cable supports at varying intervals. Cable spans shall be limited to 5 feet or less, and the length of spans shall vary along the cable path (i.e. a given span should not be exactly the same length as the span preceding or following it – "exact" spans can degrade cable performance).
c. Cables in suspended cable runs shall be supported by cable supports at varying intervals. Cable spans shall be limited to 5 feet or less, and the length of spans shall vary along the cable path (i.e. a given span should not be exactly the same length as the span preceding or following it – "exact" spans can degrade cable performance).
d. Cable installed on exposed surfaces or structural members shall be installed parallel and perpendicular to the surfaces. Surface contours shall be followed wherever possible. Cables shall be attached to surfaces at intervals not to exceed 3 feet.
e. Attaching cables to pipes, electrical conduit, mechanical items, existing cables, or the ceiling support system (grids, hanger wires, etc. – with the exception of ceiling support anchors) is not acceptable.

9. Cable in telecommunications spaces:

a. Cable straps: Install per Division 27 Section 27 11 00 "Communications Equipment Room Fittings".
b. Cable on backboards:
    1) Lay and dress all cables to allow other cables to enter raceway (conduit or otherwise) without difficulty at a later time by maintaining a working distance from these openings.
    2) Cable shall be routed as close as possible to the ceiling, floor, sides, or corners to insure that adequate wall or backboard space is available for current and future equipment and for cable terminations.
    3) Lay cables via the shortest route directly to the nearest edge of the backboard from mounted equipment or blocks. Secure all similarly routed and similar cables together and attach to D-rings vertically and/or horizontally, then route over a path that will offer minimum obstruction to future installations of equipment, backboards or other cables.
c. Cable terminating on patch panels located on racks:
    1) Route cables in telecommunications rooms to patch panels on racks by routing across cable runway to top of rack and then down vertical cable management sections to patch panel.
d. Cable bundle combing:
    1) Cable bundles shall be combed to present a neat and professional appearance. For performance reasons, combing shall occur from the cable end to a maximum of 35 feet back (or per the Manufacturer's recommendations, whichever is more stringent). For the portion of a cable bundle exceeding this requirement (if any), the exterior cables in the cable bundle shall be combed straight. Interior cables shall not be combed (i.e., they shall be left "mixed").

10. Cable bundles exiting floor or wall penetrations and running into furniture or casework shall be wrapped in spiral wrap or split-loom tubing for protection.
11. Cable Slack:

a. Except where otherwise noted, provide cable slack. length as follows:
    1) At the device box:
        a) Provide a minimum of 6 inches. Do not form a loop with the cable slack. Excess cable shall be pushed up the conduit.

b) Provide a minimum of 5 feet slack above the ceiling coiled per manufacturer's recommendations and supported off the ceiling grid.

2) In the telecommunications room: Route cable around ladder rack to provide a slack loop, minimum 5 feet.

B. Copper Cable:

1. All pairs within a cable shall be terminated. Un-terminated cable pairs are not acceptable.
2. Maximum length of station distribution cable shall be 90 meters (including required cable slack, see "Cable Slack" above). Do not exceed this length without prior approval from the Engineer.
3. Station cable which is exposed or not in conduit shall be routed to comply with TIA -569-B rules for avoiding potential EMI sources and as follows:

   a. Provide clearances of 18 inches from light fixtures.
   b. Provide clearances of 12 inches from conduit and cables for electrical power distribution.
   c. Provide clearances of 4 feet from motors and transformers.
   d. Pathways shall cross perpendicular to fluorescent lighting and electrical power cables or conduits.
4. Provide strain relief at the patch panels and at the outlets to ensure durable connections.

3.5 CABLE ASSEMBLIES (PATCH CORDS) AND CROSS-CONNECTS

A. Patch the switch ports in Telecom Rooms per Owner direction.

B. Furnish cable assemblies to Owner for the workstation outlets

3.6 INSTALLATION OF WIRELESS ACCESS POINTS

A. Install wireless access points in ceiling or as indicated on plans.

B. Patch the wireless access point in the ceiling and in the Telecom Room to the network ports designated by the Owner.

C. Provide the following documentation to the owner:

1. MAC address of each WAP
2. The cable jack number to which it is connect
3. The patch panel port number
4. The switch blade and port number to which it is patched

3.7 TESTING

A. Test devices shall be in calibration throughout the testing period. Tests performed on equipment without up to date calibration shall be rejected and shall be repeated at no additional cost to the Owner.

B. Notify the Consultant and Owner seven (7) days in advance of each type of test to be conducted. The Owner and/or Consultant may, at their discretion, witness all testing.

1. The Owner and Consultant shall be invited to attend and inspect the first instance of each type of test to be conducted. Tests conducted prior to first inspection shall be at the sole risk of the Contractor, and as such are subject to rejection. Such tests will be repeated at no additional cost to the Owner.

C. Communications Cabling System

1. Test the communications cabling system for compliance to the Governing Requirements and all applicable standards as follows:

    a. Visually inspect all labels at the station locations (faceplates/ports), patch panels/ports, and on each end of each cable to ensure that all cables and equipment are correctly identified.
    b. Copper Cable:
        1) For Horizontal Cabling (Station Distribution): Test each copper station cable, all pairs. To the extent possible, tests shall be performed with building electrical systems fully powered on (i.e. Lights, HVAC, etc.).
            a) Test each end-to-end Permanent Link (the entire link from the connector at the station to the connector or termination in the telecommunications closet) utilizing sweep tests, for Wire map (continuity), length, and parameters prescribed in TIA -568-C. Each cable shall be tested in both directions.
            b) Test results shall demonstrate compliance with the criteria specified in TIA -568-C.2 for Category 6 cables The criteria specified in IEEE 802.3z (1GBase-T 1 Gigabit Ethernet).
2. In addition to the above, tests performed shall be both those recommended and mandated by the communications cabling system Manufacturer.
3. Cables and equipment that do not pass shall be identified to the Consultant. The source of the non-compliance shall be determined, corrected or replaced, and re-tested at no additional cost to the Owner. Provide new test results to the Consultant in the same manner as above.

    a. If it is determined that a cable is at fault, remove the damaged cable and replace it with a new cable. Cable “repairs” are not acceptable. The procedure for removing the cable shall be as follows:
        1) Prior to removal of the damaged cable and re-pull of the new cable:
            a) Any cables which are in the same conduit, duct or innerduct as the damaged cable shall be tested, regardless of whether or not they are new cables installed as part of this project or existing cables installed prior to this project.
            b) If the damaged cable is a backbone or outside plant cable:
                (1) The Owner and Consultant shall be informed of the schedule for the removal and re-pull.
                (2) The new cable shall be tested on the reel prior to installation.
            c) All test results shall be provided to the Consultant for approval.
        2) The damaged cable shall be removed and the new cable shall be pulled in.
        3) After the removal of the damaged cable and re-pull of the new cable:

a. The new cable shall be tested.
b. Any cables which are in the same conduit, duct or innerduct as the damaged cable shall be tested, regardless of whether or not they are new cables installed as part of this project or existing cables installed prior to this project.
c. All test results shall be provided to the Consultant for approval.

4) Existing cables which are in the same conduit, duct or innerduct as the damaged cable, and which are damaged by the extraction and re-pull process, shall be removed and replaced at no additional cost to the Owner.

a) Existing damaged cables that are replaced shall be subject to the testing procedures of this section in its entirety.

END OF SECTION 271500

SECTION 28 15 00 - CARD ACCESS CONTROL SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements of the applicable Division 26 and 28 Sections apply to this Section.

1.2 SCOPE

A. The work under this Section includes all supervision, labor, materials, equipment, tools, devices, etc. necessary in order to provide and/or relocate security/access control system components including card readers, door contacts, door release push buttons, door controllers, fire alarm interface units, wiring raceways and supports. Provide directly integrated coordination with the Building management system for control and communication and reporting. A system of dry contacts shall not be acceptable Refer to plans for additional information. Coordinate interface of readers with Baggage Handling System.

1.3 WORK NOT INCLUDED

A. Electromagnetic door strikes shall be as specified in the door hardware section of the specifications.

1.4 SUBMITTALS

A. Provide shop drawings with complete wiring diagrams of interconnections between all components of card reader system, including Omron controllers, fire alarm system, etc.

PART 2 PRODUCTS

2.1 The Contractor shall furnish and install card readers, door controllers, electromagnetic locks, control modules, door contacts, fire alarm control module and horns as specified to be manufactured by Matrix, Omron, Ademco, Locknetics, Honeywell, etc, to the exclusion of all others.

2.2 CONDUIT: See Section 260533

2.3 POWER WIRING: See Section 260519.

2.4 WIRING: Provide as per system manufacturer's specifications in order to have a completely functional system.

A. As a minimum wiring shall be as manufactured by West Penn, No. D253652, tinned copper, shielded, twisted, plenum rated, data grade cables.

2.5 ACCESS CONTROL SYSTEM:

A. Card Readers:

1. Matrix MX Series or latest version

B. Reader Control Module: Matrix RCM #05-13998 or newer version

C. Door Controller: OMROM CJ1M with 4A, 24V secondary power supply.

1. Wall mount controller in Hoffman box with Key #A242406LP.
2. Field verify exact location with MDAD.

D. Power Supply: Provide power supply (emergency 120 vac input) unit for each reader controller as required by the system.

E. Magnetic Switch (Door contact):

1. Surface mounted, ADEMC0 7939.
2. Recessed mounted, twist-lock mag USPUS-260 with adapter.
3. Door contacts shall be monitored by the system terminal controllers

F. Electronic Lock: Locknetics 390-DSM-MBS 12/24 volt DC. 1500 lbs. holding force with door status switch connected to Matrix card reader. Mount on push side of door jamb with plate attached to the push side of the door. Provide connection from RDP for power and releases.

G. Alarm Indicating Device: 12/24VDC, Wheelock #105024 Horn and LED type blue flashing light with backbox, NEMA 1 location, Patlite WME 202 EN-B. Mount above door on side of door with camera.

H. Fire Alarm Control Module: Honeywell No. TC809A1031

1. For fire alarm release of magnet through Omron Controller. Connect to nearest intelligent fire alarm panel.
2. Provide signal from Omron controller to card reader for reporting fire alarm release to host computer.

3. Mount on 4" Sq. x 1-1/2" deep box on wall above door, above accessible ceiling near door or in secure room near door.

I. Reader distribution panels with I/O Card: Matrix Model #05-13998 or newer version.

2.6 The access control system shall grant or deny access to the defined controlled area (door) by card number, time-of-day and the day of the week. Readers shall communicate with the host CPU.

2.7 The system shall be an interactive automated system, designed and programmed to integrate alarm monitoring, alarm annunciation, access control and any remote control applications within the facility.

2.8 The system shall monitor alarm points, door status and related conditions and initiate the appropriate outputs. The system also shall control elevators through the elevator's control system. Coordinate all elevator control functions, wiring and connections with elevator equipment manufacturer.

2.9 All system readers shall be connected to their electronic package in a secure fashion (to prevent tampering). The card reader database and time keeping abilities shall have battery back-up to insure that there is no loss of information in the event of a power failure. In the event of failure in either the CPU or the communications equipment all activities are to be monitored at the reader level. Each individual card reader shall have the capability to store up to 5,000 badges in its database and 48 hour (minimum) battery backup of the clock and database. Information and any communications between individual card reader locations shall be completed via either two or four-wire communications paths.

PART 3 EXECUTION

3.1 INSTALLATION

A. Minimum size junction box shall be 4 inches square by 1-1/2 inch deep.

B. Provide conduits, inside door jambs, for installation of security wiring.

C. Provide bushings on the ends of cut conduits.

D. Provide wiring as required by the system manufacturer and these specifications, to all devices and controllers.

E. Follow all installation procedures as recommended by the system manufacturer. Coordinate all rough-in work with the Architectural drawings and door hardware requirements.

F. Provide mounting supports, brackets, etc., for the installation of card readers, door controllers, control modules, etc.

G. Any programming required to activate the card readers or the overall system onto the central security system for MIA shall be done by a qualified, factory trained, Matrix technician.

H. Contractor shall be responsible for interfacing and for performing all interconnections between Matrix equipment and all components from other manufacturers, such as Omron Controllers, door switches, push buttons, door magnets, electromagnetic locks, Honeywell control modules, Baggage Handling System MCPS, etc. System components shall be compatible with existing Matrix software and installation such that no false alarms are generated. Provide directly integrated coordination with the Building management system for control and communication and reporting. A system of dry contacts shall not be acceptable.

I. Coordinate all work with MDAD Security Shop (Telephone No. 876-7524).

J. System shall be tested and demonstrated to the Owner, including one 2-hour operational training session, by a factory trained technician, fully authorized by the system manufacturer.

K. Upon completion of system testing, an operational certificate shall be provided by the system manufacturer.

L. Any new System Component shall have a two year warranty, including all parts and labor. Labor shall include, under the warranty, all field system diagnostics, repairs and replacements, by a factory trained technician.

END OF SECTION

SECTION 282000 - VIDEO SURVEILLANCE SYSTEM

PART 1 GENERAL:

1.1 SUMMARY

A. Provide an integrated security management system in accordance with the contract documents. The work of this section includes, but is not limited to the following:

1. Section 281300: Access Control Software and Database Management

2. Section 281500: Access Control Hardware Devices

B. The Contractor shall be responsible for providing a complete fully operational turnkey security system as specified within these documents.

C. Description of Work

1. Provide and install a closed-circuit television system including, but not limited to, color cameras, pan-tilt and zoom (PTZ) lens, color monitors, lenses, auto-iris, controls, filters, switcher, amplifiers, power supplies, mounts, housings, and attendant equipment and hardware.

D. Functional Description

1. The primary functions of the CCTV system shall be for alarm assessment, access control verification purposes and general surveillance.

2. The system shall interface with the ACAMS through an Ethernet interface.

3. Each PTZ camera shall have a pre-set park position with preset alarm positions. The Contractor shall clearly identify all park positions on submittal drawings.

4. The digital video recorder shall be programmed to record all video at no less than 3.5 frames per second (in-activity), 24 hours/7days a week at a minimum resolution of 4CIF. The digital video shall be stored for a period of 30 days. The VSS shall be capable of increasing the frame rate to 30 frames per second upon alarm conditions. Provide no less than 1 terabyte of usable space per camera.

1.2 SUBMITTALS

1.3 REQUIREMENTS SUMMARY:

1. Material cost breakdowns.

2. Letters of Certification, Product Cut Sheets, or other items to support the information as requested by the Architect.

1.4 QUALITY ASSURANCE

A. Coordination Shop Drawings: Refer to Division 1 Section 01340 for requirements for

Coordination Shop Drawing.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Arecont Vision

B. Axis Communications

C. Pelco by Schneider Electric

2.2 MATERIALS:

A. Network Video System

1. The video surveillance head-end equipment (network video system) shall be IP-based and shall be capable of storing and managing all video via the network.

2. Video equipment shall be capable of, and sized, to provide recording with the following requirements (requirements identified to provide a baseline):

a. 15fps, all cameras and continuous

b. 4 CIF

c. Average storage length: 30 days

B. High Definition Fixed IP Camera Requirements (Type 1)

1. The camera must have independent 'serverless' operation. Full functionality must be available without the need to use up network bandwidth contacting a central license or administration server.

2. The camera must have a 1/3" Progressive Scan CCD sensor

3. The camera sensor must have 1280 (H) x 1024 (V) active pixels

4. The camera must have a minimum sensitivity of 0.9 Lux at F1.2 (Color) 0.1Lux at F1.2 (Mono)

5. There must be automatic or manual gain control across a 30dB range

6. The camera must have image mirror and flip control.

7. The camera Signal/Noise ratio must be better than 45 dB

8. The camera must have a horizontal resolution of 625 TVL 16:9 chart (700 4:3 chart)

9. The camera must have Back Light Compensation control.

10. The camera must have Iris Control via an Auto-iris DC drive

11. Lens mounting must be either C or CS mount
12. The camera power consumption must be 11W maximum.
13. Video compression must be H.264 (ISO 14496-10)
14. The camera must support user configurable bit rates from 32Kbps to 8Mbps
15. The camera must support 720p HD standard resolution (1280 x 720 pixels)
16. The camera must have 2 opto-isolated binary inputs and 1 solid-state relay output.
17. The camera must have a standard Ethernet interface complying with IEEE802.3 and IETF 10/100 Base-T Ethernet
18. The camera must use Linux as an embedded operating system.
19. The camera must have an IP firewall, which can block all except an allowed list of IP addresses.
20. The camera must support simultaneous connections from up to 16 unicast users plus unlimited multicast users
21. The camera must support standard media transport protocols: TCP, UDP, UDP Multicast
22. The camera must have an embedded real-time clock and be able to use the NTP protocol to synchronize time across a network.
23. The camera must be powered either using standard Power over Ethernet (802.3af) or 24V AC/DC @ 0.45A
24. The camera must have full-duplex audio capability and use MPEG-4 Advanced Audio Encoding.
25. Audio sampling must be 16 kHz sample rate; 16 bit resolution; 100 – 7000 Hz bandwidth
26. The camera must support user-selectable audio bit rate of 32, 48 or 64 Kbps
27. Operating temperature: 0°C to 40°C
28. The camera must be supplied with the following choice of HD lenses:
    a. Ultra Wide: 1.3mm, Horizontal view angle 110o, F1.8, Auto-iris, CS Mount
    b. Standard: IR Corrected 3mm - 8mm, Horizontal view angle 100° (W) 35° (T), F1.2, Auto-iris, Vari-focal, CS Mount
    c. Standard: non-IR corrected 2.8mm – 8mm, Horizontal view angle 90.7° (W) 35.2° (T), F1.2, Auot-iris, Vari-focal, CS Mount
    d. Telephoto: IR corrected 5mm - 50mm, Horizontal view angle 53.8° (W) 5.5° (T), F1.6, Auto-iris, Vari-focal, CS Mount

e. Telephoto: Non-IR corrected 5mm - 50mm, Horizontal view angle 51.7° (W) 5.3° (T), F1.4, Auto-iris, Vari-focal, CS Mount

C. Standard Definition Fixed IP Camera (Type 2)

1. The camera must have independent 'serverless' operation. Full functionality must be available without the need to use up network bandwidth contacting a central license or administration server.

2. The camera must have a 1/4" interlace scan sensor.

3. The camera must have 768x494(NTSC) / 752x582 (PAL) active pixels.

4. The camera must have a horizontal resolution of at least 490 TVL Color, 540 TVL Mono

5. The camera must have sensitivity (50IRE, F1.2) Day: 0.5 Lux; Day/Night: 0.5 Lux color / 0.05 Lux mono

6. Lens Options:

   a. Standard: 3.8mm - 9.5mm, Horizontal view angle 53.9° (W) 22.3° (T), F1.2, Auto-iris, Vari-focal

   b. Telephoto: 9.0mm - 22mm, Horizontal view angle 22.8° (W) 9.6° (T), F1.2, Auto-iris, Vari-focal

7. Lens Mount: CS or C mount

8. Gamma 0.45

9. Gain Control Automatic or fixed manual setting across a 32dB range

10. Scan Mode 4CIF Interlaced; 2CIF/CIF Non-interlaced

11. Synchronization Internal

12. Back Light Compensation On or Off

13. White Balance Mode: Auto; Fluorescent; Indoor; Outdoor

14. Iris Control: Auto-iris DC drive lens as standard

15. Shutter Speeds 1/60 to 1/100,000 (NTSC), 1/50 to 1/100,000 (PAL) or Auto*

16. Operating voltage: Power over Ethernet (802.3af); 24V AC/DC @ 0.29A;

17. Power consumption: 8W Max

18. H.264 Video Compression: Full frame rate guaranteed, full color: H.264 (ISO 14496-10); 25/30fps

19. Video Bit Rate: User-configurable bit rates from 32Kbps up to 6Mbps

20. The camera must support multiple encoders allowing streaming of video at different

resolutions.

21. H.264 Resolutions:
    a. CIF: 352 x 288 pixels (PAL); 352 x 240 pixels (NTSC)
    b. 2CIF: 704 x 288 pixels (PAL); 704 x 240 pixels (NTSC)
    c. 4CIF: 704 x 576 pixels (PAL); 704 x 480 pixels (NTSC)
22. Video Output NTSC/PAL composite video, 75 Ohms 1V p-p, Terminal block connector
23. Binary Input/Output 2 opto-isolated inputs; 1 solid state opto-isolated relay output
24. Network interface: IEEE802.3 and IETF standards: 10/100 Base-T Ethernet, TCP, UDP, ICMP, IGMP, SNMP, HTTP
25. Embedded Linux firewall
26. Up to 16 simultaneous unicast video users plus unlimited multicast users
27. Time: Embedded real-time clock, NTP client
28. Operating Temperature: 0°C to 45°C

D. Standard Definition Pan/Tilt/Zoom IP Dome (Type 3)
    1. Zoom: 36x optical + 12x digital
    2. Lens: 3.4mm to 122.4mm, F1.6 to F4.5
    3. Scan Mode: Interlaced
    4. Horizontal View Angle: 1.7° to 57.8°
    5. Wide dynamic range
    6. Min Sensitivity:
        a. NTSC, F1.6, 50 IRE 0.1 lx at 1/4 sec (color) 0.01 lx at 1/4 sec (mono)
        b. PAL, F1.6, 50 IRE 0.1 lx at 1/3 sec (color) 0.01 lx at 1/3 sec (mono)
    7. Resolution:>540 TVL
    8. Day/Night
    9. Sensor: 1/4” Sony ExView HAD
    10. Active Pixels: 752(H) x 582(V)
    11. Signal/noise ratio: >50 dB
    12. Shutter/Iris/Focus: Automatic with manual override

13. Manual Shutter Speeds: 1 to 1/10000 sec
14. White Balance/Gain/IR Filter: Automatic
15. Electrical:
    a. Operating Voltage: 24V AC/DC @ 2.3 A
    b. Power Consumption: 55W
    c. Surge protection
16. Console Input/Output: RS232
17. Binary Input/Output: 2 opto-isolated inputs; 1 solid state opto-isolated relay output
18. H.264 Video Compression: Full frame rate guaranteed, full color: H.264 (ISO 14496-10); 25/30fps
19. Video Bit Rate: User-configurable bit rates from 32Kbps up to 6Mbps
20. The camera must support multiple encoders allowing streaming of video at different resolutions.
21. H.264 Resolutions
    a. CIF: 352 x 288 pixels (PAL); 352 x 240 pixels (NTSC)
    b. 2CIF: 704 x 288 pixels (PAL); 704 x 240 pixels (NTSC)
    c. 4CIF: 704 x 576 pixels (PAL); 704 x 480 pixels (NTSC)
22. Network interface: IEEE802.3 and IETF standards: 10/100 Base-T Ethernet, TCP, UDP, ICMP, IGMP, SNMP, HTTP
23. Embedded Linux firewall
24. Up to 16 simultaneous unicast video users plus unlimited multicast users
25. Time: Embedded real-time clock, NTP client
26. Presets: 250
27. Preset Accuracy: 0.05°
28. Preset Tours: 100 each with 20 presets
29. Pattern/Mimic Tours: 4 each with up to 1 minute
30. Pan Range: 360° continuous rotation
31. Tilt Range: -2° (above horizontal) to +90° (vertically down)
32. Pan/Tilt Speed: 0.001°/s to 360°/s

33. Preset Move Speeds: 200°/s

34. Privacy Zones: 24 User Defined

35. Pendant Construction: Vandal resistant die-cast aluminum

36. Bubble Construction: Optical grade polycarbonate

E. High Definition Pan/Tilt/Zoom IP Dome (Type 4)

1. Zoom: 10x optical + 12x digital

2. Lens: 5.1mm to 51mm, F1.8 to F2.1, Auto focus with manual override

3. Scan Mode: Progressive

4. Horizontal View Angle: 5.4° to 50°

5. Minimum Sensitivity:

   a. Day: 2.1 lx (F1.8, 50 IRE)

   b. Night: 0.19 lx (F1.8, 50 IRE)

6. Resolution:>800 TVL

7. Day/Night

8. Sensor: 1/3" Sony HD CMOS (2 Megapixel)

9. Signal/noise ratio: >50 dB

10. Shutter/Iris/Focus: Automatic with manual override

11. Manual Shutter Speeds: 1 to 1/10000 sec

12. White Balance/Gain/IR Filter: Automatic

13. Electrical:

    a. Operating Voltage: 24V AC/DC @ 2.3 A

    b. Power Consumption: 55W

14. Surge protection

15. Binary Input/Output:2 opto-isolated inputs; 1 solid state opto-isolated relay output

16. H.264 Video Compression: Full frame rate guaranteed, color: H.264 (ISO 14496-10); 25/30fps

17. Video Bit Rate: User-configurable bit rates from 32 Kbps up to 8 Mbps

18. Video Resolution: 720p HD (1280 x 720 pixels) Widescreen 16:9 Aspect RatiO

19. Network interface: IEEE802.3 and IETF standards: 10/100 Base-T Ethernet, TCP, UDP, ICMP, IGMP, SNMP, HTTP
20. Embedded Linux firewall
21. Up to 8 simultaneous unicast video users plus unlimited multicast users
22. Time: Embedded real-time clock, NTP client
23. Presets: 250
24. Preset Accuracy: 0.05°
25. Preset Tours: 100 each with 20 presets
26. Pattern/Mimic Tours: 4 each with up to 1 minute
27. Pan Range: 360 o continuous rotation
28. Tilt Range: -2° (above horizontal) to 90° (vertically down)
29. Pan/Tilt Speed: 0.001°/s to 360°/s
30. Preset Move Speeds: 200°/s
31. Picture Freeze option: Yes

F. Specialty Fixed Mini IP Camera (Type 5)

1. Minimum Illumination: 2.0 lux
2. Number of Effective Pixels: 3 Megapixel
3. Shutter Speed: 1s to 1/10000s
4. Gain Control: Auto
5. Exposure Control: Auto, EV Compensation
6. White Balance: Auto, Manual or Preset
7. Horizontal Viewing Angle: 88 degress
8. Focal Length: 3.3mm
9. Day/Night Feature
10. Video Compression: H.264, MPEG-4 or JPEG
11. Dual Streaming
12. Built-in Motion Detection
13. RJ-45 Connection for Ethernet

G. 19-inch LCD Monitor

1. Optimum Resolution: 1440x900
2. Contrast Ratio: 700:1 (typ)
3. Viewing Angles: 160° horizontal, 160° vertical @ contrast ratio > 5:1
4. Response Time: 5ms (typ)
5. Light Source: Long life, 30,000 hrs. (typ) Brightness 300 cd/m2 (typ)
6. Panel Surface: Anti-glare
7. Inputs
    a. Analog RGB analog (75 ohms, 0.7 Vp-p); Frequency Fh: 30~82kHz, Fv: 50~75Hz; Sync H/V separated (TTL)
    b. VGA up to 1440x900 non-interlaced
    c. Analog 15-pin mini D-sub Power 3-pin AC plug (CEE22)
8. Voltage AC 100-240V (universal), 50/60Hz (auto switch)
9. Consumption: 35W (typ)
10. Dimensions: 18.1" x 13.9" x 2.4"
11. Weight: 10.5 lb

H. 42-inch LCD Monitor

1. Tuner: Integrated NTSC/ATSC/QAM HDTV Tuner
2. Supported TV Formats 1080i
3. Native Panel Resolution: 1024 x 768
4. Supported PC Resolutions: 1366 x 768, 1024 x 768, 800 x 600
5. Panel Type:16:9 Wide Screen
6. Panel Specifications: Anti-Static and hard coated surface
7. Pixel/Dot Pitch: 0.9 (H) mm x 0.676 mm (V)
8. Signal Compatibility: 480i (SDTV), 480P (EDTV), 720P (HDTV), 1080i (HDTV)
9. Colors: 16.7 million
10. Brightness: 1,500 cd/m2 (typical)
11. Contrast Ratio: 30,000:1 (typ)

12. Viewable Angle: 178° (horizontal and vertical)
13. Inputs
    a. RF (F Connector for internal tuner): 1
    b. HDMI with HDCP: 3
    c. Analog Stereo Audio for HDMI Inputs: 1
    d. Component YPbPr plus Stereo Audio: 1
    e. Composite Video: 1
    f. S-Video plus Stereo Audio: 1
    g. Computer RGB plus Stereo Audio: 1
    h. Service Port: 1
14. Outputs
    a. Analog Audio out (RCA): 1
    b. 5.1 SPDIF Digital Optical Audio: 1
15. NTSC Video decoding via RF: Yes, thru Antenna, Cable, or Satellite
16. NTSC Video decoding via Video: Yes, thru CVBS, S-Video, or Component
17. Progressive Scan Video: Yes, thru Component YPbPr, VGA or HDMI
18. HDTV: Yes, thru HDMI or Component YPbPr
19. Computer: 640x480, 800x600,1024x768, 1360x768 via VGA or HDMI
20. Color Temperature: 6500K (standard), 5400K and 9300K
21. Color Fine Tuning: Independent Red, Green and Blue
22. Audio: Built-in 10W x 2
23. Lamp (LCD) / Panel (PDP) Life: 60000 hours
24. Power: IEC Connector for direct power line connection
25. Voltage Range100 ~ 240 Vac at 50/60 Hz
26. Power Consumption: 350W average
27. Weight Net: 62.9 lbs
28. Dimensions: Without Stand: 41.0" W x 26.5" H x 3.7" D

I. Power Injector

1. AXIS midspan power injector #TB124

2. Provide as required to meet High POE requirements for cameras.

PART 3 EXECUTION

3.1 GENERAL

A. The Security Contractor shall provide "as-built" drawings showing conduit routings, point-to-point wiring diagrams and any deviations from the Contract Documents.

1. Installation

a. The system shall be installed by qualified technicians who have been factory trained and certified.

b. Wiring shall be uniform and in accordance with national electric codes and manufacturers instructions.

c. Equipment shall be firmly secured, plumb, and level.

d. All splices shall be in easily accessible junction boxes or on terminal boards. Splices within any length of the VSS camera signal cable shall not be acceptable and will be rejected during testing and commissioning by the Engineer.

e. All cable runs at the main terminal board and in all junction boxes shall be tagged and identified.

f. Coordinate all work with other effected trades and contractors.

3.2 CABLING

A. All wiring and cabling shall be installed by the Security Contractor in accordance with National and local codes and shall be installed in conduit where shown on the plans. The Security Contractor shall furnish and install all VSS hardware.

B. All wiring where exposed shall be installed in conduit, minimum 3/4" or larger, in accordance with NFPA 70 and local codes.

C. The Security Contractor shall furnish the appropriate cabling to prevent any degradation in the quality of the video and speed/control of pan-tilt and zoom cameras.

3.3 SYSTEM INITIALIZING AND PROGRAMMING

A. System shall include all software necessary for system configuration.

B. System shall be turned on and adjustments made to meet requirements of specifications and onsite conditions.

C. System shall be programmed to function as specified.

3.4 WASTE MANAGEMENT

A. Separate and dispose of waste in accordance with the Project's Waste Management Plan.

3.5 CLOSEOUT

A. Substantial Completion Requirements:

1. Provide Final Cleaning immediately prior to Substantial Completion inspection.
2. Corrective Work:
    a. Remove, Repair and Reinstall, or Restore in Place damaged items.
    b. Replace damaged materials or items with New if repair not acceptable to Architect.
3. Provide product data to complete Operation & Maintenance Manuals.
4. Submit executed Warranties.

END OF SECTION

Division 28
Section 282300
Technical Specification

Miami International Airport
Ticket Counters, Conveyor and K-1 Doors for TC12 Through TC17

Project V043A
CCTV Camera, Installation
and
Programming Integration Services

December 06, 2021
Revision 1

TABLE OF CONTENTS

SECTION 282300
TECHNICAL SPECIFICATION
CCTV CAMERA INSTALLATION AND PROGRAMMING INTEGRATION SERVICES

PART 1 GENERAL

1.1 SUMMARY

A. Miami-Dade Aviation Department - MDAD (the **"Owner"**) as part of Miami International Airport (MIA) requires Installation and Programming Integration Services (**"Work"**) of Audio Interface Units **("Intercoms"**) and Closed Circuit Television cameras (**"CCTV"**) for Miami International Airport's **("Project"**). The Project Manual, associated Drawings including General Notes and Sequence of Operation, further specifies CCTV and Intercom installation and programming integration requirements.

MDAD IS/T will review, manage and approve all actions performed by Trade Contractors, associated contractors or vendors.

B. **CCTV Installation Services**: Trade Contractor and/or Vendor shall install, terminate, adjust Field of View (**FOV**), test and commission all CCTV cameras and associated hardware within all areas in Miami International Airport, Municipal Airports and associated MDAD property.

Trade Contractor shall provide, install, integrate and commission rooftop fixed and PTZ cameras, lenses & housings in locations directed by Owner's Drawings. Trade Contractor shall provide all required cameras, lenses, including any special housings, brackets and pedestals, all associated network hardware and software support.

C. **Intercom Installation Services:** Trade Contractor shall provide, install terminate, test and commission all required Intercom components and cabling, including Intercom Stations (w/speaker and call button),.

D. **Additional Head-End Equipment**: IF additional Head-End Equipment is required, Trade Contractor shall be requested to provide, terminate, program, test, and commission Head-End Devices. Trade Contractor shall provide all cost associated with providing, programming, documentation, testing and commissioning such devices.

IF Trade Contractor be requested to provide additional head-end equipment, then Trade Contractor shall also produce shop drawings for layout and configuration of head-end security equipment existing and required to be added and installed. Shop Drawings shall provide full detail for Trade Contractor to perform installation and interconnection of head-end equipment. Shop drawings shall be to scale for affected MSR(s) showing equipment layout for floor plan, rack and wall elevations. Shop drawings shall include schedules of all necessary products (assemblies, equipment and systems, including racks, cabinets, UPS and head-end security equipment to be installed. Shop Drawings shall depict both, existing and installed equipment.

E. **Programming Integration Services: Trade Contractor** shall integrate and test all newly installed Intercoms and CCTV Cameras with existing Access Control System

(ACS), Owner's Security System and the Security Operation Workstation **(SOW)**. Programming Integration Services include configuration and interfaces to Gateway, Digital Video Recording System **(DVRS)**, Access Control System and video equipment, and Juniper MPLS Network.

F. **Ensure Device Compatibility:** Trade Contractor shall warrant all CCTV and Intercom devices, associated terminations; software, interfaces and integration are 100% compatible with existing MDAD Systems.

~~**G.**~~ **Implementation:** Trade Contractor shall install and program Intercoms and CCTV cameras to meet program system implementation.

1.2 RELATED DOCUMENTS …

Project Manual including Drawings, Division 0, Division 1, Division 27 and Division 26 Sections shall form an integral part of the Project requirements.

1.3 DEFINITIONS, ABBREVIATIONS, ACRONYMS

Reference standards, abbreviations, and definitions contained in this Section are not necessarily a complete list, but are general to the extent they may not be defined explicitly elsewhere.

A. **DEFINITIONS:**

Managing General Contractor (MGC) – Contractor selected through bid and award process overseen and managed by MDAD IS/T

Trade Contractor – CCTV/Intercom Installation and Program Integration provider whose Individual, firm, partnership, joint venture or corporation enters into a Contract with the Managing General Contractor, including all subcontractors, vendors and suppliers at all tiers.

MGC Project Manager / MGC Project Superintendent – Authorized representative charged with the professional administration of this construction Contract.

MGC Safety Manager – Authorized and qualified MGC representative charged with the professional administration of the Safety Requirements of the Project.

Owner's Representative – An authorized representative of the Owner who is an employee of the County.

Design Professional (DP) – Engineer of Record

B. **ABBREVIATIONS – ACRONYMS**

ACS	Access Control System
AOC	Airport Operations Center
A/E	Architectural/Engineering Firm
AHJ	Authority Having Jurisdiction
AOA	Aircraft Operation Area
API	Application Program Interface
ASN	Airport Security Network
CAD	Computer-Aided Design
CCTV	Closed Circuit Television
CMS	Cable Management System

DGM	Design Guideline Manual
DP	Design Professional
DRS	Digital Recording System
DVADTS	Digital Video, Audio and Data Transport System Network
DVRS	Digital Video Recording System
DVTS	Digital Video Transport System
FAA	Federal Aviation Agency
FOV	Field of View
LAN	Local Area Network
MDAD	Miami-Dade Aviation Department
IS/T	Information Systems/ Telecommunications
MSR	MDAD Security Room
MTR	MDAD Telephone Room
NTP	Notice To Proceed
PTCS	Preliminary Trade Contractor Schedule (of Work)
SIA-TVAC	Security Institute Association CCTV to Access Control
SIDA	Security Identification Designated Area
SOW	Security Operation Workstation
TCS	Trade Contractor Schedule (of Work)
TCSSSP	Trade Contractor Site Specific Safety Plan
UPS	Uninterruptible Power Supply

1.4 REFERENCED REQUIREMENTS

The publications listed below shall form an integral part of this specification. Specific reference to codes, rules, regulations, standards, requirements of regulatory agencies, MDAD Life Safety Master Plan shall meet the latest printed edition of each in effect at date of Project Manual unless document referenced herein is specifically dated.

Trade Contractor performance shall comply with all Owner and manufacturer's requirements, Closed Circuit Television Manufacturers Association **(CCTMA)** guidelines and requirements of Authorities Having Jurisdiction **(AHJ)**.

All Work shall be performed in accordance with following standards:

A. All applicable Federal, State, and local codes, rules, regulations, and ordinances governing the Work, are as fully part of Specification and Project Manual as if hereto attached. If Trade Contractor should note items in the drawings or specifications, construction of which would be code violations, Trade Contractor shall promptly call them to attention of Managing General Contractor and Design Professional in writing. Where requirements of other sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply.

B. SIA TVAC - 01: CCTV to Access Control – Message Set for System Integration document

C. SFBC: South Florida Building Code, including adopted standards

D. MDAD Design Guideline Manual, Section 13710, titled Card Reader / Security Doors Sequence of Operation.

E. MDAD Design Guideline Manual, Section 13613, titled Cabling Standard.

F. MDAD Design Guideline Manual, Section 13700 MIA Terminal Security 12/06

G. MDAD Design Guideline Manual, Section 13705 Card Reader / Security Doors and Related Alarm Systems

H. MDAD Terminal Life Safety Master Plan – Mandatory Requirements

I. NEC Standards

J. NEMA: National Electrical Manufacturers' Association

K. NFPA 15, 70, 72, 90A and 101

L. ANSI/TIA/EIA Standards (refer to drawings)

M. UL Underwriters Laboratory including but not limited to, UL 1863

N. FCC Part 68-76 inclusive

O. Building Industry Consulting Services International (BICSI®) publications:

1. BICSI – Telecommunications Distribution Methods Manual
2. BICSI – Telecommunications Cabling Installation Manual

P. General Requirements – Division 1, Division 28 and Division 28 of the Project Manual are applicable in the execution of this Work. Applicable Sections including, but not limited to:

Section 01010: Summary of Work
Section : Allowances
Section : Application for Payment
Section : Alternatives
Section : Coordination
Section : Regulatory Requirements
Section : Existing Utilities
Section : South Florida Compliance
Section : Project Meetings
Section : Progress Schedule
Section : Shop Drawings, Product Data & Samples
Section : Schedule of Values
Section : Construction Photograph
Section : Trade Contractor's Quality Control
Section : Materials and Equipment
Section : Storage and Protection
Section : Substitutions and Product Options
Section : Project Closeout
Section : Final Cleaning
Section : Project Records Documents
` Section : Operating and Maintenance Data
Section : Spare Parts and Maintenance Material
Section : Warranties and Bonds
Section : Basic Electrical Requirements
Section : Basic Electrical Material
Section : Raceway, Box, and Cabinets
Section : Circuit & Wire Identification
Section : Prefunctional Test Checklist – CCTV and Intercom Systems
Section : Phased Functional Testing and Commissioning Requirements for CCTV and Intercom System

Q. In event of conflicts, ambiguities, or discrepancies, precedence in resolving such

conflict, ambiguities, or discrepancies shall be in accordance with General Conditions Provisions and the following under MDAD guidance:

a. Large-scale details shall govern over small-scale details

R. In case of discrepancies between plans and specifications not determined by above, the Design Professional shall be sole determiner of the intent. Such interpretations by Design Professional shall be in writing, and shall be consistent with, and reasonably inferable from intent of the Project requirements.

1.5 CCTV, INTERCOM AND SECURITY SYSTEM DESCRIPTION

A. General Description

IP CCTV cameras and IP Intercoms shall connect to an existing special security network consisting of digital network transmission equipment and digital video recording system. Video, voice and data connections are through communications rooms to demarcation panels located in MDAD Security Rooms (**MSR**) OR MDAD Telephone Rooms (**MTR**) equipped with ASN equipment. The MSRs' and MTR's contain Security System infrastructure to support installation the installation of CCTV and Intercom devices.

IP CCTV Cameras shall connect to the Security network **(ASN)**. All connectivity requirements, to extend existing network, to new MTR's will be included and provided in this project.

Owner's Security System consist of access control, live video/audio surveillance, audio/video recording and overall transport of audio, video and data, including high-speed data network and video/audio transmission and video/audio storage components.

The CCTV and Intercom Systems shall be electrically served from the Emergency Power Systems (Emergency Generator sets) or as directed by MDAD.

Trade Contractor shall ensure Intercom and CCTV installation along with program integration are completed in accordance with Schedules as defined in Division 1.

B. CCTV System Description

Functionally, Security Operation Workstation (SOW) notifies a Airport Operations Center (AOC) Security Operator monitoring the Airport at his console position when a security event occurs such as a security door violation.

C. Audio – Intercom System Description

Functionally the Audio Interface Unit provides two-way audio communications between (AOC) Security Operation Workstation and Intercom Stations located throughout the Airport.

The Intercom Station is a surface-mounted, hands free, full duplex intercom. Its internal amplifiers and speaker operate from standard Ethernet connection from intercom back to the ASN location with two LED indicators to advise user of call placed and received status.

Two-way audio shall be connected between a security operator and intercom station when one of two scenarios occur and are acted upon by the security operator.

Scenario One – When the AOC security operator initially acquires alarm from ACS queue, he/she has the option of establishing audio connection based upon how that alarm has been configured in ACS.

Scenario Two – When call button is pushed, it presents an active call in the "conference " queue of all SOW's in the group. The first operator to answer connects to the call.

1.6 SCOPE OF WORK – DESCRIPTION

A. **Scope of Work – General**

Trade Contractor shall provide MDAD IS/T all equipment, materials, labor, and services required, not specifically mentioned or shown, which may be necessary to complete or perfect all Work and to ensure Work complies with requirements stated or as reasonably inferred by Project documents. In addition, Trade Contractor shall:

1. Employ job superintendent or project manager during the course of the installation to provide coordination of Work described in this specification and with other trades. Trade Contractor shall provide technical information when requested by other trades and attend project coordination / status meetings. This person shall be responsible for quality control during installation, equipment set-up, and testing in accordance with provisions stated in the Project Manual.
2. Ensure programming integration service is performed by personnel who are MDAD Security Systems approved/certified for type of Integration Services required ensuring continuity of Owner's original equipment manufacturer's warranty and services for Head-End Systems. Trade Contractor shall use the existing Security Systems Integrator Service provider for this scope of work.
3. Provide all required documentation to MDAD IS/T.
4. Provide accurate set of redline and shop and as-built drawings. Trade Contractor shall keep redlined drawings up to date on a daily basis. This set will be used to submit periodic updated and final As-Built Drawings per schedule shown below.
   - ❖ Pay applications
   - ❖ Project Close-Out (Final)
7. Trade Contractor installation responsibilities shall include end-to-end coordination of general troubleshooting, camera adjustment, field of view, placement and camera / intercom software interfaces.
8. Trade Contractor shall provide wire management including cable dressing and machine printed labels for identification of Intercom and camera cabling, surge suppression and power as required by Project Manual. Cable identification shall be in accordance with format nomenclature referenced in MDAD structured cable specifications.
9. Trade Contractor shall submit updated Inventory Log on first day of each month for all installed Intercoms and installed or modified cameras.

Trade Contractor shall coordinate with Managing General Contractor, Owner and other subcontractors for implementation of Work in accordance with Project Manual requirements.

- Location of CCTV Camera
- Port number
- Security room #
- Drawing/ Specifications
- Physical Topology

B. Scope of Work - New CCTV and Intercom Installations

Trade Contractor shall provide all equipment, materials, labor and services required to install, program, integrate and test CCTV and Intercom Systems including but not limited to the following:

1. Camera Installation: Trade Contractor shall:

(a) Provide and Install cameras, housing, lenses, and other associated equipment

(b) Trade Contractor shall provide, all cabling, patch cords, terminations to Owner's Head-End equipment, mounting brackets, mounting kits, surge protection, power supplies and components locations to MDAD Telecom for future project planning.

(c) Ensure all camera installations are in accordance with equipment manufacturer's written instructions, in compliance with National Electrical Code, and with recognized industry practices, to ensure CCTV system complies with requirements and serves intended purposes.

(d) Be responsible for complete installation and testing of all CCTV cameras and camera settings.

(e) Install flexible conduit, fittings from existing junction box to cameras, provide indoor ceiling mounting kits, 2 foot patch cables (for elevator cab only), mounting brackets/kits, and surge suppression for outdoor camera (PTZ or fixed).

Camera power is provided from ASN communications rooms to the camera via POE. POE loads per switch shall be calculated and approved by EOR prior to installation.

Field of View Adjustment: Trade Contractor shall adjust Field of View (FOV) and focus for each newly installed camera in accordance with design requirements.

Trade Contractor shall aim each fixed CCTV camera for optimum view of the area that it is intended to cover, using a WEB browser and IP connectivity to view camera output.

Trade Contractor shall set and name all preset positions per Owner's direction. Owner shall approve final aiming and PTZ camera preset prior to Final Acceptance. All required presets are to be shown on drawing updates.

3. Surge Suppression: All exterior cameras shall include fast acting transient voltage surge suppression on all copper conductors. Signal paths for all exterior mounted cameras shall be fully protected against transient voltages with fast acting surge suppressors at every termination point. The suppression equipment shall protect each conductor utilizing both common mode and differential mode devices. Trade Contractor shall be responsible to provide, install and test suppressors for exterior cameras in accordance with requirements stated in

Project Manual and manufacturer's instructions.

The suppressor shall be installed in-line with copper circuits at the point where they enter building and via rack mountable surge suppressors at active equipment (inside MSR or MTR).

Trade Contractor shall submit in their closeout documents a letter from the surge protection manufacturer stating that the manufacturer or the manufacturers' representative has inspected the installation. The certification letter must state that the installation has been done in accordance with the manufactures' requirements and the warranty is in effect.

4. **Video, Control, Power and Audio Cabling – MSR / MTR Room Set-up:** Except as specified in drawings and specifications,Trade contractor will provide low voltage cabling and base building contractor will provide 110V power wiring.

5. **Camera Troubleshooting and Adjustment of Focus and Field of View:** For new cameras installed and commissioned under this Project, Trade Contractor shall provide camera troubleshooting and adjustment on "as requested basis" throughout the duration of this Contract.

6. **Mounting Brackets:** Trade Contractor shall:
   - ❖ Provide all CCTV mounting kits, indoor and outdoor rated as required. Roof top kits will include a lightning protection device and attachment to the building grounding / bonding system, rated for lightning dissipation.
   - ❖ Submit a detailed shop drawing indicating all mounting components proposed for each camera location.
   - ❖ Ensure all exterior camera mounts are installed rigidly to eliminate camera movement in winds up to 185 mph.

7. **Dipswitch:** Not required on IP cameras.

8. **Elevator Patch Cable:** Trade Contractor shall provide mini two (2) foot patch cable as required.

9. **Elevator Cameras:** Trade Contractor shall provide (unless otherwise directed by MDAD) and test elevator cameras and mounting enclosure. All cables, cross connects will be provided by Trade Contractor. Trade Contractor must coordinate with Elevator Installer **prior** to performing any Work.

10. **Flex Conduit:** Trade Contractor shall provide flexible conduit from junction box serving the camera-to-camera housing.

11. **Intercom installation:** Trade Contractor shall provide and test all required door and elevator Intercom Systems in strict accordance with intent of the plans, drawings and specifications subject to terms and conditions of Contract Documents.

    Signals from Intercom shall be received on standard Ethernet CAT6 cable and terminated to RJ45 patch panel mounted in the MSR or MTR.

    Trade Contractor shall interface Intercom Systems with existing Headset Preamps located at Security Operation Workstation(s). The Preamps enable low power audio headsets to interface with line level audio in/out devices. The headset's microphone output is amplified to line levels while incoming line level audio is adjusted to earpiece levels. In addition, the Preamp provides adjustable

level, monitor tone to the audio out path. Upon connection, this tone provides a record warning tone to the Intercom Station.

Trade Contractor Intercom Installation responsibilities include:

a. Termination of all connections, and provide all fastenings and support, sleeves, inserts, grommets, rings, frames, and field adjustments.

b. Integration of Intercom System with Owner's Security System.

c. Ensure all equipment exposed to elements is weather protected.

C. Scope of Work - CCTV and Intercom Programming Integration Services

To keep continuity under responsible party needed to maintain equipment until successful commissioning and start of warranty, Trade Contractor shall use only technicians certified by Juniper Networks, Qognify, and CNET. Trade Contractor will submit the following minimum certifications of individuals performing the work to ensure compliance with this requirement.

a. Digital Video, Audio and Data Transport System (DVADTS)

b. Digital Video Recording System (DVRS)

c. Digital Video Transport System (DVTS)

Certified Technician shall integrate all Security Control Cameras, Camera pan-tilt-zoom (PTZ) control, and Emcom Intercoms, MDAD Security System, and Qognify DVRS. In addition, Trade Contractor shall ensure interfaces support Security Operations' ability to use all current video display applications that allow selection and viewing of selected cameras and two-way communication of Intercom System.
A certified Contractor will be required to integrate the ACS with the CCTV System. The Trade Contractor shall use the existing Security Systems Integrator Service provider for this scope of work.

a. Security System Interface includes (but is not limited to):

- **Digital Video, Audio and Data Transport System (DVADTS) – Network**. (ASN) This existing system is a high-speed 20GbE MPLS Ethernet data network that spans the Airport. DVADTS's sole purpose is to provide high-speed inter-connectivity and integration of all security system components, equipment, computers, and any other security devices needing this type of connectivity.
- **Digital Video/Audio Recording System (DVRS)** This existing system records video from the operational or security CCTV cameras and audio from Intercoms and makes this information available to Security Operation Workstation. Recording is also automatically initiated by any alarm monitored by Access Control System or continuously recorded 24 x 7 x 365.
- **Digital Video Transmission System (DVTS)** This existing system is a real time video and audio Ethernet based switching network system that provides video and audio selected by operator of the Security Operation Workstation or automatically initiated by any alarm monitored by Access Control System.

b. Trade Contractor Programming Integration Services shall include:

(1) Interface and Integration Implementation shall be performed for:

- ❖ All fixed and PTZ Camera video and Intercoms
- ❖ PTZ camera Control, Intercom Audio and Control signals
- ❖ DVRS and DVTS Video, audio and control signals
- ❖ All new DVRS and DVTS equipment with existing and new DVADTS
- ❖ New DVADTS equipment with existing Security System equipment
- ❖ All hardware and software configuration, logical and physical settings, operating systems and application code required to integrate all new equipment to existing Security System
- ❖ All network configuration including but not limited to IP addresses, VLAN configuration, firewall configurations, etc.
- ❖ All physical connections, including demarcations, jumper cables and cable management required to connect new devices
- ❖ Configuration of Equipment to allow users to access, control and view live, recorded video and listen to live and recorded audio synchronized camera and intercom from respective security door.
- ❖ Create and implement graphics and user interface controls in audio and video systems
- ❖ Configure Equipment to allow users to access, control and view live and recorded video from each respective camera
- ❖ Integrate the controls for all PTZ cameras
- ❖ Provide interfaces that support Digital Video Transmission System control of cameras installed as part of this Project
- ❖ Provide interfaces between Intercom System and Digital Video Transmission System
- ❖ Integrate functions of the Intercom within Digital Recording System
- ❖ Verify through testing all cameras and Intercom installed under this Project meet required sequence of operations
- ❖ Interface and integration to ACS alarm processing software, the digital video, audio display, voice, and video from the camera and intercom areas. (2) Integrate System door alarm with respective door camera to automate the coordinated access control, camera and intercom response for each respective door, (3) Configure camera workstation viewing application to access all new operational cameras and intercoms.

(2) Inter-rack cabling: A service loop will be found on top of the DVRS Rack. Trade Contractor shall run and connect cabling from video and audio input over to DVTS rack and connect to CNET This shall include dressing the cable, applying connections and terminations.

(3) Each camera and intercom must be individually configured to transmit a video /audio signal. Trade Contractor shall associate camera and Intercom with a port on the chassis and configure that port in current database. In addition, each camera and intercom shall be placed in a map with its corresponding address and configuration assigned in Manager Database.

(4) Trade Contractor shall test and verify Manager Database to chassis signaling.

(5) Trade Contractor shall provide Gateway Video and Audio configuration. All new camera inputs shall be configured and tested from the sub-systems to accept API calls. Trade Contractor shall provide gateway information to ACS Vendor for ACS interface.

(6) Trade Contractor shall provide Vision Channel configuration. Each camera and Intercom shall be individually assigned to a DVRS channel and configured for that channel.

(7) Trade Contractor shall ensure all Systems and workstations are time sequenced. Configuration includes, but is not limited to:

- ❖ Record Mode settings
- ❖ Recording Parameters
- ❖ Video and Audio Channel Settings
- ❖ Manual Start/Stop Recording
- ❖ Each camera and Intercom shall be placed into its proper grouping.

(8) Trade Contractor shall test end–to–end solution. This shall involve video stream testing, local camera and Intercom configuration verification, DVADTS, DVTS and DVRS testing. Note: testing requires Trade Contractor to physically test at end station location.

(9) Trade Contractor shall provide Inter-Rack, ENET cabling, PTZ wiring and configuration.

(10) Trade Contractor shall update data tables with:

- ❖ Alarm ID number
- ❖ Camera ID number
- ❖ Camera location description
- ❖ Camera Shortcut number
- ❖ Intercom ID Number
- ❖ Intercom location description
- ❖ PTZ Presets and camera “Home Position”

D. Testing and Commissioning

Testing and Commissioning of CCTV Camera and Intercom Systems shall be a process of quality assurance and testing to ensure CCTV and Intercom Installation and Integration Services meet performance, functionality and quality requirements approved by MDAD. Trade Contractor shall perform **System** Testing and Commissioning for all new camera and Intercom installations and integration end-to-end in accordance with requirements stated in Project Manual.

Trade Contractor shall be required to perform Out-of Phase Testing and Commissioning for CCTV and Intercom installations that are deemed substantially complete and are available for Beneficial Occupancy. This shall hereafter be known as “Phased Testing and Commissioning”. In such event, Trade Contractor shall perform all testing and documentation requirements, satisfy all punch list items and accompany Managing General Contractor and Owner’s Representative or their designee on all Phased Testing and Commissioning which will be reviewed and

approved by MDAD IS/T and/or assigned MDAD official.

Shutdown Requirements: Trade Contractor shall follow Owner's Shutdown requirements prior to performing work on operational (live) CCTV Cameras.

1.7 SUBCONTRACTOR'S QUALIFICATIONS

A. Trade Contractor Qualification Requirements: Trade Contractors must have at least five (5) years of successful installation experience with projects of similar size and environments utilizing brand of CCTV equipment proposed for this project. Installation experience must be for Work completed within last five (5) years and must include at least one (1) airport installation of similar size, complexity, and brand of CCTV and Head-End equipment.

B. Trade Contractor shall include with Bid a list of references with specific information regarding type of project, size of project, involvement in providing of equipment and systems, name of CCTV, Intercoms and head-end equipment manufacturers. List shall include contact names and contact phone numbers.

1.8 TRADE CONTRACTOR DUTIES (include, but not limited to)

A. Trade Contractor shall provide Installation and Programming services for CCTV Cameras and Intercoms in a neat, safe and professional manner according to standards.

B. Trade Contractor shall provide material and equipment that is new, and conforms to grade, quality, and standards as specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout duration of Contract. If supply, availability or construction environment requires substituting any product for a product specified herein or previously Approved, Trade Contractor shall notify Managing General Contractor as described in Division 1 of Project Manual.

C. Trade Contractor shall be responsible for providing a safe work environment for its own employees as well the general public, Owner's employees and contractors, airline employees and contractors, and vendors or other airport customers and service personnel.

D. Trade Contractor shall take all necessary precautions and preventative steps in assuring its employees, subcontractors and others are completely protected from any harm because of construction activities.

E. Trade Contractor shall comply with MDAD Site Safety, Health & Environmental Program. Trade Contractor is held accountable for implementing all OSHA, Federal, State, and local codes, standards or regulations that are applicable to Work being performed under this Contract.

1.9 PERMITS, FEES, AND CERTIFICATES OF APPROVAL

A. As applicable, Trade Contractor shall make application and coordinate obtaining permits for all construction and installation that are part of this Project. All cost associated with such Permits and Fees shall be deemed included in Contract Pricing.

B. As prerequisite to final acceptance, Trade Contractor shall satisfactorily complete commissioning and all punch list items.

C. Current Calibration Certifications must be submitted for all test equipment.

1.10 SUBMITTALS

A. **General:** Trade Contractor submittals shall comply with all requirements stated in Project Manual including, but not limited to:

- Division 0, Section Trade Contractor Safety Requirements
- Division 0, Section Trade Contractor Hurricane Preparedness Plan
- Division 1, Section Progress Schedule
- Division 1, Section Shop Drawings, Product Data & Samples
- Division 1, Section Schedule of Values
- Division 1, Section Construction Photographs
- Division 1, Section Substitutions and Product Options
- Division 1, Section Systems Demonstrations
- Division 1, Section Project Close-out
- Division 1, Section Project Records Documents
- Division 1, Section Operating and Maintenance Data
- Division 1, Section Spare Parts and Maintenance Material
- Division 1, Section Warranties and Bonds

Process for documentation submittals and approval are further described in Division 1.

B. **Submittal Log:** Within ten (10) days after Notice to Proceed (**NTP**),from MDAD IS/T and MDAD PM, Trade Contractor shall provide a Submittal Log matrix listing all required submittals and scheduled date for each submittal. This Log shall be updated monthly with the date documents were submitted and status of each submittal.

C. **Installation and Programming Plan:** Within fifteen (15) days after NTP, Trade Contractor shall submit to MDAD IS/T and MDAD PM for approval, an Installation Plan and Schedule for entire project indicating when (and number of days required) for procurement, installation, programming, testing and commissioning. The Plan shall detail how Work will be accomplished, highlighting minimal interruption to ongoing Airport operations and/or construction activities. Plan shall provide daily Work Schedule for employees and subcontractors, protection of existing equipment, daily cleanup and other activity that assures continuing operation with minimal impact on other construction activities.

Plan shall meet requirements of the Project Schedule and reflect phasing requirements for all trades. Approved Installation Plan and Schedule shall be maintained and updated in accordance with Division 1. At a minimum, Plan and Schedule shall clearly show:

1. Specific location / identification of each Work activity per phasing drawings
2. Sequence and interdependency of all activities required for complete performance
3. Delivery activities for all equipment including dates for ordering long lead items
4. Detailed schedule for all pretesting and phased commissioning / testing activities

D. **Three-Week Rolling Schedule:** Trade Contractor shall submit to MDAD IS/T and MDAD PM a Three Week Rolling Schedule each week to be used at weekly progress and coordination meetings. The Rolling Schedule shall reflect previous week's activity progress along with a projection of activities expected during following two-week period.

E. **Project Management Plan:** Trade Contractor shall provide to MDAD IS/T and MDAD PM at Pre-Construction Meeting a Project Management Plan describing basic goals, budget, strategic, logistic, physical and technical objectives for project and quality control standards. Plan shall also include the following:

(1). Work Flow Chart describing each stage of the project

(2). Organization Chart showing Trade Contractor and their subcontractors and interrelationships with Managing General Contractor and Owner along with their lines of authority

(3). Description of Trade Contractor project personnel and daily duties

(4). Total dollar value of Project with estimated dollar value of each Phase Description

(5). Method to be used to ensure cost containment

(6). Value Engineering Recommendation

F. **Safety and Security Plan:** At the Pre-Construction Meeting, successful Contractor shall submit for approval a Site Specific Safety Plan in accordance with Project Manual - Division 0. Safety Plan includes, but not limited to:

- Hurricane Preparedness Plan
- Emergency Response Plan
- Emergency Action Plan
- Security Plan
- Incident Reporting Plan

G. **Schedule of Value:** Within seven (7) days after execution of Contract Division 1, Trade Contractor shall submit to MDAD IS/T and MDAD PM for review and approval, a Schedule of Value in compliance with requirements of Division 1, Section 01370 including, but not limited to, submittal of a preliminary Schedule of Values allocated to various portions of Work.

H. **Functional Testing and Commissioning Plan:** Trade Contractor shall submit to MDAD IS/T and MDAD PM for review and approval, a Functional Testing and Commissioning Plan six (6) weeks after NTP. Plan shall detail the objectives of all tests, test methods, test procedures, test scripts, witness sign-off and test report format.

Functional Testing and Commissioning Plan shall clearly demonstrate CCTV and Intercom Systems and their components fully comply with the requirements specified herein (Refer to Division 16).

I. **Manufacturer's Instructions:** Four weeks prior to start of first camera / intercom installation, for all Trade Contractor provided equipment, Trade Contractor shall submit six copies of the manufacturer's current printed instructions, for storage, assembly, installation, startup, adjusting and testing. These documents shall become an integral part of Testing and Commissioning process and final Close-Out Documentation.

J. **Shop Drawings & Product Data - General:** In accordance with Division 1 Requirements, Trade Contractor shall submit to Managing General Contractor shop drawings, product data (including cut sheets and catalog information), and samples.

Trade Contractor shall submit shop drawings, product data, and samples as a complete set for initial submission and for resubmission required for approval, as described in Division 1.

Trade Contractor shall submit shop drawings, product data, and samples with such promptness and in such sequence as to cause no delay in the Work or in activities of separate contractors. Trade Contractor, showing date and Trade Contractor's legitimate firm name, shall sign all drawings and documentation submittals.

1. By submitting shop drawings, product data, and samples, Trade Contractor represents it has carefully reviewed and verified materials, quantities, field measurements, and field construction criteria related thereto. Trade Contractor also represents it has checked, coordinated and verified information contained within shop drawings, product data, and samples conform to requirements of Work.
2. The approval of shop drawings, product data and samples submitted by Trade Contractor shall not relieve Trade Contractor of responsibility for deviations from Project requirements, unless Trade Contractor has specifically informed Managing General Contractor in writing of such deviation at time of submittal and Trade Contractor received written approval of each specific deviation.
3. Managing General Contractor/Owner/Design Professional will not check illegible submittals.
4. If substitution of any product is required, Trade Contractor shall submit shop drawings, product data and samples in accordance with Division 1 Section 01630 for approval. Trade Contractor shall test requested substitutions in Owner's test lab to ensure it meets specification and compatibility requirements.
5. The review and approval, or other appropriate action upon shop drawings, product data and samples, is for limited purpose of checking for conformance with information given and design concept expressed. Owner/MGC, DP review of such submittals is not conducted for determining accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Trade Contractor. The review shall not constitute approval of safety precautions or of construction means, methods, techniques, sequences, or procedures. The approval of a specific item shall not indicate approval of an assembly of which item is a component.
6. Trade Contractor shall perform no portion of Work requiring submittal and review of shop drawings, product data, or samples until the respective submittal is approved.

K. **Shop drawings – Specific Requirements:** Trade Contractor shall comply with Division 1 requirements pertaining to Shop drawings and provide information to MDAD IS/T. Shop drawing must provide detail indicating all mounting components proposed for each camera / intercom location. Submittal requirements include but are not limited to the following:

1. Show Equipment Quantities, locations, types and arrangements
2. Rough-in diagrams
3. Design calculations and methods

4. System block diagram, indicating interconnection between system components and subsystems
5. Wiring diagrams showing field installed wiring
6. Schedule and Tables
7. Flow Diagram showing normal flow of data throughout the Intercom and CCTV Systems and other systems they interface with
8. Interface requirements, including connector types to external systems and systems or components not supplied by Trade Contractor
9. Programming settings and presets
10. For Rack mounted equipment, provide assembly drawing of every equipment rack with locations, quantities, model numbers of individual components contained in the rack. MSR Cabinet Layout shall document Rack/Cabinet Number, depict location of each head-end system, serial number and asset number of each device associated with Intercoms and CCTV Cameras, and related UPS and Network devices. This is regardless if Head-end System was existing or new (installed under this contract). Trade Contractor shall provide such drawings for all MTR and MSR Rooms to MDAD IS/T.

L. **Parts List – Specific Requirements:** Within thirty (30) days after NTP, Trade Contractor shall submit a complete list of major products included in this installation. List shall incorporate all products provided by Trade Contractor, including spare parts. Parts List shall include every component used by Trade Contractor in the Installation of Cameras and Intercoms. Parts Lists shall include part numbers, model numbers, and supplier's address and contact information. Owner requires parts lists to identify each component (to lowest repairable unit) along with ordering information.

M. **Product Data – Specific Requirements:** Product Data shall include the manufacturer name, model number and related Specification paragraph numbers for each product provided by Trade Contractor. Product data shall show products' mechanical and electrical specifications, as applicable. Trade Contractor shall provide catalog cut sheets and information for the following:

1. All metallic and nonmetallic conduits, including surface raceways, outlet boxes, and fittings and flex conduit used at camera and Intercom mounting location
2. Terminal blocks and patch panels
3. Equipment housings
4. Camera ceiling and roof-top mounting kits
5. Camera mounting brackets
6. Surge protection devices and enclosures
7. Elevator Cameras, housing, kits and brackets
8. Intercom devices
9. Video Extenders
10. Head-End Equipment (if applicable)

N. **Samples:** Trade Contractor shall comply with requirements of Division 1 as it pertains to samples. At a minimum, sample submittals include the following:

1. Connectors
2. Flex conduit used at camera mounting

3. Surge Protection and Enclosure
4. Power Supply and Enclosure

O. **Operation, Maintenance and Programming Data (O&M):** Trade Contractor shall provide Operation and Maintenance Manuals for all Trade Contractor provided devices, such as but not limited to Cameras (provided by Trade Contractor), Intercoms, Surge Protection, and Power Supplies. Manuals shall include installation, operation and maintenance, including preventative maintenance instructions from the manufacturer. O&M Manuals shall meet or exceed the requirements of Division 1, O&M Manuals shall:

1. Serve as training and reference manual for all aspects of day-today-maintenance and major system repairs.
2. Include complete set of as built installation drawings for each system
3. Include photographs and drawings showing installation details and locations of equipment Routine preventive maintenance procedures, corrective diagnostic troubleshooting procedures
4. Programming Manual shall detail any software packages supplied with the systems and independent programming of system, point schedule, and software trouble shooting procedure

P. **Project Close-Out Documentation:** Trade Contractor shall comply with all Project Closeout requirements shown in Division 1. Trade Contractor shall submit as-built project records, including but not limited to the following:

1. Approved shop drawings
2. Plan drawings indicating locations and identification of Intercoms, CCTV cameras, field of view, telecommunications and MSR rooms
3. Labeling and administration documentation
4. Software Licenses in the name of the Owner (if applicable)
5. Combined Warranty Statement from the Trade Contractor
6. Warranty documents from 3rd party vendors for equipment and materials
7. All approved Test Reports
8. Final Inventory Logs
9. Product List and Product Data Sheets
10. Manufacturer's Instructions
11. Operation & Maintenance Manuals
12. Recommended Spare Parts List
13. Data Table Print Out
14. Photographs
15. Approved (fully signed) check list Pre-functional Check completed for each Phased Installation
16. Approved (fully signed) 16998 Functional Testing and Commissioning for each Phased Installation

Q. **Test Report:** Trade Contractor shall submit test results to Managing General Contractor as required.

R. **Progress Report:** Trade Contractor shall provide a Progress Report weekly to Managing General Contractor. Such report shall detail Work completed and any issues that may impede installation schedule.

S. **Camera As-Built Inventory Log:** Throughout the term of this Contract, Trade Contractor shall record and maintain Camera Inventory Log on an Excel spreadsheet. Inventory records shall include, but is not limited to, the following information:

1. Installed Camera Number
2. Installed Camera Model Number
3. Installed Camera Serial Number
4. Installed Camera Asset Number
5. Installed Camera IP address
6. Floor Location
7. Drawing Sheet Number
8. Camera Type (Fixed / PTZ)
9. Camera Specification Description (CM-1, CM-2, etc)
10. Installed Lens
11. Surge Suppressor ID
12. Dip Switch Setting (Address)
13. Location Coordinates (column lines)
14. Cable termination location in MSR or MTR. (Row#, Rack #, PP # Port #)
15. ASN Switch Port Number
16. Elevator ID, if applicable
17. Related Door ID, if Applicable
18. Date of Installation
19. Date of Commissioning
20. Equipment Provided by Owner or Trade Contractor
21. Starting Date and Ending Date of 36 month Warranty (applicable to devices provided by Trade Contractor)

1. **Intercom As-Built Inventory Log:** Throughout the term of this Contract, Trade Contractor shall record and maintain Intercom Inventory Log on an Excel spreadsheet. Inventory records shall include, but is not limited to, the following information:

1. Installed Intercom ID
2. Installed Intercom Model Number
3. Intercom Serial Number
4. Intercom Asset Tag Number
5. IP Address
6. Floor Location
7. Location Coordinates (column lines)
8. Cable termination location in MSR or MTR. (Row#, Rack #, PP # Port #)
9. ASN Switch Port Number
10. Related Door ID, if Applicable
11. Date of Installation
12. Date of Commissioning

13. Starting Date and Ending Date of 36 month Warranty

U. **Training Documentation:** Trade Contractor shall submit all training documentations as required by Division 1, Section 01670, Systems Demonstrations.

1.11 QUALITY ASSURANCE

A. Trade Contractor shall ensure provided productions and installation and programming services meet all requirements including but not limited to:

- ❖ Division 1 – Trade Contractor's Quality Control
- ❖ NECA 1
- ❖ NFPA 70
- ❖ UL Approval

1.12 WARRANTY

A. Trade Contractor shall provide a joint written warranty of the manufacturer(s) (of devices provided by Trade Contractor) and installation and programming integration services on a single document.

B. Trade Contractor shall warrant parts supplied by Trade Contractor, complete installation and programming of the equipment to be free from defects in materials and workmanship for a period of no less than thirty-six (36) Months. **The starting point for the warranty shall be from date of Beneficial Occupancy as determined by successful completion of Testing and Commissioning.**

Trade Contractor shall submit a written warranty signed by Trade Contractor, installer and program integrator for cameras and intercoms agreeing to correct system deficiencies and replace components that fail in materials or workmanship with specified warranty period when installed and used according to manufacturer's written instructions. This warranty (parts and labor) shall be in addition to, and shall not limit, other rights Managing General Contractor and Owner may have under other provisions of the Contract.

C. In addition to Warranties required, Trade Contractor shall ensure all manufacturers' warranties are transferred to Owner. Trade Contractor shall submit these warranties on each item provided by Trade Contractor. Warranty shall detail specific equipment or subparts that are subject to separate conditional warranty. Final payment shall not relieve Trade Contractor of these obligations.

D. During the warranty period, Trade Contractor shall begin rework or replacement of equipment within 2 hours of first notification and must be completed within 24 hours. Repair must be raised to the highest priority until work is completed. If repairs cannot be completed during this period, or if ordering of parts is required, Trade Contractor shall provide Managing General Contractor and Owner written update, every 24 hours, on the progress of repairs.

E. Upon receipt of notice from Managing General Contractor/Owner of the failure of any part during the Warranty period, Trade Contractor shall replace affected parts or parts with new parts and software corrected promptly at no cost to Owner for labor or parts.

1.13 COMMISSIONING AND ACCEPTANCE

Commissioning is a systematic process to ensure all CCTV and Intercom equipment and systems performs interactively according to design intent and Owner's operational needs.

A Final Acceptance of each phase of installation shall be withheld until the following have been completed successfully:

1. Acceptance of all submittals and required documentation
2. Successful Testing & Commissioning
3. Completion of Punch List

B. All cost associated with Testing and Commissioning shall be deemed included in Contract total.

1.14 INVOICING

Prices in Schedule of Values shall be referenced when invoicing for parts, installation and documentation that have received Owner's Acceptance.

1.15 SEQUENCING AND SCHEDULING

A. Trade Contractor shall complete Work according to Sequence of Work described below.

1. CAMERAS

a. .

b. Contractor shall pull wiring through conduit to junction boxes provided by the Electrical contractor. CCTV Trade Contractor must coordinate with contractor for camera mounting location and distribution needs to ensure connection paths. Contractor is responsible to install Owner Approved RJ45 connector on CCTV CAT6 and test all cables before connection to camera and intercoms

c. Trade Contractor shall then cross connect to Camera and begin sequence of settings, adjustments, focusing and pre-testing.

d. Trade Contractor shall coordinate with Owner and Managing General Contractor to ensure installation and programming of new CCTV cameras shall not disrupt existing equipment and/or Airport and Construction operations.

e. When modifying existing installation, Contractor shall coordinate Work to be done so not to disrupt Airport and Construction Operations.

f. When adding, deleting, or working on live CCTV Systems, Trade Contractor shall follow Shutdown Procedures shown in Project Manual. (Note: MDAD Shutdown request is required when adding or deleting any device or component to an active System.)

g. Trade Contractor shall be responsible for testing and commissioning of CCTV Systems and interfaces with the Security System back to the Security Operation Workstation.

2. INTERCOMS

a. Contractor shall pull wiring through conduit to junction boxes provided by the Electrical subcontractor.

b. Contractor shall provide terminated wire and cable. The CAT6 cables shall be tested , and test results submitted to MGC prior to intercom installation.

c. Trade Contractor shall provide Push-to-Call full duplex Intercom and associated terminations. Conduit, and junction boxes will be provided by Electrical contractors. Contractor will provide termination at existing termination block.

d. Trade Contractor shall cross connect Intercom connection at Intercom install location and at MSR / MTR as required.

e. Trade Contractor shall coordinate with Owner and Managing General Contractor to ensure installation and programming of new intercoms shall not disrupt existing equipment and/or Airport and Construction operations.

f. When modifying existing installation, Trade Contractor shall coordinate Work to be done so not to disrupt Airport and Construction Operations. (Note: Shutdown request is required when adding or deleting any device to an active System.)

g. Trade Contractor shall be responsible for testing and commissioning of the Intercom Systems and interfaces with the Security System back to the Security Operation Workstation.

B. Trade Contractor shall perform all Work in accordance with current Construction Schedule as defined in Division 1.

PART 2 PRODUCT

2.1 GENERAL

The approved equipment manufacturers are listed below. Functional equivalents shall be considered so long as hardware/software meets or exceeds this Specification and is 100% compatible with existing system(s). Compatibility shall be proven in Owner's Test Lab.

A.

CAMERAS –Axis and approved alternates.

a. Axis P91 Corner camera and T8640 kit if required.
b. AXIS P3364 –V or Owner approved equal.

If Trade Contractor wants to seek Owner's approval for "Equal", Trade Contractor shall test recommended substitution in Owner's Test Lab and show recommended substitution meet Specification and System compatibility requirements.

Trade Contractor shall designate and coordinate delivery dates for each product in Trade Contractor's Schedule of Work with Project PM to request required equipment from Owner's Inventory.

Trade Contractor shall assemble, install, connect adjust and finish products in accordance with manufacturer's recommendations.

B **TRADE CONTRACTOR PROVIDED EQUIPMENT**: Trade Contractor shall provide, test and commission all other equipment as needed to complete Work indicated by this specification and supporting drawings, including but not limited to:

1. Transient and Surge Suppression Equipment:

a. Ditek
b. Polyphaser

Surge Protection Devices shall also provide noise filtering for electromagnetic and radio frequency interferences (EMI/RFI), as recommended by equipment manufacturer. Frequency range for (EMI/RFI) noise filtering suppression shall be 10KHz to 100MHz at 40 db.

4. Mounting Accessories

a. Camera mounting bracket and accessories shall be provided by Trade Contractor as required for each camera position and as shown in Project Drawings.
b. The product for all exterior camera mounts shall be installed rigidly to eliminate camera movement in winds up to 185 mph. See Project Drawings for rooftop mounting configuration and mounting systems.
c. Roof-top mounting accessories shall include waterproof electrical box with surge protector inside.
d. Certain interior mounting brackets shall be custom designed to Owner's specification. Trade Contractor shall coordinate with Managing General Contractor/Owner for specific mounting bracket product to be used.

5. Intercom .

a. The Intercom Station shall be Emcom Systems Model IP860.

Intercom shall be surface-mounted, hands-free, full-duplex ¾" metal button, submersible speaker. Its internal amplifier and speaker shall operate from line level audio in and its microphone and preamp shall provide line level audio to remote systems. The unit shall provide contact signaling information to alert of activation and shall have two indicators to advise of a call placed or received. It shall include following additional features:

Dimensions: 5.00"H x 5.00"W x 1.8"D.
Panel: Stainless Steel
Weight: 3 lbs
Connectors: RJ45

b. Authorized Supplier Information:

Certified Network Professionals, Inc.
Contact: Orlando Suero
Phone: (954) 610-0443
Email: ogsuero@cnetpro.net

6. Testing Equipment

Trade Contractor shall use a Laptop with CCTV camera vendor software and POE injector to test IP CCTV cameras.

7. Surge Suppression Equipment

Trade Contractor shall provide Surge Suppression devices for all outdoor cameras. Surge suppression devices shall protect all cables that serve outdoor cameras..

8. UPS

If requested by Owner, Trade Contractor shall provide Minuteman Model E 2300 UPS for use in the MSR's and MTR's UPSs are to be installed in cabinets or 19" racks as directed by Owner. Contractor shall energize and test the UPSs. UPS requirements are as follows:
UPC: 784755150738
Warranty: Include 3 years – Parts and labor including batteries
2300VA/1380W 120 VAC true sinewave,
SNMP Card Required: YES
Back-up time – full load: 9.6 minutes
Back-up time – half load: 23.5 minutes

9. Connectors

RJ45 connecters and associated CAT6 cabling , shall be tested end to end with certified calibrated equipment. All test results will be part of project closeout documents.

10. Conduit, Cable Trays, J-Boxes, Hoffman Type Boxes, CAT6, UL Racks and Cabinets (Items listed in Attachment A, Section B2)

If requested by Owner, Trade Contractor shall provide any necessary Conduit, Cable Trays, CAT6 , 19 Inch Racks and/or Cabinets needed to complete the work. All such items shall be provided, installed, and tested in accordance with

the Contract requirements, including but not limited to Specification Sections: Division 26 and 27.

C. CAMERA QUANTITY AND MOUNTING TYPE

Estimated quantity and mounting type is shown below:

Approximate Camera Quantities (Refer to drawings for actual count)		
CM1	FIXED	TBD
	PTZ	TBD
CM2	FIXED	TBD
	PTZ	TBD
CM3	FIXED	TBD
CM4	FIXED	TBD
	PTZ	TBD
CM5	FIXED	TBD
	PTZ	TBD
CM6	FIXED	TBD
TOTAL		TBD

Refer to Project Drawings for exact detail on quantity and Mounting Type.

D. INTERCOM QUANTITY AND MOUNTING TYPE

Estimated Quantity of Intercoms and Audio Interface Mixer Units is shown below:

Emcom IP860 Intercoms: TBD

2.2 SYSTEM REQUIREMENTS

A. Cameras shall have:

1. High resolution color
2. High dynamic range for eliminating or significantly reducing adverse background lighting conditions
3. Function in very low light and nighttime lighting conditions

2.3 CAMERA ENVIRONMENTAL SPECIFICATIONS

A. Humidity: 0% to 90% relative, non-condensing

B. Operating temperature: 14 F to +122 F (-10 C to +50 C)

C. Storage Temperature: 14 F to +140 F (-10 C to +60 C)

D. Enclosure rating:

9350 Series: NEMA 4 (IP65)

9349 Series: Plenum rated

2.4 INTERCOM ENVIRONMENTAL SPECIFICATIONS

A. Operating Temperature: -20C to +50C

2.5 AGENCY APPROVALS

A. Safety: CE, UL

PART 3 EXECUTION

3.1 GENERAL

A. Trade Contractor shall ensure all Work performed shall be in accordance with requirements described in the Project Manual. Trade Contractor shall immediately correct Work performed in deviation of the requirements without additional charges, regardless of the stage of completion.

B. Owner assumes no responsibility or liability for storage fees, freight, taxes, or other costs associated with delivery and storage of system components. Trade Contractor shall be responsible for loss or damage of all material until transfer of title to Owner.

C. Before attempting installation, Trade Contractor shall verify all cables, connections and support equipment are ready for installation and integration with the rest of the system verify with responsible MDAD technical shop

3.2 COORDINATION REQUIREMENTS

A. Trade Contractor shall comply with Managing General Contractor/Owner requirements to coordinate work of various trades having independent responsibilities for installing, connecting to and placing in service associated equipment and products.

B. Trade Contractor shall coordinate with other trades towards the general purpose of having installation/construction progress as rapidly and as smoothly as possible with minimum interference between trades.

~~**C.**~~ Trade Contractor shall make provisions to coordinate with Managing General Contractor to minimize disruption of the construction operation. This may require part of installation Work performed in off-peak hours~~.~~

D. Whenever Work (or portion thereof) is dependent upon the work of other subcontractors or if Work will affect another subcontractor, or if Work may potentially be impacted by another subcontractor, then CCTV / Intercom Trade Contractor is required to, at a minimum:

- ❖ Notify Managing General Contractor
- ❖ Coordinate its Work with dependent work of other subcontractors as required by the Contract
- ❖ Provide necessary dependent data and requirements to Managing General Contractor and appropriate subcontractor(s)
- ❖ Examine dependent drawings, specifications and submittals
- ❖ Examine previously placed dependent work
- ❖ Check and verify dependent dimensions of previously placed work. Notify Managing General Contractor if dependent dimensions which are unsatisfactory or will prevent a satisfactory installation of its Work
- ❖ Attend and participate in coordination meetings with other subcontractors

E. Integration Programming Coordination: In addition to the above, the following Owner Organizations are involved in Programming Coordination of CCTV Cameras and Intercoms:

1. MDAD Information Systems and Telecommunications Division: This Division will be responsible for operation and maintenance of the data network (ASN) and Network Management components of the Security System.
2. MDAD Facilities Maintenance: This organization will be responsible for maintenance of video and audio recording and switching component of Security System. Once each Phase is tested and commissioned, this organization will be responsible for the entire System, including Cameras and Intercoms, and video / audio to the transmission, recording and monitoring equipment.

F. This Contract requires close coordination with Matrix Systems representative, the vendor for Access Control System and Certified Network Professionals, Inc. , the vendor for the Security Systems and Network.

G. If Managing General Contractor/Owner or their authorized representatives determine Trade Contractor is failing to coordinate Work with the work of other contractors as required by this Contract, Managing General Contractor/Owner or its authorized representatives may upon 72 hours written notice:

1. Withhold any payment otherwise owed hereunder until Trade Contractor complies with MGC/Owner's directions
2. Direct others to perform portions of Contract and charge cost of Work against Trade Contractor's Contract amount
3. Terminate any and all portions of this Contract for Trade Contractor's failure to perform in accordance with Contract requirements

3.3 GENERAL MEETING REQUIREMENTS

A. Project Pre-Construction Meeting: After Award of Order, Managing General Contractor will call for and administer a Pre-Construction Meeting in accordance with Division 1. Managing General Contractor and Owner's Authorized Representatives, Trade Contractor and all their sub-contractors shall attend Pre-Construction Meeting. Project Pre-Construction Meeting Agenda shall include the following:

- Introduction of Trade Contractor's authorized representative who shall be responsible for working and coordinating with Managing General Contractor's representative(s) relative to overall project
- Bill of materials, noting long lead-time items
- Preliminary draft of Bill of Materials, noting long lead-time items
- Preliminary Trade Contractor Schedule shall be based on Pre-Bid Schedule. Trade Contractor Schedule shall including all major Work components that materially affect any other Work on the project. Refer to Division 1, for more detail
- Personnel and vehicle permit procedures
- Use of premises
- Location of Trade Contractor's on-site offices
- AOA access
- Employee parking
- Security
- Housekeeping
- Safety Program

- ❖ Review of Preliminary Trade Contractor Schedule
- ❖ Clarifications of Project requirements

Contractor shall distribute copies of minutes to attendees. Attendees shall have 5 working days to submit comments or additions to the minutes.

B. Progress / Coordination Meetings: Managing General Contractor will schedule and administer weekly on-site Progress Meetings throughout duration of the Work as defined in Division 1 of the Project Manual. Trade Contractor's Project representative and sub-contractors, Owner / Owner Authorized Representative, Design Professional and Managing General Contractor shall attend all Progress Meetings. Progress Meeting Agenda shall include, but not be limited to, following items as appropriate:

- ❖ Review of Work progress
- ❖ Status of related Construction Work Schedules and dependencies
- ❖ Submittals
- ❖ Delivery schedules
- ❖ Quality Control
- ❖ Pending changes and/or substitutions
- ❖ Review of Trade Contractor's safety program activities and results, including report on all serious injury and/or damage accidents
- ❖ Other items affecting progress of Work

Trade Contractor shall distribute copies of minutes to attendees. Attendees shall have five (5) working days to submit comments or additions to meeting minutes.

C. Ad-hoc Meetings

Trade Contractor shall be required to attend meetings as may be called by any party by notifying all desired participants two (2) working days in advance, giving reason for meeting. In the event of emergency, Ad-hoc meetings may be held without advance notice.

Trade Contractor shall schedule and conduct meetings as necessary to coordinate responsibilities as described in the Project Manual. Trade Contractor shall maintain minutes of coordination meetings and ensure all attendees and interested parties receive a copy of the minutes resulting from coordination meetings with-in three (3) days from meeting date.

3.4 PRE-INSTALLATION SITE SURVEY

A. Trade Contractor shall survey site to determine system-interfacing requirements. During walk through, Trade Contractor shall inspect site and survey the conditions to be encountered during the performance of the Work prior to starting Work. Failure of Trade Contractor to become familiar with site conditions shall not relieve Trade Contractor of responsibility for full completion of the Work in timeframe required.

B. Trade Contractor shall review areas of potential interference and resolve conflicts before proceeding with Work.

C. Trade Contractor shall examine areas and conditions under which Systems are to be installed and shall not proceed with Work until satisfactory conditions have been achieved.

3.5 INSTALLATION

A. All installation activities shall be performed in a neat and professional manner in accordance with all applicable local and national codes. Additionally, Trade Contractor and their subcontractors shall obtain, or satisfy, (if applicable) the following prior to installation:

1. All licenses and permits
2. Employee and sub-contractors Access Badges
3. All insurance and bonding as required
4. All other standards or requirements specified in this document

B. Trade Contractor shall install, inspect and test all hardware required in this specification in accordance with manufacturers' instructions, the requirements stated herein including but not limited to Section 1.6 (Scope of Work) above.

C. System installation and construction methods shall conform to requirements of Federal Communications Commission and Federal and State, County, and city ordinances. Where undefined by codes and standards, Trade Contractor shall apply a safety factor of at least two (2) times the rated load to all fastenings and supports of system components.

D. Trade Contractor shall install all system components including Owner furnished equipment, and appurtenances in accordance with manufacturer's instructions, NFPA 70, and ANSI-C2. Trade Contractor shall furnish all cables, connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.

E All media shall be listed for application, marked and protected as per the NEC standards.

F. Install all media in approved flexible conduits/or penetration according to design criteria and manufacturer's written instructions. Trade Contractor shall:

1. Install transmission media without damaging conductors, shield, or jacket.
2. Not bend cable, in handling or installation, to smaller radii than the minimum specified or recommended by cable manufacturer.

G. Trade Contractor shall provide telecommunication bonding and grounding for CCTV and Intercom Systems as required to preclude ground loops, noise, and surges from adversely affecting system operation. Ground loops shall be avoided by making ground connections at only the control station.

H. All device mounting shall be of a secure permanent nature. Double-sided foam tape shall not be used to secure any devices or components.

I. Trade Contractor shall use tap connectors that are compatible with cable material. No splices are permitted unless specifically approved in writing by Owner.

J. Trade Contractor shall bond shields and drain conductors to ground at only one point in each circuit.

K. Trade Contractor shall connect components to wiring system and ground as indicated and instructed by manufacturer and according to ANSI/TIA/EIA-607.

L. Trade Contractor shall tighten connectors and terminals, including screws and bolts,

according to equipment manufacturer published torque-tightening values. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to tightening torque specified in UL Standard 486A.

M. Trade Contractor shall provide all cross-connect and jumper cables and all other connectors, cables, panels, equipment, etc., required to connect cameras and Intercoms to Owner furnished equipment for end to end Systems integration.

N. Camera Installation:

Trade Contractor shall follow manufacturers' installation requirements in addition to the following requirements:

1. Place and mount cameras as detailed by camera location drawings.
2. Aim and focus cameras to provide Field of View indicated on the drawings. Coordinate final camera aiming with Owner and Managing General Contractor being present.
3. Pendant Mounting: Secure the wall or corner plate to wall using four (4) fasteners that can each withstand 120 kg (265 lb) pullout force.
   a. A minimum 0.64 cm (1/4 -inch) stud (maximum of 10 mm [3/8-inch] stud) or equivalent is required.
   b. If using Corner or Mast plate, secure wall plate to this plate using four (4) 3/8" x 1" bolts.
4. Ceiling mounted cameras: Install ¾" flexible conduit from the end of rigid conduit / J-box termination point to camera back box to provide for future camera repositioning. Flexible conduit shall not exceed 10 ft. in length.
5. Surge Protection: Provide line surge protection and patch cable from surge protector to exterior camera location. Surge Protection shall protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
6. Outdoor Mounting: Use only liquid-tight fittings or liquid-tight conduit fittings in the two (2) holes in the back of back/wall mounting plate, or bottom of the pendant arm. When using liquid tight fittings, it is important to use appropriate cable width for a snug fit.
7. Cameras mounted on building roof shall not penetrate roof or rooftop membrane unless absolutely necessary. If rooftop penetration is necessary, Trade Contractor shall coordinate and receive Owner's written approval for design and construction change prior to any roof penetration.
8. All video connectors exposed to the weather at camera locations shall be filled with inert silicon "grease" equal to Dow Corning C #5 compound before mating with opposite connector half. The connection shall them be completely covered with heat shrink tubing.
9. Trade Contractor shall closely coordinate installation with cable contractor. The following is example of Responsibilities required by each Trade.
   a. Trade Contractor shall provide mounting bracket/kits needed for camera installation.

b. Trade Contractor shall provide flexible conduit between junction box and camera mount.
c. Trade contractor will provide power, signal and control wiring and install RJ45 terminations needed for the camera connection.
d. Trade contractor will terminate Signal and Control wiring at termination block in the Telecom Rooms.
e. Trade Contractor shall provide 24V Surge protectors at the Camera and 19" Rack Mount 16 position (RJ45) Surge Protectors in the MSR / MTR.
f. Unless otherwise noted, Head End Equipment currently exists and/or will be provided by Owner.

M. Intercom Installation:

As shown on the Typical Security Room Wiring Requirements Drawing for the Intercom, Trade Contractor shall:

a. Provide Push-to-Call full duplex intercom and associated terminations. Conduit, wiring (ENET CAT6) or approved cable and junction boxes will be provided by others. cable contractor will provide termination at existing rated patch panel . All equipment shall be set level, properly aligned and bolted together where in sections. Secure all material and equipment firmly in place.
b. Circuit identification nameplates are required for each Intercom Circuit.

O. Materials damaged during installation shall be repaired to a new condition or shall be replaced. Equipment finishes that have been scratched or marred shall be touched up to match the original finish or shall be completely refinished. Matching shall be determined by inspecting Managing General Contractor.

P. Trade Contractor shall remove all installation debris from worksite immediately to minimize potential for Foreign Objects of Destruction (FOD) being introduced into Aircraft Operations Area (AOA). Trade Contractor shall exercise care to protect occupants and facility from any damage at all times.

3.6 PROGRAMMING INTEGRATION SEVICES

A. Trade Contractor shall provide Programming Integration and System test all interfaces in accordance with manufacturers' instructions and requirements stated herein including but not limited to Section 1.6 (Scope of Work).

B. Trade Contractor shall configure and program all PTZ cameras to the following minimum parameters:

C. Trade Contractor shall work with Matrix and CNP staff to ensure that real time and recorded history viewing of camera video and intercom audio is available via application software operating or accessible from access control workstations. In addition, Trade Contractor shall ensure Matrix Frontier Software interface and can perform proper sequence of operations and that Frontier originated alarm messages are automatically presented with both video and audio from a camera and intercom from alarm area and can be processed from the Security Operation Workstation.

3.7 PRETESTING

A. Trade Contractor shall provide testing, mounting and connection adjustments in coordination with Managing General Contractor/Owner to ensure a fully functional

CCTV System.

B. Trade Contractor shall prepare equipment for Phased Testing and Commissioning as follows:

1. Align, adjust system and pretest components, wiring and functions to verify they comply with specified requirements.
2. Conduct CCTV tests at varying lighting levels, including day and night scenes as applicable.
3. Verify operation of auto-iris lenses.
4. Set back-focus of fixed focal length lenses via vendor software. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
5. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image.
6. Pretest the essential features of Intercom System.
7. Perform Pre-Functional Testing in accordance with Division 28.

3.8 DOCUMENTATION. ALL DOCUCUMINTATION FOR SECURITY and CCTV SYSTEMS SHALL BE CONSIDERED AS SSI MATERIALS, and that is controlled under 49CFR parts 15 and 1520

A. General Documentation required Phase Acceptance and Final Close-out:

1. As-Built Drawings: Trade Contractor shall supply drawings that accurately depict all installed equipment and materials. Trade Contractor shall develop all shop drawings and all “as-built” drawings using AutoCAD format as further defined in Division 1.

   Trade Contractor shall update Shop drawings / As-Built Drawing seven (7) times during the term of the Contract. Updated Drawings shall document all installed Intercoms and CCTV Camera locations along with each MSR Cabinet Layout.

   MSR Cabinet Layout shall document Rack/Cabinet Number, depict location of each head-end device, along with serial number and asset number of each device associated with Intercoms, CCTV Cameras, and related UPS and Network devices. This is regardless if Head-end device were existing or new (installed under this contract). Trade Contractor shall provide such drawings for MSR Room.
2. System Wiring Diagrams: Trade Contractor shall provide System Wiring Diagrams that show all power, signal and control wiring, all System components, wire numbers, color codes, pin numbers, component locations, grounding and connections, depicting the “as-built”, final configuration.

   Wiring diagram shall also show Surge Protection Device wiring, bonding and grounding connections.
3. Functional Block Diagram: Trade Contractor shall provide functional block diagrams that show single-line interconnections between components for signal transmission and control.

4. System Block Diagram: Trade Contractors shall provide a System Block Diagram that show interconnection between System components and subsystems.
5. Program Settings: Trade Contractor shall document all program settings and pre-sets.
6. Updated Inventory Log – submitted monthly.
7. Warranty Documentation per Specification.

B. Project Record Documents:

1. For duration of Project, Trade Contractor shall maintain Project Records in accordance with the Section of the Project Manual.
2. Trade Contractor shall provide all documentation as described in this Specification and Project Manual Division 1 Sections titled:
   - ❖ Shop Drawings, Product Data and Samples
   - ❖ Operating and Maintenance Data
   - ❖ Spare Parts and Maintenance Materials
   - ❖ Warranties and Bonds

3.9 FIELD QUALITY CONTROL

A. Trade Contractor's responsibility for Quality Control shall include, but is not limited to, inspections, tests, reports and record keeping.

B. Trade Contractor's Quality Control shall ensure conformance to applicable specifications and drawings with respect to workmanship, materials, installation, identification, testing requirements and ensuring compliance with technical performance and functional requirements.

C. Trade Contractor shall not apply power to the Systems until after:

1. Systems and components have been installed and inspected in accordance with manufacturer's installation instructions;
2. A visual inspection of system components has been conducted to ensure defective equipment items have not been installed and there are no loose connections, are set level and properly aligned;
3. System wiring has been tested and verified as correctly connected as indicated;
4. All System grounding and transient protection systems have been verified as properly installed and connected, as indicated; and
5. Power supplies connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

D. Satisfaction of the above requirements shall not relieve Trade Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage due to Trade Contractor work/equipment.

E. Set and test sensitivity of motion detection.

F. Connect and verify responses to alarms.

G. Verify operation of control-station equipment.

H. All cabling identification is verified and complete.

3.10 LOSS – DAMAGE

Trade Contractor shall be responsible for any lost or damaged Cameras and Intercoms or other associated hardware/materials provided to Trade Contractor by Owner, or Trade Contractor provided material until time of Final Acceptance. This includes damage at time of installation. Trade Contractor shall be responsible to replace immediately all such loss or damaged to all Cameras or Intercoms and materials at Trade Contractor's expense, including cost of labor.

3.11 TESTING AND COMMISSIONING

A. General Testing Requirement

1. Trade Contractor shall perform Pre-Functional Testing in full accordance with Division 28. Trade Contractor shall ensure all pre-functional checkouts are executed and documented. Owner, Managing General Contractor and/or Design Professional shall document pre-functional checkouts were completed according to approved plans. This may include Owner, Managing General Contractor and/or DP witnessing pre-functional checkout.
2. Individual Systems / Components that form an integral part of other systems shall require multiple testing to show that not only do they work on their own, but perform properly when integrated with other systems.
3. Trade Contractor shall develop a Functional Testing and Commissioning Plan in accordance with requirements stated in Division 28. The Test Plan including Procedure and Scripts shall:
   - ❖ Follow accepted industry testing practices and have a method of independent verification described.
   - ❖ Delineate responsibility of each trade affected and appropriate section of the Specification.
   - ❖ Define requirements for documentation.
   - ❖ All test plans, procedures and scripts shall contain at a minimum the following elements:
     a. Statements of purpose identifying the goals of the test
     b. The methods used for testing
     c. Test Procedure steps, expected results
     d. Duration and schedule of tests
     e. Procedure for documentation and recording test results
     f. Procedure for handling test anomalies and failures
     g. Calibration certificate of test equipment

3. Calibration: Test Equipment, used by Trade Contractor, shall be currently certified and calibrated by an independent test and calibration firm, to the manufacturer's specifications.
4. MGC/Owner's approval of the Test plan, procedure, and scripts shall be required prior to execution of each Phased Test.
5. Trade Contractor shall be present for all inspection, testing and commissioning and will be required to have applicable subcontractors present for inspections and commissioning related to their work.
6. Each test result shall be fully documented by Trade Contractor and approved by

Managing General Contractor/Owner.

7. Trade Contractor shall submit detailed Testing Records complete with witness and approval signatures.
8. MGC shall witness all testing.
9. Owner or the Owner's agent shall witness all testing.
10. Any specified item that does not satisfy the requirements of this specification shall be reinstalled, replaced, adjusted, or added by Trade Contractor as necessary to correct noted deficiencies at no additional cost.
11. After correction of a noted deficiency, re-testing shall be performed to verify effectiveness of the corrective action.
12. The acceptance of any material, workmanship or equipment by Managing General Contractor/Owner shall not preclude subsequent rejection of such items, should those items be later found defective.
13. MGC/Owner reserves the right to have Trade Contractor repair or replace any defective items or damage incurred to existing facility, concrete, etc., at Trade Contractor's expense, if damage occurs due to actions directly attributed to Trade Contractor.
14. In the event of any component of the System failing to meet part of its acceptance test, an observation shall be reported in writing detailing test failure problems.
15. All acceptance test results, observations, calibration certificates and Certificates of Compliance for all system elements shall be compiled into a Testing and Commissioning Report, and supplied to Managing General Contractor/Owner for approval, no later than five (5) days after completion of subject test.
17. The completed Pre-functional Checklist shall form an integral part of Phased Testing and Commissioning Report and Project Close-Out.
18. It shall be Trade Contractor's responsibility to facilitate the coordination of testing and commissioning activities in order to meet Work Schedule as defined in Division 1.
19. All cost for testing and commissioning shall be included in total contract price.
20. Trade Contractor shall ensure all subcontractors and vendors execute their testing and commissioning responsibilities.
21. Trade Contractor shall be responsible for all cost associated with retesting.
22. If any checklist item or test cannot be completed due to the project completion level, required occupancy condition or other deficiency, execution of such checklists items or testing may be delayed upon written approval of MGC. Such test shall be conducted prior to Final System Acceptance and Project Closeout.

B. Camera and Intercom Testing: During the course of performing Phased Testing and Commissioning, Trade Contractor shall be responsible to demonstrate CCTV and Intercom Systems complies with all requirements. These requirements include but are not limited to the following requirements:

1. Trade Contractor shall perform functional testing of Intercom System and camera video and control operation from the field locations back to the SOW.
2. IP Camera must provide all functionality, as indicated on manufactures data sheet. Camera will be installed with current version of firmware installed and

firmware version documented on the data sheet and inventory log.

3. Cameras Fixed Position: Test for proper back-focus, confirm proper field of view adjustments.
4. Pan/Tilt/Zoom Cameras: Test for proper pan/tilt/zoom operation, proper auto-homing feature functionality, and proper back-focus.
5. Link: Test total camera connection link for proper operation. Test for excessive cable and termination losses. Test from end camera device to demarcation point and connection to the System head-end equipment locations at MIA Security Rooms.
6. Ensure tests are conducted such that daytime and nighttime conditions can be evaluated as applicable.
7. Documentation must be provided listing camera ID, Cable ID, Surge Suppressor ID, Camera Type (Fixed/PTZ) , Serial Number, and Picture Quality – both daytime and nighttime.
8. Conduct end-to-end testing for each CCTV Intercom cable pair/conductor for continuity, ground fault, proper termination, shorts and crossed pairs.
9. Test Intercoms to ensure intercoms are free of audible hum, electronic noise, poor speech reproduction, and audio feedback.

C. Solution Testing: Trade Contractor shall test end-to-end solution. Solution testing must be coordinated with ACS subcontractor. This involves video stream testing, local camera configuration verification, DVADTS, DVTS, and DVRS new camera integration testing. Fixed and PTZ Door Cameras test shall include test showing when ACS Alarm is generated, the video from appropriate camera is shown on the SOW and SOW is also capable of retrieve playback from storage for all newly installed cameras. When ACS Alarm is generated, the PTZ camera moves to show door. Solution Testing must test all alarms and presets.

D. Functional Testing: Test Plan shall include performance testing of the dynamic functions and operations of CCTV and Intercom Systems using direct observation or monitoring methods. Functional testing is the dynamic testing of the Systems (rather than just components) under full operation. Functional Testing shall demonstrate CCTV and Intercom System programming are operating according to documented design intent and Project Manual.

E. Problem Correction: Any problems encountered including damage to Airport owned equipment during this test shall be documented and brought to the attention of Owner/MGC and corrected at Trade Contractor's expense. Trade Contractor shall promptly correct all problems encountered in the installation or function of a component, piece of equipment, or system that is not in compliance with Contract Documents.

F. Test Documentation: Trade Contractor shall supply forms to be used during these tests for authorization and initialing by Managing General Contractor/Owner and Trade Contractor. The forms shall clearly define items tested, leaving room for the date, CCTV /Intercom element designation, and initials. All CCTV and Intercom functions shall be demonstrated to ensure operation as required by specification and drawings.

G. Phased Commissioning: Commissioning process shall ensure all cameras, Intercoms and integrated programming performs according to Project requirements. Commissioning shall verify:

1. Equipment meets Project Manual requirements
2. Installation meets Project Manual requirements
3. Integration Programming meets Project Manual requirements
4. System Performance meets Project Manual requirements
5. Documentation meets Project Manual requirements
6. Training meets Project Manual requirements

At a minimum, documentation shall include the following verifications:

- ✓ Installation of CCTV and Intercom Systems are installed according to manufacturer's recommendations and successfully passed all pre-functional checklist and testing.
- ✓ Proper performance of equipment and associated programming interfaces.
- ✓ All required documentation is complete and approved.
- ✓ All equipment and systems are properly installed, connected, and labeled according to manufacturer's recommendations and industry accepted minimum standards.
- ✓ Interconnecting wires and terminals are identified.
- ✓ All equipment and systems receive adequate operational checkout by installing contractors.
- ✓ Operation and Maintenance documentation provided is complete.
- ✓ If applicable, verification all project closeout documentation is complete and approved.
- ✓ Field of View - photograph of each camera shall be stored on CD and made part of each Phased Commissioning Documentation.
- ✓ Trade Contractor shall complete" – Data Sheets as part of each Prefunctional Test.

H. Trade Contractor shall be responsible to coordinate Testing and Commissioning with Owner, Managing General Contractor and other subcontractors.

I. The Testing and Commissioning process does not take away from or reduce the responsibility of Trade Contractor to provide a finished and fully functioning System.

3.12 MAINTENANCE AND SUPPORT

A. Occupancy Adjustments and Emergency Repair:

Anytime after successful commissioning and acceptance of cameras and before Final Project Close-Out, Trade Contractor agrees:

1. To provide on-site assistance to troubleshoot, check cable connections, check proper operation of cameras and lenses.
2. Verify operation of auto-iris lenses and adjust back-focus as needed.
3. Adjust preset positions as requested by Managing General Contractor/Owner.
4. Provide written report of adjustments and recommendations, replacing cameras / devices and adjusting FOV / focus to suit actual occupied conditions and to optimize performance. The on-site assistance described in this provision is in addition to the Warranty requirements of the Contract.

5. In the event of camera or Intercom failure, Trade Contractor shall provide on-site support within two (2) hours of request.

3.13 TRAINING

A. Training shall be provided in accordance with the requirements in Project Manual Division 1 – Systems Demonstrations.

3.14 CLEANING

A. Trade Contractor shall comply with all requirements stated in Project Manual Division 1, Section 01710 – Final Cleaning and the following:

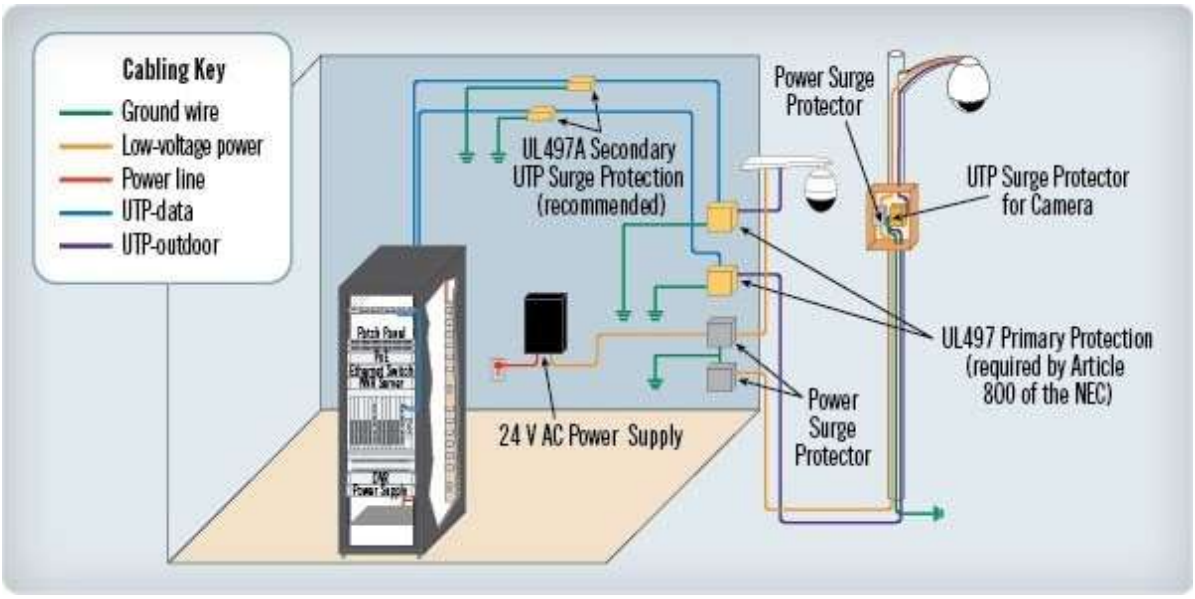
1. Clean installed items using methods and materials recommended in writing by manufacturer.
2. Clean intercom and video surveillance system components, including camera-housing windows, lenses, monitor screens and intercom faceplates.
3. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.
4. Touch-up paint as needed.
5. General cleaning and maintenance of the premises
6. Coordination and direction of the cleanup work of its employees

3.15 SPARE PARTS……..10 %

A. Trade Contractor shall comply with requirements shown in Division 1, Section 01732. Trade Contractor shall be required to provide (on-site) the following spare parts 180 days prior to final close out of the project (or sooner as may be requested by Owner).

3.16 PROJECT CLOSEOUT

Trade Contractor shall comply with the requirements stated in the Contract Documents and Specifications, including but not limited to Project Manual Division 1 – Project Closeout and Section 01720 Project Record Documents.


Cabling Key
Ground wire
Low-voltage power
Power line
UTP-data
UTP-outdoor
UL497A Secondary
UTP Surge Protection
(recommended)
Power Surge
Protector
UTP Surge Protector
for Camera
UL497 Primary Protection
(required by Article
800 of the NEC)
Power
Surge
Protector
24 V AC Power Supply

SECTION 28 11 11

FIRE ALARM SYSTEM COMPONENTS

PART-1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 - Specifications sections, apply to work specified in this Section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Conduits.

B. Wire and Cable.

C. Wire and Cable Connections.

D. Outlet Boxes.

E. Pull and Junction Boxes.

F. Terminal Cabinets.

G. Division 15 – BMS (Section 15975).

1.3 QUALITY ASSURANCE

A. The complete installation shall conform to the applicable section of NFPA-72 National Fire Alarm Code; Local Code Requirements; and, National Electrical Code with particular attention to Article 760. Entire system must be compatible with existing and augmented Honeywell BMS system for the N.T D. area.

B. Each and all items of the fire alarm system shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc., (UL), and shall bear the UL label. All control equipment shall be listed under UL category UOJZ as a single control unit. Partial listing shall not be acceptable.

C. All control equipment must have transient protection devices to comply with UL864 requirements. Provide multi-stage hybrid design surge protection at incoming 120 volt a-c supply.

D. In addition to the UL-UOJZ requirement mentioned above, the system control shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with

NEC Article 760-22. All signaling circuit cables shall be marked and listed in accordance with NEC Articles 760-50 and 760-51.

1.4 SUBMITTALS

A. Submit properly identified manufacturer's specifications and catalog data for acceptance, for fire alarm system, to include the following:

B. A material list with names of manufacturers, model numbers, and technical information on all equipment proposed for installation.

C. Complete system riser diagrams, circuit diagrams, block diagrams, and shop drawings which clearly illustrate how all components relate and how they are interconnected, and a point to point wiring diagram. System submitted must exhibit complete coordination with, and be submitted concurrent with, the likewise fully coordinated Div. 15 BRS submittal.

D. Battery calculation.

E. Submit operating and maintenance manuals complete with replacement parts data for fire alarm system.

1.5 SYSTEM DESCRIPTION

A. Complete system shall be supervised against open wire faults in the detection circuit, the alarm circuit, and an open in system alarm trouble relay coils. Wiring fault occurring in these circuits shall cause an audible and visual trouble indication in the control panel. A short in the audible alarm circuit shall cause an audible and visual trouble indicator at the control panel. Alarm signals shall override trouble signals. In the event of a trouble signal resulting from trouble on an initiating zone, an alarm from another zone takes precedence. External circuit supervision shall not require additional wires other than the pair used for detection and alarm signals. Each pair shall terminate at an end of line device.

B. General alarm shall be by means of horns and flashing lights, flush mounted where shown on drawings. Annunciation of zones shall be accomplished on face of annunciator panel. Remote annunciator panels shall also duplicate all alarm and trouble zones.

C. Manual actuation of any fire alarm station or automatic activation of any heat detector, smoke detector, duct mounted smoke detector or flow switch shall cause an alarm signal to be transmitted instantaneously to the fire alarm control panel, the annunciator panel to display alarm zone, to sound alarm signals throughout the building, to energize visual alarm signals, to shut down all air handling units, to release doors, to initiate elevator recall, to close all fire/smoke dampers and to activate smoke evacuation system.

D. In addition, the fire alarm system shall annunciate alarm and trouble signal through telephone lines to the MDAD Main Fire Control Room.

E. Each device in alarm shall be individually annunciated at the panel.

F. All fire alarm system devices must be UL and FM approved and listed as compatible with the Honeywell system, which is the existing fire alarm system throughout the Airport.

G. The Life Safety System shall include the following features and shall support the following operations in each installed system:

1. Up to 9 intelligent Loop Controller Modules.
2. Up to 100 intelligent Smoke or Heat Detectors and 100 intelligent Modules per loop.
3. Up to 120 Hardwired input/output Circuits.
4. Up to 342 Manual Control (input) switches.
5. Up to 456 LED Annunciation Points.
6. Multi-Priority, token passing, peer-to-peer network connection of up to 64 system module.
7. Ability to download all system applications programs and "firmware" from a laptop computer through a single point in the system.
8. True Distributed Intelligence, including microprocessor-based Detectors and Modules with internal diagnostics.
9. A.C. Power Trouble Signal Delay which is adjustable from 4 hours to 10 hours.
10. Electronic Addressing of Field Devices.

PART-2- PRODUCTS

2.1 CONTROL PANEL REQUIREMENTS

A. The Life Safety System shall be a multi-processor based network system designed specifically for fire, audio evacuation applications. The Life Safety System shall be a Honeywell XLS1000 communicating with the Deltanet XBSi Central Life Safety System over an FS90 F&S Bus, and shall be UL listed under Standards 864 (Control Units for Fire-Protective Signaling Systems) under category UOJZ, and ULC listed under standard CAN/ULC-S527.

B. The Life Safety System shall include all required hardware and system programming to provide a complete and operational system, capable of providing the protected premises with the following functions and operations:

1. All System operational software is to be store in FLASH memory. Control Panel disassembly, and replacement of electronic components of any kind shall not be required in order to upgrade the operation of the installed system to conform to future application code and operating system changes.
2. Up to 255 Service Groups must be definable within the system program to allow the testing of the installed system based on the physical layout of the system, not on the wiring of the field circuits connected to the Fire Alarm Control Panel. Service or "walk-test" arrangements shall not require placing an entire addressable loop or panel into the test mode.
3. Advanced Windows-based System Definition utility with Program Version Reporting to document any and all changes made during system start-up or system commissioning. Time and Date Stamps of all modifications made to the program must be included to

allow full retention of all previous program version data.

4. System Common Control Functions shall be automatically routed to any node of the system as a function of the time of day and date.

2.2 LIFE SAFETY SYSTEM USER INTERFACE

A. The Fire Alarm/Life safety System shall include a Emergency Operators' Interface Panel which shall include the following system annunciation and control functions:

1. Control Panel Internal Audible Signal shall have four programmable signal patters, to allow for the easy differentiation between alarm, supervisory, trouble and monitor conditions within the system.
2. Power Status LED_ Green LED shall illuminate when AC power is present.
3. Test Status LED – Yellow LED shall illuminate when any portion of the system is in the test mode.
4. CPU Fail Status LED – Yellow LED shall illuminate when the panel controller has an internal failure.
5. Ground Fault Status LED – Yellow LED shall illuminate when un-grounded wiring connected to the cabinets' power supply has continuity to ground.
6. Disable Status LED – Yellow LED shall illuminate whenever any point or zone in the installed system is manually disabled.
7. Reset: The Reset Switch starts the system reset operation. The associated yellow LED shall have three flash rates during this operation to inform the user of the progress of the reset cycle. The LED shall flash fast during the smoke detector power down sequence, slowly during the restart phase, and shall illuminate steadily for the restoral phase and shall go out completely when the system is back to normal mode.
8. Alarm Silence: The Alarm Silence Switch shall turn off all (audible and/or visible) Notification Appliance Circuits. The associated yellow LED illuminates when the Alarm Silence function is active, whether by the Alarm Silence Switch, or by an integral software timer.
9. Panel Silence: the Panel Silence Switch shall turn off the systems' internal audible signal when configured as a "local" system. The associated yellow LED illuminates when the panel silence feature is activate.
10. Drill Switch / LED: The Drill switch activates the fire drill function. Yellow LED indicates that the fire drill function is active.
11. Previous Message Switch: The Previous Message Switch shall scroll the display to show the preceding message in the selected queue. Scrolling through event messages may be done by the operator at any time.
12. Next Message Switch: The Next Message Switch shall scroll the display to show the following message in the selected queue. Scrolling through event messages may be done by the operator at any time.
13. More Details Switch: the More Details Switch shall show the address of the active device on display. If a zone is active, pressing the switch displays the address and message of active devices within the zone. When multiple devices are active, the "Previous/Next" message switch may be used to scroll through the messages.

B. System Liquid Crystal Display:

1. The Liquid Crystal Display shall provide the means to inform the System Operator with

detailed information about the off-normal status of the installed Fire Alarm / Life Safety System. The Main Display shall automatically respond to and display the system status on an 8 line by 21 character alpha-numeric backlit display.

2. The following system functions shall be annunciated at the Main LCD:

System "Normal" Mode, the LCD displays:

- The current Date and Time.
- A system title (2 lines x 21 characters).
- A summary total of the Alarm History of the system.

System "Alarm" Mode, the LCD shall automatically reconfigure into four logical windows.

System Status Window.

Shall show the system time, and the number of active points and disabled points in the system in this section of the LCD Display.

Current Event Window.

Shall show the first active event of the highest priority in reverse text to highlight the condition. The top line of the reversed text shall show the sequence number in which the displayed event was received, as well as its event type. The second and third lines of reversed text shall display an identification message related to the displayed event.

Last Event Window.

Shall show the total number of active events in the system, by event type. There shall be four different System Event Types which shall be displayed. "Alarm Events", "Supervisory Events", Active Trouble Events", and "Active Monitor Events".

System Message Processing

- Previous Message Switch: The Previous Message Switch shall scroll the display to show the preceding message in the selected queue. Scrolling through event messages may be done by the operator at any time.
- Next Message Switch: The Next Message Switch shall scroll the display to show the following message in the selected queue. Scrolling through event messages may be done by the operator at any time.
- More Detail Switch: The More Details Switch shall show the address of the active device on display. If a zone is active, pressing the switch displays the address and message of active devices within the zone. When multiple devices are active, the "Previous/Next" message switch may be used to scroll through the messages.

Maintenance Menu

Allows access of the following system maintenance functions through a four level password system.

System Status

Determine the status of individual system components, including active points, disabled points, and active points by panel.

Enable

Restore a disabled point (device) in the system, allowing that point (device) to operate as originally intended, restore any group or panel function, system module, "software-define zone", operator or time control function.

Disable

Disable any point (device) in the system, inhibiting that point (device) from operating as originally intended, disable any group or panel function, system module, "software-define

zone", operator or time control function.

Activate

Allow manual activation of any system output point of function, alternate Smoke 'Detector sensitivity, and message routing with the system.

Restore

Restores the primary (application program defined) operation to the Smoke Detector sensitivity and the message routing functions.

Control Output

Allows manual command of control relays and LEDs. Relays shall be able to be commanded to "Latch" to energize as a "High Priority", or as a "Low Priority", to "Energize", or to "De-Energize". LEDs shall be able to be commanded to "Latch", to energize as a "High Priority", or as a "Low Priority", to turn "On", to turn "Off", to "Slow Blink" or to "Fast Blink".

Reports

The system shall provide the following system reports at the Main LCD:

- Sensitivity listing of all detectors which have less than 75% environmental compensation remaining.
- Sensitivity listing of any particular detector.
- Sensitivity listing of all any intelligent loop within the panel.
- The system shall provide a report which gives a chronological listing of the last 800 system events.

Program

The system shall allow the authorized operator to perform all of the following system functions:

- Set the System Time/Date/Holiday Schedules.
- Set (Change) the System Passwords.
- Restart the System.
- Clear the Chronological System History File.

2.3 LIFE SAFETY SYSTEM OPERATIONS INTERFACE

A. Intelligent Communications Card

1. The Intelligent Communications Card shall be the interface between the Fire Alarm Control Panel and the intelligent Detectors and Modules. The communications format between the ICC and the Devices shall be 100% digital. Communications to devices must incorporate BROADCAST POLLING and DIRECT ADDRESS SEARCH to ensure the fastest reporting of off-normal conditions to the system human interface layer. An alarm from any devices on a fully loaded loop shall be processed by the ICC within 0.5 seconds. The ICC shall support 100% of the devices on the loop in alarm simultaneously to ensure proper operation of relays and remote indicators. Should an ICC CPU fail to communicate with the devices the circuit shall go into the stand-alone mode. The circuit shall produce a loop alarm if alarm type device becomes active during stand-alone mode.
2. The ICC shall provide a mapping report of all devices connected to the circuit for confirmation of "as-built" wiring. The map shall show physical wiring, device types, and the panel addresses of devices connected to the circuit. A report of all unauthorized

additional device addresses and changes to the wiring in the data circuit shall be provided. A specific trouble shall be reported for any off-normal non-alarm condition. The ICC shall report the following information per Intelligent Device:

- Device Serial Number/Address/Type
- Current Sensitivity Values and % of Environmental Compensation.
- Any of 32 trouble codes.

B. System Programmable Operations

1. The system shall provide 255 logical Counting AND Groups. Each group shall have a programmable "activation" number. Whenever the number of active devices in an AND Group reaches the activation number, the AND Groups' rules will execute. It shall be possible to "overlap" AND groups by having devices appear in more than one group.
2. The system shall define 255 Matrix Groups with up to 255 points each. For each matrix, it shall be possible to define a "radius" and an "activation" number. The radius number defines the proximity between detector locations. When two detectors activate at or within the value of the "radius" or whenever the number of active devices reaches the activation number the Matrix Group activates it shall be possible to "overlap" Matrix groups by having devices appear in more than one group.
3. The system shall include the ability to define an alternate set of device commands to be used in combination with the system test command. This function shall disable the normal alarm command for each of the members of the group, so that the testing will not activate the building evacuation signals, or control functions. A programmable timer shall cause the system to automatically exit the test mode after a period of system inactivity.
4. The system shall include time Control functions which will have the ability to control any system output of function, or initiate any system operational sequence as a function of the Month, Day of Week, Date, Hour, Minute, or Holiday.
5. The system shall include up to 1023 software define Logical Zone Groups, each containing up to 64,000 points. Logical zones may group any input from any intelligent device, or Initiating Device Circuit, to initiate a system output, function, or operational sequence. A device or IDC may be a member of one Logical Zone Group. Each of these zones shall have an associated message which is displayed on the LCD during an event. Activation of the "More Details" switch shall cause the LCD to then display the points within the Logical Zone, which are active.
6. The panel shall provide the ability to download data from the intelligent detectors to a laptop personal computer while the system is on-line and operational.

2.4 INTELLIGENT DETECTORS

A. Fixed Temperature Heat Detector

The intelligent heat detector shall have a low mass thermistor head sensor and operate at a fixed temperature. The integral microprocessor shall determine all alarm conditions. The heat detector shall have a nominal alarm point rating of 135°F (57°C) and shall be rated for ceiling installation at a minimum of 70 ft (21.3 m) centers. Honeywell Model XLS-HFS.

B. Fixed Temperature/Rate of Rise Heat Detector

The intelligent heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate of rise. The integral microprocessor shall determine all

alarm conditions. The heat detector shall have a nominal alarm point rating of 135°F (57°C) and a rate of rise alarm point of 15°F (9°C) and shall be rated for ceiling installation at a minimum of 70 ft (21.3 m) centers. Honeywell Model XLS-HRS. The Fixed Temperature/Rate of Rise Heat Detector is to be used generally in this project except when otherwise indicated.

C. Photoelectric Smoke Detector

The intelligent analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine sensor values and initiate an alarm based on the analysis of data. The detector shall continually monitor changes in sensitivity due to the environmental effects of dirt, smoke, temperature, humidity and aging. The information shall be stored in the integral processor and transferred to the intelligent loop controller. The photo detector shall be rated for ceiling installation at a minimum of 30 ft (9.1m) centers and shall be suitable for direct insertion into air ducts up to 3 ft (0.91 m) high and 3 ft (0.91m) wide with air velocities up to 5,000 ft/min (0-25.39 m/sec) without requiring specific duct detector housings or supply tubes. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.55. Honeywell Model XLS-PS.

The photo detector shall be suitable for operation in the following environment:

- Temperature: 32°F to 120°F (0°C to 49°C).
- Humidity: 0-93% RH, non-condensing.
- Elevation: no limit.

D. Photo/Heat Combination Detector

The intelligent photoelectric/heat combination Analog detector shall use a light scattering type photoelectric smoke sensor and a fixed temperature type heat sensor. The integral microprocessor shall employ time-based algorithms to dynamically examine values from both sensors simultaneously and initiate an alarm based on that data. The detector shall continually monitor any changes in sensitivity due to the environmental affect of dirt, smoke, temperature, humidity and aging. The information shall be stored in the integral processor and transferred to the intelligent loop controller. The photoelectric/heat combination detector shall be rated for ceiling installation at a minimum of 30 ft (9.1m) centers and shall be suitable for direct insertion into air ducts up to 3 ft (0.91 m) high and 3 ft (0.91 m) wide and with air velocities up to 5,000 ft/min (0-25.39 m/sec) without requiring specific duct detector housings or supply tubes. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The fixed temperature alarm set point shall be 135°F (57°C) nominal. Honeywell Model XLS-PHS.

The photoelectric/heat combination detector shall be suitable for operation in the following environment:

- Temperature: 32°F to 100°F (0°C to 38°C).
- Humidity: 0-93% RH, non-condensing.
- Elevation: no limit

E. Multisensor Detector

The intelligent Multisensor Analog detector shall use a light scattering type photoelectric smoke sensor, a unipolar ionization smoke sensor and an ambient temperature sensor to sense changes in

air samples from its surroundings. The integral microprocessor shall employ time based algorithms to dynamically examine values from the three sensors simultaneously and initiate an alarm based on that data. The temperature sensor shall self-adjust to the ambient temperature of the surrounding air and input an alarm when there is a change of 65°F (35°C). The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, humidity and aging. The information shall be stored in the integral processor and transferred to the intelligent loop controller. The multisensor smoke detector shall be rated for ceiling installation at a minimum of 30 ft (9.1 m) centers and shall be suitable for direct insertion into air ducts up to 3 ft (0.91 m) high and 3 ft (0.91 m) wide and air velocities up to 500 ft/min 90-2.54 m/sec) without requiring specific duct detector housings or supply tubes. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The integral heat sensor shall cause an alarm when it senses a change in ambient temperature of 65°F (35°C) or reaches it fixed temperature alarm set point of 135°F (57°C) nominal. Honeywell Model XLS-IPHS.

The Multisensor detector shall be suitable for operation in the following environment:

- Temperature: 32°F to 100°F (0°C to 38°C).
- Humidity: 0-93% RH, non-condensing.
- Elevation: Up to 6,000 ft (1828 m)

F. Duct Detector Housing
Provide a metal smoke detector duct housing assembly for mounting an intelligent photoelectric, photoelectric/heat combination, or multisensor detector to an air duct. Provide for variations in duct air velocity between 300 and 4000 feet per minute (300 to 1000 for multisensor detector). Honeywell Model SIGA-DH.

G. Remote Alarm LED:
Remote LED Alarm indicator shall have a 180 degree viewing angle. Finish shall be high impact white plastic and clearly marked as an alarm device. Honeywell Model SIGA-LED.

2.5 INTELLIGENT MODULES

A. Monitor Module
The intelligent Monitor Module shall be factory set to support one (1) supervised Class B Normally-Open Active Non-Latching Monitor circuit. Honeywell Model SIGA-MMI or for a Latching Alarm circuit. Honeywell Model SIGA-CT1.

B. Waterflow/Tamper Module
The intelligent Waterflow/Tamper Module shall be factory set to support two (2) supervised Class B (Style B) input circuits. Input A shall support a Normally-Open Alarm Delayed Latching Waterflow Switch circuit. Input B shall support a Normally-Open Active Latching Tamper Switch. Honeywell Model SIGA-WTM.

C. Single Input Signal Module
The intelligent Single Input (Single Riser Select) Signal module shall provide one 91) supervised Class B (Style Y) output circuit capable of a minimum of 2 personalities, each with a distinct operation. When selected as a telephone power selector, the module shall be capable of generating

its own “ring tone”. The single input signal module shall support the following operations:

- Audible/Visible Signal Power Selector (Polarized 24 VDC @ 2A). Honeywell Model SIGA-CR.

D. Control Relay Module

The Control Relay Module shall provide one form “C” dry relay contact rated at 2 amps @ 24 VDC to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty. Honeywell Model SIGA-CR.

E. Universal Class A/B Module

The intelligent Universal Class A/B Module shall be capable of supporting fifteen (15) types of Class A or B alarm, control and signaling circuits. Each Module can accommodate either one or two circuits depending on its specific function. Honeywell Model SIGA-UM.

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F. Intelligent Manual Pull Stations

The manual stations shall be double action type and have 2 diagnostic LEDs. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The station shall be capable of storing up to 24 diagnostic codes which can be retrieved for troubleshooting assistance. Input circuit wiring shall be supervised for open and ground faults. Honeywell Model XLS-278.

The fire alarm pull station shall be suitable for operation in the following environment:

- Temperature: 32°F to 120°F (0°C to 49°C).
- Humidity: 0-93% RH, non-condensing.

2.6 FIRE ALARM NOTIFICATION APPLIANCES

A. All appliances which are supplied for the requirements of this specification shall be U.L. Listed for Fire Protective Service, and shall be capable of providing the “Equivalent Facilitation” which is allowed under the Americans and Disabilities Act Accessibilities Guidelines (ADA (AG)), and shall be UL 1971, and ULC S526 Listed.

B. Self-Synchronized Strobes

The Strobes shall have a <red> <white> plastic face plate. They shall provide <15 cd> <15/75 cd>, <30 cd>, <60 cd>, <110 cd> synchronized flash outputs. The strobe shall have lens markings oriented for wall mounting. It shall be possible to replace the lens markings with LKW series or LKC series lens marking kits without removal of an installed strobe. <Ceiling mounted strobes shall have lens markings with correctly oriented lettering>. Honeywell Model S24 <xxx> Series.

C. Horns and Horn/Strobes – Electronic Type

The Horn shall have a <red> <white> plastic housing. Horns shall be suitable for indoor or outdoor use. A sound output level of 103 dBA Peak shall be provided. Honeywell Model XLS-757 Series.

The Horn/Strobes shall have a <red> <white> plastic housing. The strobe shall provide <15 cd> <15/75 cd>, <30 cd>, <60 cd>, <110 cd> synchronized flash outputs. The strobe shall have lens markings oriented for wall mounting. It shall be possible to replace the lens markings with LKW

series or LKC series lens marking kits without removal of an installed Horn/Strobe. <Ceiling mounted strobes shall have lens markings with correctly oriented lettering>. Horns shall provide a 100dBA Peak sound output. Honeywell Model P24<xxx> Series.

PART-3- EXECUTION

3. 1 INSTALLATION

A. Fire alarm system components shall be installed in accordance with all applicable codes. Final connections of equipment, testing of system, setting of compensating resistances, and any other necessary adjustments shall be performed under supervision of a representative of the manufacturer.

B. Number, type and size of wire shall be in strict accordance with manufacturer's wiring diagram, as required for proper operation of fire alarm system. Minimum wire size shall be No. 14 AWG Type FPL with minimum 90 degrees C insulation rating. Wiring shall be in accordance with the requirements of NEC Article 760. All wiring shall be installed in conduit. Maximum conduit fill shall be 40%. Pull and junction boxes for fire alarm system shall be provided with terminal strips and identified for wire terminations. The wiring system shall be properly wired through the terminals of all devices, no pigtail type connections are allowed. Conductors shall be tagged at all junctions points.

C. Equipment comprising fire alarm shall be installed in a neat and workmanlike manner in accord with recommendation of National Fire Protection Association and Standard Fire Alarm practice to end in a complete, acceptable and working fire alarm system.

All wiring shall be checked and tested to insure that there are no grounds, opens or shorts. The minimum allowable resistance between any two conductors or between conductors and ground is 10 megohms as checked by a Megger after all conduit, conductors, detector bases, etc., have been installed, but before the individual devices and end-of-line devices are installed.

D. All junction boxes shall be painted orange and labeled "FIRE ALARM". Wiring shall be color coded throughout the installation.

E. Installation of equipment and devices that pertain to other work in the Contract shall be closely coordinated with the appropriate subcontractors.

F. The Contractor shall clean all dirt and debris from the inside and outside of all Fire Alarm System equipment after completion of the installation.

G. Components shall be furnished and installed in accordance with accepted shop drawings of equipment and wiring diagrams. Finally, the system shall be tested for proper functioning and operation.

H. The manufacturer's authorized representative shall provide on-site supervision of installation.

I. Honeywell is the sole sourced vendor for all MIA fire alarm systems. As such, they have all available information and knowledge to bid the fire alarm and BMS portions of the project. Honeywell is expected to, within 7 days of project announcement for bid, visit the project site and review the project documents. Within 14 days of the initial advertisement for bidding on this project, Honeywell shall present any and all questions, concerns, comments, notifications, etc. which could result in an extra cost to the project from themselves, the Electrical subs or the General Contractor. If any items are not noted by Honeywell in that 14 day period, Honeywell warrants that there will be no extra cost associated with any such work due to the need for any additional panels, zone modules, loops, zone expanders, panel capacity, battery capacity, etc. Further, Honeywell warrants that all costs which might have to be borne by the electrician for any such work will be paid for by Honeywell and will not be passed on to the Owner as an extra cost. This includes conduit, wiring, boxes, etc.

3.2 TESTING

A. Upon completion of installation, entire system shall be tested in the presence of enforcement officer of local municipality and also in the presence of Architect-Engineer representative. Fire alarm system shall be tested as follow: operate every new or relocated manual station, and open the corresponding initiating and audio/visual signal zone and other circuits at the remote point to check for the correctness of the supervisory circuit. When the above test has been completed to the satisfaction of the Fire Department, the Architect-Engineer and the equipment manufacturer's representative; a letter witnessed and co-signed by all shall be forwarded to the Fire Department, the Architect and the Engineer.

B. The Contractor shall coordinate and cooperate fully with the Fire Department and give at least twenty-four hours notice of all work requiring Fire Department notification and assistance.

C. Upon completion of a successful test, the equipment manufacturer shall so certify in writing to the Owner by completing the Fire Alarm System Certification and Description form in accordance with NFPA requirements.

3.3 WARRANTY

A. The Contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of the completed and certified test or from the date of first beneficial use.

B. The equipment manufacturer shall make available to the Owner, a maintenance contract proposal to provide a minimum of two (2) inspections and tests per year in compliance with NFPA 72 guidelines.

END OF SECTION

SECTION 34 77 16

SECTION PARTS

PART 1 – GENERAL

PART 2 – PRODUCTS

PART 3 - EXECUTION

PART 4 – BHS SUBCONTRACTOR QUALITY CONTROL REQUIREMENTS

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SECTION 34 77 16

BAGGAGE HANDLING EQUIPMENT

1. GENERAL

1.1 DEFINITIONS

A. Abbreviations:

1. ACS shall mean Access Control System.
2. ANS shall mean American National Standards.
3. ANSI shall mean American National Standards Institute.
4. AOA shall mean Airport Operations Area.
5. ATR shall mean Automatic Tag Reader.
6. BHC shall mean Baggage Handling Computer System (i.e.MIS, MDS).
7. BHS shall mean Baggage Handling System.
8. BMA shall mean Baggage Measuring Array.
9. CBRA shall mean Checked Baggage Resolution Area.
10. CBS shall mean Checked Baggage Screening.
11. CBIS shall mean Checked Baggage Inspection System.
12. CEMA shall mean Conveyor Equipment Manufacturers Association.
13. COF shall mean Coefficient of Friction.
14. CS shall mead Control Station
15. CR shall mean Card Reader (security system)
16. EDS shall mean Explosive Detection System (Computer Tomography).
17. EIA shall mean Electronic Industry Association.
18. EPROM shall mean Erasable Programmable Read Only Memory.
19. E-Stop shall mean Emergency Stop.
20. FAA shall mean Federal Aviation Administration.
21. FAT shall mean Factory Acceptance Test.
22. FLA shall mean Full Load Ampacity or Full Load Amperes.
23. FPM shall mean Feet Per Minute.
24. FSD shall mean Fire Security Door
25. HDD shall mean Hard Disk Drive.
26. HMI shall mean Human Machine Interface.
27. HSPD shall mean High Speed Paddle Diverter.
28. HVAC shall mean Heating, Ventilating and Air Conditioning.
29. IATA shall mean International Airline Transportation Association.
30. ID shall mean Identification.
31. IEC shall mean International Electromechanical Commission.
32. I/O shall mean Input / Output.
33. LAN shall mean Local Area Network.
34. LED shall mean Light Emitting Diode.
35. LS shall mean Light Screen
36. MCP shall mean Motor Control Panel.
37. MDAD shall mean Miami Dade Aviation Department.
38. MDS shall mean Maintenance Diagnostics System.
39. ME shall mean Manual Encoding.
40. MEP shall mean Mechanical, Electrical and Plumbing System.
41. MIA shall mean Miami International Airport.

42. MIS shall mean Maintenance Information System.
43. MSD shall mean Motor Safety Disconnect
44. MTBF shall mean - Mean Time Between Failures.
45. NEC shall mean National Electrical Code.
46. NEMA shall mean National Electrical Manufacturers' Association.
47. NFPA shall mean National Fire Protection Association.
48. NIC shall mean Not In Contract
49. NTP shall mean Notice-to-Proceed.
50. O & M shall mean Operations and Maintenance.
51. OCC shall mean Operations Control Center.
52. OEM shall mean Original Equipment Manufacturer.
53. OH shall mean Over Height
54. OL shall mean Over Length
55. OOG shall mean Out-of-gauge.
56. OSHA shall mean Occupational Safety and Health Administration.
57. OS shall mean Oversize.
58. PAX shall mean Passenger.
59. PDP shall mean Power Distribution Panel.
60. PE shall mean Professional Engineer.
61. PLC shall mean Programmable Logic Controller.
62. PM shall mean Project or Program Manager.
63. PSI shall mean Pounds per Square Inch.
64. RF shall mean Radio Frequency.
65. RFI shall mean Request For Information.
66. ROW shall mean Right of Way.
67. SACR shall mean Security System Card Reader
68. SIDA shall mean Security Identification Area.
69. TOB shall mean Top of Belt.
70. TSA shall mean Transportation Security Administration.
71. TSO shall mean Transportation Security Officer
72. UL shall mean Underwriters Laboratories.
73. UPS shall mean Uninterrupted Power Supply.
74. USS shall mean Uniform Symbology Specification.
75. User Airline shall mean those airlines that use the Baggage Handling System(s) related to this contract.
76. VFD shall mean Variable Frequency Drive.
77. VOM shall mean Volt Ohm Meter.
78. VSU shall mean Vertical Sort Unit.
79. WAN shall mean Wide Area Network.

B. General

1. Baggage Handling System (BHS) shall mean all components, including installation materials and all required interfaces between the existing (designated to remain) conveyor equipment/components that are identified in the contract documents with the new conveyor segments/components. Such interfaces shall include all necessary hardware, software, installation coordination and construction supervision of computers/PLCs, controls and control hardware and software with management and support services required to implement the work and provide a fully functioning "Turnkey" system as described by the Contract Documents.

2. Baggage Handling System Subcontractor shall mean the firm or company that is

responsible for the design, engineering, manufacture, modification and installation of the conveyor equipment and systems required to implement the work and supply a fully functioning "Turnkey" system as described by the Contract Documents.

3. In these written Specifications and on the Contract Drawings the following clarifications/definitions shall apply:

   a. As Built shall encompass all elements of the term As Executed.

   b. Diversion Point shall mean the point at which a bag shall either be routed into the BHS for final sortation and baggage make-up or routed to the next level of security screening subsystem for further processing.

   c. Other Contractor or Other shall mean a firm or person other than the Contractor who shall enter or has entered into a Contract with MDAD.

   d. Site means the lands and other places made available or to be made available to the BHS Subcontractor by MDAD for the purpose of the Contract.

   e. Specifications means the BHS Technical Specification for the Works included in the Contract and any modifications of such Specification thereafter.

   f. Subsystem shall mean a set of conveyor segments and its related field elements (e.g., control stations, photoeyes, PLCs, MCPs, and the like), which is a system itself, and a part of the whole system.

   g. Temporary (or Interim) Work shall mean any work required in the execution of the Contract, including the installation of temporary/interim conveyor.

   h. equipment, but not forming part of the final Works.

1.2 RELATED DOCUMENTS.

A. General

1. Accompanied Drawings, Contract Provisions, Special Provisions, Supplementary Conditions, Division 1 Specification Sections, and any related Addendums apply to the work of this Section.

2. These written BHS Specifications, of this document, in conjunction with the accompanying BHS Drawings, are part of the Contract Documents for the Project.

3. As indicated throughout these contract documents (drawings and specifications) this project involves the phased demolition and installation of the existing Level 2 Ticket Counter Pods 1,2 and 3: TC12 through TC17.

4. These Contract Documents are confidential and are not to be distributed or copied, in part or in whole, without the written consent of an authorized representative of MDAD.

B. Drawings

1. The Baggage Handling System (BHS) Drawings (Ref. Drawing B001 for listing), Architectural Drawings, Communications/Network Layout Drawings, Fire Protection System Drawings, MEP (Mechanical, Electrical and Plumbing) Drawings, Structural Drawings, Overall Program Phasing Plans, existing BHS O&M manuals, existing BHS As-Build's (Record Documents), and any related Addendums apply to the work of this Section.

2. It shall be the BHS Subcontractor's responsibility to request and obtain architectural drawings, MEP (Mechanical, Electrical and Plumbing) drawings, Structural drawings and

other applicable plans required for BHS coordination from MDAD.

C. Existing Equipment Drawings.

1. Information regarding existing conveyor equipment designated for modification, relocation, or to remain, such as but not limited to Mechanical/Electrical as-built documents/information, O&M Manuals, computer/PLC architecture and layout drawings/documents, PLC/computer software and source codes along with other relative documentation relating to the existing BHS, shall be obtained from MDAD.

2. The BHS scope for this project affects the Arrivals and Departures Level of the Central Terminal, as illustrated in the accompanying BHS Drawing Package.

3. Contact MDAD and request the necessary documents, existing software and source codes that would be required for the system alterations/additions, and for coordination/reference purposes, between the existing system(s) and the specified BHS modifications, to implement the BHS alterations/additions. Make arrangements to search MDAD's library of Record documents for drawings, manuals, and other applicable information that may be relevant to the project. MDAD makes no guarantees regarding the accuracy or completeness of the files in their library, so take on the responsibility to verify all information gathered from that source.

4. If As-built documentation is not available, engage the necessary staff to obtain the needed information on the existing systems and equipment via site survey. Ensure that all project documentation for this work is presented as complete and comprehensive as possible during the detail design and shop drawing submittal phases; generate any/all pertinent information or documentation that is not available from MDAD's records in compliance with MDAD's documentation standards and the PGDS requirements.

D. Special Related Documents

1. Division 26 – Electrical Work

2. Division 27 – Communications

3. Division 28 – Electrical Safety and Security

4. To assist in the BHS Subcontractor’s engineering process, copies may be requested through MDAD. Contact MDAD to request the latest documents that would be required for the necessary coordination, testing, interface and reference purposes.

1.3 SUMMARY

A. General

1. This Section 34 77 16, Baggage Handling System Specification, is divided into four - (4) parts as follows:

a. Part 1 specifies general administrative, procedural and performance requirements for the proposed Baggage Handling System scope of work, including the removal, modification, temporary reinforcement and/or rerouting of conveyor sections (with associated conduits, control stations and related BHS field devices) and installation of conveyor equipment with required system integration between the provided components, modified and existing components that are designated to remain, as specified herein and in the accompanying drawings.

b. Part 2 specifies product information including acceptable BHS Equipment suppliers, materials to be used on this project along with control system design and approved equipment requirements.

c. Part 3 specifies execution requirements for the Baggage Handling and Checked Baggage Inspection System installation and alterations to the existing BHS that are required and shall be provided for this project.

d. Part 4 specifies the minimum field Quality Control that shall be maintained and performed by the BHS Subcontractor for this project, including required system acceptance inspections and testing (i.e., Specification Conformance Inspections/Testing).

2. The BHS Specification (34 77 16) and accompanying BHS Drawings, which are associated with this Scope of Work, are performance-based documents that are intended to outline the overall scope of work, define functional requirements and establish minimum standards of quality for the Project. Review and verify the proposed BHS layout with existing site conditions and provide the overall design intent as summarized within these contract documents. Additionally, provide the engineering, programming, and fabrication of all baggage handling conveyor equipment (with related maintenance access zones), transportation to/from the site, power, and control panels with associated distribution control system design requirements, maintenance diagnostics and statistical reporting functions, installation, testing and turning over in working order the modified BHS and new ticket counter buildout, in compliance with the project documents. Comply with all local, state and federal laws, codes and safety standards and assure a safe and efficient system for all personnel who operate, maintain or have access to the baggage handling system.

3. The alterations to the existing BHS shall include the following, as illustrated in the accompanied BHS drawings, which shall be provided via a coordinated phased-in implementation program:

a. Installation of Level 2 Ticket Counters TC12/17

b. Installation of all associated conveyor equipment for the project.

c. Demolition of all existing conveyor equipment within the proposed new Ticket Counter footprint and new BHS right-of-ways.

d. Reconfiguration and recontrol, as applicable, of existing outbound conveyor lines (ticketing, outbound transport lines).

e. Perform all necessary acceptance inspections/tests for the installed BHS, which shall include all required specification conformance acceptance inspections/tests and contract required Test Plan tests, which shall be performed in separate acceptance stages for the certification of the system and to allow the phased-in connections of the reconfigured outbound ticket counter conveyor lines.

1.4 SCOPE OF WORK

A. General

1. Provide detailed engineering, fabrication, transportation to/from the site, installation, temporary BHS conditions (e.g., interim conveyor equipment and associated control functionality, as required to maintain operations), removal, salvage, demolition, modifications, testing and turning over in working order the BHS portion of the project scope described herein, in compliance with these written Specifications and the accompanying drawings.

2. Provide a complete, operable, maintainable and safe system on a "turnkey basis", including all permanent and temporary/interim supports, header steel, hangers, anchors,

framing, trim, electrical power to all BHS related equipment/components from the sources indicated on the accompanying Contract Drawing Package (i.e., from BHS PDPs to MCPs and associated BHS field components), motors, motor starters, PLCs, MCPs (of modular design and reduced height as required), disconnects, necessary controls for all specified field components, pushbuttons, conduit, wiring, fire/security doors, control stations, stack lights, light curtains, pavement markings/striping, all other necessary BHS components/devices, whether specifically shown and described, or implied in the plans and specifications or wherever required to effectively accomplish the intended functions of the BHS scope. In all cases where a device or part of the equipment is herein referred to in the singular number, it is intended that such reference shall apply to as many such devices as are required to satisfactorily complete the installation.

3. Provide all hardware, software and construction supervision to ensure that there is a complete, total and fully functioning interface between the new and existing modified subsystems (i.e., new and reconfigured BHS), the new existing BHS modifications / reconfigurations, including the BHC system, Operator Workstations and associated satellite workstations / Remote Status Monitors for MDAD's Maintenance Group and local TSA, MEC, as well as the building Access Control and Fire Alarm Systems, so that the entire baggage handling system (existing and new subsystem conveyor equipment) operates on a fully integrated "turnkey" basis.

4. Provide all labor, materials, and equipment required for implementing the BHS alterations and the installation of components that are defined by these specifications, all of which shall include but not limited to the following:

    a. Installation of all required conveyor segments, fire/security doors including associated intrusion detection light curtains, etc. All controls additions and modifications to existing systems shall be implemented on a phased-in basis to maintain continuity of existing airline operations.

    b. Modifications to existing BHS and associated controls, with all required interfaces between the existing, modified, and new conveyor segments/equipment and related components.

    c. All required demonstrations for MDAD's specification conformance acceptance inspections/testing.

    d. Temporary reinforcement and/or rerouting of conveyor sections (with associated conduits, control stations and related BHS field devices), as needed to accommodate the sequenced implementation of the BHS alterations/additions and/or to clear the right-of-way for upcoming installations.

    e. All necessary wiring between BHS equipment/components. All related field wiring, components and controls stations, including internal MCP wiring for the specified installations relating to new conveyor equipment, shall be numbered consistent with the specified numbering scheme of the conveyor segments they are associated with.

    f. Necessary protection of conveyor equipment that is under construction.

    g. Modifications, demolition/removal, including all required materials, and conveyor equipment with all related components. Take on the responsibility to inform MDAD that equipment designated for removal has been removed and are available for review to determine what shall be salvaged for spare parts considerations and what shall be disposed.

    h. All required modifications/upgrades as required during the interim and final

conditions to the existing PLCs, Computer Systems and associated Networks, including the interconnection of all BHS related PLCs (new and existing modified) and ControlNet Communication Network (CCN) or Ethernet based connections to accommodate the interfaces between the existing modified subsystem equipment/components and the new subsystems (hard-wired I/O, data interface cabling and software driven).

i. Coordination, design and modification to existing interfaces between MDAD's CUTE and MUFIDS systems and the new outbound sortation that shall be provided under this project.

j. As part of the work associated to any re-control and modification requirements for existing conveyors, provide safety guards equal to those provided for new conveyors as noted in section 347716 – 2.4.I (Safety Guards) of these specifications if those existing conveyors do not have all safety guards described in the aforementioned specification section.

5. All modifications to the existing system, as it relates to the interim conditions for the phased implementation of the new BHS, shall comply with MDAD's approved configuration management and contingency planning criteria. Ensure that all programming changes, which directly or indirectly affect the existing outbound BHS are performed under configuration management, as specified elsewhere in this specification and closely coordinated with MDAD their representatives.

6. Develop detailed Phasing Plans for each subsystem designated for modification to accommodate the new BHS consistent with the specified requirements and after discussions/coordination with MDAD to determine/confirm the availability of the respective Baggage Handling System Area or affected subsystem(s).

7. The Contract Drawings are intended to generally outline the conveyor system configuration and function desired. Pertinent building dimensions are noted along with some specified conveyor dimensions and elevations. Conveyor length and right-of-ways are presented as approximations, but these shall necessarily be determined by review and inspection of building construction drawings (As-builts) and verified by actual field measurements by the BHS Subcontractor prior to preparing shop and erection drawings. Additionally, the number, size and locations of the BHS normal Power Distribution Panels and Motor Control Panels (MCPs) are presented as approximations. Verify the final number of panels with related cabinet sizes and locations based on the preparation of applicable engineering/electrical shop drawings and submit the System PDP and MCP Sizes, and related power requirements, in accordance with the Schedule of Submissions.

8. Coordinate the BHS with the MEP drawings (e.g., ductwork, sprinkler system, facility electrical and plumbing right-of-ways) and architectural detail drawings to fully coordinate the BHS alterations/additions with all the other systems that will be installed/modified in the same area of the facility spaces. The BHS Alterations with the new BHS installation and MEP/Architectural coordination process shall include coordination via the use of a 3D model in AutoCAD or Revit format between the BHS, architectural and MEP systems to resolve any interference issues. This coordination process shall also include the responsibility to coordinate the BHS conveyor right-of-ways, related conduit/wireway runs, and maintenance catwalk design with other systems, including the sprinkler system design, to permit the installation of the sprinkler pipes below the new and existing modified catwalks or areas where they are projecting below adjacent conveyors. The coordination between the design of other systems and the BHS equipment (conveyor segments, related conduits/wireways and catwalks) shall ensure

other systems do not interfere with the BHS operation or related maintenance access and baggage flow right-of-ways. Sprinkler system lines or other MEP equipment shall not be supported off the BHS equipment or its supporting structure (i.e., BHS overhead or floor supports). The coordination shall ensure the required interface between the BHS equipment and the adjoining architectural building elements.

9. Identify all building interface requirements necessary to install the new BHS over and above those shown on the contract drawings during the detail design and shop drawing submittal period. Verify as-built conditions and notify MDAD of conflicts. Any additional building modifications or alterations not so identified in the detail design and shop drawing submittal period shall be borne by the BHS Subcontractor.

10. All upgrades and modifications to the existing systems, including required BHS, BHC and PLC system replacements, modifications/upgrades to the existing PDPs, and construction of all the new equipment and components of the system(s) shall be in accordance with all codes and standards and local laws and regulations, applicable to the design and construction of this type of equipment, which are generally accepted and used as good practice throughout the industry, i.e., NFPA, Underwriters Laboratories, OSHA, SAE publications, National Electrical Code (NEC), American National Standards and all pertinent standards and codes of the USA, the state of Florida and Miami International Airport. Design all parts and sub-assemblies in accordance with good commercial practice and assure safe, efficient and practical design in keeping with requirements particular to this type of system. All equipment shall be in imperial dimensions.

11. Submit to MDAD any request for information, clarification of specification, and variance from the specifications as a Request for Information (RFI), in compliance with Division 1, Section 01 31 00 (Coordination).Engage Professional Engineer(s) licensed in the State of Florida in the relevant disciplines to review, verify and certify the design and installation of the BHS equipment structural systems and associated attachments to the building structure, which shall include all necessary temporary and final works. These services shall be performed at no additional cost to the Project.

12. Submit all BHS electrical drawings, structural attachment details, with associated computations, and point load drawings, signed and sealed by a Professional Engineer licensed in the State of Florida.

13. Prior to the implementation of each phase of the Project, submit all BHS Phasing Plans, electrical design and control diagrams to MDAD for review and approval.

14. Cooperate and coordinate with MDAD for the location of all Mechanical, Plumbing, Electrical, Right-of-Ways and access/egress between the BHS catwalks and the building to confirm the final number and locations of the BHS associated ladders, conveyor maintenance crossovers and maintenance catwalks.

15. Cooperate with MDAD and other on-site contractors for coordination of the building fire zones to confirm the number and location of the BHS associated fire doors as well as the number of conveyors and their interface requirements with the building fire alarm system.

16. Coordinate the requirements of all conveyor equipment/components (i.e., make and type) with MDAD's Maintenance Group, to simplify their spare parts inventory. This requirement shall apply to conveyor components such as motors, gearboxes, bearings, belting, field control components, and MCP control components.

17. The limits of the existing building structural capacity to support new BHS loads are indicated in the Contract Documents. The BHS Subcontractor is responsible to determine

BHS loads, analyze the BHS load distribution and impacts to the existing building structure, and provide the necessary support systems between existing building beams and columns to distribute or re-distribute the imposed BHS loads so they do not exceed the existing building structural capacity limits indicated in the Contract Documents. If the BHS Subcontractor's structural analysis determines the existing building structure requires reinforcing to support the new BHS, the BHS Subcontractor is responsible to reinforce the existing structure.

18. Temporarily take down existing supports and provide the re-support of existing conveyor line segments with associated conduits, junction boxes, control stations, and field control components/devices, along the BHS conveyor line right-of-ways that are planned to be reconfigured for the existing BHS alterations, as necessary to accommodate the planned relocation, reconfiguration, demolition and new installation that is required as part of the overall interim and final works.
19. Where required, provide all temporary and final conveyor equipment, components and support structures for the BHS including, but not limited to, beams and header steel and take on the responsibility to coordinate the proposed BHS support system with MDAD, the overall project implementation schedules, local TSA and airlines operational schedules.
20. Provide new fire / security doors for Central Level 2 Ticket Counters 12 through 17. This shall include intrusion detection light curtains for the security doors.
21. The base scope for repowering and re-controlling the Central Terminal Level 2 outbound BHS shall be as follows:
    a. Central Terminal TC12/17
    b. Provide new MCPs with power switching devices to control the new Ticket Counter conveyor and fire doors. Utilize existing PDP's to feed new MCP's as indicated on contract drawings.
22. Coordinate and adequately protect the conveyor equipment from the Mechanical, Electrical and Plumbing (MEP) modifications, as well as other related building service modifications and alterations, including the construction and expansion of the new bagroom facilities that will house the new baggage make-up and conveyor line devices. Ensure that adequate protection is provided around the conveyor segments (new and existing/modified) wherever the Facility and Utility modifications are occurring. Ensure that the construction around the conveyors and the protection that shall be provided around the conveyor segments allows for the uninterrupted and continued operation of the baggage handling systems in all cases.
23. Upon completion of the BHS installation and all related programming and internal testing/debugging as described in Part 4, demonstrate the system's operating capability to MDAD for acceptance to confirm compliance with the specified requirements. Provide all labor and test material as specified elsewhere in this document, including service technicians and test material handlers for the BHS Acceptance Testing, These test demonstrations shall be carried out per the following requirements, as part of the base contract:
    a. Prepare BHS Test Plans in compliance with the specified requirements of Part 4 (Section 4.2 Inspections/Testing and Acceptance

B. Existing System Overview

1. Central Terminal Level 2: The following is a brief description of each existing Ticketing check-in area.1.) Ticket Counter 12/17: Each existing check-in system utilize a single

ticket counter load/take-away belt, which transports unscreened baggage via the existing TC12/17 subsystems to merge onto the existing TC15 or TC20 mainlines to the existing Central Terminal checked baggage inspection system.

2. BHS Operations Control Center and Computer Systems:
    a. The new work for the Central Terminal shall include the modification of the Baggage Handling Computer (BHC) System to reflect the final conditions of the new BHS. These systems shall provide the required HMI, monitoring and reporting for the BHS Maintenance Diagnostics Systems (MDS):
3. The existing Maintenance Diagnostics Systems (MDSs) shall be modified to provide the fault monitoring of the new Central Terminal. Ticket Counter conveyors and shall accurately and clearly depict the new Ticket Counter conveyor subsystems.
4. Maintenance Information System (MIS):
    a. BHS contractor shall modify the existing Maintenance Information System (MIS) for BHS statistical information gathering and report generation.
5. Interface Requirements:
    a. The BHS Computer/Controls System shall interface directly with the existing fire alarm and Matrix security systems. The BHS Subcontractor shall coordinate with MDAD for the location of all fire zones and for the start and shutdown of conveyors, fire/security doors and the like that are impacted by a fire alarm.
6. Motor Control Panels (MCP), and Programmable Logic Controllers (PLCs):
    a. Provide all related power and control wiring with associated conduits from the BHS related normal Power Distribution Panels to their respective Motor Control Panels and onto their subsystem conveyor segment(s) field equipment/components, per the subsystem breakdown that is defined in the contract documents.
    b. The BHS Subcontractor shall provide all the necessary PLCs as specified elsewhere in this specification as they relate to the new Ticket Counter subsystems annunciation of fault conditions.
7. Other System Requirements
    a. Maintenance Catwalks
        1.) Provide and install all BHS related maintenance catwalks, ladders, stairs and crossovers as required and coordinated with MDAD, or their representatives. Submit detailed maintenance catwalks, ladders, stairs and crossovers drawings to MDAD or their representatives for review.
    b. Fire/Security Doors
        1.) Provide, install, and integrate all BHS related fire/security doors on new and existing subsystems in the Central Terminal.
        2.) The BHS Subcontractor shall also provide and install all draft curtains at the new fire/security door locations.
        3.) For Security Door locations, provide and install intrusion detection light curtains.
    c. BHS Draft Curtains
        1.) Provide and install draft curtains at all locations where conveyor lines pass

through wall and floor openings, consistent with the specified requirements of Part 2 and the details that are illustrated in the accompanying drawing package.

d. Security Card Reader Interface

1.) Provide the interface and coordinate with MDAD for the integration of all security card readers into the BHS operation for the BHS conveyor line startup procedure. Provide all hardware (e.g. wiring, conduit, contacts, etc.) for the interface from the BHS MCP/PLC to the required connection within the existing access control system. The intent is the interface to take place at the MCP associated to the security doors. The wiring from the access control system to the MCPs panels should be provided under Division 28, Section 28 15 00.

C. Interim BHS Conditions Manual Handling of Baggage

1. The Terminal phasing program will include interim airline operational conditions, to minimize the conveyor line`s downtime and inconvenience to the carriers/operators. In this regard, coordinate with MDAD and their third party handling agency for staffing/labor to provide manual baggage handling for certain operational conditions, as a fallback condition, should a tie-in be delayed or should a failure be experienced that will inhibit the airline's operation for scheduled overnight tie-ins and operational turnovers.

2. Coordinate with MDAD the scheduling of this activity.

1.5 BHS EQUIPMENT IDENTIFICATION

A. General

1. The item numbering system and format used for physical identification of new and existing modified conveyors, existing conveyor designated to remain (both upstream as well as downstream of the BHS alterations), including but not limited to their associated field components, devices, control stations, MCPs, junction boxes and in all related documentation shall be consistent with the subsystem identification detailed on the contract documents.

2. All of the BHS equipment shall be numbered in consecutive order.

3. Re-number existing components designated to remain, both upstream as well as downstream of the BHS alterations, as needed, to maintain sequential numbering of each existing line that shall be modified to accommodate the newly installed conveyor segments.

4. Numbering of all subsystems existing and new shall commence from the subsystem's baggage input point to the subsystem's final discharge conveyor segment.

B. Equipment Identification

1. Reference BHS Drawing B002 for listing of the subsystem abbreviations

1.6 SUBMITTALS

A. General

1. All submittals shall be in accordance with the Conditions of the Contract per Division 1, Sections 01 31 00 and 01 33 00.

2. Submit the following documentation at the time specified during the course of the work, and in accordance with the following Submittal Deadlines.

3. Prepare all documents in the English language.

B. BHS Subcontractor Documents Submitted for Review

1. Submit for review per the Division 1, Sections 01 31 00 and 01 33 00 Contract, shop and installation drawings (e.g. PDF format submitted electronically or on CDROM or DVDROM). These shop submittals shall not include any handwritten markups/ drawings.
2. If WebEx, Go-To Meeting or on-site table-top shop drawing reviews will be required as part of the shop drawing review process, provide a written request (minimum 14 days) to MDAD prior to the requested scheduled date for the table-top review meeting.
3. The baggage handling design documents are performance-based documents. Provide the complete design including all baggage handling conveyor segments, power and control panels with associated distribution, control system design, maintenance diagnostics and maintenance access zones complete as the primary component of coordination.
4. The comments from MDAD shall not be taken to imply that the arrangement has been checked in detail. The BHS Subcontractor shall be fully responsible for the suitability, adequacy, integrity, durability and practicality of the arrangement or assembly, components and systems as set out in the drawings, specifications and other information submitted for acceptance by MDAD including all subsequent amendments. In no case shall MDAD's review or comments relieve the BHS Subcontractor in any way of his responsibility of ensuring that the equipment supplied complies with all specification and functions in accord with the wording and the intent of the applicable Specifications.
5. Approved shop drawings shall be at the site at all times for use in the construction of the work.
6. Submit a drawing log that contains a complete list of all anticipated installation and shop drawings.
7. The BHS Subcontractor shall coordinate with the GC to prevent all BHS clashes with MEP. At a minimum:
    a. Conveyors
    b. Motors
    c. Overhead and Floor supports
    d. Catwalks, Platforms, Ladders, Stairs, and handrails
    e. Fire Doors, Security Doors and Draft Curtains
    f. Electrical Control Devices including MCP's, and PDP's
    g. Conveyor Impact Protection

A. Construction Document Submittal Deadlines

1. Listed below are the submittals and dates referred to in the applicable sections. (days indicated are working days).

Submittal Item	Deadline
Quality Control Manual	20 days after NTP
Configuration Management Plan	30 days after NTP

Submittal Item	Deadline
Sample of "Work Activities Bulletin"	60 days prior to commencement of on-site BHS installations
Structural Attachment Details	90 days prior to fabrication of BHS equipment
Environmental Requirements	90 days after NTP
Catalog Cuts and Equipment Specifications	75 days after NTP
System Power Requirements and MCP Sizes	150 days after NTP
BHS Equipment - Combined Heat Output Figures	150 days after NTP
Emergency Stop Zone Drawings	150 days after NTP
Controls System Description (Detailed Functional Specification) and BHS Redundancy Schematic Diagrams	80 days after NTP
Shop Detail Drawings (to include details of specified safety guarding and Conveyor Marking)	120 days prior to fabrication
Motor Schedule	90 days prior to fabrication of BHS equipment
Installation Drawings	120 days prior to Installation
Training Program	60 days prior to turn-over of BHS equipment for beneficial use of system
Estimated Parts List	120 days prior to turn-over of BHS equipment for beneficial use of respective BHS Sequence (Phase)
Functional Specification	80 days prior to BHSC Internal and Owner testing.
Inspection and Test Program	80 days prior to BHSC Internal and Owner testing.
Final Parts List	120 days prior to turn-over of BHS equipment for beneficial use of respective BHS Sequence (Phase)
Work Activities Bulletin	7 days prior to each activity
Test Reports	5 days after completion of testing for the respective BHS Sequence (Phase)
As-Built Drawings	30 days after acceptance
List of Lubricants	60 days prior to turn-over of BHS equipment for beneficial use
O & M Manual – Draft for MDAD's Review	100 days prior to turn-over of BHS equipment for beneficial use
Periodic Maintenance Inspection and	60 days prior to turn-over of BHS

Submittal Item	Deadline
Lubrication Chart	equipment for beneficial use
O & M Manual – Final	40 days prior to turn-over of BHS equipment for beneficial use
Computer/Software/Hardware Inventory	At Conditional Acceptance of BHC and PLC systems

C. Structural Attachment Details

1. Point loads for the conveyor support system are provided within the Contract Documents for review and analysis by the BHS Subcontractor's structural engineer. The BHS Subcontractor is responsible to determine BHS loads, analyze the BHS load distribution and impacts to the building structure and provide the necessary support systems (e.g., beams, header steel, hangers,anchors and the like) between building beams and columns to distribute or re- distribute the imposed BHS loads so they do not exceed the building structural capacity limits that are indicated in the Contract documents. With respect to the existing building structure, if the BHS Subcontractor's structural load distribution analysis determines the existing building structure requires reinforcing to support the new BHS, the BHS Subcontractor is responsible to reinforce the existing structure. Submit structural, seismic and hurricane wind load attachment detail drawings and the design computations of all structural supports for the BHS and associated catwalks signed and sealed by a Professional Structural Engineer licensed in the State of Florida, the same jurisdiction where this project is located.
2. For the existing modified areas of the facility, the BHS Subcontractor shall analyze the structural capacity of the existing building and provide the necessary support system between existing building beams with any redistribution of imposed BHS loads to accommodate the proposed design. The design and installation of the BHS support system and associated structural attachments to the building structure shall be in conformance with the allowable loads of the building structure and ensure that all State and Local codes for seismic and hurricane wind load requirements are met and abided by for this project.
3. Show, as a minimum, the type of anchor device to be used and the amount of load to be imposed on the building structure, include structural analysis or catalog information documenting required strength of the anchor or anchor group.
4. Take into consideration the location of building expansion joint locations which can affect the layout / installation of the conveyor or of structural attachment points.
5. Submit a complete vibration isolation-drawing package, showing isolation type, as well as method and location of installation.

D. Shop Drawings, Installation Drawings, and As-Built Documents

1. General
   a. All drawings submitted shall become the property of MDAD.
   b. All drawing submittals shall be to scale. The scale utilized shall be clearly defined in the title block.
   c. The North arrow shall also be shown on all mechanical drawings.

d. Drawings shall include the following items unless otherwise specified.

1.) Document Title Blocks

a.) In addition to information normally presented in a drawing title block, each drawing title block shall provide the following specific information:

(1.) Three letter airline code for airport designation of the project location (MIA)

(2.) Name of the Baggage Handling System

(3.) Drawing scale

(4.) Drawing title

(5.) Drawing number/sheet number

(6.) Drawing date

(7.) Drawing revision date and revision number

NOTE: All drawing revisions shall be foot noted on the drawing face as well as in the appropriate revisions section of the title block.

e. Professional Engineer Approval Requirements

1.) Engage Professional Engineer(s) licensed in the State of Florida in the relevant disciplines to design, review, verify and certify the design and installation of the BHS equipment structural systems and associated attachments to the building structure, including all necessary temporary works and supports.

2.) Minimum requirements for Professional Engineer signed and sealed drawings and calculations to be submitted are defined below. Submit any additional signed and sealed drawings, calculations or submissions required by MDAD, federal, state or local codes. As a minimum, the following drawings, calculations and submissions shall be signed and sealed:

a.) Mechanical/Structural

(1.) All structural, seismic, and hurricane wind load attachment details and design computations for the BHS and associated catwalks

(2.) All structural support details and design computations for the BHS and associated catwalks

(3.) Drawings and design computations of all structural attachment points to the parent building including imposed load on the building

(4.) Drawings defining all structural supports and attachment types and locations. Generic details will not be acceptable for this purpose.

(5.) Drawings defining all maintenance catwalks and methods of catwalk access including details of handrails, access stairs and ladders, and catwalk construction details.

b.) Electrical

(1.) All new and existing modified BHS PDP and motor control panel connected load calculations

c.) Provide the above mechanical/electrical PE signed and sealed drawings/calculations as listed above in part a) and b.) in two separate submittals:

(1.) "For Construction" drawings/calculations

(2.) Final "As-Built" drawings/calculations

2. Drawing Submittal Package Requirements

a. Submit to MDAD final installation drawings defining BHS erection procedures, mechanical and electrical component layouts, and the relationship of the equipment components to each other and to the facility prior to the commencement of fabrication.

b. Submit a motor schedule listing for the conveyor segments that are designated to remain and recontrolled, as well as for the motors for all new subsystems. The motor schedules shall include the motor horsepower, voltage, source of feed, circuit breaker size, disconnect size, conduit and wire size and overload heater size selected to be used. The motor schedule listings shall be submitted prior to the installation of overload heaters on the controllers.

c. Submit to MDAD for review the BHS equipment combined heat output figures with calculations for the following areas of the facility. Any areas of heat build- up concern (especially enclosed areas) shall be identified and documented. The information typically includes friction losses from conveyor equipment and heat outputs from the drive motors, motor control panels and computer equipment:

1.) Operations Control Center Area

2.) BHS Motor Control Panel, Power Distribution Panels and PLC/Computer Cabinet(s)

Submit As-Built drawings as per the specified submittal schedule and per Division 1, Section 01 77 00 indicating the location of the BHS existing reconfigured lines and new subsystems, including all mechanical layouts of equipment/components (with associated belt speeds), maintenance catwalks and electrical devices, operator's control panels, MCP, switches, and other control devices. The As-built documentation shall be submitted to MDAD consistent with the requirements of this specification. Ensure that the submitted "As-Built" documents and is issued on CDROMs (or DVDROMs) are accurate and include all BHS related Communication/Network Layout drawings, Final Descriptions of Operations, Final copy of the Programmable Logic Controller (PLC) programs with all relevant drawings, Final copy of BHC system and PLC software disaster recovery procedures, Computer Crash Recovery Disks and all operations and maintenance manuals. All final "As-built" drawings shall be signed and sealed by a Professional Engineer licensed in the State of Florida.

d. Submit final assembly drawings, shop detail drawings and any other pertinent drawing files in AutoCAD.DXF format, version 2012 or higher and in PDF format, for all phases of the work, indicating BHS Alterations/Additions, components, construction and assembly details of all components prior to releasing drawings for fabrication.

e. As-Built drawings shall be submitted on CDROM (or DVDROM) in addition to other forms of media described herein.

3. BHS Mechanical Drawing Submittal Requirements

   a. General

      1.) If standard parts are purchased, reproduced details and identifying part numbers shall be provided.

      2.) Each BHS device or conveyor and their related components that appears on plan, elevation and section drawings of the BHS shall be identified with the appropriate ID, as established in this Specification, and associated Drawing Package.

      3.) Number conveyor equipment and control devices starting at the beginning of each conveyor system or subsystem. If there are any discrepancies between the contract document-specified equipment ID numbers and the actual identification of existing (to be retained) equipment, such discrepancies are to be brought to the attention of MDAD for immediate resolution.

      4.) All plan views of the BHS shall be based on an overlay of the building structure as is appropriate with AutoCAD architectural backgrounds.

      5.) All plan, elevation and section drawings of the BHS shall also show the vertical and horizontal clearances between the related system equipment and the building structure with its related interferences.

   b. Provide the following types of mechanical drawings:

      1.) General arrangements with dimensions of all new, modified, and relocated equipment (plan, elevation, details and sections, as appropriate) for all mechanical, maintenance catwalks, crossovers, ladders (coordinate with MDAD for the final number and location of all maintenance access equipment), impact protection, electrical motor control panels, electrical equipment support, electrical control stations, workstations and displays.

      2.) Drawings with the appropriate level of detail, as noted in the contract documents, shall be provided for any equipment designed and manufactured for this project.

      3.) Detailed drawings are required for all BHS equipment framing, supports to include side clip attachment supports in areas of restricted access, hangers, and other required structures.

      4.) Detailed drawing indicating locations, size and type of safety signage.

      5.) Detailed drawings with dimensions of all safety guards such as, but not limited, to the following:

         a.) Conveyor underpans

         b.) Rotating shaft guards

         c.) Conveyor shrouds

         d.) Drive v-belt / chain guards

         e.) Metal bearing covers

         f.) Finger guards

         g.) Gap pans

h.) Drive pans

i.) Breakaway end cap safety guards

4. BHS Electrical Drawing Submittal Requirements

a. General

1.) Each BHS device or conveyor and related control and power devices that appear on any electrical drawings of the BHS shall be identified with the appropriate ID, as established in this Specification.

b. Submit the following types of electrical drawings:

1.) A series of plan views of the BHS, both existing reconfigured conveyor lines and new subsystems, noting the identity and location of each new and relocated control device, control station, motor, safety disconnect switches, junction boxes, and other field components as related to each BHS device of the new and existing modified subsystems. These drawings shall be provided with the following information:

a.) Detailed wiring connections for the above referenced field components, in block form, with a detail of the actual field wiring numbers and configuration.

b.) Detailed conduit routing diagrams indicating the size of conduits and the size/number of conductors for the above referenced equipment/components and associated MCPs and UPS equipment that shall also include their respective feeders and references to their main power supply sources (i.e., Power Distribution Panels or Power Distribution Points).

2.) Interior and Exterior layout of new and existing modified MCPs detailing installation/location of new control devices and indicating lamps.

3.) Submit all power requirements for the new and modified subsystems of this project as per the specified submittal schedule. Any discrepancies between the specified maximum allowable electrical loads and BHS Subcontractor design loads shall be clearly identified in the review submission. MDAD shall retain the right to reject any and all requests for additional power beyond those as indicated in the Contract Documents. System power requirements shall be calculated in accordance with the recommended practice and shall include the individual connected and demand power loads as well as a diversity factor.

4.) Provide an assessment and proposed modifications for review and approval, identifying compliance with NFPA 70E Standards for Electrical Safety in the Workplace regarding the new and existing modified MCPs that are part of these alterations, and the need for personal protective equipment.

5.) Detailed drawing indicating locations, size and type of safety signage for the modified portions of the BHS and new subsystems.

6.) Detailed block diagram of the BHS Upper and Lower Level Networks to provide a functional overview of the system architecture and a conduit routing diagram that shall illustrate the actual installation and location of the network components. These drawings shall distinguish the difference between the BHS Subcontractor provided components and non-BHS Subcontractor components that the BHS will interface with (i.e., other Airport systems). The overall submittal of these documents shall include specified redundancy

provisions and related communications links to new and existing systems (i.e., location of all network devices, switches, routers, repeaters, media converters, fiber connections, terminations, and the like). All components shall be identified as new, existing or relocated and shall include their respective part numbers, as applicable.

7.) Programmable Logic Controller (PLC) computer control system in block diagram format to include the data communication system showing the existing and new connections among all PLCs, sortation controllers and remote I/O units.

8.) MCP general layout showing new and modified existing enclosure size, type, power requirements, equipment location and enclosed component general arrangement. Include a separate revised I/O list for each existing modified PLC, the new PLCs and remote I/O in the panel. Identify I/O assignments with Equipment Item Numbers for all new and modified equipment.

9.) Detailed block diagram representing internal layout of components within PLC cabinets as required and dictated by the project requirements. Also, both internal as well as external layout of components related to such assemblies as Operation Workstations and external layout of ATR and BMA scanner arrays.

c. Submit the following types of control system drawings (note that the first 5 plan views described below can be consolidated to a single drawing in an area assuming all information is clearly contained therein):

1.) Plan view of the BHS noting the identity and location of each control device, control station, motor, limit switches, safety disconnect switches, and the like as related to each BHS device of the subsystem.

2.) Plan view of the BHS noting the identity and location of each motor with power in horsepower. Identify all motors that will have a VFD or brake. Annotate which motors are controlled by Variable Frequency Drives; indicate the location of the VFD (either in the relevant MCP or at the motor [preferred]).

3.) Plan view of the BHS noting the identity of each conveyor with expected speed in feet per minute.

4.) Plan view of the BHS noting the identity of every photocell location annotated whether a tracking or non-tracking device

5.) Plan view of the BHS noting the identity of every tracking belt tachometer or shaft mounted encoder.

6.) A set of drawings showing those conveyors that will stop by the activation of each specific Emergency Stop (both new and existing) in the modified system as per the specified submittal schedule. The drawings should indicate (using different colors or hatches) the conveyors of the specific subsystem and any adjacent subsystems that will stop for each emergency stop or group of emergency stops as appropriate. The BHS Subcontractor should take into consideration the following when developing the e-stop zones:

a.) When splitting up e-stop zones, consideration must be given to the MCP breaks. If the downstream MCP is shut down, upstream bags that are left in the system should be able to divert prior to the equipment that is inoperable.

b.) Merge e-stops should be tied into the receiving or take- away conveyor.

7.) A set of drawings showing the complete architecture of the VFD installation to include the location of the VFDs. Note that these drawings shall indicate (using different colors or hatches) the locations where the VFDs are installed (color / hatch #1 indicating field mounted and color / hatch #2 indicating MCP mounted).

d. Submit detailed shop drawings which shall include all interfaces between systems that are affected by the scope of work and shall include but is not limited to connection details (connector type, communication protocol) software protocol, transmission media, location of connections and any other required information. The types of interfaces for the specified BHS alterations/additions include; security system and fire system.

e. Provide an approved 11" x 17" reduced copy of the schematic wiring diagram(s) of each MCP including outline and wiring diagram of all special devices which shall be placed in the door pocket of the MCP. In addition, provide a total of two (2) additional copies where one copy will be kept in the BHS Document center and one copy will be retained as a spare.

5. BHC and Control System Description Submittal

a. Submit Control System Description as specified in Parts 2 and 3 of this specification. This functional controls system submittal shall include the description of operation for the interim and final works of the BHS conveyor lines/subsystems, as well as the respective conveyor line's interim operational condition.

b. The BHC System shall utilize the current BHS network(s) any modifiactions to these networks shall be documented in the current as-built drawings and documents.

6. BHS Server Room and Operations Control Center (OCC) Requirements

a. The current BHS Server Room and Operations Control Center equipment shall be utilized for this project.

E. Catalog Cuts and Equipment Specifications

1. Submit a catalog cuts manual for all manufactured and purchased items (mechanical, electrical and computer equipment) as per the specified submittal schedule.

2. The catalog cuts shall be submitted contained in binders of the "presentation" type equipped with "D" rings as well as in soft copy format. Additionally, the binders shall be equipped with a clear spine pocket to permit the insertion of the manual title. The catalog cut manual shall be contained within at least one volume of appropriate size and contain the following:

a. Record of Revisions: A "Record of Revisions" sheet shall be provided at the beginning of the catalog cut manual.

b. Table of Contents: A Table of Contents shall be provided at the beginning of the catalog cut manual.

c. Index Tabs: Each catalog cut shall be identified with an index tab with permanently printed information as well as to provide separation in the soft copy file.

3. The catalog cuts must be completely legible and reproducible, directly relevant to the specific items as used in the system. Each individual item shall be clearly indicated by the inclusion of a highlighted/shaded arrow immediately adjacent to the item. Where a

variation occurs from the standard component or a special custom ordered part has been used as a replacement for the standard supply, additional details shall be submitted to clarify the identity of the component.

4. The catalog cuts shall include the following items (this list is not to be construed as being complete since it is provided only as a guide):
    a. Speed reducers
    b. Motors
    c. Bearings
    d. Pulleys and rollers
    e. Motorized pulleys
    f. Belting
    g. Roller chain and sprockets
    h. Belts and sheaves
    i. Queue conveyors
    j. Power turns
    k. Scale Equipment
    l. Scale and Dispatch Conveyors
    m. Pushers
    n. HSPDs
    o. Tamper-proof fasteners for safety guards
    p. Wiring devices (including quick disconnect devices for removable conveyors)
    q. Control devices
    r. Soft starts, electronic
    s. Electric brakes
    t. VFDs
    u. PLC and peripherals
    v. Power regulators

F. Operation and Maintenance Manuals
    1. General
        a. Provide Operation and Maintenance (O&M) Manuals (in binders and soft copy format) for the Central and South Terminal Baggage Handling Systems as per the format and guidelines specified below and in compliance with Division 1, Section 01 78 23.
    2. Purpose
        a. The prime purpose of the Operation and Maintenance (O & M) Manual is to provide MDAD's operational and maintenance personnel with a thorough understanding of the layout of the system, its function, special features, operational requirements,

maintenance requirements, parts information, warranty information, and safety considerations including operational and maintenance access requirements for operating and maintaining the system safely and effectively.

b. This specification is intended as a guide to indicate the basic requirements of the O&M Manuals. The BHS Subcontractor's standard O&M Manual shall be acceptable provided it is functionally equivalent to that specified below and the documents are suitable and usable for the intended purpose.

c. The manual is to be divided into two main sections:

1.) The Operational portion of the manual shall present the information required for personnel to be able to operate the system in a safe and efficient manner. The operational information shall be presented in easy to understand terms to ensure that personnel not familiar with the system will have a thorough understanding of the system upon reading the operational information.

2.) The Maintenance portion of the manual shall present the information required for personnel to be able to maintain the system in a safe and efficient manner. The maintenance information shall be presented in easy to understand terms to ensure that personnel not familiar with the system shall have a thorough understanding of the mechanical and electrical equipment operation and maintenance requirements so that they shall be able to effectively and safely perform maintenance functions such as troubleshooting, servicing, and repairing.

d. For the chapters of the O&M Manuals described hereafter, provide Terminal specific sets for the individual terminals (South and Central Terminal Systems) such as the System Overview, Detailed Description of System Operation, Description of System Equipment, Mechanical Drawings, Electrical Drawings, and PLC listings:

3. Binder Type

a. Binders shall be of the "presentation" type equipped with "D" rings. Additionally, the binders shall be equipped with a clear spine pocket to permit the insertion of the manual title.

b. Binders shall be of sufficient size (number of pages) to be used by a reader with no difficulty of access. Also, the documents as bound within the binder shall not be damaged by lack of free space for movement both during storage and use.

c. Standard "letter" size format (8.5" x 11") shall be the basic size parameter for the binder selection.

4. Format

a. The O & M Manual shall be contained within at least two (2) volumes of appropriate size. Note that additional volumes may be required to accommodate multiple operational or maintenance information chapters.

b. Standard "letter" size format (8.5" x 11") shall be the basic size parameter for the documents contained in the Operations and Maintenance Manual except as noted below.

c. The title information shall be generally as follows:

1.) First line: Three letter code of the airport in which the system is located (e.g. MIA).

2.) Second line: “Operations Manual” or “Maintenance Manual”

3.) Third line: “For”

4.) Fourth line Type of system: (such as: South and Central Terminal Outbound Baggage Handling and Checked Baggage Inspection Systems)

5.) Fifth line: Date of System, as based on actual beneficial use date

6.) Sixth line: Project Number

5. Contents of Manual

a. Record of Revisions: A "Record of Revisions" sheet shall be provided at the beginning of the O & M Manual.

b. Table of Contents: A Table of Contents shall be provided at the beginning of the O & M Manual.

c. Chapter Index Tabs: Each chapter shall be identified with an index tab with permanently printed information and to provide separation in the soft copy file.

d. Chapter Index: Each chapter of the O & M Manual shall begin with an index for the related chapter.

6. Operational Information

a. Chapter 1 - Glossary of Operational Terms

1.) Shall contain a glossary of operational related terms and equipment identification/designations.

b. Chapter 2 - System Overview

1.) Shall contain, at a minimum, the following items:

a.) A basic overview of the system showing overall layout and arrangement.

b.) Identify locations, number of and types of inputs.

c.) Identify locations, number of and type of sort areas (as appropriate). d.)

Identify system and subsystem conveyor designations.

e.) Processing rate of each subsystem as well as the total system- processing rate.

c. Chapter 3 - Baggage Weight and Size Limitations

1.) Shall contain, at a minimum, the following items:

a.) Normal Size Baggage

b.) Baggage that can be processed by system but requires special considerations/handling such as but not limited to skis, and golf bags.

c.) Fragile Baggage

d.) Oversize Baggage

d. Chapter 4 - Detailed Description of System Operation

1.) Shall contain, at a minimum, the following items written in a clear concise manner:

a.) The detailed operational description of system operation must provide operational personnel a thorough understanding of how to operate the system. Operational personnel include:

(1.) Sky Caps

(2.) Passenger Service Ticket Agents (3.) Service Baggage Handlers

(3.) MDAD's Maintenance Personnel or vendor

b.) The operational information shall cover system start-up, shut down, operational stop/start control stations, Jam Reset and Emergency stop operational requirements.

c.) The operational information shall also provide a thorough understanding of the system fault annunciation system so that faults can be recognized and appropriate action can be directed.

d.) The operational information shall provide an operator's troubleshooting guide for the safe and effective correction of operational problems.

e.) to various equipment or subsystem failures.

e. Chapter 5 - Operational Safety

1.) Shall provide safety information related to the proper and safe operation of the specified system and its equipment from an operator's point of view and at a minimum must cover the following items (this list is not to be construed as being complete since it is provided only as a guide):

a.) Pre-operating procedure

b.) Start-up and Shut-down Procedure

c.) Emergency Stop and Restart Procedure

d.) Jam Detection, Jam Clearance and Restart Procedure

e.) Equipment Lockout/Tag-out Procedures (the procedure shall reflect/refer to the most current OSHA, ANSI and Local Code, Policies and Standards)

7. Maintenance Information

a. Chapter 1 - Glossary of Terms and Identification

1.) Shall include a glossary of all terms and equipment identification/designations associated with the specified system. Any industry vernacular, vocabulary, descriptions or definitions necessary for further communication of information shall also be provided.

b. Chapter 2 - Description of System Equipment

1.) Shall include, at a minimum, the following items:

a.) Detailed description of the mechanical conveyor equipment used in the system including widths of conveyors, general specifications and capabilities of the system.

b.) For the other systems monitored by the new BHC such as the South and Central Terminal Inbounds, E-Linear and North Terminal systems, include information on these system as received from MDAD in the chapter.

c.) Detailed description of the electrical equipment used in the system, including the location of motor control panels (MCP(s)), PLC(s), fire/security door(s), sortation controller(s), encoding console(s), Operator Workstation(s), bag status displays, ATR and BMA scanner arrays.

c. Chapter 3 - Electrical Control Sequence of Operation

1.) Shall include a detailed description of the electrical control sequence of operation and the locations of related field equipment/components, such as the items listed below. (this list is not to be construed as being complete since it is provided only as a guide):

a.) Location and operation of Control Stations

b.) Location and operation of Photocells

c.) Location and operation of Limit Switches

d.) Location and operation of VFDs

e.) Operation of MCP(s), as required.

f.) Operation of PLC(s)

g.) Operation of Fire/Security Door(s)

d. Chapter 4 - Maintenance Safety Procedures

1.) Shall provide safety information related to the proper and safe operation and maintenance of the specified system and its equipment from a maintenance point of view and at a minimum, the following items shall be covered (this list is not to be construed as being complete since it is provided only as a guide):

a.) Pre-operating Procedure

b.) Start-up and Shut-down Procedure c.) Emergency Stop and Restart

c.) Jam Detection, Jam clearance and Restart Procedure

d.) Equipment Lockout/Tag Out Procedure (the procedure must reflect/refer to the most current OHSA, ANSI, and local codes, policies and standards)

e. Chapter 5 - Service, Inspection and Preventive Maintenance

1.) Shall provide detailed information for the proper servicing of all of the system equipment and at a minimum must cover (this list is not to be construed as being complete since it is provided only as a guide):

a.) A general explanation, regarding what the servicing requirements is for the related system equipment.

b.) Detailed preventive maintenance program outlining required functions and frequencies for the proper preventive maintenance of the components that make up the system equipment items such as belt conveyors, power turns, HSPDs, incline pallet devices, flat plate devices, servers/computers, manual encode console, bag status displays, security doors, motor control panels, ATR and BMA arrays. At a minimum, the following items shall be covered however; this list is not to be construed as being complete since it is provided only as a guide. It shall be noted that the information shall be "brand specific" for the actual equipment provided for this system only. Information for equipment types and brands not provided in this system will

not be acceptable.

c.) Inspections for:

(1.) Straight Conveyors, Power Turns, Merge Conveyors, High Speed Paddle Diverters / pushers, Vertical Sort Units, flat plate devices, incline pallet devices, ATR / BMA Arrays.

d.) Lubrication of:

(1.) Motor Bearings, Pulley Bearings (as required), Drive Chains, Speed Reducers, and Power Turn Perimeter Chains/Guides, and all other items requiring lubrication.

e.) Cleaning of:

(1.) Motors, Drive Chains, Speed Reducers, Photocells (and related reflectors), Motor Control Panels, Remote Status Monitors / Satellite Workstations / Operator Workstations / servers, Manual Encode Console, and ATR / BMA Equipment.

f.) Adjustment of:

(1.) Straight Conveyor Belt Tracking, Straight Conveyor Belt Tensioning, Power Turn Conveyor Belt Tracking/Tensioning, Merge Conveyor Belt Tracking/Tensioning, pushers, Drive V- Belt and Sheave Alignment, Drive V-Belt Tensioning, Drive Chain and Sprocket Alignment, Drive Chain Tensioning, Photocell alignment and sensitivity, Drive Motor Brakes and ATR Laser Scanner alignment and sensitivity.

f. Chapter 6 - Warranty Information and Procedures

1.) Shall provide detailed information regarding the specific Warranty Conditions that prevail on the specified system.

2.) Additionally, the detailed information regarding the system warranty must include the following:

a.) Date of Beginning and Expiration of Warranty Period.

b.) Specific instructions regarding the procedures for the documentation and return of items under warranty.

c.) Provide detailed information regarding the specific warranty conditions that apply to the specified system, assemblies, components and parts

d.) Names and telephone numbers of the "point of contact" for warranty questions and discussions. Note that the "point of contact" information shall be provided for both "normal" 0800 to 1700 Monday through Friday hours as well as "after hours". Direct communication shall be made available 24 hours/day, 7 days/week, and 52 weeks/year.

g. Chapter 7 - Troubleshooting

1.) Shall provide detailed information for the proper remedial and corrective action required (troubleshooting) for repair of the system equipment malfunctions.

2.) At a minimum, the following items must be included in a detailed "problem and correction" type of troubleshooting chart (this list is not to be construed as

being complete since it is provided only as a guide):

a.) All mechanical equipment

b.) All electrical equipment

c.) All control equipment

d.) All computer equipment

e.) BHS/EDS Interfaces

f.) BHS/Airport Systems (e.g., BSM/MUFIDS/CUTE) Interfaces

3.) The troubleshooting information provided in the chart is to cover an exhaustive list of possible causes of system failure or malfunction.

4.) A procedural approach should be used in the documentation to allow service personnel to resolve problems. This method shall emulate the actual problem as well as provide the related solution. Information should be provided to assist in discernment of cause and effect issue as well as find solutions through cross referencing.

5.) The information is to be arranged in a three - (3) column format with respective headings of:

a.) Trouble

b.) Probable Cause

c.) Corrective Action.

6.) Empirical Readings: This subsection of Chapter 7 shall include the Empirical Readings, as noted in "Testing and Acceptance" section of this Specification that were recorded at the time of the Conditional Acceptance Testing and Inspection of the system. This information is to be provided as a maintenance reference.

h. Chapter 8 - Removal and Installation Procedures

1.) Shall provide detailed information for the proper removal and installation of all of the system equipment components.

2.) It must be noted that the information shall be "brand specific" for the actual equipment/components provided for this system only. Information for equipment/components types and brands not provided in this system will not be acceptable.

3.) At a minimum, the following items shall be included in this chapter (this list is not to be construed as being complete since it is provided only as a guide):

a.) Basic Considerations

b.) Safety Precautions

c.) Procedural Orientation

d.) List of special tools, gauges and equipment required for the maintenance of the system, together with illustrations and instructions as to how they are to be used. Sources for procurement of these items shall also be provided.

e.) Torque Values

f.) V-Belt Tension Procedures and Values

g.) Drive Chain Tension Procedures and Values

4.) Component List (this list is not to be construed as being complete since it is provided only as a guide):

a.) All the components for straight conveyors.

b.) All the components for power turn conveyors.

c.) All the components for merge conveyors

d.) All the components for queue conveyors

e.) All the components for MCPs

i. Chapter 9 - Illustrated Parts Information

1.) Shall contain detailed illustrated parts information. The illustrated parts information shall be provided for all systems, assemblies, subassemblies, components and parts, including but not limited to all mechanical, electrical and other necessary equipment.

2.) Clear, concise exploded view isometric drawings showing the parts, the relationship of adjacent parts with one another within a given conveyor equipment assembly as well as the diagram number that shall reference the specific part on the adjacent parts information sheet.

3.) The parts information sheet shall be adjacent to the isometric drawing and shall contain:

a.) Part reference number from isometric drawing

b.) Part description

c.) OEM Part Number

d.) Manufacturer of part

e.) Number of parts found in the conveyor equipment isometric drawings

4.) Provide the above information in a manner so that the isometric drawing (up to 11" x 17" that can be folded up) shall be on the left hand side of the open manual or page in the soft copy with the associated parts information sheet as the right hand page of the open manual or page in the soft copy.

5.) Include model and serial numbers for all special equipment such as power turn conveyors, vertical sort units, pushers, HSPDs, and the like. All parts shall be referenced to a “next-higher-assembly” level within the drawing hierarchy. The system of referencing shall allow the reader to follow assembly / disassembly procedures in a methodical and orderly manner throughout the documentation.

j. Chapter 10 - Manufacturer's Literature

1.) Shall provide all of the manufacturer's literature for all of the conveyor equipment mechanical, electrical and electronic components.

2.) Information shall be "brand specific" for the actual equipment/ components provided for this system only. Information for equipment/components types and brands not provided in this system will not be acceptable.

3.) Unless unavailable, the actual original manufacturers literature shall be provided. At a minimum, only a first copy of a manufacturer's original literature will be accepted if the actual original manufacturer's literature cannot be provided.

4.) All such copies shall be clear and legible.

5.) All manufacturers' literature shall be appropriately highlighted with a legible solid black arrow for identification of the specific model or type of device used in the specified system.

6.) All manufacturers' literature shall include information adequate for proper servicing of the item, proper operation of the item as well as all required information for the ordering of the item.

7.) Complete list of parts manufacturers including address, telephone number and point of contact.

k. Chapter 11 - Mechanical Drawings

1.) Shall contain a complete, clear and legible 11" x 17" set of "As-Built" BHS mechanical drawings. Additionally, a PDF copy of these drawings shall also be provided on CD-ROM and inserted into a sleeve pocket within this chapter.

2.) The 11" x 17" drawings are to be folded so that they will fit within the O & M Manual.

l. Chapter 12 - Electrical Drawings

1.) Shall contain:

a.) A complete list and definition of the electrical symbols used in the electrical drawings.

b.) A complete, clear, and legible 11" x 17" set of "As-Built" BHS electrical drawings. Additionally, a PDF copy of these drawings shall also be provided on a pre-approved media and inserted into a sleeve pocket within this chapter. The As-built drawings shall contain, at a minimum, the following:

(1.) Detailed wiring connection drawing noting each control device, control station, motor, and all other controls devices, in block form with a detail of the actual "field wiring" numbers and configuration.

(2.) Detailed conduit routing diagram indicating size of conduit, size and number of conductors, junction boxes, control devices, motors, safety disconnect switches, and motor control panels.

(3.) Detailed block diagrams representing internal and external layout of components within each motor control panel.

(4.) Detailed block diagrams representing layout of components related to Satellite Workstations, Remote Status Monitors, Operator Workstations, ATRs and ATR/BMAs.

(5.) Schematic Wiring Diagram of each MCP, including outline and wiring diagram of all special devices. An additional approved 11" x 17" reduced copy shall be placed in the door pocket of the MCP.

(6.) The 11" x 17" drawings are to be folded so that they will fit within the O & M Manual.

m. Chapter 13 - PLC Listings

1.) Chapter 13 shall include a complete, clear and legible set of "As-Built" BHS PLC listings. The listing shall include the following:

a.) Complete set of PLC program ladder logic diagrams as well as PLC and Sortation controller listings for the related system.

b.) A complete Sequence of Operation shall be included on the schematic diagrams or the PLC ladder logic diagrams.

c.) PLC ladder logic diagrams shall have detailed "right hand" margin descriptors clearly identifying the function of each device and its associated contact rung locations.

d.) Include a separate I/O list for each PLC or remote I/O in the panel.

e.) Identify I/O assignments with Equipment Item Numbers.

8. Draft O & M Manuals

a. Submit two (2) hard copy sets and an electronic copy set of a draft Operations and Maintenance Manual for review and approval to MDAD prior to Start-up of the system(s).

9. Final O & M Manuals

a. Submit four (4) hard copy Sets and an electronic copy set of the Final O & M Manuals shall be presented to MDAD in accordance with the submittal schedule. Timely submittal of a system's O & M Manual is absolutely essential to the proper operation and maintenance of the BHS.

b. All sets of the O & M Manuals must be updated by supplement to reflect any Field Changes, equipment changes due to warranty changes, and any other

c. changes, that were made during the Warranty Period of the System, so that all sets of manuals shall reflect "As-Built" information.

d. Web based electronic medium copies of the O & M Manuals shall also be required on portable storage media at no additional cost to project. One (1) copy shall be distributed to MDAD, for their records, and one (1) to MDAD's Operations and Maintenance Contractor for the systems maintenance.

e. Additionally, an electronic medium copy of the O & M Manuals shall be provided on the Operator Workstations located in the BHS OCC.

f. Note that the Electronic medium copies shall be web based and formatted to allow the O & M personnel to store the files on a portable device to assist in their maintenance activities.

G. Periodic Maintenance Inspection and Lubrication Chart

1. Provide a master chart or series of charts involving periodic maintenance of all equipment items in the system and defining, under equipment item subdivisions, the points and frequency of recommended periodic maintenance functions, including inspection, lubrication and replacement.

2. Details of the procedures involved with the periodic maintenance functions are not required within the context of this chart. Procedures shall be described in full detail in the maintenance manual. Reference, however, shall be made to specific sections and pages

therein.

H. Training Program

1. Provide an operational and maintenance training program as specified in Part 3 of these Specifications.

2. The training program shall be submitted to MDAD for review and approval prior to the start of System Testing and in accordance with the schedule of submissions.

I. Environmental Requirements

1. Submit any special environmental requirements above and beyond what is shown in these specifications that may be essential for correct equipment operation (e.g., new computer hardware, VFDs, scanner arrays and any other items with special requirements).

J. List of Lubricants

1. Submit a complete list of lubricants to be used on the new and existing modified equipment components. This list shall be standardized on one supplier and coordinated with MDAD in order to minimize the number of different lubricants used.

K. Acceptance Inspection and Testing Program

1. Submit an Inspection and Testing Program for the BHS to demonstrate compliance with all specified requirements. Prepare the inspection and test plans based on the information provided in this specification. Meet with MDAD, to coordinate

2. The Functional Specification and Test Program shall identify and demonstrate all System Control Functions relating to the operational, functional and system performance tests. The Functional Specification/Test Plan is to list each Control Station, and Control Device, and its related Control Function that is to be demonstrated/tested. Refer to the Acceptance and Testing Section of this specification for detail test plan content requirements.

3. The testing plan shall include testing of all systems integrated with the BHS.

4. The Inspection, Functional Specification and Testing Program shall be submitted for MDAD's review and approval prior to the start of System Testing.

L. Test Reports

1. Submit a report after completion of the internal testing, debugging and system tests performed prior to Acceptance Testing summarizing the detailed results of the tests with associated third party reports (if any), to MDAD prior to requesting final completion review (final acceptance testing) by MDAD.

2. In addition, carry out a "dry test run" of Acceptance Tests prior to conducting such tests with MDAD to ensure that tests conducted with MDAD are successful.

3. Submit, upon request, to MDAD the results of all in-plant tests, with associated third party test reports (if any), conducted on assemblies and sub-assemblies of equipment or tests upon equipment of similar type to that, which are planned to be installed.

M. Final Parts List

1. Provide a detailed listing and description of all individual system (subsystem) components with reference to layout and assembly drawings.

2. The listing of system parts shall include the following information:

a. Name of part

b. Complete description of part

c. Each specific location that the listed part is used in the system(s).

d. Total number of parts in system(s)

e. Manufacturer of part

f. Manufacturer's part number

g. Source of supply

h. Recommended quantity of spares per each item

i. Price per unit

j. Lead time or availability of part

k. Complete list of manufacturers, with addresses, telephone numbers and point of contact.

l. Manufacturer's catalog literature and specifications for all purchased parts.

N. System Power Requirements and MCP Sizes

1. Submit all the motor control panel (MCP) sizes and related power requirements for all the subsystems of this project. Additionally, submit all the revised power requirements for the existing modified systems.

2. The power requirements shall indicate conveyor segment horsepower removed, horsepower added, and the total connected load of the new and existing modified subsystems (horsepower and full load amps).

3. Clearly illustrate (in color) in plan view how the BHS will be powered in order to satisfy redundancy requirements.

O. Estimated Spare Parts List

1. Submit a list of estimated spare parts required for the first year of operation for MDAD's review and consideration for a budgetary allowance - include unit price per unit for the estimated spare parts list based on reasonable airline market rates. Spare parts may be purchased for each phase, as applicable, to ensure availability of spare parts for active subsystems (existing and new) prior to the commissioning of that phase. Include recommended inventory and replacement levels for each phase prior to commissioning as well as part description and identification quantities in system, delivery times, manufacturers and suppliers (their part or ordering numbers).

2. Include any special test instruments required for maintenance beyond the normal inventory of a conveyor maintenance shop.

3. Submit a spare parts list in accordance with Schedule of Submissions.

P. System Reliability Calculations

1. Submit system reliability calculations demonstrating compliance with the "System Reliability" requirements specified herein.

Q. Computer/Software/Hardware Inventory

1. Provide to MDAD a detailed listing for each computer/PC or application that will be provided as part of the BHS project to be submitted upon Conditional Acceptance.

2. Submit the listing (by computer) along with all program disks, manuals, manufacturers information, and the like information in an organized format (i.e.:
3. binder with dividers or an acceptable format to MDAD) upon Conditional Acceptance.
4. It shall include in addition to the above, at a minimum, the following:
    a. Complete software inventory by computer, including all version numbers and dates.
    b. Complete hardware inventory by computer.
    c. Registration numbers, serial numbers.
    d. Computer emergency boot/recovery disks.

R. Computer Log

1. Upon conditional acceptance it shall be the responsibility of the BHS Subcontractor to keep a computer log. The purpose of the log is to keep track of any system computer problems/issues, which occur during the conditional acceptance period for trouble shooting/tracking purposes during its operational life.
2. The log shall be compiled in an electronic format acceptable to MDAD and shall include, at a minimum, the following information:
    a. Date/Time of Occurrence
    b. Type of Issue(s)
    c. Description of the issue.
    d. Name/shift of individual that discovered the problem.
    e. Resolution to the problem on site.
    f. Effect on the system.
    g. The BHS Subcontractor Individual Contacted for support and troubleshooting.
    h. Programs, files affected by the resolution to the issue.
3. As a minimum, the computer log should be issued to MDAD on a weekly basis, or as requested by MDAD.

1.7 BHS SUBCONTRACTOR'S QUALITY ASSURANCE GENERAL REQUIREMENTS

A. Non-Standard Equipment

1. Any proposed equipment which is appreciably different from items previously fabricated or which has not displayed satisfactory performance in a similar environment for at least one year (for a minimum of 18 hours per day, 7 days per week), shall be so noted in the appropriate submittal. As a reference, any of the following components that do not meet the requirements listed in the previous sentence shall be considered non-standard:
    a. Power Turns
2. Prior to the start of fabrication, a prototype of the new item shall be built andtest data shall be presented showing that the item has successfully performed the equivalent of one full year of operation. MDAD or their representatives shall be invited to witness the test and review the test data atno additional cost to project.
3. The testing requirements and demonstration will identify such requirements as follows:
    a. Number of hours of run time

b. Number of test cycles

c. Throughput/Processing rates

d. Mean time between failures

e. Repair time, serviceability

4. MDAD must approve the design before the final design and fabrication, provided that the BHS is produced by a firm with at least 3 years of experience in manufacturing and installing such systems comparable to that required under this contract. MDAD must approve the use of firms with less than 3 years' experience.

5. In lieu of developing a prototype, arrangements may be made for MDAD to inspect an existing component in operation at an airport at no additional cost to project.

1.8 PROJECT CONDITIONS

A. General

1. MDAD does not guarantee the accuracy or the completeness of the information relating to the new or existing utility services, facilities, or structures that may be shown on the drawings or encountered in the work. Any inaccuracy or omission in such information shall not relieve the responsibility to protect such existing features from damage or unscheduled interruption of operations and services.

2. It is noted that the MIA South and Central Terminal are currently fully functional facilities and must remain in operations for the entire duration of the Project. Therefore, the BHS Subcontractor is instructed to closely follow the outlined phasing plans and coordinate all activities with MDAD, so as not to cause any undue disruptions to the operations.

3. Prior to commencing the work in the general vicinity of an existing system, utility service or facility (i.e., a subsystem that has been previously handed over to operational use by the BHS Subcontractor or an existing subsystem that is in operational use), notify MDAD in advance and obtain approval before proceeding with the work. Failure to give notice shall be cause for MDAD or their representative to suspend the BHS Subcontractor's operations in the general vicinity of the System, utility service or facility.

4. Should damage or unscheduled interruption of airline operations, utility service or airline facility occur by accident or otherwise, the BHS Subcontractor shall notify MDAD and take all reasonable measures to prevent further damage or interruption of service. In such events, cooperate with the utility service, and

5. MDAD until such damage has been repaired and service restored to the complete satisfaction of MDAD and the utility service.

6. Coordinate all building modifications performed by any trade to accommodate the phased installation of the BHS.

7. Comply with the minimum phasing sequence illustrated in the contract drawings, the coordinated detailed phasing plans that shall be submitted to MDAD, and in compliance with the overall project schedule.

B. System Right-of-Ways

1. Considering the sequenced implementation requirements of the BHS scope within the Central and South Terminals for the interim as well as the final conditions, the BHS conveyor equipment and their associated main conduit / wireway runs (e.g., between the

BHS related Power Distribution Panels and the Motor Control Panels) shall have first priority to the available right-of-ways within the facility space and as provided by the demolition and clearing of other systems during the sequenced implementation process. Provide all necessary coordination between the BHS conveyor equipment, their associated main conduit / wireway right-of-ways, and adjacent MEP systems right-of-ways that will be installed within the facility in compliance with the Division 1 requirements to accommodate the specified systems installation.

1.9 PROTECTION OF THE WORK

A. General

1. Provide protection of the work and property in compliance with Division 1, Section 01 35 16.

1.10 SYSTEM DESIGN AND PERFORMANCE REQUIREMENTS

A. General

1. All equipment shall be in strict accordance with the specifications described herein. It should be noted and stressed that the system shall be designed, engineered, fabricated and installed with the objective of being of rugged, heavy duty, impact resistant equipment capable of withstanding the abuse and exposure to damage experienced in an air transportation baggage handling facility. Other key factors to be considered in the development of the system and its elements shall be simplicity, reliability, maintainability, and safety.

2. The BHS Subcontractor is deemed to have studied the proposed system layout and requirements presented in the drawings and specifications of this Design Criteria Package and accepted the design intent and requirements as suitable and appropriate to safely design and accomplish the alterations, functions and processes described herein. Any alternate designs developed by the BHS Subcontractor must meet or exceed the design criteria as listed in these documents.

3. Consideration shall be given to the design, fabrication and installation of all projections, welds, and transfer points between conveyor segments and conveyor items to eliminate damage to the various types of baggage processed.

4. The system and subsystem layout configuration and item/component functional requirements are specifically described on the contract drawings.

B. Material and Equipment Approvals

1. Where manufacturer's name, brand or trademark is specified, it has been selected to establish a standard of quality for the materials, components or equipment required. Materials, components or equipment of different manufacture considered to be equal to the materials, components or equipment specified will receive full consideration and shall be subject to approval by MDAD before being incorporated into the work. Provide a listing of sources where any material, component or equipment, for which a substitution approval is being requested, can be obtained.

2. Furnish all engineering data, engineering/shop drawings, literature, test results, calculations, and any other requested information, for review of substituted material, components or equipment. The BHS Subcontractor shall pay for any redesign necessary to accommodate an “approved equal”.

C. Request for Deviations from Drawings or Specifications

1. Requests for deviations from drawing or specification requirements shall comply with Division 1, Section 01 25 00 (Product Substitutions) and may be approved at the discretion of MDAD to permit use of standards inherent in the equipment when it has been determined by MDAD that such deviations will in no way be detrimental to the conveyor equipment, the safety, operation and maintenance of the specified system, system design, system reliability and its associated inventory of spare parts.
2. Any materials, components or equipment submitted for substitution for this BHS shall be previously proven under the loads as specified in Part 1 of this Specification in an operational or test equivalent environment for a minimum of 1 year, 18 hours per day, 7 days per week.

D. Baggage Conveyors

1. Conveyor Loads
   a. Design the conveyors and their supports using the following loading criteria:
      1.) The live and dead static load imposed on the building (composed of the conveyor components, supports and baggage) used for designing structural elements, rollers and pulleys shall be 100 pounds per linear foot except for merges and conveyors designated as Oversize conveyors, in which case it shall be 150 pounds per linear foot.
      2.) All conveyor equipment shall be capable of supporting a single concentrated static load of 250 pounds.
      3.) The live dynamic load to be utilized for sizing drives, belts, bearings, and other components, shall be 60 pounds per linear foot for oversize, load, unload and accumulating conveyors operating up to a speed of 120 feet per minute. For all other conveyors (e.g. transport, or sortation) it shall be 40 pounds per linear foot operating at a conveyor speed of 90 feet per minute and a throughput of 25 bags per minute adjusted proportional to speed and throughput. As an example, a sort line traveling at 360 feet per minute and rated at 60 bags per minute would have to be rated at 24 pounds per linear foot for load testing. The following formula shall be utilized to determine the test ballast for the purpose of load testing and preparation of related test plans during the BHS acceptance period:
      4.) Formula: 40 lbs per Linear Foot x (90 FPM / actual conveyor speed) x (throughput rate / 25 bags/min) = xx lbs per linear feet
2. Conveyor Dimensions
   a. All equipment shall be of U.S dimensions.
   b. Unless otherwise specified on drawings, construct conveyors to the following dimensions:

Conveyor Type	Overall Width	Between Guide Width	Belt Width
Standard Conveyor and Power Turns	42"	39"	36"
Oversize Conveyors and Power Turns	60”	57”	54”

Note: 1. Standard Power Turn inside Radius shall be 4' 0".
Note: 2. Oversize Power Turn inside Radius shall be 5’ 0”.

3. Conveyor Side Guard Heights

   a. Refer to Part 2 of this specification for side guard heights.

4. Conveyor Speeds

   a. Unless otherwise specified, conveyors speeds shall be selected by the following criteria to minimize the system processing time between the input conveyor(s) and the output sort destination; to accommodate the specified throughput rate requirements and specified speed changes between adjacent conveyor segments.:

Type/Location	Speed (Feet/Min)
Public Area Load Conveyors	90
Make Up Devices	90
Sortation (Central Terminal)	270*
Sortation (South Terminal)	Maintain Existing Sortation Mainline Speed (assumed to be 300)*
Non-Public Load / Unload Conveyors	120

   b. Speed Changes

      1.) Make speed changes between adjacent conveyors to increase or decrease a maximum speed (nominally 30 feet per minute) so as not to adversely affect baggage spacing or tracking. Conveyor speed changes between adjacent conveyor segments shall be set that the specified positive bag tracking requirements are not compromised.

      2.) Feed conveyor speed onto the related make-up device will not be greater than 120 feet per minute, unless otherwise specified.

E. System Throughput Processing Rates

1. Unless otherwise specified, System Processing Rate shall be: The design of the system shall ensure the following:

Conveyor Type	Minimum Processing Rate
Existing Modified Ticket Counter and Curbside Lines (Each Subsystem)	25 bags per minute
Oversize Conveyors	20 bags per minute
Transfer Conveyors	20 bags per minute
Outbound Transport Conveyors with More Than One Input	55 bags per minute
Sortation Mainline (Each Subsystem)	55 bags per minute

2. The overall design of the BHS program shall also pay particular attention to the following requirements:

   a. Cost effectiveness while providing the levels of security and performance in passenger level-of-service.

   b. Deliver bags with spacing that will sustain the throughput of the screening equipment and foreseeable future screening technology.

c. Safe and efficient use of space for maintenance staff at entry / exit points and within working spaces.

d. Consideration of the amount of time a bag is in the system i.e. 95th percentile to arrive at the make-up device / sort pier within 15 minutes from induction onto the ticket counter load conveyor.

e. Flexible design to allow for future upgraded security technologies.

F. Baggage Characteristics

1. Design the BHS to convey standard airline baggage tubs and to process baggage having the following characteristics:

a. Size of Single Piece

Conveyor Type	Length	Width	Height
Standard Conveyor Maximum	54"	33"	30"
Standard Conveyor Minimum	12"	12"	4"
Oversize Maximum (OS6)	13'	50"	34"
Oversize Maximum (OS7)	13'	50"	24"
Oversize Minimum	12"	12"	4"
CTX 9800 SEIO	54”	29”	23”

Note 1: Average bag length for the purpose of rate testing shall be 28". The system shall be capable of accommodating 42" bag lengths without compromising the baggage-processing rate. The standard outbound conveyors shall also be capable of accommodating 54" bag lengths at lower processing rates. The specified dimensions for the standard baggage sizes are intended to provide the maximum individual dimension for each of the three magnitudes indicated, and not to exceed the maximum baggage weight. For any given length or width dimension, the baggage conveying surface area must not exceed 12 ft². For example:

(1.) Given a 54" max length dimension, the width must not exceed 32" wide and 12" high.

(2.) Given a 33" max width dimension, the length must not exceed 52" long and 12" high.

Note 2: The specified dimensions for oversize baggage sizes are intended to provide the maximum individual dimension for each of the three magnitudes indicated and not to exceed the maximum baggage weight. For example, given a 10' length dimension, the width must not exceed 18”:

b. Weight of Single Piece

Conveyor Type	Weight
Standard Conveyor Maximum	120 lbs.
Standard Conveyor Minimum	5 lb.
Oversize Conveyor Maximum	150 lbs.
Oversize Conveyor Minimum	5 lb.

c. Shape

1.) At least one flat conveyable surface. Baggage meeting the above size

limitation but lacking a flat conveyable surface (such as baby carriages, round duffle bags, and the like) shall be processed in standard airline tubs.

2.) Design system to accommodate 90% of the baggage normally encountered with or without the use of standard airline tubs, including but not limited to, golf bags.

d. Surface Material

1.) Complete spectrum of package materials found in air transport baggage, including paper, cardboard, cloth/canvas, plastic, leather, wood, and metals in the following conditions:

a.) Dry to Wet

b.) WIth/Without:

(1.) Paper/cloth/plastic tape/wrapping

(2.) Plastic/steel bands

(3.) Fiber cord

(4.) Twine

(5.) Wheels

(6.) Straps

G. Physical Constraints

1. Design the BHS to accommodate the following physical constraints imposed on the System by either operational or facility considerations:

a. All conveyors, supports and related components (unless shown as floor supported, within the confines of protective guard rails, or within a confined and protected space) shall have the following minimum underside clearance from the bottom of the support structure to the floor, unless otherwise specifically noted on the Contract Drawings.

1.) 7'-6" for the Central Terminal

2.) 8'-0" for the South Terminal

b. Although the BHS Controls Functionalityshall be designed to accommodate the specified dimensions of the baggage characteristics in Paragraph 347716-1.09.F, the minimum clearance on all conveyors fromthe top of the conveyor belt to the underside of any obstruction shall be 36 inches for the final completed works, unless otherwise specifically noted on the Contract Drawings, to accommodate operational and maintenance access to the BHS. Ensure through proper coordination with other Contractors on site and in the BHS design that these conditions are not compromised to a lesser dimension than that stated in the contract documents. Additionally, lateral clearances to building elements shall be 12" (minimum) along a wall and 6" (minimum) along columns, hand/guard rails or other architectural elements such as bollards or the like, unless otherwise specifically noted on the contract documents

c. All inclined and declined conveyors shall have the following:

1.) A maximum slope of 18° for non-tracking conveyors. unless otherwise indicated on contract drawings.

2.) In all cases, where space permits a shallower angle, the BHS Subcontractor shall minimize the slope utilizing the least possible incline/decline angle to achieve the proper elevation change.

d. If any of these design criteria cannot be maintained, notify MDAD in writing for resolution.

II. Vibration

1. Provide shaft mounted components (e.g., reducers, pulleys, sprockets) and other components subjected to vibration with some means of preventing loosening of the component such as snap rings, cotter pins, or other methods approved by MDAD.
2. Mount all conveyors on vibration isolation pads or hangars except those components supported from a ground floor slab or other structural floor whose characteristics prevent vibration from the conveyors from being transmitted to adjacent structure(s) or perceived surrounding area.
3. Mount all conveyor components supported from structural elements adjoining TSA work areas, public and office spaces on vibration isolation pads or hangers to eliminate perceivable vibration from being transmitted to the building.
4. Conveyors and components that are header steel surface mounted to building elements and mezzanines shall not transmit any vibration. Such items shall be fitted with vibration isolators to eliminate vibration.
5. Vibration isolation devices shall be determined based on individual support loads, vibration frequency and vibration amplitude so that appropriate vibration isolation is proved.

I. Balancing

1. Dynamically balance all rollers and pulleys.

J. Service Conditions

1. Design each element to operate satisfactorily in its respective environment as follows:
   a. Mechanical - Indoor (Bagroom Environment)
      1.) Temperature: 32° to 120° F (0° to 48°C)
      2.) Relative Humidity: 5% to 99% Non-condensing 3.) Protected from direct exposure to weather
   b. Electrical/Electronic Equipment Inside Control Panels
      1.) Temperature: 32° to 140° F (0° to 60°C)
      2.) Relative Humidity: 5% to 99% Non-condensing
   c. Electrical/Electronic Equipment - Indoor (Bagroom Environment)
      1.) Temperature: 32° to 120° F (0° to 48°C)
      2.) Relative Humidity: 5% to 99% Non-condensing
      3.) Protected from direct exposure to weather.
   d. Mechanical - Outdoor
      1.) Temperature: 20° to 120° F (-7° to 48° C)
      2.) Relative Humidity: 5% to 100% condensing 3.) Covered but not protected

from driving rain.

e. Electrical/Electronic Equipment - Outdoor

1.) Temperature: 20° to 120° F (-7° to 48°C)

2.) Relative Humidity: 5% to 100% condensing 3.) Covered but not protected from driving rain.

f. Electrical Equipment Inside Server / OCC Rooms

1.) Temperature: 55° to 80° Fahrenheit (13° to 27° Celsius)

2.) Relative Humidity: 5% to 50% Non-condensing

2. During construction if sealed office area is not available for the BHS related computer equipment, provide a filtered air environment as required to accommodate the installation of the BHS related computer equipment.

3. Submit and clearly identify any special environmental requirements more stringent than what is shown in these specifications that may be essential for correct equipment operation (e.g., computer hardware, scanner arrays, and any other components with special environmental requirements).

K. System Safety

1. Design, engineer, manufacture, supply, install and construct the BHS in accordance with all of the requirements in the Contract Documents, and meet or exceed all applicable laws rules, orders, regulations and codes. In this regard, the BHS Subcontractor shall be responsible throughout this Contract to bring to the attention of MDAD in writing any changes in such laws, rules, orders, regulations and codes and any condition(s), whether caused by its design or any BHS Contract requirements, which the BHS Subcontractor believes may result in or has resulted in an unsafe condition(s). Where MDAD and the BHS Subcontractor mutually determine that such condition(s) is directly a result of any Contract requirement(s) or any changes in laws, rules, orders, regulations and codes, then MDAD and the BHS Subcontractor shall seek a mutual resolution of the condition(s) to be effected by a Change to the Contract.

2. The operation of the system shall be convenient and safe to use, and control functions to be performed shall be simple to minimize possible errors. The BHS Subcontractor shall provide convenient means for emergency system shutdown.

3. Utilize control methods and techniques, circuitry, mechanical and electrical equipment and operating/maintenance procedures to provide maximum safety for the public and operation and maintenance personnel and to minimize potential damage to the equipment and to the baggage being processed. Incorporate failsafe techniques to prevent the occurrence of unsafe conditions, which could result from an equipment failure or improper implementation of the operating procedures.

4. As employed herein, the failsafe principle shall be interpreted as follows: In the event an equipment failure or external influence such as improper operation, high temperature, power failure, or other adverse condition affects the proper function of a system or element involved with the safety of life or health, said system or element shall revert to a state known to be safe to all personnel interfacing with the equipment.

5. Locking Switches – In public areas, all unattended control stations shall be protected with locking type key switches to prevent operation by unauthorized persons.

6. Protrusions - Equipment shall be free of sharp edges and mechanisms that could catch

limbs and/or clothing. The material being handled, or any containers in which the material is being handled, shall also not be damaged due to such items.

7. Operator Controls - BHS operating controls shall be convenient, clearly identified, simple, and safe to use. Any possible chance of error shall be minimized. Emergency stop switches shall be provided as required by this specification.
8. Overhead Protection - Protection against falling material shall be provided in those areas beneath overhead portions of the BHS where the material may be dislodged from, or spill over, the sides of the overhead handling equipment/conveyors.
9. Motor Disconnects - All motors, including those on powered doors, shall be provided with lockable safety disconnect switches to permit shutting off the motor power circuits.
10. Protective Covers - Protective covers or screens shall be provided over moving mechanisms (such as bearings, return rollers, and return conveyor belts) that could catch limbs and/or clothing of personnel performing maintenance duties as defined under the heading Enclosures and Safety Guards.
11. Fall Protection/Restraint - Ensure appropriate fall protection/restraint where equipment is installed at continuous heights.
12. Walking/Working Surfaces - At elevated working levels, ensure appropriate walking/working surfaces, with ladder systems, are designed and installed.
13. Head Protection - Ensure protective coverings are installed to prevent head injury to personnel.
14. Ensure that all provided and installed equipment meets all applicable local, state and federal safety codes, including applicable OSHA standards and requirements, for baggage handling systems/conveyors and industrial machinery environments.
15. Provide safety signage throughout the new and modified portion of system.
16. Provide work space in all limited access areas.
17. Provide audible and visual warning signals along all areas of the system to make apparent any potential hazards to the public, operating and maintenance personnel resulting from moving or about-to-start equipment.
18. Provide protection from falling objects in work areas or aisles located beneath overhead portions of the system with gap pans or netting.
19. Locate conduits and all other electrical components where they shall not be subject to damage by maintenance or operational personnel.
20. Coordinate access provisions for operators so as to minimize obstructions. Locations of control stations and electrical boxes shall be coordinated to support unrestricted access by staff. The provisions of the conveyor supports, drive configurations, personnel guarding and side guards shall allow for maximum operator accessibility.

L. Noise Levels

1. Design, fabricate and install the BHS to limit combined equipment and controlled ambient noise levels to the following allowable maximum requirements. However, the BHS equipment shall not increase the ambient noise level by more than 15 dB (A). In any case, ambient noise levels for the BHS equipment shall not exceed OSHA standards.

Noise Level	Ambient
45 dB (A)	In adjacent or nearby office areas (measured at the center of room at a height of 5'-0" above the floor).
65 dB (A)	In public areas, or ceiling above public areas and offices, and TSA staffed OSR room (measured at a number of positions normally occupied by passengers, public and staff).
75 dB (A)	In bagroom and all other associated non-public areas or unoccupied areas.

2. To accommodate noise levels of 65 dB (A) or less the BHS Subcontractor shall consider the following items for conveyor segments installed in these spaces to minimize noise levels:
    a. Use low noise PVC belting.
    b. Use either shaft mounted drives or underslung drives with toothed v-belts (no chain drives).
    c. Mount all safety guards with rubber isolation washers between fasteners and the conveyor frame.
    d. Use bolted return rollers (i.e., no spring loaded return rollers). The use of UHMWPE polyethylene washers shall be placed between the rollers and mounting brackets to reduce side play and noise caused by side play. Provide high quality low noise bearings.
    e. VFDs shall not be set with a maximum output frequency of greater than 72 Hz. This is to limit the amount of noise generated and difficulties stopping with output frequencies set beyond this limit. Set the VFD carrier frequency as to not increase the motor audible noise level.
    f. Use vulcanized spliced belting in areas that require reduced noise levels. The conveyor must facilitate the replacement of a clipper lacing for repair/replacement of damaged conveyor belt.
    g. Provide under-guarding on all conveyor segments, regardless of their elevation, in areas that require reduced noise levels.
    h. Add a fire retardant sound damping material to the inside of under guarding to reduce sound levels.
3. Unless otherwise specified the measurements shall be taken at a maximum distance of 5' vertically and 5' horizontally from noise producing components.
4. The noise level measurement shall be accomplished utilizing an integrating sound level meter supplied by the BHS Subcontractor. A qualified person employed by the BHS Subcontractor shall accomplish measurements and evaluation. The BHS Subcontractor shall submit a certificate of calibration.
5. The noise level shall be the Equivalent Continuous Sound Pressure Level measured over a period of one minute or more at each location. In addition, to the overall A-weighted noise level, the Equivalent Continuous Sound Pressure Level shall be measured for each octave frequency band from 125 Hz to 4000 Hz.
6. Conveyor noise shall not be unduly impulsive. Observing the difference, between the measured Equivalent Continuous Sound Pressure Level and the instantaneous sound

pressure level, shall test the impulsiveness of the noise. A component shall be considered unduly impulsive if the differences exceed 3dB (A).

7. Conveyor noise shall not be unduly tonal. Tonality shall be determined by observing the difference in level between any A-weighted octave band and each of its adjacent A-weighted octave bands. The sum of the differences shall not exceed 6 dB (A). All octave bands from 125 Hz to 4000 Hz shall comply with this requirement.
8. Every conveyor component shall be tested. The components shall be tested at full design speed under load conditions.
9. Where conveyors are located in the ceiling spaces of non-bagroom areas, the noise measurements shall be taken after the architectural ceilings are in place.
10. Noise level measurements shall be taken during non-operational hours to ensure passenger conversations or movements do not unduly increase the ambient noise levels in public areas.
11. Measurements shall be taken during a time when the ambient noise levels are at least 6 dB (A) below the conveyor noise level. The ambient noise level shall be determined both before and after the measurement of the components. The ambient noise level shall be determined as follows:
    a. The BHS equipment shall be turned off.
    b. All other equipment (i.e., air-conditioning and heating equipment) shall be on and outside noise sources (from aircraft and mobile ground equipment) shall be as normal.
    c. Noise level readings shall be taken throughout a zone 5' vertically and 5' horizontally from the BHS equipment using an integrated sound level meter set to the A-weighted network.
    d. After the ambient noise level has been determined, the BHS equipment shall be turned on and the total noise level shall be measured at the same points throughout the zone that the ambient levels were measured.
12. The BHS Subcontractor shall provide a written report to MDAD detailing the results of the noise level measurements.

M. Radio Frequency Interference/ Electro Magnetic Interference (RFI/EMI)

1. Ensure by design and shielding that system equipment shall not create electromagnetic emissions, which can, in any way, cause interference with communications within the airport or between the airport and aircraft or ground support vehicles.
2. Choose all electrical and electronic equipment (including computer and related equipment) to operate without malfunction in the presence of normal electromagnetic emissions generated by other equipment normally installed or used at the airport including but not limited to the aircraft communications bands, high-power radar systems, various electrical motors and controls, power tools, welding equipment, automotive vehicles, ground power units and air handling units. Provide isolation transformers and line suppression units, if required.
3. Radio frequencies, if used for communications or information transmission within the systems, shall be applied for to the relevant Airport and Government Authorities for their designation and assignment.

N. Maintainability, Life & Reliability

1. The requirements set forth in this section are minimum requirements and do not relieve the obligation to provide a system in which all required maintenance tasks can be readily performed.
2. Design all components so they can be easily disconnected and removed from the equipment without the necessity for extensive disassembly. Design the components for removal and replacement by two - (2) staff in a period not to exceed two - (2) hours. List in the maintenance manual all component removal/replacement or other maintenance tasks, which require more than four
3. (4) staff-hours to accomplish. Be prepared to demonstrate that any maintenance task, not so listed, can be accomplished as described above. Correct any installation, without charge, as required to accomplish this demonstration.
4. Design the system so that equipment components requiring inspection and servicing are readily accessible. Provide suitable doors for this purpose. Where necessary, provide access holes in frames or guards but keep them to a minimum number and size, and ensure that they do not create protrusions or discontinuities detrimental to the baggage being conveyed.
5. Design equipment to facilitate maintenance functions in preference to ease of fabrication.
6. Design equipment such that, whenever possible, assemblies shall not require dismantling in order to troubleshoot, repair or replace assemblies or components of assemblies involved in such servicing procedures.
7. Affix cover plate attachment hardware to, or hold captive in, the cover plate assemblies.
8. Provide all electric assemblies, panels, or boxes with the appropriate schematic, enclosed in a clear-faced envelope affixed in a location visible to personnel while servicing such items.
9. Provide one set of special test instruments and tools for each group of equipment items requiring such special test instruments and tools. These shall be provided in a metal toolbox with identification of the equipment for which the tools shall be used and shall become the property of MDAD.
10. Provide a device for measuring conveyor speed and shaft/pulley rotational speed prior to commencement of Acceptance Testing for use by MDAD, during the Acceptance Testing period.
11. Provide fixed, liftable and mobile ladders, service catwalks, lifting lugs or other applicable provisions to ensure easy access to components requiring servicing, either as shown on the specification drawings or as required to assure a safe and efficient system for all personnel who operate, maintain or have access to it.

O. Standard/Interchangeable Components

1. Minimize the number of different types and makes of components used in the BHS to simplify spare parts inventory.
2. Design all equipment and components to definite standard dimensions, tolerances, and clearances to provide maximum inter-changeability.
3. Provide like types of equipment from the same manufacturer wherever practicable.

P. Lifespan

1. Provide equipment components and items for a system equipment life of a minimum of

15 years and an operating duty cycle of 18 hours a day, 365 days per year. This provision is a design objective, not a warranty.

2. It is understood that PC based computer equipment may not have the identical hardware available for the full 15 year period (PLC equipment does not fall under this category), as such the BHS Subcontractor shall submit a list of the estimated spare parts required to maintain the PC based computer hardware for the 10 years of operation for MDAD's review and consideration for a budgetary allowance - include unit price per unit for the estimated spare parts list based on reasonable airline market rates.

Q. System Reliability

1. Reliability requirements of the total BHS shall be measured in terms of "System Availability" (A_s).

2. Failure

a. A failure is defined as any malfunction of a System component, assembly, or subassembly which stops normal operations. A failure shall be charged against only the one subsystem, which causes that failure. The following shall not be classified as failures:

1.) Malfunctions caused by a failure on MDAD's part (after system acceptance) to properly maintain and operate the System in accordance with recommended procedures.

2.) Malfunctions due to causes outside the System such as but not limited to sabotage or general power outage.

3.) Malfunctions due to baggage jams not caused by failure of a system component, assembly or subassembly unless it is a defective part, a poor installation, or a failure of a component or subassembly to perform its intended function.

4.) Incipient failures, which are detected and repaired without affecting normal operation of the System.

5.) Malfunction of one of a redundant Computer/PLC pair where the repair time does not affect normal operation of the system. However, reliability of redundant computer pairs is defined elsewhere in this specification.

3. Sub-System Availability (As)

a. Sub-System Availability (As) shall be defined by the following equation:

As = (ST - RT) / ST Where:

ST = Scheduled Operating Time: The scheduled time that the BHS is available for baggage processing (normally 18 hours per day).

RT = Repair Time: The interval of time between initiation of repairs due to a failure and return of the BHS to operation.

b. Each subsystem of the BHS shall have an availability of not less than 0.999 (99.9%) to be calculated monthly. However, the maximum allowable downtime in a single operating day shall be no more than 15 minutes on one subsystem; additionally, the accumulative downtime for all subsystems shall not exceed 20 minutes.

c. The time taken to clear a bag jam that was proven to have been the result of a bag being incorrectly introduced into the system (as reported by maintenance/operations

or TSA personnel (e.g., bags on wheels, straps not removed, for example, item that should have been in a tub) shall not be counted against the subsystem availability.

d. No more than one failure per month of one of the computers, PLCs, Operator Workstations and any other control equipment within of any slave/master pair shall be acceptable.

e. All computer and control systems (including but not limited to BHS host computers, Sortation computers, and Operator Workstations) shall have an availability of not less than 0.999 (99.9%) to be calculated monthly. However, the maximum allowable downtime in a single operating day shall be no more than 2 minutes for a single event. The maximum downtime where both slave/master pair within computers, PLCs, and workstations fails simultaneously shall be 10 minutes in a year. System availability shall be demonstrated and monitored during system acceptance testing and shall be proven (through operational reports) that it is maintained during the operational period prior to system final acceptance.

R. BHS Subcontractor Proprietary Parts Availability

1. Maintain, for immediate delivery, an adequate inventory of spare parts that are BHS Subcontractor proprietary items (especially long lead time items) required for routine maintenance of the system. Ensure that critical proprietary spare and replacement parts required by the system are made available for a minimum of a fifteen - (15) year operational period through the availability of shop and as-built drawings and through the availability of the actual proprietary parts.

2. If the BHS Subcontractor fails to make such proprietary parts available during the fifteen - (15) year operation period or should pricing become unreasonably high on a competitive basis, MDAD has the right to permit the use of the project drawings, at their discretion, for fabricating such parts, or having such parts fabricated so as to maintain the specified system.

1.11 STANDARDS AND CONSTRUCTION CODES

A. General

1. The design and subsequent installation shall provide adequate safety factors and shall conform to all current standards and codes of the USA, the State of Florida, the City of Miami, the Miami Dade Aviation Department and Miami International Airport, whichever that are enforced / adopted by MDAD.

B. Construction Codes

1. In the event no specific local codes or standards can be identified, the BHS Subcontractor shall comply with the most recent version, applicable provisions and recommendations of the following:

a. American Welding Society (AWS) 1.) D-1.1 - Welder Qualifications

1.) AWS-C1.1 - Recommended Practice for Resistance Welding in Building Construction

2.) AWS-A2.0 - Standard Welding Symbols

3.) D-1-0 - Standard welding practice in building construction

b. American Gear Manufacturers Association Standards (AGMA) 1.) 6009-A00 - Practice for Gear Motors

1.) 6035-A02 - Practice for Worm Gear Motors

c. American National Standards Institute (ANSI)

1.) A-1264.1 - Safety Code for Floor and Wall Openings, Railing, and Toe Boards

2.) B-20.1 - Safety Code for Conveyors, Cableways, and Related Equipment 3.) B-29.10M - Transmission Roller Chains and Sprocket Teeth

3.) C-33.1 - Safety Standard for Flexible Cord and Fixture Wire 5.) Z535 - Safety Color Code

d. National Bureau of Standards (NBS)

1.) Handbook H28 - Screw-Thread Standards

e. National Fire Protection Association (NFPA)

1.) NFPA No. 70 - National Electrical Code Volume 2, National Fire Code

2.) NFPA No. 79 - Electrical Standards for Industrial Machinery

3.) NFPA No. 80 - Standard for Fire Doors and Fire Windows

f. NEC National Electrical Code

g. Underwriters Laboratories (UL) Standards (Components shall be labeled appropriately)

1.) UL 508 - Industrial Controls Equipment 2.) UL 508A - Industrial Control Panels

2.) UL 508C - Power Conversion Equipment

3.) UL 1998 - Software in Programming Components

4.) IEC 61508 - Functional Safety Standard for Electrical /Electronic / Programmable Electronic (E/E/PES) Safety Related Systems

h. National Electrical Manufacturers Association Standards (NEMA) 1.) ICS - Industrial Controls and Systems

1.) MG1 - Motors and Gear Motors

i. American Society for Testing Materials (ASTM) 1.) A-36 - Structural Steel

1.) A-794 - Sheets cold rolled

2.) A-659 - Sheets & Strip - hot rolled 4.) A-307 - Fasteners (Bolts)

3.) A-563 - Fasteners (Nuts)

4.) F-844 - Fasteners (Washers)

j. American Wood Preservers Association (AWPA)

1.) C-27 Fire Retardant Wood

2. All equipment and accessory items furnished and installed under this Contract shall be governed at all times by applicable provisions of federal laws, including but not limited to the revision of the following in effect as of the Contract date:

a. Williams-Steiger Occupational Safety and Health Act (OSHA), of 1970, Public Law 91.596, most current version.

b. Occupational Safety and Health Administration (OSHA)

1.) 29 CFR Part 1910 Subpart D (Walking-Working Surfaces)

2.) 29 CFR Part 1910 -211 (Definitions)

3.) 29 CFR Part 1910 – 212 (General Industry Standards and Requirements) for machines

4.) 29 CFR Part 1917.48 (Conveyors)

5.) 29 CFR Part 1926.555 (Conveyors, Construction Industry Standards)

6.) 29 CFR Part 1926.1053 (Ladders)

c. Office of State Health Planning and Development (OSHPD)

d. American Society of Mechanical Engineers (ASME)

1.) ASME B20.1 – 2006 Safety Standards for Conveyors and Related Equipment, and all Addenda up to and including ASME B20.1-2006

e. Conveyor Equipment Manufacturers Association (CEMA) 1.) ANSI/CEMA 402-2003 Belt Conveyors

1.) ANSI/CEMA B105.1-2003 Specifications for Welded Steel Conveyor Pulleys with Compression-type Hubs

2.) International Building Code (IBC) for all stairs and handrails

1.12 WARRANTIES

A. General Warranty

1. Warrant any new BHS equipment for one (1) year against defective parts and labor.
2. Warrant all new BHS equipment for five (5) years against design defects.
3. Warrant all new BHS software, high level (i.e., Computer Systems) and low level (i.e., PLC) controls, including ATRs, and BMAs for five (5) years against design.
4. Warrant existing modified, relocated/reused, and repowered/recontrolled equipment for one - (1) year against defective parts and labor.
5. Assign MDAD all warranties for all materials and equipment received from Subcontractors and Suppliers.
6. MDAD shall be provided with a sample warranty for their review, comment, and acceptance during the GC Pre-Construction period.
7. Considering the construction program for this project is specified to be performed under a Phased-in Implementation Program, where existing subsystems and related conveyor equipment will either be removed from service, modified, reconfigured or tied-in with new conveyor lines that shall be installed and turned over for operational use on a Phase-By-Phase basis, the warranty for the BHS conveyor equipment and associated controls systems shall begin as follows:

a. Upon the Substantial Completion Date of a given Phase (when turned over for beneficial use) for all BHS related field components, such as motors, gearboxes, bearings, belting, field control components, and MCP control components.

b. Submit a certified warranty statement per Division 1, Section 01 33 00 summarizing the type of warranty coverage with the warranty commencement date for that given

Phase and outlining the BHS equipment that has been substantially completed and turned over for operational use.

c. Upon the Final Acceptance Date as related to this project for all relatedBHS related Computer Systems, Manual Encode Consoles, and PLC systems hardware and software provisions. Submit a certified warranty statement summarizing the type of warranty coverage with the warranty commencement date and an outline of the BHS equipment that will be covered under the warranty.

B. Warranty Exclusion

1. This warranty shall not apply to any defects or inconsistencies, which are attributable to repair, alteration, misuse or abuses by any person other than authorized personnel or Subcontractors. Liability shall be limited to repairing or replacing defective or non-performing part(s) at no cost to project.

C. Warranty Limitation

1. Liability shall be determined in the Contract Agreement and shall also include repairing or replacing defective or non-performing part or parts at no cost to project

D. Technical Support

1. Provide on-site technical support as defined by the Contract Documents and agreed upon by MDAD. This support shall be by personnel qualified to advise MDAD on training, provisioning, start-up and maintenance of the equipment.

2. The technical representative(s) for warranty support shall be within 6 hours travel distance of Miami International Airport, in the City of Miami, State of Florida, where the equipment is to be located, as required by MDAD.

E. Royalties and License Fees

1. Pay all royalties and license fees and defend all suits or claims forinfringements of any prior or patent rights and save MDAD harmless from liability, expense of loss on account thereof, with respect to any processes, devices, methods, articles, inventions, things or procedures used in the project.

F. Labor Warranty

1. Warranty support shall be provided as follows:

a. Provide labor to accomplish any warranty repair work. In the event such labor is not provided in a timely fashion, pay MDAD to accomplish warranty labor repair with its maintenance staff.

b. The BHS Subcontractor shall provide labor for work related to design deficiencies.

G. Parts Warranty

1. Terms

a. Provide a parts warranty which states material and equipment furnished and installed shall be new and free from faults and defects in material, workmanship, detail or incorrect component selection; shall conform to the functional and technical requirements of this Section and Contract Drawings contained herein; shall comply with all laws, statutes, ordinances and codesapplicable at the installation site; and shall be suitable for the intended purposes. Excessive wear shall be considered a defect within the provisions hereof.

b. Parts shall be shipped freight pre-paid to the location specified by MDAD. Failed/malfunctioned parts shall be returned to the BHS Subcontractor, FOB, within ten - (10) days of notification of detection of such failed/malfunctioned parts.

2. Spare Parts

a. Spare parts for each construction phase, shall be made available for purchase by MDAD prior to the commissioning of the construction phase to assure availability of spare parts for active subsystems (interim and final). MDAD may, taking the recommendations of the BHS Subcontractor, purchase such spare parts as it deems necessary, and said parts, shall be stocked on the Airport property. Stock control shall be by MDAD who shall grant reasonable access to the BHS Subcontractor's warranty service agency during the warranty period. All items withdrawn from stock shall be replaced, regardless of whether the item was purchased by MDAD or MDAD's Maintenance Group directly from the BHS Subcontractor or from a third party, pursuant to warranty services, within two weeks of such withdrawal.

b. Ending of the warranty period shall be contingent on the replacement of all stock withdrawn pursuant to warranty services whether the warranty service agency or MDAD accomplished such services. Where the BHS Subcontractor has cause to believe that an item or items may require stocking pursuant to the terms and conditions of warranty provisions, which item or items MDAD declines to stock, the BHS Subcontractor shall stock such items separately at no cost to project. In no case shall the absence of appropriate spare parts in MDAD's spare parts stock be construed in any way to abridge or interfere with the responsibilities of the warranty services as defined herein.

II. Design Warranty

1. Terms

a. Provide a Design Warranty which states that the system, materials, equipment, software and high level and low level controls furnished and installed shall be free from faults and defects in design; shall conform to the functional and technical requirements of this Section and Contract Drawings contained herein; shall comply with all laws, statutes, ordinances and codes applicable at the installation site; and shall be suitable for the intended purposes. Excessive wear shall be considered a defect within the provisions hereof.

2. Design Failure

a. In the event a design failure occurs during the warranty period, replace all such components, assemblies or devices utilizing the design in a similar application in which the failure occurs by components, assemblies or devices redesigned to prevent such occurrences at no cost to project. Submit proposed redesign drawings and re-selected component designations to MDAD for their approval. Issue a new warranty period upon the replacement of such redesigned items.

b. Components, assemblies or devices shall be considered as design failures if any of the following occurs during the warranty period:

1.) A leakage loss of over 10% of an operating fluid in any hydraulic assembly.

2.) A demand for frequent, unscheduled adjustment or other maintenance action in similar devices.

3.) Failure of a component to perform its specified function or a failure of a

component to operate at its specified rate.

4.) Frequent activation of overload protection elements in similar devices.

5.) Loosening of anchoring or attachment provisions on similar devices.

6.) An increasing level of noise being generated by similar devices.

7.) A structural failure due to BHS supports, hangers, or headers.

8.) Inappropriate action of control or sensor elements during operational conditions.

9.) Occurrence of an accident or an imminent safety hazard revealed during operational conditions.

10.) Uncovering of a condition of specification non-compliance or degradation of specified functional requirements during the warranty period.

11.) More than 2 failures on one or more components or assemblies of components of similar construction or design, used in similar devices.

12.) More than 2 unscheduled replacements of an expendable component in similar devices.

c. The MDAD shall act to resolve any disputes regarding the definition of a design failure in a fair and equitable manner and in compliance with Division 1.

3. Period and Responsibility

a. If, within five – (5) years from the date of Final Acceptance of the work, the work or the system, or any equipment, material or software is found, in any respect, not to conform to the Warranty set forth herein, within forty-eight - (48) hours of notification by MDAD, initiate the following series of steps in order to correct the deficiency:

1.) Determine the cause of failure.

2.) Prepare drawings showing recommended design changes and submit to MDAD.

3.) MDAD shall comment with a change request or approval.

4.) Make design changes if requested.

5.) After MDAD has approved the design, all components of the system incorporating the same design deficiency shall be modified as agreed upon by MDAD.

6.) The Parts Warranty period and the Design Warranty period shall start again for the changed item/system on the date that the design change has been incorporated if the make, manufacture or model is replaced.

- END OF PART 1 -

2. PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General

1. In order to establish a minimum standard of quality and reliability, the following manufacturers have been listed for various components of the BHS.

2. The listing below has been presented to establish this standard and the manufacturers on this list shall not be perceived or construed as favored or preferred. This list shall, in no way, preclude other manufacturers, provided that their equipment and components have been reviewed by MDAD and determined to be of equivalent or similar quality, functionality, and reliability. MDAD's decision in this regard shall be final. The use of specific product manufacturers or models on previous projects that are not identified on the following list of approved equipment does not constitute pre-approval on this project.

B. Conveyor System Manufacturers

a. Jervis B. Webb Company, Inc.
34375 W. Twelve Mile Road
Farmington Hills, MI 48331
Phone: 248-553-1000

b. Diversified Conveyors International, Inc.
2163 Airways Blvd #300
Memphis, TN 3811
Phone: 901-746-3018

c. Vanderlande Industries, Inc. 1765 W. Oak Parkway
Suite 700
Marietta, GA 30062
Phone: 770-250-2800

d. Five Start Airport Alliance
2810 Pennsylvania Avenue
P. O. Box 9815
Ogden, UT 84409
Phone: 801-401-5500

e. Approved Equal

C. Controls and Integration

1. The following manufacturers have been listed for control components, programming, networks and integration for the BHS.

a. For Programming, Networks and Integration:

1.) Brock Solutions

b. For MCPs, Control Stations and other Assembled Controls Hardware Enclosures:

1.) Brock Solutions

D. BHS Equipment

1. The following manufacturers have been listed for BHS equipment.

a. For Belting:

1.) Ammeraal Beltech

2.) Siegling America, Inc.

b. For Belt Lacing:

1.) Clipper Belt Lacer Company

2.) Gator Belt Hook System (45 degree merges only)

c. For Bearings:

1.) Dodge (Baldor Electric Company)

d. For Brakes:

1.) Dodge ("D" Type) (Baldor Electric Company)

2.) Stearns Electric (Rexnord Industries)

3.) Warner Electric (Failsafe)

e. For Motorized Pulleys:

1.) Interroll

f. For Power and Spiral Turns:

1.) Portec, Flo-Master Division

2.) Jervis B. Webb, Inc.

g. For Scales with Integrated Conveyor

1.) Atrax preferred model ABS-960 or approved equal.

h. For Scale and Dispatch Conveyors

1.) Jervis B. Webb, Inc.

i. Motor Starters:

1.) Allen-Bradley

j. Programmable Logic Controllers (PLCs):

1.) Allen-Bradley

k. Photoelectric Controls:

1.) Allen Bradley

l. Variable Frequency Drives (VFD):

1.) Nord Gear

m. Light Curtains

1.) Allen Bradley 440L-P4J0320YD

n. Motor Safety Disconnect

1.) Allen Bradley 440L-P4J0320YD

o. For Motor Control Panels (MCP Cabinets):

1.) Saginaw Control & Engineering

2.) Hoffman

p. For Power Distribution Pnanels:

1.) SquareD

q. For Motors:

1.) Nord Gear

r. For Reducers (shaft mounted):

1.) Nord Gear

s. For Reducers (foot-mounted or base-plate mounted):

1.) Nord Gear

t. For Rollers Chains:

1.) Dodge (Standard)

2.) Rexnord (Sidebow)

u. For Rollers and Pulleys:

1.) Jervis B. Webb, Inc. (Rollers)

2.) The Chantland Company (Pulleys)

v. For Signaling Devices (audible alarms):

1.) Allen Bradley

w. For Signaling Devices (visual alarms):

1.) Allen Bradley

x. For Uninterrupted Power Supply (UPS):

1.) APC

y. For Draft Curtains:

1.) Necor

z. For Powered Fire/Security Doors:

1.) Airport Equipment Specialists, Inc.

aa. For Soft Start Devices:

1.) Allen-Bradley

bb. For Power Regulators:

1.) Sola/Hevi-Duty Electric

2.2 MATERIALS

A. General

1. All welding and qualification of welders shall comply with AWS D1.1.
2. All fasteners shall be zinc-plated, cadmium plated or stainless steel. All fasteners shall be locked with lock nuts or lock washers.
3. Use of alternate materials
   a. Whenever an article or any class of articles, devices or material are specified by the

trade name or by the name of any particular patentee, manufacturer, or dealer, or by reference to the catalog of any such patentee, manufacturer or dealer, it shall be taken to mean and specify the articles, devices or materials specified and none other.

b. If the BHS Subcontractor desires to use any articles or materials which he believes are equal in quality, finish and durability, and equally as suitable for the purpose for which intended as the particular articles, devices or materials specified, he shall indicate his desire to MDAD in writing.

c. The articles, devices and materials specified shall not be changed except with the written consent of MDAD, and the BHS Subcontractor shall not contract, purchase or cause to be delivered any substitute articles, devices or materials prior to obtaining such consent.

B. Material

1. Structural Steel: ASTM A-36
2. Stainless Steel (Trim): AISC Type 304 with #4 Brush Finish
3. Plywood (FR-S Rated Fire retardant): Interior Type A requirements in AWPA Standard C-27.
4. Lumber (FR-S Rated Fire retardant): Interior Type A requirements in AWPA Standard C-20
5. Rubber/Neoprene: ASTM D-2000

2.3 FABRICATION

A. General

1. Fabricate equipment-using steel clean and free from rust, rust pits, kinks and sharp bends. Use forming methods that will not fracture or otherwise damage the metal. Remove burrs, sharp edges, and sharp corners. Smooth all joints and round all corners. Align joints in components to ensure smooth conveyance of baggage.
2. Holes in metal side guards for photocell beams are to be "punched", not burned, and tapered from the inside (wide) to the outside (narrow).
3. When two sections of conveyor bed meet, these joints shall be chamfered to ensure that there is no step-up condition between bed sections.

2.4 BELT CONVEYORS

A. Belting

1. General

a. All conveyor belting shall be flame retardant according to ISO 340, DIN 22103, ASTM D-378 and NFT-47108 or equal.

b. Belt widths shall be 3" less than the between frame (guard) dimension unless otherwise specified. Belt edges must be sealed after being cut to width.

c. Ensure that no belt slippage occurs in order to meet all tracking performance requirements specified herein.

d. The actual length of belting installed on each unit shall be included on the system's drawings and in the spare parts list.

e. All belting shall have a minimum acceptable working tension of 100 pounds per

inch of belt.

f. Ensure all ratings for proposed belting designated for exterior use exceed the local environmental weather conditions.

g. When sizing belts for proper length, material shall be allowed for take-up pulleys to be at a maximum of one-half the take-up distance with the belt running.

h. All rough top belting to be ground smooth within 1" of the cut end to allow proper seating of the belt lacing.

2. Conveyors

a. For level, general purpose baggage handling applications such as load, unload transport and inclines/declines of 7° or less use two ply urethane impregnate, solid woven fabric polyester or bare by bare (if not exposed to the public), top face of 0.02" PVC, smooth (public areas), maximum coefficientof friction of 0.3 with elongation of 1% maximum rated tension. For load conveyors provide belting that is flat lying, roll resistant and cut/wear resistant.

b. For incline and decline conveyors of greater than 7° use 0.08" PVC two ply urethane impregnate, solid woven fabric polyester or bare by bare, rough top, maximum coefficient of friction of 0.25 with elongation of 1% maximum rated tension.

c. For incline and decline conveyors or other locations where bag slippage may occur, the use of longitudinal rough top belt may be used. Habasit Trackmate, model 135 LR (or approved equivalent), shall be used.

3. Power Turns: Provide belts for power turns suitable for the application, as provided by the power turn manufacturer.

4. Spiral Turns: Provide belts for spiral turns suitable for the application, as provided by the spiral turn manufacturer.

B. Belt Splicing

1. Lacing

a. All belt lacing (except for power turns) shall be of the Clipper “Unibar” type with a minimum #2 hook-type of the size recommended by the belt manufacturer for the belt being used.

b. Belt lacing for power turns shall be of the Clipper type with either #1 or #1A hook-type of the size recommended by the belt manufacturer for the belt being used or as recommended by the power turn manufacturer.

c. Belting and related hardware must be trimmed in a 1" deep “V” notch fashion, lacing connecting pin must be enlarged by heating the lacing connecting pin nylon jacket, provided with a leader crimp or bent 90° to prevent lateral movement of the pin.

d. Belt lacing for applications in 30° and 45° merge conveyors shall be suitable for the application as provided by the merge manufacturer.

e. Belt lacing connecting pins for the Clipper type-lacing materials shall be of the nylon covered steel cable type of appropriate diameter for the lacing hooks being used.

C. Pulleys

1. General

   a. All shafts shall be designed to CEMA standard No. 402-1992 and all subsequent revisions. Shafts are to be AISI 1018 steel, polished and ground and within tolerances for the associated bearings.

   b. All pulleys shall be fabricated in one piece construction, with the shaft extending full length through the entire length of the pulley drum. Two piece shafts are unacceptable.

   c. All pulleys are to be dynamically balanced. Rollers of eccentric material, such as standard pipe, are to be dynamically balanced.

   d. Run-out:

      1.) The maximum shaft run-out of all assembled pulleys, shafts and bearings under a no-load condition, measured from the centerline of the bearing to the end of the related shaft furthermost from the conveyor, shall not exceed .0075" per inch.

      2.) The maximum run-out of any pulley shell shall not exceed .060".

   e. Machining:

      1.) Swaged:

         a.) Pulleys shall be 10-gauge (minimum) thickness with ⅜" (minimum) thick end plates.

         b.) End pulleys are to be swaged between centers to create a trapezoidal face with a taper from the pulley end to a minimum 25% of the pulley length thereby having 50% of the pulley flat in the center.

      2.) Machined:

         a.) If end pulleys are machined (not swaged) using Schedule 40 pipe, center plates must be made from ½" thick steel plate and shall have bored centers to facilitate a slip fit on the shaft.

         b.) Pulleys are to be turned between centers to create the crown or trapezoidal. Pulleys shall be crowned from each outer end to within ½" of the centerline leaving 1" straight but turned true to standard thickness required for each pulley application. When welding is involved, turn the assembly after welding to true the weldment and create the crown/trapezoidal.

         c.) The recommended minimum wall thickness after crowning or trapezoidal shall be as follows:

Pulley Diameter	Minimum Wall Thickness
8-5/8"	5/32"
12-3/4"	7/32"
16"	11/32"
18"	11/32"

   f. Hub plates shall be made from ⅜" (minimum) thick steel plate turned and bored to fit on the shaft or have a taper locking hub arrangement welded in the end plate.

   g. All pulleys shall be manufactured for high-speed application.

h. All bearings shall be supplied pre-lubricated and sealed for life with plugs inserted into the grease fitting bore. Bearings are to be secured to their respective shafts with an approved form (as specified in the submittal procedure) of eccentric or squeeze locking type collar arrangement. Bearings shall be provided with metal caps, which are mechanically fastened with fasteners which require the use of tools to be removed by trained personnel. Plastic safety caps may be used in lieu of metal bearing caps, provided they are mechanically fastened as described previously. If mechanically fastened plastic safety caps cannot be provided, then mechanically fastened metal safety caps shall be provided.

2. Powered Pulleys

a. Drive pulleys

1.) All drive pulleys for intermediate-type drives shall be lagged with vulcanized lagging of 70 Durometer rating with a minimum thickness of ⅜". Lagging material on individual pulleys shall be compatible with the type of belting used on the associated conveyor. Examples of lagging material are as follows:

a.) Minimum 70 durometer carboxiled nitrile

b.) Minimum 70 durometer thermo-set urethane

2.) Powered pulleys shall be steel, crown faced, flat faced, or trapezoidal (per the belting manufacturer's recommendation), shall be equipped with taper- lock type hubs with 1-7/16" minimum diameter shafts mounted in eccentric locking-type or squeeze locking type precision and ground flange-type ball-bearing units.

3.) The minimum acceptable belt wrap on drive pulleys shall be 210°.

4.) Drive pulleys for end-type drives must be lagged with a minimum ⅜" thick vulcanized lagging of 70 durometer, again using lagging material compatible with the type of belting used on the associated conveyor. In addition, powered pulleys shall be 6" with taper lock hubs with 1-7/16" minimum diameter 1018 TGP (turned, ground and polished) steel shafts mounted in eccentric locking type precision and ground flange ball bearing units.

5.) Drive pulley and shaft sizes shall be determined by maximum belt pull. The following are provided as examples:

a.) Light-Duty: 250 lb. maximum belt pull. Consists of a 6-3/4" minimum diameter drive pulley with a 1-7/16" minimum diameter shaft. Bearings mounted with two bolts can be used with light duty applications.

b.) Normal-Duty: 500 lb. maximum belt pull. Consists of an 8¾" minimum diameter drive pulley with a 1-11/16" minimum diameter shaft. Roller chain, if used, shall not be less than RC - 60. Bearings mounted with two bolts can be used with normal duty applications.

c.) Intermediate-Duty: 1000 lb. maximum belt pull. Consists of a 10¾" minimum diameter drive pulley with a 1-15/16" minimum diameter shaft. Roller chain, if used, shall not be less than RC - 60. Bearings mounted with four bolts are to be used with intermediate duty applications.

d.) Heavy-duty: 1,500 lb. maximum belt pull. Consists of a 12¾" minimum diameter drive pulley with a 2-7/16" minimum diameter shaft. Roller chain, if used, shall not be less than RC - 80. Bearings mounted with four bolts are

to be used with heavy-duty applications.

b. Motorized Pulleys (Ticket Counter Locations only)

1.) The reduction gears and motors associated with power driven pulleys shallbe mounted in an oil bath for lubrication and heat dissipation. The design of the pulley shall permit the lubrication oil level to be checked without dismounting or removing the drum motor from the conveyor frame. The lubricant shall be rated for 10,000 hours of life. Gears shall be hardened and ground steel alloy.

2.) In addition, drums shall be machine crowned and lagged to facilitate belt tracking. Lagging material on individual motorized pulleys shall be compatible with the type of belting used on the associated conveyor.

3.) Power: The power supply shall be connected directly to the starter without the use of slip rings and brushes. The terminal board housing (if used) must be capable of being rotated 180° to facilitate the direction of cable inlet.

3. Non-Powered Pulleys

a. Snub Pulleys

1.) Snub pulleys are to be installed on all conveyors at all points where the slack portion (non-load carrying portion) of the conveyor belt makes a change in vertical or horizontal direction. At a minimum, such points of vertical or horizontal change shall include:

a.) Points immediately adjacent to head, tail, take up and drive pulleys.

b.) Points on the underside of any conveyor where the belt bends vertically or horizontally (nose-over sections).

2.) All snub rolls shall be a minimum of 4" in diameter and equipped with fixed (welded) 1-7/16" minimum diameter shafts mounted in eccentric locking-type or squeeze lock type precision and ground flange-type ball-bearing units.

3.) Bearings are to be secured to their respective shafts with an approved form (as specified in the submittal procedure) of eccentric or squeeze locking type collar arrangement.

4.) All snub rollers used for belt tracking shall be equipped with jacking bolts to facilitate adjustment. Jacking bolts must be equipped with jam nuts to prevent the jacking bolts from loosening.

b. Take-Up Pulleys

1.) All take-up pulleys shall be steel, crown faced, flat faced, or trapezoidal (per the belting manufacturer's recommendation), and at a minimum 4" in diameter. Take-up pulleys are to be equipped with taper-lock type hubs or squeeze lock type and 1-7/16" minimum diameter shafts mounted in eccentric locking-type precision and ground flange-type ball-bearing units. Pulleys must be mounted on threaded take-up devices with steel guides and have a minimum allowable adjustment of 10" (6" on conveyors less than 12'-0" in length). Take-up mechanism for queue conveyors and short takeaway merges shall follow the BHS manufacturer’s specifications for their standard design.

2.) All conveyors shall be provided with take-ups for field adjustment of 2% of the conveyor bed length. Take-ups shall be an integral part of the drive frames on all intermediate-drive conveyors.

3.) Automatic take-up devices shall be installed:

a.) On all conveyor sections in excess of 60'-0" in length

b.) On conveyors which operate outside the building or are subject to extreme temperature and humidity changes. In areas where belts are subject to stretch/shrinkage that will cause weekly adjustment.

4.) Spring take-ups are not acceptable.

5.) Take-ups used in heavy-duty or high-speed applications shall be a minimum of 6" in diameter with a minimum 1-7/16" diameter shaft and shall otherwise comply with the above specifications.

6.) Bearings are to be secured to their respective shafts with an approved form (as specified in the submittal procedure) of eccentric or squeeze locking type collar arrangement.

7.) All take-up pulley bearing adjustors are to be chain coupled so that both bearings are tightened and slacked in equal increments. All belt lengths shall be adjusted so that the respective take-up pulley adjustments shall permit a further adjustment of 85% before the belt length needs to be shortened. The 15% maximum adjustment of the take-up pulley adjusters shall have been accomplished prior to Acceptance Inspection and Testing.

c. Head and Tail Pulleys

1.) All non-powered head and tail pulleys shall be steel, crown-faced or trapezoidal and equipped with taper-lock type hubs. Pulleys shall be equipped with shafts having a minimum diameter of 1-7/16" mounted with eccentric locking-type precision and ground flange type ball bearing units. All head and tail pulleys shall be a minimum of 6" in diameter x #10-gauge wall. In addition, all head and tail pulleys shall be of a single-piece construction having steel end discs attached to the rim by continuous welding.

2.) Slider beds shall be arranged to minimize the gap between the end section and the end pulley such that the gap does not exceed 1" with a ½" design objective.

3.) All head and tail pulleys used for belt tracking shall be equipped with jacking bolts to facilitate adjustment. Jacking bolts are to be equipped with jam nuts to prevent the jacking bolts from loosening.

4.) Bearings are to be secured to their respective shafts with an approved form (as specified in the submittal procedure) of eccentric or squeeze locking type collar arrangement.

5.) Finger Safety Guards:

a.) All end pulley rollers in staffed areas (manual encoding, load conveyors (public and non-public areas), sort pier conveyors, or run out conveyors) shall be narrower than the belt width by a distance not less than two times the difference between the belt width and the between-guides width of the conveyor (usually 6").

b.) A securely fastened steel finger guard matching the radius of the end roller shall take up the remaining width on each side of the roller. The BHS Subcontractor shall ensure that the outer surface of the finger guards are

smooth and that the junctions between the finger guards and the slider bed and that between the finger guards and the pulley do not subject the belting to any undue damage or wear. Attachment of the finger guards shall be such that the guards will move with the pulley when it is adjusted, therefore ensuring proper alignment.

c.) At the tail end of load belts, pulleys shall also be covered with a removable metal shroud located just above, but not in contact with, the conveyor-belting surface. Where exposed to public view, these pulley shrouds shall be constructed of stainless steel matching that used on their respective conveyors (type 304 stainless steel with #4 brushed satin finish, unless otherwise specified).

d.) The BHS Subcontractor shall submit to MDAD the proposed finger safety guard design for review and approval.

4. Return Rollers/Idlers

   a. Return rollers shall be constructed from 12-gauge steel and must be full-faced with a minimum 2½" diameter equipped with an 11/16" hex axle for belt speeds up to 150 fpm and a minimum of 3½" in diameter with an 11/16" hex axle for belt speeds above 150 fpm.

   b. In locations that require a noise level of 65 db (A) or less use return rollers/idlers with female threaded spindles attached to the conveyor frame and bolted connections. Do not use spring-loaded rollers.

   c. All hex shaft return idler rollers shall be equipped with sealed, permanently lubricated, caged, semi-precision type ball-bearings. Return idlers shall be located on centers not exceeding 10' 0", with spacing being reduced in areas where belting may drag against the floor or conveyor structure. The shafts shall be mounted to the conveyor bed with adjustable retainers for proper belt tracking.

   d. Provide two return rollers spaced on 5' 0" centers in each 10' 0" intermediate section from which lateral diversion of baggage takes place. Center the return rollers on the associated pusher or diverter.

   e. Return rollers must not be used at snub points.

   f. Provide a minimum of one return roller per 10' 0" section. The position of the return rollers shall assure that the return belt is routed and supported so that it does not contact any stiffening members. Mounting for the end of each return roller shall be adjustable for belt tracking.

   g. For application where conveyors are exposed to inclement weather, provide a minimum of one return roller every 5' 0" on center on load and transfer belts to help the conveyors start when wet or frozen to the bed. The position of the return rollers shall ensure that the return belt is routed and supported so that it does not contact any stiffening members. Mounting for the end of each return roller shall be adjustable for belt tracking.

   h. Provide return roller finger guards at all possible return roller mounting positions where accessible by personnel.

5. Tapered Rollers

   a. To facilitate changes of direction up to 15°, 5° tapered rollers having a large end diameter not less than 6" with shaft size not less than 1" shall be installed. The

number of required rollers is determined by dividing the angle of directional change by 5.

b. Tapered rollers are to be slave driven from the powered tail pulley of the adjacent downstream conveyor. The tail pulley used to drive the tapered roller must be lagged. Lagging material on individual pulleys shall be compatible with the type of belting used on the associated conveyor.

c. Tapered roller units are to be installed with conveyor underpans and guards as specified elsewhere.

d. To minimize the gap between a tapered roller and the adjoining conveyor, ensure the conveyor end roller is extended a minimum of 1/8" beyond the frame.

D. Drive Assemblies

1. Submit to MDAD for approval a schedule of all drive assemblies showing configuration of motor and reducer assembly. Minimize the number of conveyor drive configurations and ensure that the design does not restrict maintenance access in and around the conveyor drive maintenance access area. The selection of the drive assembly shall be based on efficiency, low noise, sized for the application, achieves long service life and has low maintenance. In all cases, design and install the equipment to maximize the maintenance access around the conveyor drive section.

2. End-type drive units may be used for conveyors 25' 0" or less in length, with intermediate drives used for conveyors over 25' 0" long.

3. The configuration of the drive assembly motors and reducers shall be based on a direct shaft mounted speed reducer and gear box design to simplify the installation, and maintenance of the equipment, noise levels, and spare parts considerations.

4. The use of a non-direct shaft mounted speed reducer and gearbox design shall only be permitted in select locations upon the review and approval of MDAD.

5. For non-reversing conveyors and non-reversing conveyors, the drive assembly shall be located as close to the midpoint of the conveyor as possible while maintaining required clearances below the conveyor drive assemblies (intermediate drive preferred).

6. For conveyors in areas with a maximum noise level of 65 db (A) or less use either shaft mounted drives or underslung drives with toothed belts (no chain drives) to minimize noise levels

7. Motors:

a. The conveyors shall be driven by AC induction motors (except where motorized pulleys are used). The motors shall conform to AIEE, NEC and NEMA standards. These motors shall be equipped with two-groove minimum, taper-lock type hubs, and “A” or 3VX -belt sheaves.

b. Motors shall be sized for maximum load and belt speed requirements under continuous operation (minimum of 1 HP unless approved by MDAD) and, where applicable, shall be capable of withstanding shock caused by frequent starting and stopping under full load conditions. Motor FLA will be measured with full load during load tests and any motor that draws more than the name plate FLA (after start up in rush current has flattened) must be replaced with a motor of appropriate size that will result in no more than the max name plate FLA during load test.

c. Motors shall also be of the constant speed (nominally 1800 RPM), continuous

service, and ball-bearing type with a minimum of class "F" insulation. For 2 HP motors and smaller class “B” insulation shall apply.

d. If overrun is critical to system control operation (i.e., wherever baggage tracking is required), motors shall be equipped with automatically applied brakes to prevent overrun after the motors are de-energized.

e. With the exception of “High-Slip” design motors, for applications that require dual drives, and motors that are controlled by “VFDs”, all of the BHS motors shall be copper-wound NEMA Design "B" open drip proof or TEFC with Class F insulation, utilize a "T-frame" base, and shall be provided with overload protection in the motor control panel. These motors shall have a minimum of 1.15-service factor. High-Slip Motors are required by specification where the use of dual drives is used. These motors shall be copper-wound NEMA Design "D", Class "H" Insulation at 1.0 Service Factor with Class "F" temperature limits. Inverter Duty or Inverter Ready Motors shall be used at "VFD" controlled applications. These motors shall be copper-wound NEMA MG1, Part 31 Rated Design "B", Class "H" Insulation at

f. 1.0 Standard Service Factor with Class "F" temperature limits. All motors shall be of the "high efficiency - low energy" type. All motors shall meet the following criteria:

1.) Low noise

2.) Fitted with low noise fan reduction guard or equivalent.

g. Motor size selection shall be based on the design load and friction coefficient requirements as described in these specifications. Use minimum 1 HP motors (unless other specified and approved by MDAD). All drive motors shall be provided in 1, 1½, 2, 3, 5 or 7½ horsepower. Although 7½ HP is indicated as the maximum size allowed for use on the project, motor size shall not exceed 5 HP, unless otherwise reviewed and approved by MDAD. Size conveyor equipment drive motors to permit start-up under full load conditions at the specified frequency of start-up cycles per minute without exceeding a temperature rise of 68°C based on an ambient temperature of 40°C. Provide motors designed for 480 VAC, three phase, 60-Hertz operation.

h. C-faced motors or motorized pulleys (with VFD control) can be utilized. Such usage shall be coordinated with MDAD.

i. Motor mounts shall be equivalent in function to Dodge Type "A" slide motor bases with boltholes drilled and tapped, or tack-welded nuts under the holes in the top portion of the mounting plate. Use of loose nuts to hold the motor mount is unacceptable. Provide jacking bolts to resist effect of belt or chain pull on foot mounted motors.

j. On all belts with frequent start/stop operations, such as indexing belts, all motors shall be continuous-running NEMA-B design, coupled with VFD control arrangement as necessary.

8. Reducers

a. Shaft-mounted reducers shall be attached with tapered type bushings or full length bore with keyway.

b. Reducers shall be sized for a Class II application (minimum). Based on actual motor horsepower, the service factor required to obtain an L10 life of 70,000 hours shall be as follows:

1.) For reducers utilizing ball bearings the service factor used shall be 2.4 2.) For reducers utilizing roller bearings the service factor used shall be 2.2.

c. Reducers shall have adequate provisions for drain, fill, inspection ports and sight gauge. The manufacturer's recommended lubrication shall be attached to the reducer by means of a riveted, or bolted stamped metal tag. All units shall be installed with proper lubrication and vent plugs intact upon start-up of conveyor.

d. Reducers used on inclines where roll-back would be critical shall be equipped with “backstop" devices or brake motors.

e. All bearings within the reducer shall have a minimum L-10 life of 70,000 hours based on service factor and loading of conveyors, and on the manufacturer's published data showing load rating of each bearing used.

9. General Drive Requirements

a. Where applicable, all gear reducer-mounting frames shall be fabricated from

b. ¼" thick steel "C" channels. The mounting frame shall be so designed to allow bolting to both the bottom and sides of the conveyor bed. The mounting frame shall be a totally separate weldment that can be unbolted to allow for installation as either a right or left hand drive. The mounting frame shall span the full width of the conveyor bed and attach to both sides of the bed frame.

c. Electro-mechanical brakes, if required, shall be internally mounted. The stopping torque shall be at least equal to the starting torque of the motor.

d. The drive unit shall be provided with a factory warranty for 2 years or 15,000 operating hours, whichever is longer.

10. Mounting

a. C-Faced

1.) In-line foot mounted reducer is an acceptable mounting method.

2.) The C-faced configuration with VFD control used on conveyors capable of continuous stop/start operation (i.e. queues or indexing conveyors) shall be capable of a minimum of 60 continuous start/stop operations per minute in an unloaded condition.

b. Foot Mounted or Base-Plate Reducer and Motor Mount

1.) The gear reducer shall be mounted on a fully adjustable mount. To allow for fast, easy motor and gear reducer replacement and adjustment, the mount shall be designed as follows:

a.) The mount shall be a two-piece assembly:

(1.) The bottom portion can be bolted or welded to the mounting frame (as specified above).

(2.) The top portion shall be designed to slide over the bottom portion and be adjustable via a single bolt adjustment. The top of the motor mount shall have boltholes drilled and tapped to accept the layout pattern as the gear reducer mounting feet or the multi-mount feet.

b.) Use of tack-welded nuts under the holes in the top portion of the mounting

plate shall be acceptable in lieu of tapped holes; however, the use of nuts to hold the motor in place shall not be acceptable.

c.) The purpose of this design is to allow replacing the motor by using an extension and properly sized socket from above without having to hold locking nuts.

d.) Use of Dodge Type "A" Slide Motor Bases is recommended, or an approved equal, for this application.

e.) All drive units shall be equipped with a suitable guard of "clamshell" design with tamper-proof fasteners, and fabricated from a minimum of 16-gauge steel. All guards shall comply with applicable OSHA standards and have an expanded metal-screened window to allow belt inspection without removal of the guard.

11. All drive motors and reducers shall be equipped with drip pans. The drip pan shall be constructed out of minimum 14-gauge steel. The drip pan shall be appropriately mounted such that the pan must be secured in the horizontal attitude and shall not impact maintenance access.

12. Whenever possible, all drive sprockets and V-belt sheaves shall have a taper-lock type of hub construction, with keyways. When keyways are used, they shall be secured by two sets of screws, one on top of the other to ensure positive locking of keyway. Sprockets shall be steel with a minimum of thirteen Type B form teeth.

13. Driving and driven sheaves shall be (minimum) two-groove "A" or 3VX section sheaves with taper-lock type hubs.

14. Roller chain shall be compatible with the torque and horsepower requirements of the application and shall be RC-60 minimum size. The roller chain ends shall be connected with a removable connecting link.

15. All pulley and sprocket adjustments provided for the purpose of adjusting belt tension, belt tracking, drive chain tension, and drive chain alignment shall incorporate a positive means of adjustment and restraint (i.e., tensioning screws and locking nuts). Slotted holes for mounting bolts shall not in themselves be considered satisfactory.

16. Chain drive sprockets shall be designed for a sprocket ratio between the driven and drive sprockets as close as possible to 2:1, but not less than 1.5:1 or greater than 2.25:1. The maximum size for driven and drive sprockets shall be 35 and 18 tooth respectively. Wherever possible within the standard range of stock Taper lock-type sprockets, hardened tooth sprockets shall be provided.

E. Flexible Couplings

1. Mount coupling hubs to their respective shafts with keys and two setscrews, one of which shall be over the key and the other 90□ from the key. When keyways are used, they shall be secured by two sets of screws, one on top of the other to ensure positive locking of keyway. The use of a screw-locking compound in lieu of two (2) setscrews is acceptable.

2. Select the coupling so as to permit the replacement of internal parts without removal of the motor or reducer.

F. Intermediate Sections

1. Provide conveyor frames capable of supporting a uniform load as specified with supports at a maximum center distance of 10' 0".

2. Construct the slider bed shell of 12-gauge minimum hot rolled steel and designed to present a smooth surface to the belt. The slider bed shall be braced for rigid construction with the side frames a minimum of 6" x 1½" channel or equivalent. A

3. When two – (2) sections of slide bed meet, both sections shall have chamfered slider bed lips to ensure that there are no step-up conditions between slider beds

G. Floor Supports

1. Provide floor supports for conveyors located within 7' 6" of the floor or any mezzanine that is shown on Contract Drawings. Each conveyor segment shall be independently supported. Locate floor supports within 3" of conveyor end pulley assembly or within 12" from intermediate section joints. Where multiple queue conveyors are required to be installed butted together, provide them on a common (single) support frame assembly to maximize operational and maintenance access and simplify the overall installation with minimum overhead and/or floor supports (as applicable), while ensuring that each conveyor segment is still independently supported, as specified elsewhere in this specification.

2. Supports shall be on 5' 0" centers on loading/unloading conveyors and on 10' 0" maximum centers elsewhere. In all cases, each bed joint shall be supported.

3. All floor supports shall be of an "H" type design (i.e. two legs with a horizontal brace member) with vertical field adjustability of +/- 3". Floor support vertical members shall be constructed of 10-gauge, hot rolled formed steel channel with 10-gauge, hot rolled steel universal foot and head plates.

4. All conveyor floor supports shall be secured to the floor with a minimum of two (2) anchoring devices per leg (e.g., stud expansion anchor bolts).

5. All conveyors shall be adequately sway braced in order to ensure that there is no lateral or longitudinal displacement.

6. All support structure must be designed and installed so that maintenance access to the conveyor components and access to catwalks, work areas and drive aisles are not blocked.

7. The location of the floor support shall not impede the installation/removal of the conveyor gap pan.

H. Overhead Supports

1. Provide overhead supports for conveyors located 7' 6" or more above the floor or any mezzanine that is shown on the Contract Drawings. Locate overhead supports within 3" of conveyor end pulley assembly or within 12" from intermediate section joints.

2. All supports shall not exceed 10' 0" maximum on-center spacing. In all cases, each bed joint shall be supported.

3. Ceiling hangers of threaded rod shall have a minimum diameter of ¾" with structural angle, channel, unistrut or pipe sills. The hangers shall have provisions for anchoring to the building structure and header steel. A Structural Professional Engineer must approve all hanger supports.

4. Threaded rods shall have a lock washer, a single flat washer, and a single nut above and below any header steel channel assembly. A 4" x 4" x ¼" minimum steel support plate shall be used on the load bearing side of the header between the channels and flat washer.

5. All conveyors shall be sway braced in order to ensure that there is no lateral or

longitudinal displacement, providing a rigid and rugged installation. Spacing must not exceed 20' 0".

6. Installation and layout of header steel and all support structure shall not pose interference to maintenance and operation access.
7. Repair/replace both new and existing fireproofing materials removed to allow the installation of BHS equipment header steel and support structures.
8. Equip all hangers with vibration isolators to ensure that there is no noticeable vibration transmitted to the building.
9. Where catwalks are specified, the conveyor and adjacent catwalks shall be supported by a double sill configuration wherever possible without inhibiting maintenance and operational access. A single sill application is permissible at specific locations as approved by MDAD.
10. To achieve maximum drive aisle clearance (minimum 7' 6" from finished floor to bottom of conveyor or overhead support structure unless otherwise noted) under the conveyor the BHS Subcontractor is permitted to utilize a side clip attachment configuration or other low profile attachment means for the conveyor hanger to support the bed section instead of a sill type application.

I. Safety Guards

1. Provide and install conveyor underpans on conveyors with clear heights between 18" and 7' 6" above the floor or within an envelope around a catwalk defined as 7' 6" high and 4' 0" wide on either side of such catwalk. Fabricate underpans of either solid sheet metal or expanded metal at least 14-gauge thick and fasten to the conveyor intermediate section. The underpans, regardless of type shall be piano-hinged and provided with mechanical fasteners which require the use of tools to be removed by trained personnel. These fasteners shall provide easy maintenance access, with tools; also, the pin shall have a lanyard attached to reduce potential of losing the pin. Sheet metal screws will not be accepted.
2. Protect all exposed moving parts of conveyors, such as, but not limited to, pulleys, rollers, lower or return belts, shafts and couplings less than 7' 6" above the floor or within an envelope around a catwalk defined as 7' 6" high and 4' 0" wide on either side of such catwalk. The guards shall be made of sheet metal not less than 14- gauge thick, and secured with which are mechanical fasteners which require the use of tools to be removed for easy maintenance access. Sheet metal screws will not be accepted.
3. Install appropriate safety guarding secured with tamper-proof fasteners on all exposed parts associated with the conveyor drive's rotating shaft and direct drive gearbox, in compliance with OSHA Standards 1910.219. Ensure that the proposed safety guarding does not restrict maintenance access and it is easily removable with appropriate tools, as the location requires, for maintenance access.
4. Enclose all drive chains and belts using sheet metal protection covers at least 16-gauge thick. Hinge the covers at one end for ease of maintenance and size the s with clearance to prevent contact to chains and belts. Fasten with fasteners ring the use of tools for removal by trained personnel with captured nuts or similar means of avoiding losing parts.
5. Eliminate or round unguarded exposed sharp corners and edges of items such as, but not limited to, support legs, braces and trim, to prevent injury to personnel or damage to their clothing. Locate no overhead steel framework, conveyor part, or support structure less

than 8' 0" above any catwalk, ramp or stair tread nose. If due to building constraints, support structure is less than 8' 0", the structure, framework, and supports shall be encased in padding, identified with safety marking (yellow/black stripped tape) and a prominently positioned low overhead warning sign.

6. Install mechanically fastened bearing caps with fasteners which require the use of tools to be removed by trained personnel on exposed rotating shafts in workstation areas and in all maintenance areas with catwalks. Workstation areas shall include, at a minimum, manual encode station, sort devices/conveyors, and load conveyors. Install appropriate safety guarding on all exposed parts associated with the conveyor drive's rotating shaft and direct drive gearbox, in compliance with OSHA Standards 1910.219. Ensure that the proposed safety guarding does not restrict maintenance access and it is easily removable with appropriate tools, as the location requires, for maintenance access.
7. Install mechanically fastened finger guards with fasteners which require the use of tools to be removed by trained personnel on all Return/Idler Rollers on conveyors not equipped with underpans.
8. For conveyors in areas with a maximum noise level of 65 db (A) or less, mount all guards with rubber isolation washers or strips (as applicable) between sideguards and the conveyor frame to minimize noise levels.
9. Gap pans must be provided and installed on all conveyor-to-conveyr junction points or transfer locations, where there is any likelihood of small objects falling to the floor, mezzanine or catwalk. Gap pans must be solid sheet metal not less than 12-gauge, unless otherwise approved by MDAD, with minimum 2" high sides on the edges. The gap pan must be no wider than the conveyor width and 8-12" long. Mounting must be such as to permit easy lowering and removal for cleaning.
10. Drive pans shall be provided and installed on all conveyor drive sections. Drive pans must be solid sheet metal. They shall be no wider than the conveyor and associated platform width, and no longer than the drive section.
11. All gearbox assemblies shall be equipped with drip pans. The drip pans shall be fitted with drain plugs to assist with clean up. Drip pans shall be solid sheet metal, not less than 12-gauge, unless otherwise approved by MDAD, with minimum ¾" high sides on all four edges. The drip pan shall be a bolt-mounted unit of the gearbox assembly.
12. Provide safety guards and signage adjacent to the pinch points associated to High Speed Paddle Diverters.
13. Breakaway End Cap Safety Guard
    a. Provide a safe and reliable breakaway end cap safety guard on all run out conveyors that will immediately stop the conveyor and prevent injury to personnel and damage to baggage in the event that a person or part thereof or a bag gets lodged between the conveyor belt and the end cap.
    b. The design of the end cap safety guard shall not cause undue nuisance alarms during ordinary operation. Activation of the end cap interlock must annunciate an alarm on the MDS display.
    c. When resetting the end cap interlock device, the operator must go through the normal subsystem startup procedure following all safety starting procedures.
    d. Construct the end cap for public areas of stainless steel to match ticket counter stainless steel finish; in all non-public areas, paint the end cap safety yellow to

comply with all safety requirements.

14. Refer to “Head and Tail Pulleys” section of this specification for details on end pulley finger safety guards.

J. Side Guards

1. Provide side guards the full length of both sides of all conveyors except at points that baggage is loaded or removed.
2. Provide hinged or removable sections only where overhead clearance restricts access for clearing jams. Design hinged or removable side guards to permit rapid removal (removable without tools). The design must preserve rigidity and alignment equivalent to fixed side guards. MDAD must approve all locations where hinged or removable sections are to be used.
3. Side guards shall be minimum 12-gauge hot rolled steel, integral to the slider bed. Side guards shall incorporate a formed 90° edge turned away from the conveyor and a formed 90□ edge turned down to eliminate sharp edges. There shall be no gap between the side guard and bed section that can cause jams or baggage tags to be snagged/ripped off.
4. Use type 304 stainless steel with #4 brushed satin finish uniform throughout passenger areas (such as but not limited to for any reworked check-in, or curbside) and through penetrations into non-public areas. Stainless steel in public areas shall incorporate smooth flush edge seams. Radius type edges are not acceptable.
5. All stainless steel back guards in any reworked public areas such as ticket counter and curbside load belts shall incorporate stiffening supports that are attached to the conveyor frame by means of a welded or bolted connection. The stiffening supports shall be attached to the stainless back guarding by means of a keyhole slot in the support and a welded stud on the back guarding.
6. Use cold rolled or hot rolled low carbon steel galvanized or hot dip, primed and painted on both surfaces in areas exposed to the weather.
7. Use cold rolled or hot rolled low carbon steel primed and painted on both surfaces in all interior areas.
8. Provide side guards with vertical stiffeners a maximum of 40" on center for transport conveyors and 30" on center for load conveyors. Make the stiffeners from steel angle at least 1¼" by 1¼" by 3/16".
9. Provide 30° transition panels between side and back guards of different heights.
10. Conveyor Side Guard Heights:
    a. Unless otherwise specified on drawings, construct conveyor side guards for this project to the following heights:

Conveyor Type	Side Guard Height
Check-in Take-away Back Guards	21”
Transport Conveyors	12"
Incline/Decline conveyor Side Guards	12"
Decline-fed Power Turns (flat or spiral)	21"
Power Turns (flat) Fed by Straight Conveyors	12"
Power Turns (spiral) Fed by Straight Conveyors	12"

11. Provide holes 1½" in diameter located either 2½" or 3" (must be consistent, e.g. all 2.5” or all 3”) from the top of the belt to the center of the hole through side guides for photocell beams as required. Punch the holes with a dimple away from baggage flow to minimize the possibility of snagging a bag and causing a jam. Deburr all photocell holes so that they are free of sharp edges and burrs.
12. Mounting of any mechanical or electrical equipment on the outside radius side guard of power turns is not accepted since it restricts maintenance access to the outer perimeter chain or guide bearings of the turn belt.

K. Break-Overs

1. Provide break-overs wherever conveyors follow a convex curve.Vertical or horizontal to vertical bends shall be constructed in the same manner as slider bed conveyor sections. The bed shall have a 10' 0" radius break-over slider bed to effect a smooth change in belt direction.
2. For return belt idling, vertical horizontal to vertical bends shall be equipped with a snubber pulley to ensure that the return belt does not extend below the conveyor frame.

L. Bearings

1. All bearings shall be pre-lubricated, self-aligning, anti-friction and sealed for the specified life of the bearing. Lubrication fittings shall be removed (removal to be approved by MDAD) at the time of installation or at the factory and replaced with appropriate plugs.
2. All bearings shall have a minimum L-10 life of 70,000 hours based on service factor and loading of conveyors, and on the manufacturer's published data showing load rating of each bearing used.
3. All bearings shall be surface-mounted flange bearings attached to the outside of the conveyor bed.
4. Bearings are to be equipped with an eccentric or squeeze locking type collar arrangement to secure the bearing to the related shaft.

M. Hardware

1. Provide zinc plated or otherwise treated fasteners. Use washers, lock washers and nuts.
2. All fasteners in public areas are to be made of stainless steel and are described elsewhere in these specifications.

N. Straight Belt Conveyor

1. Construct transport, queue, load, unload, incline and decline conveyors of components as specified previously.
2. Design each baggage handling belt conveyor with a length to width ratio less than with special tracking provisions to ensure positive belt tracking.
3. The maximum length of a straight belt conveyor shall be 60' 0" unless otherwise shown in the contract drawings.
4. In the case where the conveyor line configuration, related controls and baggage input/processing are directly associated with the EDS or is in a tracking zone, the conveyor shall be equipped with a VFD.

O. Power Turns

1. All power turns shall be provided with a four - (4) foot inside radius for standard conveyors and five - (5) foot inside radius for oversize conveyors, unless noted on the contract drawings. All power turn support structures are to be of metal construction. Where multiple power turn segments are required to be installed butted together, provide them on a common (single) support frame assembly to simplify the overall installation and modify the mating ends of each power turn, as necessary and per the supplier's recommendations, so that the complete assembly between each segment closely fits together to minimize the transfer gaps at the junction points, which shall not exceed 1" (max.) between the belt face(s). Power turn shafts shall be 1-7/16" diameter 1018 TGP (turned, ground and polished) steel.
2. The conveyor system layout shall be designed to permit maximum radius power turns of 180° for flat power turns.
3. Ensure that the outside circumference side guard shall remain readily removable for maintenance. Ensure that no conduit is fastened to it.
4. If an "S" power turn configuration is incorporated in the project design, provide a "gap brush" between the power turns to fill the gap; alternatively trim the mating frame ends on each power turn, as necessary and per the supplier's recommendations, to lessen the transfer gap at the junction point.
5. To minimize the gap between a power turn and straight conveyor, ensure the end rollers (both power turn and straight conveyor) are extended to gain a maximum gap of 1" between the faces of the belts.
6. Belt speed shall be measured on belt centerline.
7. Drive assemblies, bearings, and pulleys shall be designed as per straight conveyors detailed within this section of the specification.
8. If a power turn is installed prior to a 45° merge conveyor, the turn shall be equipped with a VFD so that baggage queuing can be achieved on the turn.
9. In the case where the conveyor line configuration, related controls and baggage input/processing are directly associated with the EDS or is in a tracking zone, the turn shall be equipped with a VFD.

P. Spiral Turns

1. All spiral turns shall be provided with a four - (4) foot inside radius for standard conveyors and five - (5) foot inside radius for oversize conveyors, unless noted on the contract drawings. All spiral turn support structures are to be of metal construction. Where multiple spiral turn segments are required to be installed butted together, provide them on a common (single) support frame assembly to simplify the overall installation and modify the mating ends of each spiral turn, as necessary and per the supplier's recommendations, so that the complete assembly between each segment closely fits together to minimize the transfer gaps at the junction points, which shall not exceed 1" (max.) between the belt face(s). Spiral turn shafts shall be 1-7/16" diameter 1018 TGP (turned, ground and polished) steel.
2. The conveyor system layout shall be designed to permit maximum radius spiral turns of 225° where the rate of incline or decline is less than or equal to 24" in 90°.
3. Match side guard height with adjacent conveyors where rate of rise or fall is less than 12" per 90°. Provide 21" high side guards for other spiral turns with a greater degree of rise or

fall.

4. Ensure that the outside circumference side guard shall remain readily removable for maintenance. Ensure that no conduit is fastened to it.
5. To minimize the gap between the spiral power turn and an adjoining straight conveyor, ensure the end rollers (both spiral power turn and straight conveyor) are extended to gain a maximum gap of 1" between the faces of the belts.
6. Limit rise or fall to a maximum rate of 24" in 90° except as noted otherwise in the contract drawings.
7. Belt speed shall be measured on belt centerline.
8. If an "S" spiral power turn configuration is incorporated in the project design, provide a "gap brush" between the power turns to fill the gap; alternatively trim the mating frame ends on each power turn, as necessary and per the supplier's recommendations, to lessen the transfer gap at the junction point.
9. Drive assemblies, bearings, and pulleys shall be designed as per straight conveyors detailed within this section of the specification.
10. In the case where the conveyor line configuration, related controls and baggage input/processing are directly associated with the EDS or is in a tracking zone, the turn shall be equipped with a VFD.

Q. Queue Conveyors

1. Provide queue conveyors of the manufacturers approved design capable of sustaining continuous stop/start operation at thirty - (30) cycles per minute under loaded conditions, without compromising a 60 bag per minute minimum processing rate for the associated subsystem in which the queue conveyor is installed. Where multiple queue conveyors are required to be installed butted together, provide them on a common (single) support frame assembly to maximize operational and maintenance access and simplify the overall installation with minimum overhead and/or floor supports (as applicable), while ensuring that each conveyor segment is still independently supported, as specified elsewhere in this specification.
2. Design the queue conveyors so that trained maintenance personnel can easily accomplish belt tracking.
3. Design of the queue conveyor shall be so that adjustments to belt tracking should only be required at a maximum of once every thirty- (30) days.
4. Design, manufacture and installation of queue conveyors shall be in accordance with the design specifications of transport conveyors.
5. In the case where the conveyor line configuration, related controls and baggage input/processing are directly associated with the EDS or is in a tracking zone, the conveyor shall be equipped with a VFD.

R. Ticketing Scale Dispatch Unit

1. Provide Atrax Scale model XXX or approved equal. Equal model must be approved by JSM and MDAD team prior to Bid. GC shall submit equal model cut sheets with all technical information for comparison 14 days prior Bid date for review and approval.
2. The Scale-Dispatch Conveyor Unit is a two-stage induction system. The customer places a bag on the scale conveyor where it is weighed, and the bag weight is displayed to both

the ticket agent and the passenger via a display screen. The ticket agent then advances the bag to the tail end of the dispatch conveyor where it stops and holds position. At this point the agent assigns an identity to the bag and affixes a bar code label to the bag for later identification in the system. The agent then releases the bag and it advances to the discharge end of the conveyor where it transfers to the collection conveyor if there is an open window. If there is not an open window on the collection conveyor, the bag stops at the head end photo eye on the discharge conveyor and waits for a signal from the PLC indicating an open window on the collection conveyor.

3. A motorized pulley unit shall independently drive the scale conveyor and the dispatch conveyor. Each is wired to a junction box on the conveyor and connected via a plug-in receptacle located on the collection conveyor. The scale conveyor is mounted on load cells at each wheel, making the scale an integral part of the scale conveyor assembly. The scale conveyor and the dispatch conveyor roll in a track anchored to the floor for easy alignment and positioning.
4. The conveyor side frame assembly is constructed of 10 gage laser cut and bent sheet steel members with welded angle cross ties, slider bed and stiffeners. The slider bed surface is made from 12-gage sheet steel. The conveyor frame assembly rests on a support frame constructed of 2" square structural tube members welded together into a rigid frame.
5. The conveyors use a monofilament carcass belt with a waffle top cover for increased traction and improved bag knock down performance. Mechanical belt splice can be provided.
6. The conveyors use a 4.50" diameter, 0.30 horsepower motorized drive pulley for non-braked applications and 5.45" diameter, 0.33 horsepower motorized pulley for applications with a brake. Horsepower varies for the required speed and conveyor length and will be verified for each application.
7. The tail pulleys are a 3.50" diameter dead shaft pulley on a 1.25" diameter shaft with machined flats. Both the tail and the motorized drive pulley incorporate a belt screw take-up mechanism. Both the tail pulley and the motorized drive pulley incorporate sealed bearings for minimum maintenance.
8. Both conveyors are clad on all exterior surfaces with 12 gauge 304 stainless steel, #4 brush finish to match typical ticket counter area decor.
9. The knockdown cone is machined from UHMW bar stock and rotates on bearings on an 11/16" hex shaft that locks into the conveyor frame beneath the stainless. The shaft retainers are laser cut steel that is welded to the conveyor support leg assembly.
10. Control station and stanchion shall be similar to those aready installed at other ticket counter scale dispatch locations.

S. Knockdown Cone

1. The knockdown cone shall be machined from UHMW bar stock and rotate on bearings on 11/16" hex shaft that locks into the conveyor frame beneath the stainless. The shaft retainers are to be lazer cut steel that is welded to the conveyor support leg.

2.5 MISCELLANEOUS MECHANICAL EQUIPMENT

A. Catwalks

1. Provide as a minimum, the maintenance catwalks required to ensure safe access for all

personnel who operate, maintain or have access to the BHS in compliance with the applicable requirements of OSHA and NFPA 101 Life Safety. All catwalks used as a means of egress shall meet life safety requirements for guardrails and handrails. The BHS Subcontractor shall be responsible to coordinate with MDAD to confirm the final number and locations for all maintenance catwalk right-of-ways, along with the associated ladders, stairs, and crossovers.

2. Include personnel protection at all catwalks to ensure that any potential injury is minimized. This includes swing gates or off-sets at access locations per OSHA standards 1910.23, padding, rounded corners, smooth welds, deburred surfaces and any other measures as may be necessary.
3. For catwalk decking, provide open steel grating (Ry-Weld 19W4 or approved equal). In select locations subject to the review and approval by MDAD, the BHS Subcontractor can request to use sheet steel using stitch welds every 24". The BHS Subcontractor shall coordinate the type of catwalk deck (solid or open grate) with MDAD to ensure fire code/protection measures and lighting considerations are complied with.
4. Attach all catwalks to the support structure, whether using decking of either sheet steel or open steel grating.
5. Design catwalks to provide adequate space for operating and maintenance personnel.
6. Design structure to limit the deflection to 1/360 of the unsupported span length, under a concentrated 300-pound load.
7. Design all catwalks capable of supporting a minimum uniformly distributed live load of 40 pounds per square foot and a dead load of 25 pounds per square foot (total load of 65 pounds per square foot). The use of pan type catwalks constructed of #12-gauge hot rolled steel is acceptable.
8. Notch the decking where needed to clear obstructions. Add angle clips as required to maintain adequate support of notched structure.
9. Where lengths of decking are butted end to end, ensure that the joint falls on a structural cross member.
10. Securely weld all pieces of decking to the catwalk frame and all structural cross members.
11. Any catwalks with inclines of up to 8° will be equipped with an anti-skid walking surface. Catwalks with inclines of more than 8° will be equipped with steps as well as the anti-skid material.
12. Provide steps at all locations where there is an elevation change in excess of 8". Paint the step "yellow".
13. Minimum catwalk width shall be nominally 36" with a 3" gap between the conveyor and the catwalk.
14. Unless otherwise noted on the drawings, the top of catwalk shall be installed 8" below the top of belt at the intermediate section of the conveyor (between drive sections) and 15" below the top of belt at the drive sections.
15. Design and installation of access into the conveyor catwalk areas shall be based on a minimum 36" wide by 6'-8" high clear access, but not be less than a 36" wide by 48" high, clear access envelope, to allow maintenance staff and fire fighters with breathing apparatus enough room to climb up to and access the catwalk area. The 6'-8" clear

height requirement shall be maintained where Crossovers within the facility and adjacent MEP limits.

B. Crossovers

1. Provide the below outlined functionality at all crossover access stairs, ladders, platform, handrails, swing gates and similar such hardware to provide a complete, safe and operable crossover.
2. Provide a request access pushbutton control station located at each access point to the crossover that includes the following control devices:
    a. Request Access Illuminated Green Pushbutton.
    b. Release Access Illuminated Red Pushbutton.
3. For Crossovers with ships stairs or standard stairs, provide the bi-directional swing gate with interlocks to the e-stop circuit. Hinge the swing gate so as not to block egress when opened in either direction.
4. For Crossovers with vertical ladders, provide an adequately protected light curtain at the top of the vertical ladder mounted such that any person trying to cross the conveyor line will interrupt the light curtain.
5. The associated crossover PLC shall inhibit the normal startup procedure while the equipment is in "Crossover mode".
6. Provide a dual stack light mounted on a stanchion at each crossover location. Sequence of operations as follows:
    a. Normal Sequence of operations shall be as follows:
        1.) In normal mode, when not in active crossover mode, the red stack light and the release access illuminated red pushbuttons shall be illuminated.
    b. An operator will request access by pushing the request access pushbutton which will cause the following to occur:
        1.) Request access green pushbutton shall flash at 2Hz until safe to access.
        2.) The conveyor immediately upstream of the conveyor under the crossover shall stop. All other upstream conveyors will cascade stop if the associated conveyor photocell is blocked.
        3.) The conveyor under the crossover shall run for its length and then stop.
        4.) The conveyor immediately downstream of the crossover shall stop once the conveyor under the crossover stops.
        5.) The request access green pushbutton shall light solid and the green light in the light stack shall illuminate solid.
        6.) The operator opens the gate, crosses the crossover, opens and closes the gate on the opposite side of the crossover.
        7.) The operator presses the release access pushbutton causing the release access pushbutton and the red light in the light stack to flash at 2 Hz for 10 seconds (configurable).
        8.) After 10 seconds, the red release access pushbuttons and the red light in the light stack changes to solid illuminated.

9.) The conveyors start up again after 5 second start-up warning alarm (duration to be configurable).

7. In the event one of the gates is open (or a light curtain is blocked in the case of a vertical ladder cross-over) when the release access button is pressed, the operation shall be ignored by the control system (and an audible alarm sounds). The release access pushbutton can only activate the release access sequence if all gates are closed.
8. In the event the release access pushbutton is not activated within 2 minutes (configurable) after initial activation of the request access sequence, an alarm message shall be displayed to the MDS/MIS and the red illuminated stack light (and an audible alarm sounds) and release access pushbuttons shall flash at 3 Hz. In order to reset this condition, the release access pushbutton must be activated at the crossover.
9. The swing gates (or light curtain in the case of a vertical ladder crossover) shall not activate an e-stop circuit if the normal sequence of operations are followed as per above.
10. In the event the normal sequence of operation is not followed and a swing gate is opened or a light curtain is activated, an emergency stop shall be activated, the conveyors in the zone under the crossover shall be stopped and can only be reset from the e-stop reset pushbutton at the location of the crossover.
11. The current mode and all sensors and lights in the crossover shall be indicated on the associated BHS MDS. As a minimum, the following modes shall be indicated:
    a. Normal Mode – Green.
    b. Crossover Mode – White.
    c. Release Access Fault Mode – Flashing Red.
    d. Fault – Red.
12. The MIS shall report how many times a day the crossover was operated and the total time the conveyor was stopped due to the crossover operations.

C. Toeboards

1. Provide toeboards on both sides of all catwalks and ramps 24" or more above the finished floor except where adjacent equipment or building structure provides the required function. Construct toeboards of ¼" x 4" minimum steel flat stock and install so as to leave no gap between the catwalk walking surface and the lower edge of the toeboard. It is acceptable to use #12-gauge rolled steel 4" high toeboard. Securely weld toeboards to vertical handrail posts and to the access way support structure.
2. Design toeboards in accordance with OSHA standards.
3. Toeboards shall be painted "yellow".

D. Stairs

1. Provide as a minimum the stairs required to ensure safe access for all personnel who operate, maintain or have access to the BHS. Coordinate with MDAD to confirm the final number and locations for all stairs/ladders.
2. Design stairs to the following specifications or per local code if more stringent:
    a. Stairs:
        1.) Minimum of 10" deep 2.) Non-skid upper surface

2.) Extend front edge of tread over rear edge of lower tread a maximum of 1¼".

b. Risers:

1.) 9" (maximum)

2.) Equal in height in any one flight within ⅛"

c. Minimum inside clear width of 36".

d. Provide catwalks as required so that intermediate flights do not exceed 15 steps.

e. Provide protective measures (i.e. swing gate or offset) at the top of stairs.

3. Design stairs in accordance with OSHA standards, section 1910.24 and 1910.23.

4. Provide stairs with handrails from top to bottom in accordance with OSHA sections 1926.500 and 1926.501.

5. Stairs shall be painted "yellow".

E. Handrails

1. Provide handrails around all catwalks more than 24" above the adjacent floor and on all stairways. Design handrails to withstand a minimum load of 200 lbs. applied in any direction at any point on the top rail. Vertical support posts shall be spaced not more than 8' 0" on centers. Make handrails continuous.

2. Design all handrails to consist of a top rail with one intermediate rail positioned halfway between the top of the walking surface and the top of the top rail as per OSHA code of Federal Regulation Part 1926.500

3. In areas of restricted clearance (vertically or horizontally), make intermediate rails spanning across conveyor drive locations removable for drive maintenance access.

4. Close all open handrail ends, vertical or horizontal, by welding a metal cap.

5. Grind smooth all handrail welds.

6. Handrails shall be painted "yellow".

F. Fire Door (Powered)

1. Provide automated fire doors with related support frame (e.g., steel "C" channels, metal studs or the like) at the locations illustrated in the contract documents. The installation of the fire doors (e.g., door, support frame and location) shall be coordinated with the conveyor right-of-ways, related wall openings and any related conveyor enclosures, and shall be located so that they are aligned with the respective conveyor's discharge end junction point so that they pass through the conveyor segments (the doors shall not close on top of the conveyor slider-bed) unless noted otherwise on the contract documents (see item o. below). Take on the responsibility for the procurement, power and control design, mechanical and electrical installation of rolling shutter, slat-type, between-jamb-mounted and interior-face-mounted fire doors, including, as a minimum, the following features:

a. U.L. labeled hour rating to match fire partition walls where door is installed. For example, at 2-hour rated walls provide minimum UL labeled 2 hour rated doors. Obtain the proper fire rating from MDAD for all fire doors within the scope of the BHS Contract.

b. Electric Operator with 480 VAC, 3 phase, 60-hertz motor controller provided by the door manufacturer.

c. Up and Down limit or proximity switches connected to PLC input.

d. Provide a photocell or proximity switch to sense the door obstructions (e.g. detecting a bag under the door).

e. Fire/heat/smoke detectors located to sense approaching fire, heat or smoke source on the conveyor shall be provided and coordinated with the Fire Alarm System requirements.

f. Coordinate the facility fire zones with MDAD and interface the BHS controls functionality of the fire door with the South and Central Terminal Fire Alarm System, so that if a fire is detected the respective subsystem will perform the necessary shutdown. Coordinate the spatial and access requirements within the PLC enclosure for these contacts with Fire Alarm System requirements. Provide the necessary relays for all outbound subsystems with normally open dry contacts, mounted and wired to a terminal strip inside the PLC enclosure (i.e., inside the control cabinets whose PLC is controlling the conveyor line that the fire door(s) is mounted on). Connect each normally open dry contact to the appropriate PLC I/O module. The contact(s) shall be maintained closed by the fire-alarm system and open upon detection of a fire, heat or smoke condition to signal the requirement for closure of the fire door. Subsystem fire doors shall close only upon receiving a signal from the Fire Alarm System for closure and open upon normal start-up sequence, otherwise they shall remain open at all times. If the fire door also serves as a security door it shall open and close consistent with the respective subsystem start-up and shut-down sequence.

g. 160°F fusible links which, when broken, shall cause the door to close automatically and report to the central facility security/fire system the status of the door (e.g., open or closed). All wiring between the BHS MCP and the facility central fire-alarm system for this reporting function shall be provided as required. Provide the appropriate interface within the MCP/PLC to accommodate this reporting controls function and coordinate the interface requirements with the Fire Alarm System and Security System Contractors.

h. A means for manual operation. If operation is accessible from one side only, select the side offering the most danger should the door close and block a potential exit.

i. The door shall be equipped with an externally mounted limit or proximity switch. The limit or proximity switch shall be mounted in such a manner so that the "fully open" position of the door is sensed. If the door is sensed by the limit or proximity switch not be in the fully open position, the associated conveyor shall be stopped if running or shall not be permitted to start if the conveyor was not already running. Note that this limit or proximity switch is in addition to those limit switches provided with the door operator if the door is powered.

j. Provide all stainless steel trim elements around door openings for public spaces and painted steel trim elements for non-public spaces. Coordinate the trim requirements with MDAD.

k. Coordinate installation and framing of the fire door(s) with MDAD and other contracts.

l. Clearly define by way of detail plans and elevations (on the submitted mechanical drawings) all of the required operational and maintenance clear zone requirements in order to avoid any obstructions with other trades involved in building

construction.

m. Coordinate the testing of fire doors with MDAD, the fire system contractor and the appropriate authorities.

n. All fire doors that are directly associated with BHS shall be installed perpendicular to the conveyor centerline. Coordinate installation and framing of the fire door(s) with other contracts.

o. For fire doors that are directly associated with the BHS which do not pass between conveyor segments, provide a minimum 2" gap in the associated conveyor's sideguard to permit the fire door to close upon the conveyor bed. Additionally, provide the necessary fire shield materials in the body of the conveyor bed as well as other fire stop materials to meet the requirements of the local Fire Codes.

p. The design of the fire door control system is described in the BHS "Special Control Requirements" section of this specification (Part 3).

G. Security Door (Powered)

1. Provide BHS security doors with related support frame (e.g., steel "C" channels, metal studs or the like) at the locations illustrated in the contract documents. The installation of the security doors (e.g., door, support frame and location) shall be coordinated with the conveyor right-of-ways, related wall openings and any related conveyor enclosures. The mechanical and electrical installation, power and control of rolling shutter, slat-type, between-jamb-mounted and interior-face- mounted security doors, shall include as a minimum, the following features:

a. Electric Operator with 480 VAC, 3 phase, 60-hertz motor controller provided by the door manufacturer.

b. Provide a photocell or proximity switch to sense door obstructions (e.g. detecting a bag under the door).

c. Provide a light curtain for intrusion detection similar to the existing conditions.

d. The door is to be equipped with an externally mounted limit switch, photocell or proximity switch to sense door position connected to PLC input. The limit, photocell or proximity switch must be mounted in such a manner so that the "fully open" position of the door is sensed. If the door is sensed, by the limit switch, photocell or proximity switch not be in the fully open position, the associated conveyor shall be stopped if running or shall not be permitted to start if the conveyor was not already running. Note that this limit switch, photocell or proximity switch is in addition to those limit switches provided with the door operator if the door is powered.

e. Provide all stainless steel trim elements (around door opening) for those security doors located in public view and painted steel trim elements for non- public spaces. The BHS Subcontractor shall coordinate the trim element requirements with MDAD. Subsystem security doors shall open and close consistent with the respective subsystem start-up and shut-down sequence.

f. All security doors that are directly associated with the BHS shall be installed perpendicular to the conveyor centerline. The BHS Subcontractor shall coordinate installation of the security door(s) with other contracts.

g. The design of the security door control system is described in the BHS "System Control Requirements" section of this specification (Part 3).

H. Draft Curtains

1. Provide draft curtains at all BHS related wall and floor penetrations between conditioned and non-conditioned space, conditioned and tempered, or tempered and non-conditioned spaces.
2. Construct the draft curtains with two staggered layers of black 8" wide anti-static vinyl (PVC) strips. Each strip shall be 0.080" (minimum) thick at center and include a 0.120" (minimum) thick beaded outer edges, installed with a 50% overlap (i.e., staggered strip layers) to create a barrier between the two spaces for dust and temperature control.
3. Provide stainless steel fascia around wall openings for in public areas and painted steel trim for non-public spaces. Coordinate these draft curtain trim requirements with MDAD.

I. Conveyor Impact Protection

1. Provide impact protection as required to protect MCPs, stairs, ladders, conveyors and make-up devices / sort piers. Minimum requirements for installation of impact protection shall be at the following locations:
   a. Transfer Line Unload Conveyors.
   b. Stair and Ladder locations, which are located adjacent to drive aisles and cart/dolly staging areas.
   c. All make-up devices / sort piers.
   d. All outbound oversize load conveyors.
2. In addition to the above, provide independently anchored impact protection wherever power distribution panels, control panels, control consoles, or control stations are exposed to work area traffic.
3. Construct the impact protection and supports of structural steel, heavy walled sections in shapes as indicated. Securely fasten all impact protection components to each other and to the floor.
4. Field verify, all dimensions shown on the drawings to insure proper fit with the equipment system interface.
5. Apply primer and then one coat of "yellow" paint to all impact protection steel members that are not exposed to the weather (e.g. within the bag room).
6. Hot-dip galvanize all impact protection steel members that are exposed to the weather.
7. Design impact protection so that maintenance access to the protected equipment is not restricted.

2.6 SPECIAL MECHANICAL EQUIPMENT REQUIREMENTS

A. General

1. Certain portions of this project require the modification, interfacing with, removal and demolition of existing conveyor equipment as shown on the Contract Drawings. Accomplishment of this work shall have to be carefully coordinated with the ongoing operations of the airlines associated with the existing baggage system in the building area.
2. Conduct a thorough field check of the existing conveyors and their relationship within the existing system as well as their relationship with the configuration of the specified system.
3. Ensure that the design and installation of all conveyor equipment provides maximum

access for operation and maintenance personnel.

2.7 ELECTRICAL TECHNICAL REQUIREMENTS

A. Electrical Service to be Provided by the BHS Subcontractor

1. The existing reconfigured outbound subsystems are powered and controlled by their respective motor control panels and PLCs cabinets which shall be secured and protected during the phased-in implementation program of the new BHS.
2. The TC12-TC17 reconfigured conveyors shall utilize the existing MCPs and vfield devices unless noted on the drawings. Provide new MCPs, field devices, conduit and wiring for the scale and dispatch conveyors as indicated on the contract drawings.
3. Utilize the existing PLCs to accommodate the reconfigured TC12-TC17 BHS (existing and new) and related controls, including sortation of baggage and required interfaces to existing systems (e.g., Fire Alarm System, Access Control System). The existing PLC's associated with the existing subsystems shall be modified as necessary to accommodate the phased-in implementation program and related interim conditions.
4. Power for the various subsystems shall be provided at the existing Power Distribution Panel locations, which shall feed their respective MCPs, as shown on the Contract Drawings. Supply power shall be 480 volts, 3 phase, and 60 hertz. Verify and advise MDAD that the ampacity at each PDP is sufficient for the requirements of the system.
5. Provide and install all mains (conduit and cable, normal 480 VAC plus 120 VAC Power) to the BHS Motor Control Panels (MCPs) that will power and control the BHS. Provide and install all necessary conduits and wiring from the various MCPs and onward to the BHS field equipment/components, as necessary to meet requirements of the specification. Size feeders from the power drops at 1.25 times the minimum NEC (or applicable local code) permitted size for the full-load amperage required.
6. Provide power for the MCP's 120 volt, NEMA 5-20R grounded receptacle, fused to 3 A, and MCP's lighting by obtaining the BHS 120 volt supply via a transformer and a separate disconnect, connected to the line side of the 480 volt input power.
7. Provide and install all services, feeders and disconnect switches for branch circuits to each control panel, with separate circuits for each subsystem as specified and provide and install all panel boxes, wireways, conduits, conductors, transformers, breakers/fuses, and any other equipment and materials required to complete the electrical power distribution for the operation of the system. Refer to NEC Article 300 for wiring methods.
8. Provide an assessment, identifying compliance with NFPA 70E Standards for Electrical Safety in the Workplace regarding the BHS PDPs and MCPs that are part of this project and the need for personal protective equipment.
9. During the engineering design phase, provide detailed power in an effort to reduce the PDP amperage provided and thereby reduce the power provided to the system. Coordinate the detailed power requirements including any reductions with MDAD.
10. Calculate the electrical power supply requirements on the basis of total connected load with a diversity factor. Size the conductors to ensure that the voltage drop does not exceed 3% at the farthest outlet of power, heating and lighting loads, or combinations of such loads. Also ensure that the voltage drop does not exceed 5% at the farthest outlet for both feeders and branch circuits.
11. Provide 120 volt, single phase, and 60-Hertz power for operation of the BHS control circuits.

12. Obtain the control power at each MCP by means of a transformer connected to the load side of the 480 volt input power.

13. All baggage systems that use PLC control systems shall be equipped with the appropriate number and size of power regulators to ensure that the power for the respective PLC control systems is properly conditioned. Regulators are to be of the type manufactured by the Sola Corporation (or approved equivalent).

14. All electrical components, devices, accessories, and equipment shall be listed, labeled and identified as suitable for use intended by testing agency acceptable to authorities having jurisdiction. This shall include MCPs and any control panels/cabinets, whether factory or BHS Subcontractor fabricated.

B. Power Source

1. All of the electrical equipment, computers and PLC control systems shall be compatible with, and operate reliably and effectively with, the normal electrical supply typically available at airport locations. The equipment shall not be unduly sensitive to fluctuations in supply voltage which may typically vary by plus or minus ten percent (10%) of nominal values.

2. Provide necessary electrical supply filters, conditioners and regulators for all equipment, which cannot meet the specifications stipulated.

C. Raceways

1. General

a. Enclose all power and control wiring, including low-voltage wiring, in Rigid Metal Conduit (RMC), Electrical Metallic Tubing (EMT), Liquid Tight Flexible Metal Conduit or wireways. Intermediate Metal Conduit (IMC) is not acceptable.

b. Horizontal runs of conduit shall not be supported by power turns, their safeguards, or by any side guard that is designated to be removable for the purpose of maintenance access. Rack such horizontal runs and support them from the building steel in locations not interfering with the BHS, maintenance areas, or catwalk areas. Local conduit/wireway runs between subsystem Motor Control Panels and BHS conveyor equipment shall be installed so that they follow their respective subsystem conveyor line right-of- ways, without infringing on operational and maintenance access to conveyor equipment.

c. Install drops to motors or other devices adjacent to the nearest available equipment or building column.

d. Avoid conduit runs on the floor. Provide minimum clearance of 6" below horizontal conduit to the floor. MDAD must approve exceptions to the above.

e. RMC and EMT Conduit runs must be mounted so as not to restrict maintenance access to the BHS equipment, conveyors and system/conveyor components that required servicing.

f. Do not run communication, low voltage (less than 30 volts), or DC control wires in the same conduit, wireway or panduit with power wires.

g. It is acceptable to run 120 VAC minimum control wire and 480 VAC maximum power wire in the same conduit, wireway or panduit provided it is in conformance with local codes and VFD manufacturer's guidelines, as applicable.

h. Conduit runs must not be run or mounted on outside guards or perimeter chain guards

of power turns.

i. Conduit runs shall be mounted on unistrut using a two piece unistrut strap or other means of fastening which is suitable for BHS applications as approved by MDAD.

2. Rigid Metal Conduit (RMC)

a. Conform to all aspects of NEC Article 344 for RMC (or applicable local code).

b. Use a minimum 3/4" for all wiring.

c. Run all conduits parallel or at right angles to structural members and equipment.

d. Do not run conduits underground or in floor slabs unless provided for that purpose by the Building Contractor.

e. In public areas, make conduit runs inconspicuous by running under cover plates, behind conveyors or otherwise concealed from public view.

f. In non-public areas, run exposed conduit in protected locations to prevent damage by moving vehicles, equipment or maintenance personnel.

g. Use Rigid Metal Conduit in areas of the BHS installation that are at elevations less than 8'-0" above the building's local finished floor that are exposed to vehicular traffic and possible damage by operating or maintenance personnel.

h. Use malleable iron or steel threaded fittings.

i. Include gaskets and covers for all fittings.

j. Use standard threaded couplings at all conduit joints.

k. Ensure that the ends of the conduit are cut square, reamed and joined butt- tight.

l. Electro-galvanize all conduit, elbows, fittings, couplings and nipples.

m. Make changes to conduit size only at pull boxes, distribution panels, or branches to motors. Do not use reducers for in-line reduction of conduit size.

n. Remote control, signaling and power limited circuits shall be installed in compliance with NEC Article 725, (or applicable local code) as applicable.

o. Support conduit at intervals not to exceed 10'-0". Every individual conduit section must be supported. Install conduit supported from building walls with a clearance of not less than 1/4" from the wall to ensure against the accumulation of dirt and moisture behind the conduit, using one-hole malleable iron clamps and clamp backs. For parallel conduit runs, provide trapeze hangers or wall brackets fabricated from preformed channel with conduit clamps. Make anchors in concrete of the expansion shield type. Limit conduit run on a given conveyor to that, which is required for that particular conveyor or directly adjacent (downstream/upstream) to that particular conveyor.

p. Ensure that metallic and non-metallic motor disconnect boxes, wireways, control stations, outlet boxes, junction boxes, pull boxes and cover plates are compatible with the RMC conduit used and conform to the National Electrical Code (or applicable local code) for minimum wiring space requirements and material thickness. Provide all boxes with screw fastened covers. Use NEMA 12 enclosures for interior equipment and NEMA 4 for all exterior equipment. Provide metal boxes; non-metal boxes shall not be used.

q. Appropriately sized insulated bushings and jumpers shall be installed on all conduits

and conduit fittings that enter MCP(s), workstation/computer cabinet(s), outlet boxes, disconnects, or j-box/pull box(s).

3. Electrical Metallic Tubing (EMT)
    a. Apply the above requirements for Rigid Metal Conduit to EMT except as noted below:
        1.) Use rain and concrete type compression fittings with steel compression nuts.
        2.) Use insulated throat type connectors with case hardened nuts. 3.) Use minimum size tubing of 3/4" diameter.
        3.) Use EMT only in areas at elevations greater than 8' above the building's local finished floor in areas exposed to vehicular traffic or damage by operating and maintenance personnel. EMT may be used in areas under 8' above the local finished floor in lieu of RMC in areas not exposed to vehicular traffic or possible damage by operating and maintenance personnel.
        4.) Appropriately sized insulated bushings and jumpers shall be installed on all conduits and conduit fittings that enter metallic or non-metallic MCP(s), Operator Workstations / computer cabinet(s), outlet boxes, control stations, disconnects, or j-box/pull box(s).
        5.) Ensure that motor control panels, power distribution panels, wireways, motor disconnect boxes, control stations, outlet boxes, junction boxes, pull boxes and cover plates are compatible with the EMT used and conform to the National Electrical Code (or applicable local code) for minimum wiring space requirements and material thickness. Provide all boxes with screw fastened covers. Use NEMA 12 enclosures for interior equipment and NEMA 4 for all exterior equipment.
    b. Conform to this specification and NEC Articles 300 and 358 for EMT (or applicable local code).
4. Flexible Metal Conduit
    a. Conform to this specification and NEC Articles 300 and 348 (or applicable local code) for flexible metal conduit and fittings.
    b. Use liquid-tight flexible metal conduit for connection to motors or any device, which may be subject to vibrations or require adjustment after installation. The use of non- liquid-tight flexible metal conduit such as "green field" is not acceptable.
    c. Do not exceed 3' 0" in length.
    d. Every section of flexible metal conduit must be clamped/supported.
    e. Appropriately sized insulated bushings and jumpers shall be installed on all conduits and conduit fittings that enter metallic or non-metallic MCP(s), Operator Workstations / computer cabinet(s), outlet boxes, control stations, disconnects, or j-box/pull box(s).
    f. Use minimum ½" for power wire.
    g. Use minimum ½" for control wire.
5. Wireways
    a. NEMA 12 rated wireways may be used in place of rigid conduit provided the

application conforms to the requirements of National Electric Code Articles 376 and 378 (or applicable local code).

b. Use wireways with hinged, solid covers.

c. Position wireways to permit access with the equipment fully operational.

d. Fasten covers using captive screws or some other means of fastening not subject to loss such as clamps.

e. Do not use wireways in areas subjected to vehicular traffic at elevations less than 8'-0".

f. It is not acceptable for any means of splicing in wireways such as terminal strips, wire nuts or other mechanical means of joining wires.

g. Metal dividers are acceptable in wireways as a means of separation between communications / DC wiring and AC wiring to ensure no induced voltages from the AC wiring to the communications / DC wiring.

h. Use lay-in type wireways to avoid the necessity of threading wires through end connectors.

D. Wire and Cable

1. General

a. Use stranded copper conductors of appropriate gauge, Type THHN or approved equal, with insulation rated for 600 volts.

b. Connect pre-wired electrical devices to terminal blocks mounted in junction boxes adjacent to the devices.

c. Do not use blade connectors (such as but not limited to fork or ring style) for connections.

d. It is acceptable to use multi-conductor cable for connecting portable electronic equipment. Refer to National Electrical Code (or applicable local code) for requirements on multi-conductor use.

e. Tag control and power circuit conductors with "machine" printed identification numbers at both ends of the wire. Tag method shall be of the sleeve or other permanent type submitted to and approved by MDAD. The use of multiple tags to create a single tag is not acceptable.

f. Keep all wires on reels while being pulled. Do not allow wires to contact the ground or floor.

2. Minimum wire size

a. Power - #12 gauge

b. VFD Motor - #10 gauge (if individual wires are used in lieu of VFD rated cables and when allowed by VFD manufacturer's guidelines)

c. Control - #14 gauge

d. PLC I/O - #16 gauge (Connections between I/O modules and terminal strips inside MCPs)

e. Communication Circuits - #18 gauge

3. Splicing

   a. Splicing of 480 VAC power wiring is unacceptable, except when performed as described in paragraph e. below. All 480 VAC wire pulls shall be from the MCP to the device (e.g. from MCP to the individual motor safety disconnect).

   b. Splices are acceptable when parallel type connections are used for "hot" and "neutral" control wires (e.g. power wire for photocells, and e-stop circuits within a subsystem).

   c. Do not splice signal wires between I/O panel and component, except for when performed as described in paragraph e. below.

   d. Terminate control wires on terminal strips or on screw connectors at each component only.

   e. In conjunction with the provision of a Junction Box for each BHS conveyor line, at the interface junction point between existing and temporary (not part of the final works) conveyor segments, it is permitted to provide splicing between field components and the MCPs. Splice the existing wiring within new Junction Boxes (segregating AC wiring from DC wiring), using appropriate screw connection terminal blocks, for all wiring within the referenced conduits. Use terminal blocks or approved equal for all wire splices related to this work. Label/tag all wires at the Junction Box splice points with "Machine" printed identification numbers at both ends of the wire. Tag method shall be of the sleeve or other permanent type submitted to and approved by MDAD. The use of multiple tags to create a single tag is not acceptable.

4. Spare Conductors

   a. Provide a minimum of 5% spare conductors in all conduit home runs, with a minimum of two spare control wires and one spare power wire.

   b. Coil all spare conductors allowing sufficient length to permit future connection.

   c. Tag spare conductors as required above, i.e., each spare conductor is to be identified as a spare with its own unique wire identification number and field termination location.

5. Wiring Identification

   a. Color code all electric wire and cable as follows:

      1.) MCP Power Wiring:

         a.) Apply the following to all MCP power wiring from source to line and load side of Main Disconnect fuses for MCPs. Verify color-coding of phase conductors on the line side to ensure compatibility with normal electrical supply available at the airport. Terminate the neutral, if applicable, at the terminal board:

Item	Wire Color
Phase A (480 VAC)	Brown
Phase B (480 VAC)	Orange
Phase C (480 VAC)	Yellow
Neutral	Grey
Mechanical Ground	Green

2.) BHS Field Components Power and Control Wiring: Load Side

a.) Apply the following to power and control wiring from the load side of fuses in MCPs to all devices that are powered and controlled from the respective MCP as follows:

Item	Wire Color
Power (To Motors and Control Transformers)	Brown, Orange & Yellow
AC Control:	Red
DC Control:	Blue
AC Neutral:	White
Mech. Ground	Green

E. Grounding

1. Ground all electrical equipment to building ground mat by a dedicated equipment-grounding conductor installed in accordance with the applicable codes.
2. Appropriately sized insulated bushings shall be installed on all conduits and conduit fittings that enter and exit the MCP or j-box/pull box.
3. Include a green 600V insulated copper ground conductor in each conduit (raceway).
4. Refer to National Electrical Code Article 348 (or applicable local code) for flexible metal conduit grounding requirements.
5. Refer to National Electrical Code Article 250 (or applicable local code) to determine grounding conductor requirements and sizes.

F. Support

1. Mount conduit supported from building wall using uni-strut type mounting channels to provide clearance to the wall.
2. Do not weld conduit to structural members.
3. Avoid conduit runs to the floor. Provide minimum clearance of 6" between horizontal conduit and the floor and do not allow runs to cross any walk or access aisles.
4. Support cordsets running to items such as, but not limited to, photocells and shaft encoders with cable mounting clips only. The cordset shall not be supported/secured with plastic wire ties.

G. Boxes

1. Provide outlet boxes, junction boxes, pull boxes and cover plates compatible with the conduit used. Provide boxes with screw fastened covers. Use NEMA 4 for all exterior equipment and NEMA 12 for interior equipment.
2. Conform to NEC Article 314 (or applicable local code) for minimum requirements for outlet boxes, junction boxes, pull boxes and cover plates.
3. Appropriately sized insulated bushings/seals shall be installed on all conduits and conduit fittings that enter/exit the box(s).
4. Unused openings in power distribution panels, motor control panels, junction boxes, raceways, cabinets, and pull boxes shall be effectively closed to afford protection substantially equivalent to the wall of the equipment.

2.8 ELECTRICAL COMPONENTS

A. Wiring Devices

1. Provide full size oil-tight operators.
2. As much as possible, use the same type sensors (such as but not limited to photocells and limit switches) to minimize the number and type of spares. Select sensors with the same mounting system wherever practical.

B. Control Devices/Stations

1. Control Device Locations
   a. Control Stations and Control Devices shall be located as specified herein. The location of the Control Stations and Control Devices is to be such as to provide maximum possible access to the Devices for servicing of the devices. For example, all Jam Detector and Head End Sensor Photocell devices are to be mounted so that they are accessible from catwalks adjacent to conveyors. For specific operators noted herein, protective guarding may be required to protect the Control Devices. However, the design and installation of this protective guarding must not prevent quick access to the control devices for adjustment, servicing or replacements.
   b. The location, mounting and guarding of control stations and control devices must not in any manner restrict the access and servicing of any mechanical components of the BHS.
2. Control Device Mounting
   a. The mounting of Control Stations and Control Devices, shall comply with the basic requirements established in these specifications and as noted in the following:
      1.) Control Stations in Public View
         a.) All Control Stations located in the view of the public shall be mounted in stainless recessed cover plates located on the soffits above the conveyor. Coordinate the design and locations of these control stations with the architect.
         b.) Scale and dispatch control pusbuttons shall be integrated into the stainless-steel scale display enclosure. Coordinate these devices with the scale equipment supplier.
      2.) Control Stations in Non-Public View
         a.) All Control Stations located on load conveyors in non-public view shall be mounted on the horizontal portion of a Control Station mounting assembly bridging the load conveyor. This assembly shall be located and built so as to also act as an Over-Height Photocell Mount and Bag Restraint. Consider the "chording effect" of baggage at the discharge end of a horizontal load conveyor feeding onto an incline conveyor when determining the location of such an assembly. The vertical element of the assembly may also be used for the mounting and protection of head end photocells, if applicable.
         b.) All Control Stations located on sort piers or make-up devices in non-public view shall be mounted on a Control Station mounting assembly. Design, manufacture and installation of these Control Station mounting assemblies must be such as to provide a "solid", well braced mounting for the related Control Station and Control Devices. Note also that the Control Station

mounting assembly must provide a minimum vertical bag clearance of 36" above the surface of the sort pier or make-up device.

3. Control Devices

   a. All photocells shall be mounted in a vertical attitude with the LED photocell status indicator clearly visible to operation and maintenance personnel from the side of the associated conveyor or conveyor equipment. Photocells that are used for jam detection; baggage tracking, and the like are to be mounted so that the center of the photocell beam is 2½" or 3" (must be consistent, e.g. all 2.5" or all 3") from the top surface of the conveyor belt.

   b. Limit switches that are used to sense the position of Fire doors shall be mounted as an external unit to the door adjacent to the track of the door so that the switch can detect when the door is in the fully open position.

   c. Indicating lamps, other than those associated with MCPs, are to be located as required to properly alert personnel.

   d. Shaft encoders used for determining conveyor speed must be directly coupled to either the head or tail pulley of the associated conveyor. Use of tension loaded friction drive types of shaft encoders is not acceptable.

   e. Start-up warning alarms (i.e., audible and visual) shall be located at strategic locations to alert operations and maintenance personnel of the imminent start- up of conveyor equipment. As a minimum provide start-up alarms at baggage input areas, on top of the MCPs and along the conveyor line right-of-ways. Audible/Visual Fault Warning and Start-up Alarms may utilize the same control devices. However, the audible and visual indications shall differentiate between the two separate functions.

   f. Fault warning alarms (i.e., audible and visual) shall be appropriately located to alert operations and maintenance personnel of conveyor subsystem fault conditions. As a minimum provide fault alarms on top of the MCPs. Audible/Visual Fault Warning and Start-up Alarms may utilize the same control devices. However, the audible and visual indications shall differentiate between the two separate functions.

   g. System Start-up and Fault Indication Rotating Beacons: System start-up and fault indication beacons, with amber globes, shall be located on top of the MCPs, at the baggage input areas and along the conveyor right-of-ways.

   h. Emergency Stop Switch Rotating Beacons: Emergency Stop Switch beacon with red rotating globe shall be mounted on top of the associated subsystem MCP (or on the side of the MCPs in locations with reduced clearance).

4. Types of Control Devices

   a. Pushbutton Switches: All Momentary Contact Pushbutton switches shall be of the Allen Bradley Series 800T type (or equivalent). The color coding for the Pushbuttons shall be as follows:

Function	Color
Start/Re-Start (non-public locations)	Green (flush head)
Normal Stop (non-public locations)	Red (flush head)
Alarm Silence (non-public locations)	Yellow (flush head)
Lamp Test (non-public locations)	Gray (flush head)
Jam Reset (non-public locations)	Orange (flush head)

Function	Color
Others (non-public locations)	Black (flush head)
Motor Overload (non-public locations)	Blue (flush head)
Open (non-public locations)	Green (flush head)
Close (non-public locations)	Red (flush head)
Advance/Label	Green
Dispatch	Blue

b. Illuminated Pushbutton Switches: All Illuminated momentary contact pushbutton switches shall be of the Allen Bradley 800T - PA16 type switch with guards (or equivalent). The color coding for the Pushbuttons shall be as follows:

Function	Color
Start (for initial startup conditions at public areas)	Green
Jam Reset	Amber
Emergency Stop Reset	Red
Over-Height/Over-Length Reset	White

c. Emergency Stop Pushbutton Switches: All Emergency Stop pushbutton switches shall be of the Maintained Contact, "Push to Stop" Illuminated Red Mushroom Head switch, Allen Bradley 800T - FXP16RA1 type (or equivalent). Note that the Emergency Stop pushbutton switches must be equipped with a manual lockout clip manufactured by the switch manufacturer for locking the switch in the "conveyor off" position.

d. Selector Switches: All Selector Switches shall be of the appropriate series based on the application, and of the Allen Bradley 800T type switch (or equivalent).

e. Key Operated Switches

1.) "Off/On Function" and "Start Function" Key operated Switches for application in Public Areas shall be of the type manufactured by the Best Lock Company (or equivalent), but must use a six-pin lock cylinder and core. MDAD will provide the final Operational Core. The Construction Core, normally supplied with the lock, must be removed before the project will be accepted. The switch must provide a spring loaded center return.

2.) Key operated Switches for all functions other than the "Off/On Function" and "Start Function" in Public Areas shall be Allen Bradley type 800T, (or equivalent).

f. Audible Warning Alarms

1.) Start-Up Warning Alarms for other locations shall be of appropriate frequency and volume levels for the application location (such as baggage make-up areas, outbound transport line areas, and ticketing areas (public)). Such Audible Warning Alarms shall be as follows:

a.) Ticketing Areas: Allen-Bradley 855H Series horn, Catalog Number 855H-BA10CD (or equivalent).

2.) Audible Fault Warning Alarms shall be of a horn type of appropriate frequency and volume level for the application location (such as baggage

make-up areas, and outbound transport line areas). Such Audible Fault Warning Alarms shall be as manufactured by Allen-Bradley 855H Series horn, with Amber Beacon Catalog Number 855H-BCA10CDR5 or without Beacon 855H-BA10CD (or equivalent).

g. Audible/Visual Combination Alarms: Combination alarms for start-up or fault warnings mounted to MCPs, or elsewhere as approved by MDAD, may be Allen-Bradley 855E Series with 120 VAC control.

h. Limit or Proximity Switches: Provide precision oil tight plug-in type limit switches with contacts rated for a minimum of 10 amperes continuous duty at 120 volts A.C. Limit switches that are used to sense the position of fire/security doors are to be mounted as an external unit to the door adjacent to the track of the door.

i. Motor Safety Disconnect Switches

1.) Provide motor safety disconnect switches of the 3-pole, heavy-duty type, horsepower rated and non-fusible with a quick-make and quick-break operating mechanism and a means of padlocking the switch in the OFF position.

2.) Provide a N.O. auxiliary contact for connection to a PLC input.

3.) Motor safety-disconnect switches for motors equipped with soft start devices must have an auxiliary N.O. contact interlocked with the associated emergency stop circuit.

4.) Each Motor safety disconnect switch shall be identified with a permanently attached white phenolic plate, engraved with black characters, providing the identification of the conveyor with which the motor is associated. Dymo - type labels are not acceptable. Attaching the ID plate to the safety disconnect door is acceptable.

5.) Use NEMA 12 enclosures for interior equipment and NEMA 4 for exterior equipment.

j. Fire/Security Door Safety Disconnect Switches

1.) Provide safety disconnect switches of the 3-pole, heavy-duty type, horsepower rated and non-fusible with a quick-make and quick-break operating mechanism and a means of padlocking the switch in the OFF position.

2.) Provide a N.O. auxiliary contact for connection to a PLC input.

3.) Each Fire/Security Door safety disconnect switch shall be identified with a permanently attached white phenolic plate, engraved with black characters, providing the identification of the door the disconnect is associated with. Dymo - type labels are not acceptable.

4.) Use NEMA 12 enclosures for interior equipment and NEMA 4 for exterior equipment.

k. Relays: Use general-purpose industrial, panel-mounted relays with convertible contacts rated at 10 amperes continuous current at 120 volts A.C. Ensure that all relays are capable of manual operation.

l. Timers: Provide solid-state timers or utilize timer functions by PLC logic. All timers are to be mounted within the appropriate MCP. Use of timer devices within

photocells is not acceptable.

m. Magnetic Motor Starters (IEC)

1.) IEC starters shall comply by IEC, UL, CSA and VDE standards. NEC article 430 shall apply for group motor installation.

2.) Provide a separate IEC motor starter for each motor drive section.

3.) Provide one auxiliary contact on each starter and wire to PLC input module. Provide monitoring of tripped condition on the MDS. Provide visible trip indication on the IEC starter

4.) The IEC rated contactors are to be sized one rating higher than recommended by the manufacture.

5.) IEC starters shall be selected by motor full load current and the motor service factor.

6.) Provide IEC with lockout provision.

7.) Be provided with thermal overload protection on all poles.

8.) Provide overload relays of the manual reset type (unless they are already within the IEC motor starter).

n. Combination Magnetic Motor Starters

1.) In addition to the requirements listed for magnetic starters, equip each combination magnetic starter, if specified, with:

a.) An adjustable instantaneous trip circuit breaker interlocked with the enclosure cover with provisions for padlocking the disconnect switch in the "Off" position.

b.) An enclosure door capable of being opened only with disconnect switch in the "Off" position.

o. Overload Heaters

1.) Size overload heaters for each starter in accordance with the full load current rating shown on the actual nameplate of each manufacturers selection tables.

2.) Each individual motor starter should be equipped with overloadheaters.

3.) Provide a N.O. auxiliary contact for each overload relay for connection to a PLC input.

4.) Annunciate individual overload failure on the MDS fault reporting system.

p. Soft Start Devices

1.) Provide a soft start device for all drive units within any baggage make-up device as recommended by the manufacturer. The use of a VFD device instead of a soft start device is acceptable.

2.) Provide an electrical/electronic soft start device with adjustable starting curve from 0 to 10 seconds for any conveyor drive equipped with a 7½ horsepower motor or larger.

3.) Ensure that the electrical control circuitry design provides that the soft start device is always used whenever the associated drive motor(s) are started,

regardless of start condition; i.e., regardless if drive motors are started with a control sequence or with activation of the related motor safety disconnect switch.

q. Electric Brakes

1.) Provide brakes on all incline conveyors and decline conveyors, if not equipped with a VFD, and for any other conveyors where coasting of the conveyor would be detrimental to the operation of the baggage system. The implementation of dynamic braking may be used in lieu of electric brakes, however, if the dynamic braking does not perform successfully then electric brakes shall be installed at no additional cost to the Project.

2.) Provide an electric brake for decline conveyors that are equipped with a VFD. Wire the brake separately from the Variable Frequency Drive power source to prevent conveyor coasting.

3.) Provide dry friction, spring set, solenoid release type brakes integral with the drive motor.

4.) Incorporate automatic adjustment of brake disk wear or provide a brake, which requires minimal adjustment.

5.) Select the brake to be capable of cycling as required by the conveyor application under full load with no excessive wear.

6.) Choose brakes to have a minimum torque rating equal to the starting torque of the motor.

7.) Motor brakes that are installed on the end bell of the motors are to be equipped with an external means of "manual release" that would permit maintenance personnel to operate the motor in case of a failure of the brake.

r. Variable Frequency Drives (VFD)

1.) A programmable Variable Frequency Device (VFD) shall be utilized to control the operation of three-phase induction AC motors for queue, power turns, merge conveyors, HSPDs, VSUs, all conveyors on which bags are being trackedDynamic braking shall be provided for all conveyors within bag tracking zones.

2.) For incline conveyors, on which bags are being tracked, that are equipped with a Variable Frequency Drive unit “anti-roll back” provisions shall be provided on the associated gear box to prevent conveyor coasting.

3.) Provide an electric brake, wired separately from the Variable Frequency Drive power source, for decline conveyors, on which bags are being tracked, to prevent conveyor coasting.

4.) Type of VFD utilized shall be UL listed and IEC compliant.

5.) Provide a means of dissipating drive shaft voltages and bearing currents to ground for all conveyors, which are provided with a VFD to prevent premature bearing failures.

6.) To conserve MCP space it is preferred that the BHS Subcontractor the VFD remotely at the drive unit. VFDs shall be typically installed within the respective MCP. The BHS Subcontractor can propose to install the VFD within the respective MCP; MDAD must approve this type of configuration.

7.) Factor in heat dissipation when designing the remote mounted VFD arrangement or when designing MCPs with VFDs and if excessive heat is anticipated from the braking resistors, then mount them in a separate NEMA 12 (for interior equipment) or NEMA 4 (for exterior equipment) rated panel.

8.) Provide the ability to program and monitor all drive parameters. Provide programming devices with pre-programmed parameters for various types of VFD programs (e.g. standard queue, merge) to allow simple downloading of such programs when replacement or reprogramming of a VFD is required.

9.) Provide a local keypad control or a VFD OEM supplied handheld device for start, stop, speed reference and reverse functions.

10.) Provide dynamic braking resistors where required for faster stopping.

11.) VFDs shall be capable of permitting the appropriate number of engagement cycles per minute for the specific application under full load with no objectionable heating, overload tripping or other VFD faults. The BHS Subcontractor shall factor this when designing the system and provide VFDs and dynamic braking resistors of a larger power rating if required to meet the application's requirements.

12.) When using VFDs, either an approved method of wiring by the VFD OEM shall be provided or VFD rated shielded cable needs to be used. Use Belden, O'flex or equivalent cable. The shield should be connected to both the motor and the PE (Potential Earth) ground on the AC drive.

s. Light Curtains

1.) Re-use existing light curtains.

t. Photocells (Photoelectric Sensors)

1.) Provide photocells of the self-contained, retro-reflective type using an infrared modulated light source with sensitivity adjustment and LED status indicator that is readily visible. Retro-reflective type photocells are to be used for applications where the distance between the photocell and the reflector is less than 10'.

2.) Photocell applications that require a scan distance of 10' 0" or greater are to use a separate transmitter and receiver rather than the single retro- reflective photocell.

3.) Use photocells with quick disconnect cable for ease of replacement; the cable shall be UL recognized, 18AWG; one-piece molded design and be highly visible.

4.) Due to wiring constraints and noise on low voltage lines generating false triggers, DC type photocells are not permitted.

5.) Mount photocells to structural members or side guards using an adjustable bracket as supplied by the photocell manufacturer so that the photocell is mounted in a vertical, not horizontal, attitude. Alignment and status LEDs shall be easily visible for maintenance personnel. All sensors and cabling shall be firmly anchored and protected from equipment and personnel impact and from random forces imposed by maintenance personnel servicing the equipment or staff working in the area. Mounting and protection devices shall inhibit tampering with sensors and their setting by non-maintenance

personnel.

6.) Photocell mountings are to be directly attached to the conveyor structure as required. Use of shims between the conveyor structure and the photocell mountings is not acceptable. No penetrations through the side guards or attachment by means of magnets or other non-permanent attachment methods shall be permitted for photocell mountings or mounting brackets.

7.) Hex head ¼" - 20 bolts of appropriate length and related ¼" -20 hardware (flat washers, lock washers and nuts) are to be used for the mounting of the photocells. Use of round head bolts is not acceptable.

8.) Mount reflectors to side guards using brackets providing both vertical and rotational adjustment. No penetrations through the side guards shall be permitted for reflector bracket mounting.

9.) Where holes through side guards are required, the holes shall be a maximum of 1½" in diameter and located so that the center of the photocell beam is located either 2½" or 3" above the conveyor belt. The holes in the side guards shall be dimpled away from baggage flow to minimize the possibility of snagging a bag and causing a jam. Oblong openings in the conveyor side guards are not acceptable.

10.) Only one side guard opening per photocell and one side guard opening per related photocell reflector would be accepted. Any unused photocell/reflector openings in the side guards must be properly filled with a welded circular blank, ground smooth and properly painted.

11.) Locate photocells on the side of a conveyor having the lesser chance of contact by operating personnel. Guard photocells if susceptible to personnel contact. The photocells are to be located on the catwalk side of conveyors to ensure maintenance access.

12.) Do not attach the white phenolic plate photocell device ID plate to the plug-in type photocell or its wired base. Mount the ID plate on the side guard adjacent to the photocell.

13.) Provide photocells as required by the functional needs of the BHS. Photocells shall indicate a reliable life of over 10 million cycles, and be repetitive and unaffected by environmental conditions such as vibration, rain, humidity, cold, heat, dust and sunlight. Provisions shall be made to effectively accomplish the sensing of any of the typical types of airline baggage and packages. Photocell installation shall minimize vibration and shall provide protection for both the sensor and its associated wiring. Specifically, care shall be exhibited in the mounting of the photocell and its control wiring to minimize the hazard of damage from the moving of baggage, contact with associated components or by personnel working on or in the vicinity of the system.

14.) Provide a flexible cordset for connection of photocells to minimize vibration and shall provide protection for both the sensor and its associated wiring.

15.) The BHS Subcontractor shall supply cordsets of an appropriate length to connect to photocells such that there is no greater than 12" of excess cable length remaining. The excess cable shall be coiled and secured to the associated conveyor with the use of cable mounting clips. The BHS

Subcontractor shall not use plastic cable ties to secure the cordset.

16.) Photocells shall not be subject to interference from standard communication systems employed at the airport location due to airport and airline radio ground communications, ground to aircraft communications, aircraft to aircraft communications or any form of radar equipment operation.

u. Shaft Encoders

1.) Shaft encoders used for determining conveyor speed must be directly coupled to either the head or tail pulley of the associated conveyor and shall be of appropriate industrial type.

2.) Install appropriate safety guarding on all exposed parts associated with the conveyor drive's rotating shaft and direct drive gearbox, in compliance with OSHA Standards 1910.219. Ensure that the proposed safety guarding does not restrict maintenance access and it is easily removable, as the location requires, for maintenance access.

3.) Use of tension loaded friction drive types of shaft encoders is not acceptable.

4.) The BHS Subcontractor shall supply cordsets of an appropriate length to connect to shaft encoders such that there is no greater than 12" of excess cable length remaining. The excess cable shall be coiled and secured to the associated conveyor with the use of cable mounting clips. The BHS Subcontractor shall not use plastic cable ties to secure the cordset.

5.) Ensure the shaft encoder model chosen is applicable to meet the subsystem tracking criteria based on conveyor belt speed/resolution required.

C. Electrical Device Identification

1. The electrical control stations, their related control devices, field wired control devices shall be identified with a permanently attached white phenolic plate, engraved with black characters, providing the identification of the control station or control device. Dymo-type labels are not acceptable. Do not attach the white phenolic plate to any field device that can be easily replaced due to failure ((i.e. plug-in type photocell or its wired base) as this would also require the removal and reattachment of the ID plate), attach the plate to the side guard or non-removable structure adjacent to the device.

2. The electrical control stations, their related control devices, field wired control devices and the electrical control devices mounted within the BHS related motor control panels (MCPs) shall use the following device identification format and designations. The format and identification that are used in this specification are to be used throughout the BHS project and are to appear on the designated equipment and the entire project related documentation.

a. Control Stations

1.) Control Stations shall be identified with the prefix CS followed by the actual Conveyor or BHS Equipment Identification Number to which the Control Station is related. For example, CS/TC12-6 identifies a Control Station located on Ticket Counter Subsystem #1 related Conveyor #6. Note that when there is more than one Control Station associated with a Conveyor or BHS Device, alpha designators will also be used. For example, CS/TC12-6A, CS/TC12-6B, CS/TC12-6C signifies that Ticket Counter, Subsystem #1 related Conveyor #6 has three Control Stations. The "A" alpha designator

identifies the Station related to the charge end of the Conveyor while the last or highest letter indicates the Station closest to the discharge end of the Conveyor.

2.) Each Control Station shall be identified with a permanently attachedwhite phenolic plate, engraved with black characters, providing the identification of the Control Station. Dymo- type labels are not acceptable.

b. Control Station Devices

1.) Control Station Devices shall be identified as follows:

Control Station Device	Identification
Start Re-Start Pushbutton	SPB
Normal Stop Pushbutton	PBS
Emergency Stop Pushbutton	EPB
Reset Pushbutton	RPB
Selector Switch	SSW
Key Operated Switch	KSW
Sonalert Warning Device	ALM
Bag Advance Switch	BAS
Lamp Test Pushbutton	TPB
Alarm Silence Pushbutton	APB
Door Close Pushbutton	CPB
Door Open Pushbutton	OPB
Up Pushbutton	UPB
Down Pushbutton	DPB
Jog Pushbutton	JPB
Jog Selector Switch	JSW
Colored Indicator Light (the first letter of the lamp color will appear instead of the underscore)	LT_

2.) For example: The designation CS/TC12-6/RPB identifies a Reset Pushbutton in the Control Station located at Ticket Counter Conveyor TC1-6.

3.) Note that the above Control Station Device designations are to appear on all electrical drawings, including wiring and schematics.

4.) Control Station Control Devices (pushbuttons, pilot lights, switches and audible alarms) identification descriptors shall be clearly identified by permanently attached white phenolic plates, engraved with black characters, except emergency stop devices which are to be red with white letters, showing their operational relationships to the system(s) or subsystem(s).

5.) All e-stop pushbuttons shall clearly indicate all conveyors affected by that e-stop (i.e.: TC12-1/TC12-8 indicates that the E-stop will stop conveyors TC12-1 through TC12-8). Dymo - type labels are not acceptable.

6.) All Jam reset pushbuttons shall indicate the conveyor segments, which are controlled by that jam reset control station.

7.) Control Station Control Device Function ID Tags must be positioned for ease

of reading. Align the tag's legend so that it is legible (oriented) from the operator's access side of the control station.

c. Field Wired Control Devices

1.) Photocells shall be identified as PE followed by the Identification of the Baggage Handling Device or Conveyor on which the Photocell is mounted. For example: PE/TC12-5 identifies a Photocell located on Ticketing Conveyor TC12-5.

2.) Limit Switches shall be identified as LS followed by the identification of the Baggage Handling Device or Conveyor to which the Limit Switch is related. For example: LS/TC12-2 identifies a Limit Switch on Ticket Counter Conveyor TC12-2.

3.) Warning Alarms shall be identified as WA followed by the Identification of the Baggage Handling Device or Conveyor to which the Warning Alarm is related. For example: WA/TC12-1 identifies a Warning Alarm associated with Ticket Counter 12.

4.) Lights shall be identified as LT followed by the identification of the Baggage Handling Device or Conveyor on which the light is mounted. For example: LT/OS1-1 identifies a light located adjacent or mounted on Oversize Bag Conveyor OS1-1.

5.) Hour meters shall be identified as HM followed by the identification of MCP to which the hour meter is related. For example: HM/MCP-l identifies an hour meter on motor control panel MCP-l.

6.) Shaft Encoders shall be identified as SE followed by the identification of the Baggage System Conveyor on which the Shaft Encoder is mounted. For example: SE/ML1-24 identifies a Shaft Encoder mounted on Mainline Conveyor ML1-24.

7.) 12.) Motor Safety Disconnect Switches shall be identified as "MSD" followed by the identification of the Baggage System Conveyor to which the Motor Safety Disconnect Switch is related. For example: MSD/TC12-01 identifies a Motor Safety Disconnect Switch related to Ticket Counter Conveyor TC12-01.

8.) Field Wired Control Devices (Security Card Readers, Photocells, Limit Switches, and Bag Status Displays) are to be clearly identified by permanently attached white phenolic plates, engraved with black characters with the control device ID. Dymo type labels are not acceptable.

9.) All field installed Junction Boxes are to be provided with white phenolic plates engraved with black characters. The ID tags are to be located, so as to be easily read from the adjacent maintenance access areas. The ID tags must be consistent with the associated subsystem identifications noted on the wiring schematics. For example the second junction box from MCP-TC12 would be "JB/TC12-02".

d. Control Devices within Motor Control Panels and Operator Workstations

1.) The identification of control devices and components such as relays, timers, transformers, power supplies, overloads, fuses, and PLCs within motor control panels, Operator Workstations and computer cabinets must be

identified with ID tags.

2.) The ID tags must be constructed of a white phenolic plate engraved with black characters. Dymo type labels are not acceptable. The ID tags must be located so that they can be easily read when the related motor control panel, workstation or computer cabinet door is opened.

3.) The ID tags are not to be mounted on the covers of the plastic wireways within the related cabinet or control panel.

4.) The ID tags for motor starters must contain the conveyor ID. For example: The motor starter ID tag for conveyor TC12-1 would be "TC12-1M".

2.9 MOTOR CONTROL PANELS (MCP)

A. General

1. All control equipment for the newly installed subsystems shall be housed within new motor control panel(s) for the associated subsystems. Ensure capacity within the panel(s) for all necessary control devices.
2. All control equipment for the existing conveyor subsystems that are designated to remain shall be housed within existing motor control panel(s) for the associated subsystems.
3. Provide motor control panels that are UL listed employing NEMA 12 enclosures with fully gasketed doors for interior use or NEMA 4 enclosures for exterior located MCP(s) (or applicable local codes).
4. The MCP shall include a fusible disconnect switch (with Class J or R fuses) or molded-case circuit breaker for the incoming power supply. Additionally, the fused disconnect switch for the MCP shall have the following features:
    a. Flange enclosure construction where the external handle, connecting bar/cable and disconnect switch are always connected regardless if the MCP door is open or closed.
    b. Provides a quick make / quick break design.
    c. Provides an indication at the circuit breaker or the fusible disconnect switch inside the MCP that the disconnect is in the ON or OFF position.
    d. Provides a color-coded external handle which shall provide visual indication external to the MCP if the disconnect switch is in the ON or OFF position.
    e. Provides the ability for the external handle to be padlocked in the OFF position for to support Lock-out / Tag-out requirements
    f. Provides a mechanical interlock to prevent the disconnect switch from being moved to the ON position unless the mechanical interlock is operated.
    g. Provides a mechanical interlock with the motor control panel door to prevent the motor control panel door from being opened with the disconnect switch in the ON position. The disconnect switch mechanical interlock to the door must have a manual override provision to permit the opening the door by qualified personnel using appropriate tools with the disconnect switch in the ON position.
5. Provide a plexiglass Safety Shield with standoffs (or similar suitable finger-safe protection provisions) over the fuses / circuit breaker for the incoming 480v relating to all MCPs.

6. The exterior of the MCP must be painted. The interior of the panel or cabinet including the mounting panel shall be painted white.
7. Ensure that all Motor Control equipment complies with NEMA Standard ICS-1, ICS-2, UL publication 845 and other applicable standards of NEMA, UL, IEEE, ANSI and National Electrical Safety Codes (or applicable local codes).
8. Provide thermostatically controlled cooling fans or air conditioning units within the MCP cabinet to monitor and prevent internal temperatures from exceeding component environmental limits that are sized based on an ambient temperature of 100°F (configurable). Provide replaceable or cleanable filters on the intake vents. Configure, through appropriate controls functionality, the cooling equipment to run when the respective subsystem is operational, and the pre-set ambient temperature is exceeded. The MCP cabinet over-temperature (e.g., 120° F) shall be monitored by the MDS, which is described elsewhere in this specification. When the MCP temperature exceeds the pre-set limit (which shall be configurable) a distinct alarm message shall be displayed on the MDS graphics and text display. Provide separate circuits for the power and control of the MCP cooling fans; note that these circuits shall originate within the respective MCP.
9. Prior to the installation of overload heaters on the controllers, submit a motor schedule listing motor horsepower, voltage, phase, source of feed, circuit breaker size, disconnect size, conduit and wire size and overload heater size selected to be used.
10. Base interrupting rating of all circuit breakers, fused disconnect switches, motor control centers, and panel boards on short circuit calculations and ensure they are compatible and coordinate with base contract equipment. Refer to National Electrical Code Articles 110 and 430 (or local applicable code) to determine short circuit and overload requirements.
11. Mount overload protection for each starter directly above the starter.
12. A laminated card showing motor schedule with horsepower, fuse size and heater size shall be affixed to the inside of the MCP door.
13. The working space in front of the MCP panel shall be a minimum of 36". In all cases, the workspace shall permit at least 90 degree opening of the MCP doors. Refer to National Electrical Code Article 110 (or local applicable code) to determine working space requirements.
14. For any MCPs, power distribution panels, or other electrical enclosures, that are not located on a raised curb or raised floor (on a housekeeping concrete pad), provide a concrete or galvanized steel plinth, pedestal, legs or similar means to raise the MCP, power distribution panels, or other electrical enclosures, a minimum of 4" above the floor to minimize the possibility of any ground water damage to the MCPs, power distribution panels or other electrical enclosures.
15. Appropriately sized insulated bushings/seals shall be installed on all conduits and conduit fittings that enter/exit the Motor Control Panel(s).
16. The BHS Subcontractor shall supply and install transformers as necessary to power the MCPs to provide control and convenience power in the MCP.

B. Installation Requirements

1. Comply with the following design and installation requirements:
    a. Wire the line side of fuses or circuit breakers to a line side terminal strip for their incoming supply.

b. Wire the load side of the magnetic starter to a load side terminal strip for the outgoing load.

c. Connect all control wires to terminal strips designated for control wiring.

d. Make vertical runs of power and control wiring within the panel on either or both of the right or left sides of the backboard.

e. Run horizontal runs of power and control wiring between the horizontal rows of starter/fuse block units.

f. Enclose all vertical and horizontal wiring in plastic wireways.

g. Make minimal wire runs to and from these wireways only to the nearest adjacent fuse block starter or terminal block.

h. Use of "latching relays" is not acceptable.

i. Use of "alternating relays" is not acceptable.

j. Any "plug in" type device such as a relay, or IEC starters must be equippedwith a spring clip type restraint to prevent the "plug in" device from becoming loose in its socket.

k. Splicing of control or power wiring within any MCP is not acceptable. All internal and external "field" wiring must be terminated on the appropriate MCP terminal strips.

l. Appropriately sized insulated bushings shall be installed on all conduits or conduit fittings that enter the related MCP.

m. All fuses will be of the appropriate type and size of the FRN or FRS dual element type.

C. Panel Identification

1. Each Motor Control Panel must be identified with an ID Tag mounted on the outside face of the Panel Door to the immediate left of the MCP Main Disconnect. The Tag shall identify:

   a. MCP Designation

   b. Related Baggage Subsystem

   c. Related Conveyors or Devices Controlled by the MCP

2. The ID Tag shall be constructed of a white phenolic plate with a minimum thickness of 1/8" engraved with black characters. The ID Tag engraved characters shall be a minimum height of 1" or greater as required for readability.

3. Provide a permanently attached white phenolic plate, engraved with black lines and characters of the subsystem layout, on the door face of each BHS Motor Control Panel, illustrating a graphic representation of the respective subsystem. Orientation of the graphic representation shall be the same as the actual subsystem. The MCP layout map shall be consistent with the Graphic Display of the MDS Operator Workstation equipment, which shall monitor the faults of the entire outbound baggage handling system.

4. The ID Tag shall be secured to the MCP door surface with a minimum of four rivets or screws combined with an appropriate adhesive. Large tags shall require a minimum of four rivets or screws, one for each corner of the tag.

D. Utility Outlet

1. In each enclosure or cabinet include a minimum of one appropriately fused grounded duplex receptacle utility outlet meeting locally applicable standards of 120 volt, 20-ampere capacity conveniently located.
2. The outlet is to be fed from the line side of the MCP power source so that the outlet power will remain on regardless of the condition of the MCP power.
3. The hot wire providing power to the outlet shall be yellow. All terminations of this wire shall be guarded in order to protect personnel from accidental contact. Mount a warning on the outside of the panel, next to the disconnect switch stating: “CAUTION - THIS CONTROL CABINET CONTAINS YELLOW WIRES WHICH WILL REMAIN “ENERGIZED” WHEN THE DISCONNECT SWITCH IS TURNED OFF.”

E. Lighting

1. Equip each enclosure or cabinet with an appropriately fused fluorescent lamp extending at least three quarters of the width of the panel. Operate the lamp by a switch located inside the enclosure on the latch side of the primary door so that the light becomes illuminated whenever the enclosure or cabinet door has been opened.
2. The lamp(s) is to be fed from the line side of the MCP power source (supplied by others unless otherwise noted) so that the fluorescent lamp will remain on regardless of the condition of the MCP power.
3. The hot wire providing power to the lamp shall be yellow. All terminations of this wire shall be guarded in order to protect personnel from accidental contact. Mount a warning on the outside of the panel, next to the disconnect switch stating: "CAUTION - THIS CONTROL CABINET CONTAINS YELLOW WIRES WHICH WILL REMAIN “ENERGIZED” WHEN THE DISCONNECT SWITCH IS TURNED OFF."

F. Control Devices

1. General
   a. All MCPs are to be equipped with the following control devices regardless of the type of status monitoring being employed:
      1.) System Ready Indication Lamp
         a.) The MCP shall be equipped with a Green Indicator Lamp, which shall become illuminated to indicate that the system is ready for start-up and no faults are indicated on the MDS.
      2.) MCP Re-Start Pushbutton Switch
         a.) A green momentary contact start pushbutton switch is to be provided for each system or subsystem that is controlled from the MCP. The MCP Re-Start Pushbutton Switch shall not be able to start the subsystem from a non-operational mode. It shall only be able to Re- Start the subsystem if the MCP fault has been cleared.
      3.) MCP Emergency Stop Pushbutton Switch
         a.) Each MCP shall be equipped with a red illuminated maintained contact mushroom head pushbutton switch for each system or subsystem controlled from the MCP.
      4.) Jam Indication

a.) Amber Indicator Lamp shall be used to indicate a Jam condition. The Jam Indicator Lamp shall become illuminated whenever a Jam Detector within the subsystem has sensed a Jam Condition. The Indicator Lamp shall remain illuminated until the Jam Condition has been corrected.

5.) Motor Overload Indication

a.) Blue Indicator Lamp shall be used to indicate Device or Conveyor Groups in which one or more Motor Overloads have tripped. The Motor Overload Blue Indicator Lamp shall become illuminated whenever a Motor Overload Condition develops and shall remain illuminated until the tripped Overload has been reset.

6.) Alarms

a.) Start-Up/Fault Warning Alarm(s): Each MCP shall be equipped with one amber rotating beacon and one audible horn (see below) to indicate imminent subsystem start-up or faults (such as but not limited to jams and motor overloads). The design of the control circuitry shall be such so that multiple faults will always activate the audible and visual alarms; i.e., if a jam condition has activated the fault alarms and the alarm silence pushbutton has been depressed but the actual fault has not yet been corrected, a second fault occurring after the alarm has been silenced shall again activate the alarm.

b.) Emergency Stop Warning Alarm(s): Each MCP shall be equipped with one red rotating beacon and one audible horn to indicate an Emergency Stop situation in the subsystem.

7.) Alarm Silence Pushbutton Switch

a.) Each MCP shall be equipped with a yellow momentary contact "Alarm Silence" pushbutton switch. Activating the Alarm Silence Pushbutton shall silence the Audible Warning Alarm. However, the appropriate Indicator Lamp shall continue to be illuminated until the Fault Condition (such as but not limited to jam, motor overload, and e-stop.) has been corrected.

8.) Lamp Test Pushbutton Switch

a.) Each MCP shall be equipped with a yellow momentary contact "Lamp Test" Pushbutton switch. Activating this common lamp test push button shall test/illuminate all indicator lamps on the MCP door.

G. System Status

1. Status Monitoring on the MDS Workstations

a. Each conveyor subsystem's (new and existing modified conveyor) status shall be monitored by the current BHS Maintenance Diagnostics System (MDS) Operator Workstations, TSA Satellite Workstations and BHS Satellite Workstations.

2.10 CONTROL SYSTEM DESIGN

A. General Design Requirements

1. This control system specification is intended to define the overall functional requirements of the system. The BHS Subcontractor is responsible for the definitive architecture, design, engineering and all associated interface with the facility systems (e.g., Fire Alarm, Access Control System, and the like), and other Computer Systems as necessary to provide the functions specified herein.

2. The design philosophy that shall be adopted for the control system shall be one of hierarchical control. Centralized supervisory and maintenance control shall be accomplished by fully redundant computers. The outbound system status will be monitored (both graphics and textual displays) by the centralized MDS Operator Workstations, which shall be located in the Operations Control Center and the satellite MDS workstations and Remote Status Monitors that shall be located remotely. The Sort Controllers, MDS, MIS Database and Software Application Servers shall be located within Server Rooms adjacent to the Operations Control Center and shall include all sortation and reporting functions that are associated with the BHS .
3. All of the Central Terminal outbound conveyor subsystems shall be controlled by centralized programmable logic controllers (PLCs) with Hot Back-up for redundancy purposes, which shall be located in the Server rooms adjacent to the Operations Control Center. There shall be an independent set of PLCs and related communications networks associated to the Central Terminal BHS.
4. Identify the philosophy on which the BHS control system design is based and clearly identify in detail the proposed control system architecture, the major components to be utilized and the methodologies employed for software development. In addition, the following philosophy shall be adopted in the BHS control system design:
    a. No single fault can bring down the entire system i.e. no single point of failure
    b. The system can be easily and economically enhanced to meet the future requirements in the next fifteen (15) years (e.g. add/increase hard drive(s), RAM capacity, increase operating speed (CPU upgraded))
5. Understanding the design shall be the result of modifications/refinements to the minimum requirements established herein.
6. Submit for MDAD's review, a comprehensive and detailed Functional Controls system description. This description shall include full details of operational procedures and control system provisions associated with the BHS including but not limited to the following:
    a. Control system development and implementation master schedule
    b. Schedule of system hardware employed (main elements)
    c. Interfaces to Terminal Fire Alarm and Security Access Control Systems as required.
    d. Start-up/shutdown procedures
    e. Description of conveyor control logic outlined by subsystem
    f. Data input and output routines (i.e., management/maintenance information systems)
    g. Automatic operational/maintenance/defect/status routines (including format)
    h. Audio/Visual indications
    i. Control station layouts/functions/operations
    j. Communications Highways, Redundancy, Schematics and product specifications
    k. Proposed overall system architectural diagram clearly identifying modifications and additions to the existing lower level controls with respective data communication highways.
7. Attend a minimum of one (1) mandated control system meeting at the job site or

MDAD's office to review the Control System Functional Specifications and Electrical Control System design, the Fire Alarm and Security Access Control Systems. This meeting shall be in addition to the required coordination meetings with other Contractors, MDAD, MDAD IT, etc. Submit all material to be reviewed at the meetings at least two weeks prior to the meetings. The control system meetings attendance will include as a minimum, representatives from the user Airlines (as necessary), the BHS Subcontractor, and MDAD and/or their representatives. The meeting shall review the following minimum discussion items:

a. Design Considerations - Meeting No. 1

1.) BHS Computer and PLC Interface Requirements

a.) Hardware Requirements

b.) Software Requirements

c.) Existing and new Fire/Security Door and Security Card Swipe Interfaces

d.) Interface requirements for Fault Monitoring of Existing Systems not modified by the Project.

2.) Subsystem control functions Baggage Flow/Logic/PLC Control. At a minimum review, the following:

e.) Start-up/Shutdown Procedures

f.) Jam Detection and "Restart" Procedures

g.) Cascade Operation

h.) Emergency Stop and "Restart" Procedures

i.) Audio/visual indications and locations

j.) Fire/Security Door and Security Card Swipe Procedures

k.) General Control Logic per Subsystem

l.) Outstanding Issues

8. Control System Elements

a. The control system (comprised of the High Level Controls and Low Level Controls) provided for Central Terminal shall comprise (as a minimum) the following elements:

b. The following elements are considered to be a part of the High Level Controls:

1.) MDS Computers which allow for the following functions:

a.) Automatic switching to a "hot back up" fully redundant MDS computer.

b.) Collect and store data from the sortation and field PLCs to include in reports and status displays at the BHS workstation.

c.) Software program(s) as required to accomplish the functions specified herein.

2.) BHS Operator Workstations which allow for the following functions:

a.) Software program(s) as required to accomplish the functions specified herein.

b.) Keyboard units for command and data input to the sortation control system.

c.) Video Display Units (VDU) for data output.

d.) High-speed color printers (one for the Central Terminal Operator Workstations and one for the South Terminal Operator Workstations).

e.) Communication modems.

f.) Transfer switches/interface modules/selector switches.

3.) Communications highways

4.) Local Area Networks (LANs)

c. The new control system shall comprise (as a minimum) the following elements which are considered to be a part of the Low Level Network:

1.) Subsystem MCPs

2.) Programmable Logic Controllers (PLCs), which control the outbound BHS by communicating with the system devices, level equipment (such as but not limited to photocells, motor starters, encoders, and the like)

3.) Remote I/O located in the subsystem MCPs.

9. Hardware: All control systems hardware for the BHS Computer and the BHS PLC systems, and associated purchased software shall be supplied by manufacturers whose products are supported locally, and can demonstrate a minimum of five (5) years' experience in providing control systems for conveyor systems of similar size. MDAD must approve any equipment that does not meet this requirement.

10. System Design Parameters

a. The system design shall pay attention to the following requirements:

1.) High throughput capacity 2.) Energy conservation

2.) Satisfactory environment

3.) Operational flexibility

4.) Component and system reliability (including back-up provisions)

5.) Multiple flow paths to permit continued operations despite equipment failure or momentary peaks.

6.) Default capability (anti-grid lock) to ensure that in the case of saturation of any subsystem a back-up and failsafe alternate process path or discharge point is available (i.e., in no case shall total system saturation occur). Provide "anti-gridlock" software.

11. Environment: All communication and equipment must be capable of functioning in an industrial environment. Where special environmental conditions are essential for correct equipment operation (e.g. computer hardware), such requirements control must be clearly identified in the submittals identified in this specification. Factors such as dust, air contamination, and heat from local sources, abrasives, moving or falling objects, or vibration shall also be considered. Advise of the necessity for these provisions as well as the specific requirements for each system.

12. Responsibility for Supply and Installation

a. Supply and install all necessary Baggage Handling Server / Operations Control Center area and Control System hardware that is required for the BHS installation, to provide a fully functioning system on a "turnkey basis; this includes all related control consoles, monitors, control stations, PDPs, MCPs, PLCs and associated mounting structures to satisfy the implementation of the BHS.

b. Coordinate the requirements of the control system elements in the BHC System Server racks/cabinets MCP/PLCs, field control components and related functions with MDAD.

13. Responsibility for Programming

a. Program the BHS Computers and PLCs for all conveying, and reporting functions associated with the project. Program the control system interfaces between the BHS and any other interfacing system (e.g. Fire Alarm and Access Control Security Systems).

b. Program all monitoring system functions, associated with the BHS project. These functions shall include:

1.) Provide audible and visual system alarms at the Operator Workstation(s) (e.g. both on the computer monitor and, on the printers,).

2.) Real time reaction to a failure and the capability of choosing alternate paths from the monitoring system.

c. Programming techniques, data structures, and documentation shall be acceptable to, and approved by, MDAD. Details of the above shall be made available to MDAD.

d. Submit the as-built programming documentation for the BHS computers, PLCs and system monitoring computers to MDAD as follows:

1.) Two complete (duplicate) CD sets covering all applicable computer, PLC and system monitoring programming documentation.

2.) Two complete (duplicate) sets of hard copy documentation (all programs).

3.) Software for the BHS computer systems as well as the BHS PLC control system including all PLC ladder logic shall be provided in both searchable .pdf format and software versions.

4.) The system software shall be written using as much non-proprietary software as possible.

5.) Delivered software shall include both executable files and fully commented source code for all applications (with the exception of purchased "off the shelf" software). Include all 3rd party software required to view or edit the source code. Establish with a reputable escrow service company a "software escrow account" for all withheld source code as well as documentation required to reconstruct the executables to invoke "prior intellectual property" rights and withhold source code for any system. This software escrow account must provide MDAD access to the source code and documentation for a minimum of 10 years. Access to the escrowed information will be authorized in the event of the BHS Subcontractor's inability to correct design errors in the software, contract default, insolvency or termination of business activities.

14. System Redundancy

a. Preserve all redundancy functionality incorporated in the existing system.

B. Computer and PLC Control System Architecture

1. General

a. The current Computer and PLC Control System Architecture and equipment shall be utilized for this project.

b. The Control System Network Architecture for the and Central Terminal Outbound BHS shall be one of centralized Baggage Handling Computer (BHC) System design per Terminal and a centralized redundant Hot Back-up PLC system design with remote I/O per Terminal. The control system for each Terminal are primarily controlled by new PLCs, these PLCs interface with two (2) types of equipment:

1.) BHS field devices (such as but not limited to motors, sensors scanners, and encoders)

2.) MDS computers

c. The BHS conveyor control system shall be based on multiple Programmable Logic Controllers (PLCs) per Terminal, interconnected to each other by the BHS low-level data communication highways.

d. Local area networks (high level communications) are employed to provide data messaging between the BHS computers and PLCs. Provide industrial network(s) to link together distinct remote stations..

e. BHS computer system equipment and outbound BHS PLCs (primary and hot back-ups) are located in the server rooms adjacent the Operations Control Center and I/O located within the Motor Control Panels.

C. Building Fire System

1. The BHS shall interface directly with the building fire system (via the airport backbone network). Coordinate the specific origin of the building fire alarm system information and requirements with MDAD. The intent is the interface to take place at the MCP associated to the fire door. The wiring from the building fire alarm system to the MCPs should be provided under Division, Section 28 15 00.

2. Coordinate with the Fire Marshal, MDAD or their representatives the location of all fire zones and for the shutdown of conveyors and fire doors impacted by a fire alarm.

3. Clearly display alarmed fire zone(s) on the MDS display.

D. Programmable Logic Controller (PLC) Functional Description

1. Provide Programmable Logic Controller(s) (PLCs) for direct interface between all input and output devices in the BHS. Wire emergency stop circuits through mechanical control relays which, when interrupted, will remove all power from the output modules of the PLC.

2. Provide each PLC with an EPROM or similar safeguard to provide memory backup.

3. Provide PLCs with Ethernet capability for connection to external devices, such as workstations.

4. Provide each PLC with a minimum of 15% excess memory or capacity for 10% expansion and each I/O with space for adding 10% more modules.

5. Input/output (I/O) modules shall have a visual indication of the status of each I/O point. The status displayed shall be for both signals input into each I/O module and the output

signal from each I/O module

6. Provide a fully annotated printout as well as a software copy of the up-to-date PLC software and program.
7. All PLCs shall employ a battery back-up system capable of storing data for a minimum period of two hours, should a power outage occur.
8. In the event of an emergency stop or a power outage on a subsystem, the PLC shall retain all baggage tracking information such that upon restart of the conveyors, the subsystem shall route bags to the appropriate location(s).
9. The primary function of the Programmable Logic Controllers (PLCs) shall be the control of all conveyors including, but not limited to:
    a. Tracking of baggage on conveyors from shaft encoders and strategically located photoelectric sensors for verification.
    b. Tracking shall be of shift register methodology; the use of FIFO shall not be implemented.
    c. Jam detection
    d. Normal Start/stop routines
    e. Auto-Stop/Auto-Start timing circuits and start-up routines
    f. Actuation of pushers, diverters, or vertical sort units.
    g. Cascade stop control
    h. Inch-and-Store control, start/stop routines
    i. Control of associated feed conveyors
    j. Confirmation of bag received on make-up devices / sort piers
    k. Statistical reporting to MDAD's BHS computers
    l. Selection of alternate flow paths in the event of a failure
    m. Self-diagnostics
10. All PLCs interface modules and I/O cards shall be located in MCP cabinets.
11. Commonality of PLC manufacturers shall be maintained utilizing the minimum number of individual models.
    a. Data Communications Interface
        1.) Electrical interface to be EIA RS-232C or RS-422.
        2.) Date format shall be bit-serial ASCII and must be able to work with 7 or 8 data bits.
        3.) Baud rate shall be selectable: 9600, 14400, 28800, 36600 or 56,000 baud.
    b. Transmitted/Received Data

E. Network

1. General
    a. The intent is that the existing BHS high-level and low-level data communication networks shal be used for this project.

F. Low Level Network Architecture

1. ControlNet (or approved equivalent) may be installed as an industrial network to link together and provide high-speed communications between distinct remote components of the outbound BHS. The network must be capable of a minimum scan time of 5msec and be capable of receiving, processing, and transmitting information within 50msec or as required to facilitate baggage tracking. The network must be capable of operating in a hot backup configuration without any degraded functionality. The cables that form the main backbone shall not have the same cable-laying route and shall be routed a minimum distance of 15' 0" apart from one another. This shall ensure that in the event of cable mishap involving a single cable the backbone will not be lost.
2. The network communication speed must not be less than 5 M bits/sec. The network architecture should be designed to optimize data transfer between network devices to fulfill the required time constraints.
3. At a minimum, shielded cable shall be used as the physical media to connect components of the network. Cable must be capable of normal use in high noise environments. NEMA approved cable taps, connectors, and adapters suitable for use in a bagroom environment must be used. Fiber optic cable should be used wherever possible.
4. Particular attention must be given to voltage across network components.
5. Refer to manufacturer's literature for exact range of voltage potential.
6. Appropriate power supply ratings must be considered and applied for network components.
7. Repeaters must be used as recommended by the manufacturer to maintain network communication speed and reliability.
8. The network architecture must be designed to operate in conjunction with multiple processors. A minimum of 99 addressable nodes must be available for communication. Communication with essential components shall be prioritized and used for reporting. The overall allowable length of the network cabling and remote components must be at least 15,000 feet.
9. Redundant ControlNet system (or equivalent) must be utilized. 10.) No more than 32 I/O points may be assigned to each I/O module.

A. Maintenance Diagnostic System (MDS)

1. Update the current centralized diagnostic system for use by trained operations and maintenance employees to accomplish the following:
    a. Display and locate any system malfunction or failure through text or graphic simulation of the entire system and text display.
    b. Visually monitor the oerational configuration, including conveyor flow direction, operational status (On/Off/E-Stop/Overload) and operating mode (such as but not limited to cascade and indexing).
    c. Isolate location and cause of equipment failures.
    d. Initiate fallback procedures.
    e. Display status of all monitored fire/security doors in the South and Central Terminals plus the North Terminal Inbound systems (such as but not limited to intrusion detected, open, closed, or malfunctioning).

f. The MDS system is designed and installed shall be such, that MDAD's maintenance personnel can easily modify/add subsystems, display faults, and modify/add reports in the event that additional/modified subsystems are installed as part of any future project (i.e. very user friendly).

2. The diagnostic monitors shall identify the following conditions (this listing is not to be construed as being all inclusive):

   a. Emergency Stop Actuated (identify location)

   b. Motor Overload Tripped (identify location)

   c. Excessive actuation time of a conveyor sensor (other than in a normal queue/accumulation condition) to identify a probable jam condition or similar operational problem (identify location)

   d. Photocell failure (identify location)

   e. System configuration (Mode Of Operation)

   f. Operational status

   g. Failure of tracking encoder/pulse generator

   h. Over Temperature Warning for any computer or PLC cabinets

   i. Fire Alarm System Faults

   j. PLC Failure (identify location)

3. Operator Workstations Graphic Screens

   a. The graphics screen shall display, in near real time, dynamic pictorial format, the operational status of individual conveyors and sort devices that are connected to the sortation control system and system programmable logic controllers. Framed icons and specific conveyor IDs representing the conveyor sections shall change color according to the following scheme. This shall immediately highlight problem areas so that the problems that arise may be corrected in the minimum amount of time.

Condition	Color
Normal Running Mode	Green
E-Stopped	Red
Fire Alarm	Flashing Red
Over Temperature	Flashing Red
Communications Loss (Individual Components)	Red
Jam	Yellow
Missing Bag Jam	Yellow
Overlength/Overheight	Flashing White
Motor Overload	Blue
VFD Fault	Flashing Blue
Cascade Stopped	Magenta
Timed Out	Black
Out of Service	Brown
BHS Fault	Flashing Red

Data Communication Error	Yellow
Shaft Encoder Fault	Cyan
Ticket Counter Normal Running Mode	Green

b. Graphics Manipulation

1.) The system operator shall have the capability to zoom in on any portion of the BHS on any of the two graphics monitors.

2.) Each portion of the BHS, split between the two screens, shall have predefined sectors for the purposes of the dynamic zoom function. Once selected, the individual conveyor shall be displayed in greater detail, with all functionality as described previously, such as color depiction of conveyor status. In addition, textual descriptions of all related status shall be displayed (i.e., motor disconnect on/off, motor starter normal/overload, conveyor running/E-stopped/ cascaded/jammed/ timed out).

3.) In the zoom steps, the overall system normally displayed on that associated graphics monitor shall be shown on a reduced scale in the corner of the screen with the zoomed sector shaded for reference. This reduced display shall disappear upon return to the overall system display.

4.) A single keystroke or mouse click shall return the operator to the previous zoom display.

5.) Should one graphics monitor fail, the second shall display the entire system with all zoom functionality as described above by means of an operator initiated command on the textual operator interface monitor.

c. Operator Workstation Text Monitoring

6.) It shall be possible to configure the MDS application at the BHS workstations to provide system status in text format.

7.) In a manner similar to the graphic screens, the text format shall use dynamic text to represent conveyor sections status. The fields next to the conveyor IDs noted above change color and value according to the following scheme:

Condition	Color	Text Displayed
Normal Running Mode	Green	Running
E-Stopped	Red	E-Stopped
Fire Alarm	Red	Fire Alarm
Over Temperature	Red	Over Temperature
Communication Loss	Red	Communication Loss
Jam	Yellow	Jam
Missing Bag Jam	Yellow	Missing Bag Jam
Overlength/Overheight	White	Oversize
Motor Overload	Blue	Overload
VFD Fault	Blue	VFD Fault
Cascade Stopped	Magenta	Cascade Stopped
Timed Out	Black	Timed Out

Out of Service	Brown	Out Of Service
Communication Error	Yellow	Communication Error
Shaft Encoder Fault	Cyan	Shaft Encoder Fault

G. Software Confidentiality

1. The BHS Subcontractor shall not disclose, or use in future work, any proprietary operation information of MDAD's facility, or any information considered a trade secret by MDAD, which was obtained during the course of the project work.
2. Except as otherwise required by law, MDAD will not publicly disclose trade secrets or proprietary software information obtained from the BHS Subcontractor in the performance of the BHS Subcontractor's obligations pursuant to this Contract. To the extent it is necessary to provide the BHS Subcontractor's trade secrets or proprietary software information in order to operate or maintain the BHS, MDAD, by contract, will prohibit MDAD's operation and maintenance contractor from publicly or privately disclosing the BHS Subcontractor's trade secrets or proprietary software information.
3. Any information that the BHS Subcontractor believes is a trade secret or proprietary software information shall be specifically identified and marked as such. Blanket type identification shall not be permitted.
4. In the event MDAD receives a request for the BHS Subcontractor's specifically identified trade secrets or proprietary software information, MDAD will notify the BHS Subcontractor and the BHS Subcontractor will be required to fully defend, in all forums, MDAD's refusal to produce such information.
5. All software version upgrades which are compatible with the system design and bug fixes for proprietary software shall be provided during the one-year warranty period.

H. Source Code

1. All software shall be delivered with well-commented source code in addition to the executable version. Software shall be delivered in both hard copy and machine- readable formats on a media acceptable to MDAD. The BHS Subcontractor may propose a non-disclosure agreement.
2. MDAD shall have permission to use the software as necessary to support operations at South and Central Terminals, Miami International Airport, Miami, Florida once obtained from the BHS Subcontractor.
3. A backup copy of the configured system software shall be provided on DVD-ROM media or a portable hard drive. All original distribution software shall be delivered with an installable backup. While DVD-ROM is the preferred media types, portable hard drive or tape is acceptable if required by the specific software.

- END OF PART 2 –

3. EXECUTION

3.1 PREPARATION

A. General

1. The BHS Subcontractor shall verify conditions in the field prior to start of work. If unanticipated mechanical, electrical, or other elements that conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit written report to MDAD in accurate detail. Pending receipt of directive from MDAD, rearrange work schedule as necessary to continue overall job progress without undue delay.
2. Cover and protect systems and equipment from damage and soiling during installation, demolition, removal or alteration work, including equipment to be salvaged and stored.
3. Provide supports or bracing to prevent movement, settling, or collapse in which an area is to be removed and adjacent system is to remain. If safety of system appears to be endangered, cease operations and notify MDAD immediately. Take precautions to support endangered work until determination is made for continuing operations.
4. Locate, identify, stub off and disconnect electrical system services that are not indicated to remain, abiding by the most current version of the NEC. Provide bypass connections to maintain continuity of electrical service to remaining system. Obtain permission and provide advance notice to MDAD if shutdown of electrical service is necessary during changeover.

3.2 WORKMANSHIP

A. General

1. Ensure that all equipment is manufactured and installed in accordance with the best commercial practices consistent with the intended design and usage and is acceptable to MDAD. Ensure that all material and components are new and free from defects. Do not provide used equipment, whether refurbished or reconditioned, unless indicated in the specifications and drawings or without the express approval of MDAD.
2. Perform installations, demolition, removal and alteration work as shown within the specified BHS right-of-ways, with due care, including support and bracing. Be responsible for damage, which may be caused by such work, to any part of existing system or items designated for reuse.
3. Perform restoration and new work in accordance with applicable technical sections of the specifications. Where cutting and new work involve the exterior building envelope, consult MDAD to ascertain if existing guarantees, warranties or bonds are in force and execute the work so as not to invalidate such agreements.
4. Execute the work in a careful and orderly manner, with the least possible disturbance to the public and to the occupants of the building(s).
5. Materials installed by the BHS Subcontractor, whether provided by him or not, shall be installed in a neat and workmanlike manner. Particular attention shall be paid to manufacturer's instructions as to installation procedures.
6. The BHS Subcontractor shall comply with all appropriate safety measures as prescribed by OSHA in all places of employment for all employees engaged in the construction work.

7. Take necessary precautions to keep noise producing operations (such as impact hammering, Carborundum sawing, compressed air machinery and the like) to a minimum. Select equipment, which is of a quieter nature than others and enclose areas of operation with acoustical screens and partitions or other means necessary to accomplish reduction of noise.
8. Equip motorized equipment with mufflers or other types of sound control and blanket equipment with acoustical materials.
9. Locate installation, demolition and alteration equipment safely so that no part thereof shall endanger normal airport operations, including runways, terminals, terminal buildings, approach ways, and power utility, lighting and communication lines.
10. Promptly remove debris to avoid interference with system operations.
11. Replace any damage or work in place, including existing fireproofing that has been damaged as part of the Work.
12. Cut out embedded anchorage and attachment items as required to properly provide for patching and repair of the respective finishes.
13. Ensure that the standard of work and materials throughout the Project shall be of first-class quality and workmanship in every respect, MDAD will not accept workmanship, which for any reason, is otherwise.
14. Ensure that all equipment, components and materials are free from defects.
15. MDAD reserves the right to inspect any conveyor component at the BHS Subcontractor's factory prior to shipment of said components. Coordinate with MDAD the fabrication of any components that MDAD requests to inspect such that the said components are fully assembled and are available for inspection by MDAD at the previously arranged time of the factory visit.

3.3 FABRICATION & INSTALLATION SPECIAL CONSIDERATIONS

A. General

1. Equipment is to be designed to meet the requirements of handling airline baggage. This entails consideration and care to be used particularly in fabrication of all components to ensure that projections, welds, sharp corners and transfer points that may cause possible damage to various types of bundles, handbags, suitcases, and trunks are eliminated. Ensure that bottom glides on cases, strings, tags, straps, bag handles, destination tags and the like are guarded against damage on side guards, transfer points, and all surfaces which baggage may contact on the conveyor system.
2. Coordinate all on-going site work and with concurrent airport/airline operations.
3. Take into effect any long lead procurement items and bring them to MDAD's attention for prompt processing.
4. Ensure that the design and installation of all conveyor equipment provides maximum access for operation and maintenance personnel.

3.4 DELIVERY, STORAGE, HANDLING AND ON-SITE RESPONSIBILITIES

A. Delivery, Storage, Handling

1. Assume responsibility for the receiving, unloading, storage, protection, security and distribution of all material delivered to the site associated with this Contract.

2. Assume responsibility for receiving, storing, handling, setting and connecting all equipment required for the BHS installation.

3. Furnish to MDAD, on demand, Bills of Lading for all equipment being shipped to the work site. Identify on each Bill of Lading each component and assembly involved, the equipment items to which they belong, the date and time of pick-up and the expected date and time of delivery to site. The shipping of such material shall involve proper identification of items, proper packing and proper means for unloading them at the work site.

B. On-Site Responsibilities

1. General

   a. Provide exhaust fans (e.g. HEPA filter) to limit fumes/odors from welding, metal cutting and painting if the work being carried out is in an occupied/operational area.

   b. Coordinate with any interfacing, on-going site work.

2. Mechanical Work Responsibilities

   a. Provide and install all supports, anchors and any other special considerations or requirements not provided for in this Specification but necessary to facilitate the complete mechanical installation and safe operation of all equipment and components.

   b. Provide electrical connections for heavy-duty machinery, such as welding machines, and battery chargers as required for the installation of the BHS.

   c. As construction proceeds, perform any additional site surveys which may be necessary.

   d. Document in writing any mechanical, electrical or piping conflicts that may impact conveyor installation and submit to MDAD immediately following the site inspection and prior to the installation.

   e. At no additional cost do any reasonable location adjustment of mechanical equipment requested by MDAD prior to installation.

   f. At no expense to project, correct work improperly installed due to lack of construction verification.

   g. Provide all supports, anchors and any other items necessary to facilitate the complete mechanical installation and safe operation of all the equipment and its components.

3. Electrical Work Responsibilities

   a. Provide the necessary conduit, wiring and other electrical components to complete the electrical installation from and including the normal, emergency and emergency / normal power distribution panels (PDPs), and Motor Control Panels (MCPs) with associated power switching equipment for PDPs which power the that contain fire/security doors and associated conveyors, to the equipment and be responsible for all electrical interconnections within the equipment and system.

   b. Provide all labor, materials, equipment and service necessary for and reasonably incidental to proper completion of all electrical work including electronic controls as required for the proper operation of the system as detailed in these specifications. Provide within the design standardization of components, function and maintenance

procedures.

c. Drawings and specifications are to be considered as supplementing each other. Work specified but not shown, or shown but not specified, shall be performed or furnished as though mentioned in both specifications and drawings.

d. Provide and install as required, at no additional cost to project, minor items, accessories or devices reasonably inferable, as necessary, to complete the electrical installation.

e. Refer all conflicts between the requirements of these specifications and drawings or between either and applicable codes to MDAD for clarification before proceeding with the affected portion of the installation.

f. BHS Subcontractor will be required to pay for all electrical and mechanical permits, inspection fees, and certificates relative to the electrical work. Deliver all certificates and letters of approval to MDAD upon completion of the work.

g. Locate all electrical equipment as shown on drawings. However, actual field conditions shall be checked to determine exact locations and avoid interference with other trades. MDAD must approve all deviations from the Contract Drawings.

h. At no additional cost do any reasonable location adjustment of electrical equipment requested by MDAD prior to installation.

i. At no expense to project, correct work improperly installed due to lack of construction verification.

j. Install materials and components in a neat and proficient manner. Particular attention shall be paid to manufacturer's instructions as to installation procedures.

k. Ensure timely completion. Accelerate construction as required to facilitate schedule.

l. Provide and install as required, at no additional cost to the Project, minor items, accessories or devices reasonably inferable, as necessary, to complete the electrical installation.

m. Coordinate with any interfacing, on-going site work. This includes, but is not limited to: the Baggage Handling System installation and its associated components, electrical and telecommunications work and finish floor installation.

3.5 INSTALLATION

A. General

1. Installation of the BHS shall be in strict compliance with the Construction Drawings, to be prepared in compliance with this Specification document and Contract Drawing Package. These drawings shall show in detail the location of each conveyor and the relationships between adjoining conveyors, conveyors and slides or chutes and any other transfer, which might affect baggage movement.

2. Assume responsibility for all interfaces between the BHS and the Facility. Check the "As-Built" condition of the Facility as defined in drawings and as confirmed by site inspection prior to fabrication, installation or removal of any BHS equipment. The system arrangement and layout shall ensure equipment alignment and clearance when installed in the Facility.

3. Provide all supports, anchors and any other items necessary to facilitate the complete mechanical installation and safe operation of all equipment and components.

4. Take into consideration the location of building expansion joint locations which can affect the layout / installation of the conveyor or of structural attachment points.

B. Tolerances

1. Maintain the following tolerances for BHS equipment installation:
    a. Maintain dimensions to exterior building walls or building columns within ¼".
    b. Install all conveyors level from side to side, within 1/8" across the width of the conveyor. In the event that the floor/ceiling is sloped, install the conveyors parallel to the floor in the direction of belt travel.
    c. In plan and in elevation, install conveyors straight to within ¼" of a taut line stretched at the belt elevation over the length of each intermediate section of conveyor.
    d. Plumb supports vertical within ⅛" per 3'.
    e. Clearances to building elements shall be 12” (minimum) along a wall and 6” (minimum) along columns, hand/guard rails or other architectural elements such as bollards or the like, unless otherwise specified.
    f. Verify all “As-Built” and existing building conditions prior to final fabrication.
    g. Shimming between adjacent intermediate sections of conveyors is permissible but do not exceed ¼" of total shim stock at any one location.
    h. As the building area becomes available, install all header steel (even if header steel is ahead of conveyor fabrication/delivery), to preserve conveyor right-of- ways. Preserve conveyor right-of-ways in all cases as soon as practicable.
    i. The maximum allowable lateral offset in the conveyor slider bed shall be ⅛" in 40' 0" of length.
    j. Both sides of the pulley shaft elevations at the bearings shall be set within 1/32" of one another.

C. Side Guards

1. Install side guards so that adjoining guards do not project into the flow of baggage. Clean any field cut edges and welds of burrs, and slag and grind smooth. Filler material at joints or seams is not permissible.
2. Notch the formed edge of the side guards around any vertical hanger or leg.
3. All side guard joints are to provide a snag-free surface. Side guards shall provide a continuous, uninterrupted surface the entire length and height of the joints. Lapped or out-of-line joints will not be accepted. Welding of joints is not permitted.
4. Care is to be used in the design and installation of the side guards at the point of intersection with the conveyor fire/security doors. This interface point must not act as a snag/catch point for baggage or baggage tags.
5. Conveyor side guards must be flared on the downstream side of the intersection with the conveyor fire/security doors. Additionally, special detail must be provided with the conveyor bed section at this point. Its width must be extended to close the void between the bedside rails and the flared side guards.
6. Adjacent side guard joints are to be of the bolted butt coupled joint type at power turns and conveyor sections. Coupling of adjacent side guards or head/tail pulley supports to

power turns shall be in alignment with the effective belt width of the turn to prevent interference with baggage movement.

7. Side guards of power turns must not be welded to adjacent straight conveyor side guards.
8. Mounting of any mechanical or electrical equipment on the outside radius side guard of power turns is not accepted since it restricts maintenance access to the outer perimeter chain or guide bearings of the power turn belt.

D. Belt Splicing/Lacing

1. Belting material and the related lacing hardware must be trimmed in a 1" "V" notch fashion. Additionally, the nylon jacket of the lacing connecting pin (cable) must be enlarged with heat or provided with a leader crimp to prevent any lateral movement of the connecting pin (cable).
2. If "dutchmans" are used, the length of the "dutchman" must be at least equal to or greater than the circumference of the conveyor drive pulley.
3. All belt splices, shall be cut square, to ensure proper tracking.
4. Install each lacing with a single lacing pin (cable) extending the full width of the belt.
5. Assemble the lacing so that the centerlines of the matching belts are in line within ⅛".
6. The actual length of belting installed on each unit is to be included on system drawings and in the spare parts list.
7. All rough top belting to be ground smooth within 1" of the cut end to allow proper seating of the belt lacing.
8. In locations that require a noise level of 65 db (A) or less use vulcanized spliced belting. The conveyor shall facilitate the replacement of a clipper lacing for repair/replacement of damaged conveyor belt.

E. Belting

1. Check all pulleys and rollers for squareness to the centerline of the conveyor. Adjust when necessary.
2. Free conveyor beds of all foreign material and broom clean before pulling the belt.
3. Minimize number of belt lacings on each conveyor. Do not make belt segments shorter than 4' 0". Maximum acceptable number of lacings per conveyor belt segment is two - (2).

F. Belt Tracking

1. Ensure all belts track within 1" of center on any drive, tail pulley or intermediate point.
2. Run each conveyor for a minimum of 4 hours with no load and 4 hours with a baggage load as encountered in actual service before acceptance testing.

G. Floor Supports

1. All conveyors shall be sway braced in order to ensure that there is no lateral or longitudinal displacement.
2. All support structure must be designed and installed so that maintenance access to the conveyor components, gap pans and access to catwalk(s), work areas and drive aisles are not blocked.

H. Overhead Supports

1. The BHS Subcontractor is responsible for the design and structural integrity of all bolts, hangers, and support structures including all necessary materials required for installation.
2. All conveyors shall be sway braced in order to ensure that there is no lateral or longitudinal displacement.
3. Locate conveyor supports at intermediate sections splices at 10'-0" maximum to provide a rigid and rugged installation. Hanger rods shall be a minimum diameter of ¾".
4. Installation and layout of header steel and all support structure shall not pose interference to maintenance and operation access.
5. The BHS Subcontractor shall repair/replace both new and existing fireproofing materials removed to allow the installation of BHS equipment header steel and supports structures or BHS electrical conduits / wireways.
6. Vibration isolators shall be used to ensure that there is no noticeable vibration transmitted to the building. For installation of vibration isolators, adhere to the following criteria:
    a. Where compression-type vibration isolators are installed below the sill, the threaded rod shall have a lock washer, a single flat washer, and a single nut above the sill while utilizing a single flat washer with a single nut and a single jam nut, installed in a jam configuration, below the vibration isolator. In this instance, the diameter of the flat washer must be equal to or greater than that of the contacting surface of the isolator.
    b. Where compression-type vibration isolators are installed above the overhead support structure, the threaded rod shall have a single flat washer (the diameter of which being equal to or greater than that of the contacting surface of the isolator) and one eccentric locking nut above the vibration isolator. Below the support structure the threaded rod shall have a lock washer, a single flat washer, and a single nut.
    c. Where spring-type vibration isolators are used, the threaded rod shall havean eccentric locking nut, a single flat washer, and a resilient washer in contact with the spring mechanism.
7. Provide means of height adjustment on all hanger rods. Once the proper heights are established, lock the adjustments by means of lock nuts.
8. Provide sufficient length of hanger rods to allow for height adjustment. Do not deform threads on threaded rod, which would prevent the ability for height adjustment.

I. Anchoring

1. Firmly anchor all equipment and structures to the floor or building structure where permitted, subject to review and approval, by MDAD. Align, level and finish grout, as required.
2. Anchor floor supports to the floor with a minimum of two - (2) stud expansion anchors having a minimum size of 3/8" diameter by 2¾" long, unless otherwise noted on the specification drawings.
3. Weld floor supports, which rest on a steel mezzanine or intermediate structure.
4. Anchor impact protection with a minimum of four ½" diameter epoxy adhesive anchors, each having a minimum tensile strength of 3000 psi, and a minimum shear strength of 18,000 pounds, and a maximum embedment of 3 ½", unless otherwise noted on the

specification drawings.

J. Lubrication

1. Fill all reducers to the proper oil level using oil recommended by the manufacturer.
2. Install breathers at the highest opening.
3. Clean roller chains of dirt or debris and manually lubricate per manufacturer's recommendations.
4. Replace all lubrication fluids if testing or checkout period exceeds manufacturer's suggested start-up change-out interval.
5. Apply grease per manufacturer's specifications to all grease fittings (unless they are sealed for life type bearings) prior to initial start-up of the equipment.

K. Motor Installation

1. Wire each motor on all components to a separate disconnect switch which shall be mounted within sight of the motor but not more than 3' 0" from the motor.
2. Provide a means of disconnecting power, including the capability of being locked in the "Off" position that meet or exceed the requirements of NEC Article 430 (if separately or group powered) mounted as part of drive unit so as to minimize the potential of electrical shock during any servicing or maintenance operations.

L. Jacking Bolt Installation

1. Install all jacking bolts in conjunction with pulley and motor bearing housings based on the following criteria:
    a. When mounted in a threaded bracket, engage the bearing with the cup of the jacking bolt and lock the jacking bolt in position with a jam nut on the inside of the bracket (i.e., between the bearing housing and the bracket) to ensure the proper locking configuration.
    b. When mounted in a non-threaded bracket, engage the bearing with the cup of the jacking bolt, position a jam nut on the inside of the bracket, and position asingle flat washer, lock washer, and finished or semi-finished nut on the outside of the bracket (i.e., between the jacking bolt head and the bracket) to achieve the proper locking configuration.
2. Use of socket male/female adapters in conjunction with the jacking bolt is unacceptable.
3. Allow for minimum adjustability of the jacking bolt on either side of the mounting bracket equal to the maximum amount of adjustability provided for the associated bearing by the mounting slots.

M. Sheave/Sprocket Alignment

1. Align shafts, sprockets and sheaves using a steel straight edge. The use of a string for this purpose is not acceptable. Demonstrate during Acceptance Test that corresponding surfaces of mating sprockets/sheaves are in line within 1/32" in 24". Misalignment shall be determined by placing the straight edge against the face of one sprocket/sheave and measuring the gap it makes with the opposite sprocket/sheave. The operation shall then be reversed so that a total misalignment can be determined.

N. Fasteners

1. Protect all fasteners (such as but not limited to nuts, bolts, screws, and setscrews) against

accidental loosening by the use of lock nuts, lock washers, jam nuts, or other suitable means, and against corrosion by plating or the use of corrosion resistant materials such as zinc plating or stainless steel materials.

O. Shaft Mounted Components

1. Mount all shaft mounted components using keys, splines, or equivalent, with positive retention devices.

P. Painting and Finishing

1. Equipment Finish

a. Stainless Steel

1.) Cover all metal components and surfaces of conveyors in public view with Type 304 stainless steel with No. 4 brush finish. Stainless steel shall incorporate smooth flush edge seams. Radius type edges are not acceptable.

2.) The BHS Subcontractor shall also be responsible for the design, fabrication and installation of stainless steel trim frames around conveyor wall penetrations in public areas. The trim frames shall be constructed of 12 gauge, 4" x 4" stainless steel angle. The BHS Subcontractor shall coordinate trim design/details with MDAD.

3.) All stainless steel trim elements and related connections are to be smooth and flush without openings or projections on which bag tags or straps may catch.

4.) All flat head screws used to attach the stainless steel shrouding, such as the horizontal portions attached to the conveyor bed, are to be completely countersunk so that no portion of the screw head is above the adjacent surfaces. Such flat head screws are to be of the Phillips Head type. Grinding or filing of the screw heads to accomplish the above is not acceptable.

5.) Field welding of any stainless steel trim element is not acceptable. Additionally, no blemishes of the stainless steel trim elements shall be accepted. This includes those blemishes that are caused by poor manufacturing practices as well as those caused in the field plus those caused by field attempts to remove any blemish.

b. Protect all metal surfaces from corrosion using one or more of the following methods:

1.) Electro-galvanize or use stainless steel for slides and chutes unless otherwise specified on the contract drawings.

2.) Electro-galvanize or hot-dip galvanize conveyor side guards if exposed to outdoor environment, and paint on the outside only if used in interior areas.

3.) Use cold rolled or hot rolled low carbon steel primed and painted on both surfaces in all interior areas.

4.) As an alternative to items .2) and .3) above, the BHS Subcontractor can offer Powder Coating as an alternative due to superior quality and resistance to the elements.

5.) Use as received pre-painted housings from component supplier, such as motors, gearboxes and bearing housings.

6.) Paint conveyor slider bed components only on the outside exposed surfaces.

Do not paint the surface in contact with the belting. However, if the BHS Subcontractor's fabrication includes it, the powder coating process and conveyor components that are used for each conveyor segment shall ensure that the installation will not compromise the specified conveyor belting maximum coefficient of friction requirements and shall not introduce any foreign particles to the conveyor equipment/components (e.g., paint gumming or chips, drive pulley lagging or conveyor belting material dust particles, or any other debris that can potentially harm the performance or longevity of the equipment).

7.) Finish paint electrical enclosures normally purchased primed prior to assembly and delivery to the construction site.

8.) Protect all unpainted surfaces (shafts, slider bed, side guards) with a suitable rust inhibitor during shipping and installation.

9.) Prime and finish paint all catwalks, stairways, ladders, and support steel.

10.) Provide galvanized threaded rods. Protect the ends of all threaded rods with a suitable galvanizing spray after the threaded rods are cut to length.

11.) Apply an industrial quality primer and enamel to all to-be-painted surfaces in accordance with the manufacturer's directions. All paint shall be of the same make, type and color.

c. Prepare surface to be painted in accordance with paint manufacturer's requirements and as described below. If there is a discrepancy between the two, the manufacturer's requirements will take precedence. Suitable precaution shall be taken to ensure cleanliness during the period between cleaning and other finishing processes.

1.) Preparation of Surface

a.) Prior to the application of any finish, clean all surfaces to be free of dirt, grease, oil, flux, flash metal, spatter metal, sand, rust, scale, oroxides, and all other debris that might interfere with the effective application of the finish. Clean surfaces immediately before the finishing operation. Take suitable precaution to ensure cleanliness during the period (which shall be of minimum duration) between cleaning and other finishing processes. For galvanized surfaces, adhere to the following:

(1.) Clean: Prepare surfaces so prime coat bonds well and adheres permanently.

(2.) Rust-Inhibitive Wash: Use a compatible chemical solution suchas phosphoric metal etches. Thoroughly remove solution with water and allow drying.

2.) General Application: Apply primer and enamel to provide a surface of high quality appearance free from runs, sags, cracks, flaking, peeling, blushing, or other defects which may affect drying characteristics, durability, and appearance of the painted surfaces. Apply primer and enamel by brushing, spraying, or dipping.

3.) Basic Application: Finish surfaces with not less than one coat of primer and one coat of enamel. Apply the primer and one coat of enamel at the factory and the touch up of enamel, if required, shall be applied at the installation site,

after erection, by brushing. When primer or enamel applied to the equipment prior to erection has been burned, chipped, or otherwise removed during erection, or where new unfinished metal is installed, finish the exposed surfaces with not less than one coat of primer and a finish coat of enamel, of the same color and type as originally painted, after sanding the surface to be painted down to the bare metal. After installation, clean and touch up all scuffed or otherwise marred surfaces, as above.

4.) Masking: Do not obscure equipment nameplates, identification plates, or other identifying markings when painting the equipment. Whenever possible, apply the plates and markings after painting. In all cases where they cannot be applied after painting, mask or otherwise protect them toretain their legibility. After painting, thoroughly and effectively remove all masking and protective coatings.

2. Conveyor Identification

   a. Permanently and indelibly mark all conveyor equipment such as but not limited to conveyors (both powered and slave driven), merge conveyors, pushers, diverters, sort devices, power turn conveyors, and tapered pulleys with its respective (discrete) identification as defined on the contract drawings. All conveyor segments and other equipment such as diverters, vertical sort units and the like shall be identified as specified elsewhere in this document by carefully and neatly painting with black paint the equipment identification characters utilizing a stencil, nominally 4" in height, in a conspicuous location (on both sides of a conveyor adjacent to the conveyor drive in the case of a conveyor). The only acceptable identification markings on any conveyor equipment, is to be of the specified conveyor identification numbers for this project. Any other form of identification or markings on the conveyor equipment is not acceptable and must be removed.

   b. Identify conveyors in public areas by means of engraved plaques (riveted or bolted) with 2" high black lettering on a stainless steel background.

   c. Conveyor identification shall be consecutive with no missing numbers in a sequence. In the event of any additions or deletions prior to each system installation, renumber the conveyors to adhere to this requirement.

   d. Completely remove or print over any identification on reused equipment or any temporary markings associated on new conveyors for manufacture, shipping or installation.

   e. Where temporary markings or labels on the conveyors or other equipment are required for installation, use a medium which is readily removable with water or a readily available commercial solvent, such that they may be removed without requiring any refinishing of the surface on which they appear. After installing, remove any temporary markings.

3. Equipment Nameplates

   a. All major items of the BHS equipment, such as conveyor drives, security door and MCPs, etc., shall be identified by nameplates.

   b. Nameplates shall identify each piece of equipment as to category and number and shall be securely affixed to each individual piece of equipment. Contact MDAD Maintenance and Engineering Divisions for the equipment requiring nameplates.

c. Nameplates shall be aluminum with black enamel background and etched or engraved natural aluminum lettering 1" high.

d. Plates shall be as manufactured by Seton Name Plate Company, Inc. or approved equal.

e. The contractor shall contact MDAD Maintenance and Engineering Divisions, to coordinate the identification number to be used for the equipment so that each piece of equipment has a dedicated I.D. number.

Q. Safety Signage

1. Furnish and install safety signage throughout the BHS as described within these Contract Documents and any associated addendums. The safety signage shall be located in all areas and locations where there is exposure to hazards for maintenance/operational personnel and the public. Refer to OSHA, ANSI, NEC, National Safety Council, local, federal and state codes for recommended location, size, shape, design and verbiage required for safety signage. The verbiage of the sign shall be appropriate for the particular location/hazard.

2. The safety signs shall be clearly visible and firmly affixed. The following is a list of locations where safety signage should be placed as a minimum, this list is not to be construed as being complete since it is only provided as a guide:

   a. All potential pinch points

   b. Rotating parts

   c. Chain and V belt guards

   d. On all conveyors that are under the control of auto start

   e. Outside of electrical cabinets and disconnects boxes

   f. On all catwalks including step up/step down locations

   g. At load and unload (make-up devices / sort piers) areas

   h. Adjacent to HSPDs

   i. Adjacent to Vertical Sort Units

   j. Areas of low overhead clearance

   k. Fire/Security doors

   l. Around areas of false ceilings

3. Safety chains and prominently displayed placards/signs shall be placed at the bottom of ladders and stairs to indicate restricted area for "authorized and trained personnel only".

4. Placards/signs indicating locations of all E-stop control stations and lanyards shall be clearly visible.

R. Welding

1. Certified welders shall perform all welding, and all welding shall be in strict compliance with local and national codes. Provide to MDAD upon request, copies of certificates verifying that the welder(s) are certified.

2. Only compressed natural gas (CNG) and electric welders shall be used.

3. Connecting welding equipment to any MCP power supply shall not be acceptable.

4. Provide a fire watch at all times during welding and other forms of hot work in compliance with local codes per Division 1. Before approving any cutting or welding operation, a fire safety supervisor or appointee shall inspect the work area and confirm that the following indicated precautions have been taken in order to prevent fires:
    a. Ten pound ABC Dry Chemical Fire Extinguisher to be kept on site.
    b. No flammable liquids permitted within 50 feet of work.
    c. Floors swept clean of combustibles.
    d. All wall and floor openings covered.
    e. Covers suspended beneath work to collect sparks.
    f. Opaque screens placed between work and spectators.
    g. Fire watch is required to observe all work and shall remain on site for a minimum of 30 minutes after completion of work per Division 1.
    h. MDAD is to be notified prior to beginning work.

S. Maintenance Access

1. Where walls immediately adjacent to conveyor equipment affect maintenance access, advise MDAD of the location and size of the wall opening that needs to be developed to permit access to drive components, bearings, and other equipment that would normally be inaccessible because of the wall or other building elements.

3.6 SPECIAL CONTROL REQUIREMENTS

A. Control Stations

1. Mount controls, consisting of but not limited to push buttons, selector switches, indicator lights, in Control Stations. All controls shall be grouped to minimize the number of operating points throughout the system. In the application of a single control for a specific function, pushbutton stations may be employed.
2. Locate control stations as specified. Position control stations so as not to impede access to the equipment for servicing.
3. Mount all Control Stations located in public areas flush to the equipment and equip with stainless steel cover plates. Control stations located in the view of the public shall not be mounted on the top surface of the conveyor front cladding.
4. Locate Control Stations so as to be clear of normal vehicular and personnel traffic lanes. Install guards to prevent inadvertent actuation where this cannot be accomplished.
5. Control Stations shall contain the appropriate control elements such as push buttons, selector switches, and those indicator lights, which will augment operations.
6. Control Station functions shall be identified in English using elementary concise terms supplemented by graphic symbols. All identification plates shall be mechanically affixed to the console face.
7. Control Stations shall conform to the environmental requirements specified herein. Outdoor applications shall employ weather tight, corrosion resistant boxes, switches, push buttons, and lights.
8. Emergency Stop push buttons, disrupting electrical control power, shall be employed where an emergency may require immediate shut down. Where more than one emergency

stop pushbutton is used in any circuit or subsystem, only the indicator lamp in the activated E-Stop pushbutton shall be energized. Actuation of any emergency stop shall be announced on the respective status monitoring system.

9. Indicator lights, especially outside the facility, shall not be affected by extraneous light, and shall be clearly visible in all lighting conditions.
10. Control elements such as but not limited to switches, push buttons, and handles, shall be selected for ease of operation in an industrial "bagroom" environment.
11. Control elements such as but not limited to switches, push buttons, indicator lights, and bulbs, shall be easily replaceable and reasonably protected from physical damage.
12. Freestanding control stations shall be mounted on rugged and braced pedestals with firmly anchored base plates. The design shall account for extraneous loading and generally abusive conditions.
13. Provide independently anchored impact protection wherever control panels, control consoles or control stations are exposed to work area traffic.
14. Provide yellow background behind all emergency stop actuators, per NFPA 79. It is permitted for the yellow background to be a yellow enclosure or via the use of a label/legend that is yellow.

B. Photocell Functions

1. As a minimum, provide photocells to perform the following functions:
    a. Cascade Stop
    b. Jam Detection
    c. Over-Height Detection
    d. Over-Length Detection
    e. Baggage Tracking
    f. Missing Bag Jam
    g. Merge And Priority Control
    h. Auto Start
    i. Auto Stop
    j. Indexing Control (Accumulation)
2. Combine photocell functions wherever possible provided proper operation of each circuit is maintained.
3. Cascade Stop
    a. Locate a head end sensor photocell within 12" of the discharge ends of all straight conveyors and 6" on power turns and queue conveyors (or an appropriate distance from the discharge end to ensure that the piece of stopped baggage does not transition/stop on the downstream conveyor) so that the center of the photocell beam is approximately 2½" or 3" above top of the conveyor belt to provide the signal for operation of cascade stop circuits.
    b. Should a downstream conveyor stop as a result of a jam condition or mechanical/electrical failure, the conveyor immediately upstream of the stopped

conveyor shall continue to run until the head end photocell is blocked. At that moment, the conveyor shall stop. The preceding upstream conveyor will run until its head end photocell is blocked. This cascade stop function will continue through the upstream conveyors until the jam/failure is cleared or the first conveyor in the subsystem has stopped.

c. The cascade stop photocell shall also be utilized for jam detection functions, but no control station shall be installed in conjunction with this photocell. Upon the detection of a jam at this photocell, initiate the following steps:

1.) Stop the conveyor with the cascade stop photocell and the one immediately downstream.

2.) Provide a jam indication signal at the MDS and MCP, and a visual warning signal in the field (within the vicinity of the jam location).

3.) Illuminate the jam indicator light in the nearest jam reset/restart control station.

d. Cascade controls logic shall include programming to initiate the Ticket Counter (and Curbside) Start Ready Pushbutton "Green light" to flash when the respective ticket counter (or curbside) conveyor subsystem has cascaded back to the load belt. This will notify the ticket counter/curbside agent that a jam/fault has occurred in the subsystem.

4. Jam Detection

a. Locate a head end sensor photocell to provide the signal for operation of jam detection circuits within approximately 12" of the discharge ends of all straight conveyors and 6" on power turns and queue conveyors (or an appropriate distance from the discharge end to ensure that the piece of stopped baggage does not transition/stop on the downstream conveyor). The center of the photocell beam is to be approximately 2½" or 3" above top of the conveyor belt.

b. As a minimum, provide jam detection photocells and a jam indicator with a jam/restart/emergency stop control station in areas that have a relatively high frequency of jams. This shall include the discharge ends of all conveyors feeding onto power turns, at the bottom of inclines and decline conveyors, at all merges for both the primary and secondary lines, opposite all pushers and diverters and at any other location where experience indicates a potential jam point.

c. As soon as the photocell detects a jam (blocked for longer than an adjustable (0 to 10 seconds in the PLC), predetermined (nominally set to 6 seconds) length of time), initiate the following steps:

1.) Stop the conveyor with the jam detection photocell and the one immediately downstream.

2.) Provide jam indication signal at the MDS and MCP.

3.) Illuminate the jam indicator light in the control station.

d. Whenever a conveyor stops for any reason, reset the jam detection timer and hold until the conveyor restarts.

e. The jam detection circuitry is only to function whenever the associated conveyor is running; i.e., if the conveyor is stopped and the jam detector photocell is blocked, the jam detection circuitry will not sense a jam condition and thus report a false jam

condition.

f. Conveyors that cascade stop as a result of a jam are to be "latched stopped" through PLC logic until the jam reset push button has been activated.

5. Overheight Detection

a. Provide Overheight detection photocells at every baggage input to the system, to detect bags that are too high to clear the lowest downstream obstruction for all possible routes. This photocell shall be set at 28" above the top of the conveyor belt for standard conveyors, unless otherwise stated.

b. Modify the existing or replace Overheight photoeyes at the existing TC inputs to set them at 28".

c. As soon as the photocell is interrupted, stop the conveyor.

d. Provide Overheight indication signal at the MDS and MCP.

e. Provide an oversize indicator lamp in the control station; this lamp may be the same unit as that for overlength detection. Illuminate the oversize indicator lamp in the control station if an overheight bag is detected.

f. Program the overheight circuit to require the following sequence to reset:

1.) Actuate associated E-stop on the respective Control Station (not required for reset).

2.) Clear the photocell by removing or re-positioning the overheight bag. At this point the photoeye is cleared, the Overheight indicator lamp shall flash to indicate the fault condition has been cleared and the conveyor is ready to be reset.

3.) Reset the E-stop (if required) and actuate the respective Control Station's "Reset/Restart" pushbutton to restart the conveyor segment; at this point the Overheight indicator lamp shall extinguish and the fault on the MDS and MCP shall be cleared.

6. Overlength Detection

a. Provide Overlength detection photocells at every baggage input in the system. These photocells shall be set at the maximum bag length the BHS and EDS machines will accept (i.e., 54").

b. Program the overlength measurement circuit to stop the conveyor if a preset bag length (adjustable in the PLC) is exceeded.

c. Provide Overlength indication signal at the MDS and MCP.

d. Provide an oversize indicator lamp in the control station. Illuminate the oversize indicator lamp in the control station if a preset bag length (adjustable) is exceeded.

e. Program the overlength circuit to require the following sequence to reset:

1.) Actuate associated E-Stop on the respective Control Station (not required for reset).

2.) Clear the photocell by removing the over-length bag. At this point the photoeye is cleared, the Overlength indicator lamp shall flash to indicate the fault condition has been cleared and the conveyor is ready to be reset.

3.) Reset the E-stop (if required) and actuate the respective Control Station's "Reset/Restart" pushbutton to restart the conveyor segment; at this point the Overlength indicator lamp shall extinguish and the fault on the MDS and MCP shall be cleared.

7. Merge and Priority Control – Ensure compliance with new Ticketing installation.

   a. All Merges

      1.) Merge windows shall be dynamic in that the control system establishes a window only upon indication that a bag has arrived at either the merge or through line induction photocell (i.e., a fixed window control system will not be acceptable). Merge windows shall be variable and shall be established based on bags per minute (BPM) throughput requirements per subsystem with associated window spacing. Bag length shall be measured by the control photocells to adjust the merge window length as required.

      2.) Photocells, timers, and appropriate control stations shall be located on the conveyor equipment in merge situations with functionality as follows. For all intents and purposes for this project, the conveyor line onto which bags are to be merged shall be referred to as the primary line, while the conveyor line from which bags are merged from shall be referred to as the secondary line:

         a.) A photocell shall be located at the discharge end of the secondary line merge conveyor. This photocell shall have the functions of jam detection, head end sensing and priority control. The jam detection function of this photocell shall detect a jam at themerge point resulting from bags being transferred from the secondary line onto the primary line. When this occurs, both belts involved shall be stopped until the jam is cleared (along with other appropriate conveyors upstream that will cascade stop as necessary).

         b.) All merge conveyors are to be programmed in a run on demand mode and use energy management timers to stop. As a bag is transported towards the merge conveyor an auto- start photocell, located on the upstream conveyor, once blocked will actuate the start- up of the merge conveyor. If after 20 seconds (adjustable in the PLC) the auto-start photocell does not detect any baggage, then the merge conveyor shall stop.

         c.) Merge window logic in the PLC is used to monitor and track the flow of bags on the primary conveyor line upstream of the merge. The merge window logic shall use a photocell and timer to measure bag length to determine the required merge window for proper transfer onto the primary line. The merge window logic is used to track the position of bags and the space between the bags on the primary line. The head end photocell on the conveyor immediately upstream of the merge conveyor on the secondary line shall be used to measure the length of bags as they move onto the merge. The PLC utilizes this length to calculate the bag window size required on the primary line to merge a bag into. If the required bag window is determined to be available on the primary line then the bag is not stopped and is merged onto the primary line. If the bag window is determined to be unavailable then the bag is stopped and held on the merge conveyor until the appropriate size window is detected on the primary line.

         d.) The merging function shall be provided in two modes. Primary priority and reverse priority.

(1.) In primary priority mode (to be considered normal mode of operation) bags on the primary conveyor line shall have priority over bags on the secondary conveyor line. The secondary line will have to wait for openings between bags on the primary line to be able to merge into. Priority control shall monitor the time in which the photocell on the primary line is being blocked, indicating that the appropriate merge window is being searched for.

(2.) Reverse priority mode shall be actuated in two different cases.First, if the merge conveyor is stopped with bags in queue upstream (to a point which will be determined in design review meetings based upon criteria such as but not limited to subsystem length and BPM requirements) then the secondary line is considered to be full and the reverse priority function shall be actuated for the period of time it takes to empty the secondary line of bags from the point in which the reverse priority was actuated. Second, if a bag is on the merge waiting for a window and an opening is not detected for 60 seconds (adjustable in the PLC) then reverse priority shall also be enabled. The primary line conveyor onto which bags are being merged shall be stopped, and all merge control functionality of the secondary line shall be disengaged to allow for continuous and uninterrupted baggage flow from the secondary onto the primary line for 60 seconds (adjustable in the PLC), thus purging the secondary line of bags. Upon completion the merging function will revert back to primary priority mode.

e.) In the event that there are multiple merges onto the mainline each merge should receive equal priority in order to prevent any one of the merges from not being able to discharge bags onto the mainline.

8. Auto Stop (Time-Out)

   a. Provide Auto Stop photocells upstream of sections of transport conveyors not specifically controlled by START/STOP switches. The same photocell may control both Auto Start and Auto Stop circuits.

   b. Program Auto Stop circuits to stop a string of conveyors if an Auto Stop photocell does not sense a bag for an adjustable time period (adjustable in the PLC).

   c. If a conveyor stops for any reason, reset the auto stop timer and hold until the conveyor restarts.

9. Indexing Control (Accumulation)

   a. Provide a photocell at the discharge end of each conveyor feeding an indexing conveyor or at the charge end of an indexing conveyor immediately after the chute, such as a sort pier or oversize unload conveyor.

   b. Program the indexing conveyor to run when the photocell is blocked and to stop when it is clear.

   c. Include a time delay so that the conveyor can be programmed to continue for a preset interval after a bag clears the photocell and is completely on the indexing conveyor.

   d. In locations where the indexing conveyor has a chute mounted to the discharge end of the conveyor, baggage may index past the discharge end photoeye onto the discharge

chute.

C. Motor Overloads

1. Size the motor overload heaters not to exceed 115% of the full load amps as indicated on motor nameplate.
2. In the event of any subsystem motor drawing excess current, appropriate protection shall be provided to isolate supply to all subsystem elements. Either the single "motor overload" indicator on the affected MCP panels shall illuminate, or if individual "motor overload" indicators are specified for each drive then the effected drive indicator will illuminate.
3. Following rectification of the cause of the overload and resetting of the overload protection device in the motor control panel as applicable, the system may be restarted by actuation of the "start" button, at which stage, the "motor overload" indicator shall be extinguished and normal control shall resume.
4. "Motor overload" fault conditions shall be reported both visually and audibly (asapplicable) on the associated subsystem MCP and MDS.
5. In the event of individual conveyor motor overloads, all upstream conveyors shall revert to cascade stop mode, while all downstream conveyors shall continue to run in normal mode of operations.

D. Jam Indication/Restart

1. Provide an Illuminated Amber Jam Light (in a common enclosure with an Emergency Stop pushbutton and green re-start pushbutton) adjacent to all jam detection photocells as follows:
    a. As a minimum, provide jam detection photocells and a jam indicator with a jam/reset-restart/emergency stop control station in areas that have a relatively high frequency of jams. This shall include but not be limited to the discharge ends of all conveyors feeding onto power turns, spiral turns, at the bottom of incline and decline conveyors, at all merges for both the primary and secondary lines, opposite all high-speed paddle diverters and pushers, adjacent to VSU, Fire/Security Door locations, and at any other location where experience indicates a potential jam point.
2. Illuminate the Jam Lamp in a steady burning mode and the MCP Amber Fault Beacon when the jam detection photocell senses a jam condition.
3. Restart the conveyor (after warning alarm sequence) and extinguish the respective Control Station's Jam and E-Stop indicator lamps along with the MCP fault andE- Stop beacons only after the following sequence:
    a. Actuate (push in) Emergency Stop pushbutton; at this point the E-Stop indicator lamp on the respective Control Station shall illuminate in a steady burning mode, and the MCP E-stop beacon shall turn on at the MCP.
    b. Clear the jam condition; at this point the Jam indicator light shall flash to indicate the jam fault condition has been cleared and the associated conveyor segments are ready to be reset.
    c. Reset (pull out) emergency stop pushbutton; at this point the Jam indicator light shall continue to flash to indicate "E-stop Reset" required.
    d. Depress the respective Control Station's green "re-start" pushbutton to restart the subsystem conveyor equipment; at this point the jam indicator light shall extinguish along with the MCP fault and E-stop beacons and the subsystem conveyor

equipment shall restart after the appropriate warning alarm sequence.

4. Paint the control station enclosure with "Safety" yellow paint and label with the conveyor Item Designations of the conveyors being controlled in ½" high block letters. Jam detection reset control stations shall be placarded with the conveyor designations, which are being controlled.
5. In most cases the control stations shall be located adjacent to the conveyors under control and shall be accessible only to the personnel clearing the jam to avoid a subsystem being re-started in an unsafe condition (e.g. personnel on conveyor).

E. Start-Up Warning

1. Provide amber rotating beacons and audible horn alarms as start-up warnings in areas as specified.
2. Activate the beacon and the horn for an adjustable period of time prior to the start- up of the conveyor system.
3. Appropriate audible start-up warning alarms shall be provided at public and non- public areas such as ticket counter, curbside check in, make-up areas, and transfer unload area.

F. Alarm Silence

1. Provide an ALARM SILENCE momentary contact pushbutton on the door of the MCP which, when depressed, shall silence the audible alarm. The design of the control circuitry shall be such that multiple faults shall always sound the associated fault warning alarm; i.e., if a jam condition has caused the alarm to have been sounded and the alarm has been silenced by the actuation of the pushbutton but the jam fault has not yet been corrected, a second fault occurring after the alarm has been silenced shall again cause the fault warning alarm to sound.
2. Do not extinguish the illuminated fault indicator until the fault has been corrected.

G. Emergency Stop Pushbuttons

1. Locate Push buttons as required to ensure that operating and maintenance personnel can easily and quickly reach an Emergency Stop Pushbutton from anywhere in the system. In addition, ensure that Emergency Stop Pushbuttons are installed at the following locations:
   a. Around the perimeter of all new make-up devices.
   b. At each end of load/unload conveyors.
   c. Along lengths of conveyors, whether running at floor level or overhead mounted on conveyor support legs or building columns a maximum of 50' 0" apart.
   d. In each jam indication enclosure.
2. 45-degree and 30-degree merge Emergency Stops shall also be interlocked to the receiving or takeaway conveyor.
3. Wire all Emergency Stop push buttons for a single subsystem in series with the coils of one or more emergency stop relays. Size the normally open contacts of the relays in series with the power source of the PLC output module(s) controlling the conveyors in the subsystem. The PLC shall not be required to remove power from the associated conveyors for an emergency stop condition.
4. Upon actuation of an Emergency Stop pushbutton, stop the associated conveyors in the subsystem, illuminate the lamp in the head of the pushbutton in a steady burning mode,

and illuminate the red emergency stop fault beacon at the MCP.

5. Restart the conveyors (after the warning alarm sequence) and extinguish the indicator lamp and MCP fault beacon only after the following sequence:
    a. Reset (pull out) emergency stop pushbutton; at this point the E-stop indicator lamp extinguishes and the Jam indicator lamp on the respective Control Station shall flash to indicate “E-stop Reset” required.
    b. Depress the respective Control Station’s green “Re-Start” pushbutton to restart the subsystem conveyor equipment; at this point the Jam indicator lamp shall extinguish, the MCP fault beacon shall turn off and the subsystem conveyor equipment shall restart after the appropriate warning alarm sequence.
6. When a jam has been detected and an Emergency Stop pushbutton in the jam indication enclosure is activated, follow the same sequence of stopping the conveyors and illuminating the light in the head of the pushbutton, but do not activate the fault warning circuits at the MCP.
7. Note that the activation of an Emergency Stop pushbutton switch must not close any powered fire/security door within the area of control of the Emergency Stop switch (i.e., doors shall remain in the state that they were in when the E-stop was activated).
8. "E-Stop" conditions shall be provided with “Reset Required Alarms” and reported both visually and audibly on the MCP and MDS.
9. If the Emergency Stop pushbutton is mounted in a yellow enclosure, provide a red nameplate. If the Emergency Stop pushbutton is not mounted in a yellow enclosure, provide a yellow nameplate. Provide a label with the conveyor Item Designations of the conveyors being stopped by this emergency stop in 1/2" high block letters.

H. Security/Fire Door

1. Provide a photocell to detect bags under the security/fire door.
2. The door is to be equipped with either a limit, photocell or proximity switch mounted in such a manner so that the "fully open" position of the door is sensed. If the door is sensed by the limit or proximity switch not be in the fully open position, the associated conveyor shall be stopped if running or shall not be permitted to start if the conveyor is not already running. Note that this limit or proximity switch is in addition to those limit or proximity switches provided with the door operator if the door is powered.
3. The subsystem security doors shall open and close consistent with the respective subsystem start-up and shutdown sequence. The subsystem fire door’s normal state shall be in the open position and close only upon detection of fire/smoke, per the appropriate interface with the terminal fire alarm system. The BHS controls for the fire door and the associated subsystem(s) shall interface with the fire/security system, as required, to provide the response to the fire alarm requirement for door closure (with related control functionality to stop the associated conveyor line).
4. The door shall also be equipped with a limit, photocell or proximity switch mounted in such a manner so that the "fully closed" position of the door is sensed. If the door is sensed by the limit or proximity switch not be in the fully closed position, annunciation shall be sent to the fault monitoring system for rectification of the problem. Note that this limit switch is in addition to those limit or proximity switches provided with the door operator if the door is powered.
5. Interface and test the door interface with the building Fire Alarm and Access Control

Systems for door open/closed status, as it relates to the local fire/heat/smoke detectors and/or fire suppression system water flow module(s) and coordinated building fire alarm and security zones.

6. Program the Fire/Security door to operate as follows:

   a. Normal Start/Stop

      1.) Start: Open the security/fire door immediately if the door is not currently open. Ticket counter, Oversize and Curbside inputs require card swipe permissive start. PLC to provide Building Security System with "Running status".

      2.) Stop (Fire/Security Door):

         a.) Run the feeding conveyor for one minute, stop the conveyor and lower the Fire/Security door. The BHS PLC shall be programmed/ interfaced to provide the Building Access Control System with "Door Closed" status.

         b.) If a bag is detected under the door via the door clear photocell, continue to run the conveyors until the photocell is clear and reattempt to close the door. The door should continue attempting to close, however an alarm should be displayed on the fault monitoring system that the door has failed to close after the third attempt.

      3.) Stop (Fire Door Only):

         a.) The fire door shall remain in the open position when the conveyor line stops due to either Manual or Auto Stop controls functionality. The fire door shall close only upon detection of fire/smoke per the appropriate interface with the building fire/security system.

         b.) Upon detection of fire/smoke, if an obstruction is not detected within the door's right-of-way, stop the conveyors and lower the fire door. PLC to provide Airport Security Access Control System with "Door Closed" status.

         c.) If an obstruction is detected under the door via the door clear photocell, continue to run the conveyors until the door clear photocell is clear and reattempt to close the door. The door shall continue attempting to close for 15 seconds, after which the conveyors shall stop and the door shall close with bottom bar coming to rest on the obstruction. The entire detection and door close process must complete within a total of 25 seconds. An alarm should be displayed on the fault monitoring system that the door has failed to close after the third attempt.

   b. Upon Fire Detection:

      1.) Close the dry contact.

      2.) If no bag is detected under the door by the clear photocell, stop all conveyors and close the door. PLC to provide Airport Security Access Control System with "Door Closed" status.

      3.) If an obstruction is detected under the door via the door clear photocell, continue to run the conveyors until the door clear photocell is clear and reattempt to close the door. The door shall continue attempting to close for 15 seconds, after which the conveyors shall stop and the door shall close with bottom bar coming to rest on the obstruction. The entire detection and door

close process must complete within a total of 25 seconds of the fire detection. An alarm should be displayed on the fault monitoring system that the door has failed to close after the third attempt.

c. Upon Loss of Power:

1.) The fire doors shall close immediately when a loss of power occurs.

d. Light Curtain:

1.) Security doors shall be provided with a light curtain for intrusion detection.

2.) If an unexpected blockage is detected by the light curtain when the door is open, an alarm shall be displayed on the fault monitoring system.

e. A security/fire door control station shall be installed adjacent to each security/fire door for maintenance personnel use only (not accessible from the public side) which shall contain the following:

1.) Maintenance/Auto Switch

2.) Emergency Stop

3.) Start Pushbutton

4.) Door Open Pushbutton

5.) Door Closed Pushbutton

f. When the Maintenance/Auto is in the Maintenance position, the door open and door-closed switches are active. Related conveyor systems are not active when in the maintenance mode. Coordinate the security card swipe requirements with MDAD for the operation of the door in the maintenance mode.

g. All powered security/fire doors shall be equipped with a manual release mechanism to permit the disengagement of the door drive unit so that the door can be either raised or lowered.

I. Fault Warning Alarm

1. Provide an audible/visual alarm on the MCP controlling the subsystem. Activate the alarm and one of the following indicator lights whenever any fault has caused a section of conveyor to stop or prevent it from starting:

Condition	Color
Jam	Amber
Motor Overload	Blue
Emergency Stop	Red

J. Motor Safety Disconnect (MSD)

1. Provide Motor Safety Disconnect Switches as described in part 2 of this specification.

2. Rotation of the MSD to the off position shall cause the conveyor or other component to stop and appropriate alarm/statuses to be displayed on the MDS Operator Workstations as described in part 2 of this specification.

3. Rotation of the MSD to the On position shall allow the conveyor or other component to restart (with appropriate startup alarm) only if:

a. The conveyor does not pass through a wall or floor penetration.

b. The conveyor is not a public area conveyor.

K. Interlocks

1. Provide Failsafe interlocks and limits in the system to ensure safe operation. Assume responsibility for the integration of all interlocks and limits that may be necessitated by the characteristics of the elements selected for combination into a total system. Interlocks and limits shall be included for the protection of personnel, equipment and baggage, and in the performance of the operational functions specified for the subsystem and elements comprising the system.

2. Provide electrical interlocks between the various conveyors in a subsystem to inhibit a conveyor from discharging baggage onto a stopped conveyor. Interlocks shall be cascaded from the last conveyor in a train to the first. This provision shall apply to all subsystems even if two different suppliers provide the equipment under separate contract.

3. Provide warning signals, which are activated automatically upon start-up, where appropriate. Flashing lights shall be visible from all points in the vicinity of the equipment concerned. Alarms shall be audible within the equipment vicinity and each alarm in the system must be distinctive from any sound within the hearing range, and shall not be unduly annoying to working personnel and shall comply with all applicable codes and regulations. Although not specifically mentioned in the control subsystem descriptions all automatic start-up functions shall be preceded with appropriate audible and visual indicators unless otherwise specified.

4. Inhibit further equipment action upon sensor failure should personnel safety be in doubt. Inform the involved equipment operator or maintenance personnel of such failure through the, MDS. Sensors shall be selected and positioned such that false signals from debris, ambient light, and personnel movement do not cause activation.

5. Coordinate the facility fire zones with MDAD and to add a dry contact to the subsystems controls, so that if a fire is detected the system will perform the necessary shutdown. This feature shall be provided to the BHS control system, regardless if the system includes a fire door or not.

3.7 ELECTRICAL AND CONTROLS SPECIAL CONSIDERATIONS

A. Power Source

1. The electrical equipment and PLC control systems provided shall be compatible with, and operate reliably and effectively with the electrical supply typically available at Miami International Airport. The equipment shall not be unduly sensitive to fluctuations in supply voltage which may typically vary by plus or minus ten percent (10%) of nominal values.

2. Provide necessary electrical supply filters, conditioners, and regulators for all equipment, which cannot meet the specifications stipulated.

3. Equipment of the respective subsystem are to be controlled and powered by normal building power supply. Emergency power is not required.

B. Outbound System Input/Collection Conveyor "Manual Start" Sequence

1. The following describes the typical operation of the outbound system's input conveyor's Manual Start Sequence.

2. Each ticket counter and curbside check-in, outbound oversize, and international to

domestic re-check subsystem shall be initiated to start via a local "Subsystem Start" Security Card Swipe Device. Activation of the security card swipe shall supply power to the respective control station, located at the associated conveyor segment area. Actuation of the Subsystem's Illuminated Start push-button shall energize the respective Visual/Audible warning alarms along the conveyor line, both in the public space and air side, for 10 seconds (adjustable) - e.g., oversize, curbside, check-in area, and re-check input conveyor respective subsystem ceiling conveyor right-of-way catwalks. The subsystem's respective fire/security doors shall open while the "Run" 10 second alarm sounds and flashes. After the 10 (ten) second "Run" alarm period and when the fire/security doors are fully opened, the subsystem input/collection conveyor(s) shall start. The downstream transport conveyors shall start via an auto-start function sequentially, from the output to the input, with an appropriate delay between each motor starter actuation to ensure electrical power surges are minimized.

3. The subsystem security doors shall open and close consistent with the respective subsystem start-up and shut-down sequence. The subsystem fire doors shall close only upon receiving a signal from the Fire Alarm System for closure and open upon normal start-up sequence, otherwise they shall remain open at all times.

C. System Ready Indication

1. A green indicator light, labeled SYSTEM READY and located on the door of each MCP shall serve to indicate that the devices under its control are ready to operate upon receipt of a START signal, from the BHS control system and local card swipe device. To accomplish this, the light shall illuminate under the following conditions, per the respective subsystem:
   a. Power is applied to the MCP.
   b. The local conveyor motor and Fire/Security door disconnect switches are in the "ON" position.
   c. All Emergency Stop pushbuttons are reset.
   d. No Motor overloads are tripped.
   e. No Jam conditions are indicated.
   f. No oversize conditions are indicated.
   g. No faults are indicated on the MDS or MCP.

D. Relocation and Modification of Existing Control Stations

1. Relocate any existing control stations and electrical field components that are associated with the existing conveyor equipment re-configurations (interim and final works) that are illustrated on the contract drawings. Re-wire existing control stations as required to accommodate the interim conditions and replace these control stations for the final works.
2. The existing control stations downstream of belt 4 shall remain.

E. Check-In Decline Conveyor Functionality

1. The conveyor functionality on the existing conveyors upstream of the new CBIS (e.g., Ticket Counter and Curbside Lines) due to the greater than 18 degree declines shall be modified as follows to hold baggage and release baggage from the Check-In Conveyors as follows:
   a. When the control system detects that baggage has cascade stopped to the departures

level conveyors (i.e., conveyors are cascade stopped from check- in subsystem merge through the decline and to a point on the departures level conveyors), the decline conveyor shall stop until all conveyors from the subsystem merge to the conveyor immediately downstream of the decline are running (bags are flushed) or until a configurable duration has elapsed.

b. When the bags are flushed downstream of the decline or the configurable duration has elapsed, the decline shall restart to flush bags from this conveyor. The conveyor upstream of the decline shall remain stopped until the decline has flushed all bags or until a different configurable duration has elapsed.

c. When the bags are flushed from the decline or the configurable duration has elapsed, the conveyors upstream decline shall restart and the system will resume normal operations. The failsafe zone shall be approved by MDAD or their representatives through the design review process

2. The specific Check-In Decline Conveyor Functionality to include specific triggering photoeye locations and hold / run times for these subsystems shall be approved by MDAD through the design review process:

3.8 BHS DETAILED CONTROL DESCRIPTIONS/REQUIREMENTS

A. General Design Requirements.

1. The following subsystem control descriptions apply the referenced components and circuits to the operational aspect of the system and specify the actual elements under their control.

2. Reference the Contract Drawings for conveyor equipment power distribution and subsystem indication. Location for each of the new MCPs and modified existing MCPs are referenced on the BHS Partial Plan and Control Plan Drawings. Power distribution point (PDP) locations for the new MCPs are at the immediate area of the respective MCP as shown on the BHS Partial Plans.

3. The Control Functions associated with the outbound sort system, the outbound screening system and each of the ticket counter check-in lines are described in the following paragraphs. Apply the generic subsystem/conveyor line functional description to the detail design of each electrical subsystem of similar type.

4. Provide software for the control system reflecting the sequence of operation for each subsystem as described in the following paragraphs. The paragraphs describe the particular subsystem specific controls that will be required in addition to those standard controls (i.e., Jam Detection, Jam Reset, Cascade Stop, Oversize Detection, Merge Control, Auto Start, Auto-Stop, Emergency Stop, and all other controls functionality described elsewhere in this document) that will be required for each subsystem (described elsewhere in this document).

5. Provide dry contacts to the subsystem controls, within the respective MCP, as specified elsewhere in this document, so that in the event that an appropriate signal is sent from the Fire Alarm system (as coordinated with the fire alarm system), the conveyor system shall shut down and the associated fire doors shall closedown.

B. Ticket Counter Subsystems.

1. General.

a. The central outbound ticket counter, systems consists of the following subsystems.

b. TC12 – TC17 (including the new associated 2 segment ticket counter dispatching conveyors).

c. As part of the reconfiguration of the Central Terminal TC12-TC17 ticket counter subsystems, the remaining conveyors upstream of new conveyors will remain unchanged.

d. All fault annunciation and status reporting for the outbound ticket counter conveyor subsystems (new and reworked existing) shall be displayed both graphically and in text on the Operator Workstation MDS system.

e. Note that the controls at the Level 2 departures level associated to the ticket counter subsystems that include 2 segment dispatching conveyors shall match the existing functionality.

f. The following describes the TC12 ticket counter line sequence of operation; all other ticket counter conveyor lines will operate in a similar manner.

2. Control Equipment Components.

a. Three (3) control stations shall be provided for Start/Stop control of each ticket counter conveyor lines TC12 through TC17. These control stations shall be located on the soffit in a stainless recess. The final location of these control stations shall be coordinated with MDAD.

1.) The control station located at the charge end of the first ticket line load belt shall include the following operators/control devices.

a.) Lighted “Start” Pushbutton.

b.) “System Stop” Pushbutton

c.) Lighted Push-Pull (lockable) “E-Stop”

d.) Sonalert Warning Device.

2.) The control station located on the second ticket line load belt shall include the following operators/control devices.

a.) Lighted “Start” Pushbutton.

b.) “System Stop” Pushbutton

c.) Lighted Push-Pull (lockable) “E-Stop”

d.) Sonalert Warning Device.

3.) The control station located at the discharge end of the third ticket line load belt (power turn) shall include the following operators/control devices.

a.) Lighted “Start” Pushbutton.

b.) “System Stop” Pushbutton

c.) Lighted Push-Pull (lockable) “E-Stop”

d.) Sonalert Warning Device.

e.) Oversize Indicator / Reset Illuminated Pushbutton.

b. Control stations shall be provided for at each of Scale-Dispatch Unitts. These control stations shall be located on a stanchion mounted stainless steel enclosure. The location of these control stations shall be coordinated with MDAD.

1.) TheScale Dispatch control stations shall include the following operators/control devices:

a.) Scale Interface Screen.

b.) “On/Off Keyswitch

c.) “Label” Pushbutton

d.) “Dispatch” Pushbutton

e.) “Reset/Restart” Pushbutton

f.) Lighted Push-Pull (lockable) “E-Stop”

3. Control Functions.

a. Ticket Counter Conveyor Start Sequence.

1.) The conveyor line's local "Subsystem Start" shall be enabled via the "System Start" function, from the Operation Control Center's BHS Operator Workstation. This function shall allow the local security card swipe to supply power to the respective TC line Start/Stop control stations.

a.) Automatic System Cascade Start.

(1.) The conveyor segments downstream of belt 3 shall start via an "Auto Start" sequence for TC12 through TC17. Provide auto start photocells upstream of sections of outbound transport conveyors, not specifically controlled by the "Start/Stop" control station. Program the auto start circuit to start conveyor segments downstream of belt 3 and the downstream conveyor lines (if not already running) whenever an auto start photocell on the TC12 through TC17 subsystems is interrupted. The downstream transport conveyors shall all start sequentially from the output to the input with an appropriate delay between each motor starter actuation to ensure electrical power surges are minimized.

b.) Automatic System Cascade Stop.

(1.) The conveyor segments downstream of belt 3 on TC12 through TC17 shall stop via an "Auto Stop" sequence. Provide auto stop photocells upstream of the outbound transport conveyors, not specifically controlled by the "Start/Stop" control station. Program the auto stop circuit to stop conveyor segments downstream of belt 3 whenever the auto stop photocell on does not sense a bag for 5 to 30 minutes (adjustable). The same photocell may control both "Auto Start" and "Auto Stop" functions.

c.) Manual Start.

(1.) The Ticket Counter conveyors shall be activated by a security card swipe. This action shall supply power to the pushbutton control stations located at the Ticket Counter area. Pressing a “Start” pushbutton on any ticket counter control station shall energize the Start-up alarm(s) in the check-in area, along the outbound ticket counter transport line and downstream outbound conveyors for 10 seconds (adjustable). The start-up alarms in along the downstream outbound conveyors shall sound only if the conveyors are not already running. The Fire/Security door shall open while the "Run" 10-second start-up alarm sounds and

flashes. After the 10 second "Run" alarm period and when the Fire/Security door is fully opened, the ticket counter check-in conveyors downstream shall start.

(2.) The control stations located on ticket counter conveyor segment 3 shall start the belt 3 (power turn) and all conveyors downstream of belt 3 for the respective ticketing conveyor. Control stations located conveyor 2 shall start the belt 2 and all conveyors downstream of belt 2 for the respective ticketing conveyor. Control stations located conveyor 3 shall start the belt 3 and all conveyors downstream of belt 3 for the respective ticketing conveyor. The intent is to keep ticketing load belts from running when when there are no active stations feeding them, assuming stations will be allocated starting from the most downstream stations (Belt 3).

(3.) Control stations located conveyor 2 shall cascade start all of the conveyors of the respective ticketing conveyor.

d.) Manual Stop.

(1.) Depressing the "Stop" pushbutton on any of the Ticket Counter Control Stations shall stop conveyors belts 1 through 3 after a predetermined period to clear all bags on the conveyor segments and close the Fire/security door (if the Door Clear Photocells are not blocked); conveyor segments downstream of belt 3 shall run for a predetermined period to clear all bags on the conveyor segments, prior to the stoppage of these conveyor segments.

e.) Scale and Dispatch Conveyors.

(1.) New scale and dispatch conveyors shall be installed on the TC14 through TC17 conveyor lines. Stachion mounted controls stations shall be provided at each scale/dispatch location. The ticketing agent will control the movement of bags using the ‘Label” and ‘Dispatch’ buttons provided at these control stations.

(2.) A bag is placed on the scale conveyor charge end of the scale conveyor by the passenger. The ticketing agent then uses the “Label” button to advance the bag to the photoeye at the end of the scale conveyor, where it will stop. The ticketing agent will then record any information and label the bag.

(3.) When the ticketing agent has completed processing the bag on the scale conveyor, the ‘Dispatch’ button is used to advance the bag from the scale conveyor to the dispatch conveyor. The bag will then advance to the photoeye at the end of the dispatch conveyor. The bag will then either merge (if merge conditions allow) or stop at the photoeye and wait to merge.

f.) Start-up alarms and fault alarms shall be located as required, along the outbound transport line. Start-up and Fault Warning Alarm(s) location and function shall be consistent with the specified requirements indicated elsewhere in this document.

g.) Jam Reset and Emergency stop control station(s) location and function shall be consistent with the specified requirements indicated elsewhere in this

document. All Jam Reset and Emergency stop stations associated with the TC10 line's outbound transport conveyors in the departures floor level ceiling space shall be located adjacent to each conveyor drive on the maintenance catwalk side, so that they are accessible by maintenance personnel.

4. Other Control Functions.

   a. Control Functions associated with the conveyor line's Fire/Security Door operation, Cascade Stop, Jam Detection/Restart, Oversize Detection/restart, Emergency Stop/Reset, Motor Control Panels, Motor Overload conditions and respective Alarm Silence function(s) shall be compliant with the specified requirements described elsewhere in this document.

   b. Flash the Ticket Counter Start Pushbutton "Green light" when the respective ticket counter conveyor subsystem has cascaded back to the load belt. This will notify the ticket counter agent that a jam/fault has occurred in the subsystem.

   c. Merge Control functions associated with any of the ticket counter conveyor lines 45 degree merge and mainline conveyors remain as currently programmed.

3.9 CONSTRUCTION PHASING SEQUENCE

A. General

1. The BHS installation with associated demolition and modifications to the existing systems shall be completed in phases. The BHS scope of work, such as the installation of new conveyor equipment and the removal of existing conveyor equipment, including all required interim conditions, shall be in accordance with the minimum project phasing sequence illustrated in the contract documents, and in compliance with the overall project schedule. The implementation area for the BHS installation and existing modifications (as they relate to the interim and final conditions) shall become available as dictated by the overall program phasing plans and as coordinated with MDAD's schedule. The BHS Subcontractor shall be required to schedule and coordinate all work with MDAD, other disciplines working in the immediate area of construction, airline flight schedules and hours of operation, so as not to impact the Terminal's normal functions and concurrent airline operations.

2. The BHS implementation staging is of vital importance to the success of the BHS installation of the new conveyor equipment and modifications to the existing subsystems. Installation of the new conveyor equipment and removal/modifications of the existing equipment will occur simultaneously with on- going airline operations. The new conveyor system and the modifications to the existing subsystems will increase the existing outbound operational capacity, as illustrated on the accompanying drawings, and it is therefore vital that the outbound baggage make-up area continue to process baggage throughout the implementation period without operational disruption or capacity reduction. Make every effort to ensure continuity of operation in each Phase with related BHS Activities, and throughout the entire duration of the Project.

3. Communication shall be an essential element of the phased-in implementation program. Under no circumstances shall a new phase or BHS Activity of the project commence without proper notification (according to the project schedule in advance and in writing).

4. Short duration system shutdown will be permitted for the changeover from the existing subsystem configuration to the new. Shutdown of the system during changeover shall be scheduled during times of low impacted terminal operating demands. The BHS

Subcontractor shall check and field-verify actual site conditions to determine and coordinate the schedule for any shutdown period. Submit schedule of work to MDAD 14 days prior to the actual work being performed, for review and approval. Schedule shall be submitted on a BHS Phase- by-Phase basis. Additionally, notify the respective carrier via the GC (through MDAD) in accordance with the requirements of MDAD's Contract Documents, in writing, and obtain approval before proceeding with the shutdown of the system(s). Ensure that an approval is obtained from MDAD before proceeding with the shutdown of the system(s); there will not be any exceptions to this requirement.

5. The BHS work within the existing facility operational spaces shall be performed during the 1st shift period. 2nd level deliveries shall be coordinated and performed on the 3rd shift period. For reference purposes, 3rd shift work period may be considered between the hours of 9:30 pm and 5:30 am. However, all of the BHS work shall be performed as coordinated with MDAD and the TSA or their representatives. Coordinate, through MDAD, the work windows within the existing BHS and baggage screening operational areas to establish the times during the day and/or night for each BHS Phase, which will also be dependent on the work to be performed so as to allow the BHS Subcontractor to take down portions of the system for the respective phase. Within each BHS Phase, the BHS Subcontractor shall have an average of a seven (7) to eight (8) hour work window, to perform his work, as coordinated with MDAD. MDAD will have the right to allocate separate areas of the existing operational spaces, on a daily basis (if necessary), to allow the BHS Subcontractor to break-up his work window within the coordinated work space(s) that satisfy the allowable work window without compromising the BHS operation. Determine the quantity of work required during the day, including the third shift period, based upon a comprehensive analysis of the existing systems (in coordination with MDAD), the necessity to maintain uninterrupted BHS operations, and the reviewed and approved phasing plans(s) as the basis of schedule and implementation.

6. Transfer all of the necessary construction material, conveyor equipment, tools, and components required for the implementation of the BHS to and from the designated Lay-Down areas during the work period and in conjunction with the Phased Implementation schedules. This may necessitate additional manpower due to the short duration of time available for implementation during any particular Phase and related BHS activity. All Airline operational areas associated with the BHS work shall be left broom clean at the end of the BHS Subcontractor's shift without any equipment, tools, or components left in the area. BHS construction material, equipment and tools/components will be permitted in the immediate area of construction only during the BHS Subcontractor's work period/shift. Ensure all alteration areas are broom clean after completion of the work.

7. Provide all associated equipment and services necessary to accomplish the BHS Phases, which shall include but not be limited to:

    a. Controls modification requirements during the interim conditions.

    b. Staging and storage requirements.

    c. Logistics needed for demolition and installation.

    d. Staffing and scheduling to complete the work during non-operational hours or within a single "shut down" period (i.e. no BHS Phase or related activity shall remain incomplete at the conclusion of the scheduled period). In the event that this shall occur, either the system shall be reverted to the original state or work around conditions shall be provided (at the expense of the BHS Subcontractor) to maintain operational continuity without degradation of service levels.

e. Operational considerations to maintain continuity of service for the TSA and airlines as each Phase is implemented.

B. BHS Alterations Interim Conditions

1. The reconfiguration of the existing BHS shall be performed in a sequenced implementation process, so as not to have an effect on the Airport, or any tennants' daily functions. The overall reconfiguration of the systems, as well as the inspections and testing of the new BHS, shall also include BHS interim conditions that shall include, but not be limited to, the following requirements to permit the inspection/testing and certification of the new BHS, maintain the operation of unaffected BHS equipment and/or equipment that are in the process of getting modified as part of the BHS alterations:

   a. Provide temporary electrical connections, including conduits / wireway, wiring, junction boxes and pull boxes with related supports.

2. All required BHS interim conveyor equipment (i.e., mechanical, electrical and controls) and their associated supports / connections shall be included as part of the overall project phased-in implementation plan. Coordinate with MDAD for the necessary manpower and provide the equipment that shall be required for the interim conditions to minimize the system downtimes and inconvenience to the airlines and TSA operation; this work shall also include the coordination with MDAD and their third party handling agency to provide manual handling of baggage for airline operations during the outage of their existing conveyor line(s).

C. BHS PLC and MDS/MIS Software Implementation Requirements

1. The updates of the PLC and BHS MDS/MIS software shall be performed in a phased-in implementation process, so as not to have an effect on the Airport and airline daily functions.

D. BHS Phased Implementation Summary

1. Reference the overall Program Phasing Plans for a general layout and the following outline of the BHS phased-in implementation. Perform the work in any sequential order but shall do so only to expedite the work for each Phase and to minimize subsystem downtime, without compromising the existing outbound operation cart capacity.

2. Note: Prior to any BHS work where conveyor segments will need to be installed, all related BHS right-of-ways shall be cleared and the area shall be prepared for the upcoming BHS conveyor subsystem(s) installations.

3. Note: Ensure that all necessary conveyor equipment/components and/or temporary conveyor segments (e.g., slider bed, end pulleys, sections and the like) that are required for the conveyor tie-ins are on-site and available for the intended work, prior to proceeding with the respective phased-in implementation. Additionally, all preparatory work such as conduit runs, wiring and the like are performed prior to the scheduled outages to minimize the operational downtimes of the respective conveyor subsystem.

4. Note: During the phased-in implementation, coordinate with MDAD and their third party handling agency for staffing/labor to provide manual baggage handling for certain operational conditions, as a fallback condition, should a tie-in be delayed or should a failure be experienced that will inhibit the airline's operation for scheduled overnight tie-ins and operational turnovers.

5. Central Terminal Level 2 Detailed Phasing.

a. Note: In addition to the PDPs and MCPs required to support the installation of the new BHS conveyor systems within the Terminal Building, the following PDPs and MCPs located in the Central Terminal bag room are required to support the required testing.

1.) PDP-B11, MCP-TC20B.

b. Phase 1 – TC14 & TC15 Reassign carriers utilizing existing TC14 & TC15 to alternate ticket counters.

1.) Step 1: TC14 & 15 Demo:

a.) Demo TC14-01 through TC14-04 and TC15-01 through TC15-04. BHS contractor to demo and remove existing K1 doors and associated support structure.

2.) Step 2: Install

a.) Install TC14 scale (S) and dispatch (D) conveyor sections TC14-01S & D through TC14-08S & D

b.) Install take away conveyor sections TC14-01 through TC14-04

c.) Install TC15-01S & D through TC15-08S & D

d.) Install take away conveyor sections TC15-01 through TC15-04 and K1/fire/security doors FSD/TC14-03 & FSD/TC15-03.

e.) Install new MCP-14A and MCP-15A and power from PDP-A12.

f.) Reuse existing electrical conduit and wiring where possible. Provide combination of new and existing relocated control devices.

3.) Step 3: Test & commission

a.) TC14 & TC15 - Test & Commission (CONTRACTOR AND OWNER)

4.) Step 4: Go live

a.) TC14 & TC15 - GO LIVE - TURN OVER FOR BENEFICIAL USE

c. Phase 2 – TC16 & TC 17 Reassign carriers utilizing existing TC16 & TC17 to alternate ticket counters.

1.) Step 1: TC16 & 17 Demo:

a.) Demo TC16-01 through TC16-04 and TC17-01 through TC17-04. BHS contractor to demo and remove existing K1 doors and associated support structure. Reuse existing electrical conduit and wiring where possible.

2.) Step 2: Install

a.) Install TC16 scale (S) and dispatch (D) conveyor sections TC16-01s & d through TC16-10S & D

b.) Install take away conveyor sections TC16-01 through TC16-04; install scale and dispatch conveyor sections TC17-01S & D through TC17-10S & D;

c.) Install take away conveyor sections TC17-01 through TC17-04; and K1/fire/security doors: FSD/TC16-03 & FSD/TC17-03.

d.) Install new MCP-16A and MCP-17A and power from PDP-B12.

e.) Reuse existing electrical conduit and wiring where possible. Provide combination of new and existing relocated control devices.

3.) Step 3: Test & commission

a.) TC16 & TC17 - Test & Commission (CONTRACTOR AND OWNER)

4.) Step 4: Go live

a.) TC16 & TC17 - GO LIVE - TURN OVER FOR BENEFICIAL USE

d. Phase 3 – TC12 & TC 13 Reassign carriers utilizing existing TC12 & TC13 to alternate ticket counters.

1.) Step 1: TC12 & 13 Demo:

a.) Demo TC12-01 through TC12-04 and TC13-01 through TC13-04. BHS contractor to demo and remove existing K1 doors and associated support structure. Reuse existing electrical conduit and wiring where possible.

2.) Step 2: Install

a.) Install take away conveyor sections TC12-01 through TC12-04

b.) Install take away conveyor sections TC13-01 through TC13-04; and K1/fire/security doors: FSD/TC12-03 & FSD/TC13-03.

c.) Provide combination of new and existing relocated control devices.

3.) Step 3: Test & commission

a.) TC12 & TC13 - Test & Commission (CONTRACTOR AND OWNER)

4.) Step 4: Go live

a.) TC12 & TC13 - GO LIVE - TURN OVER FOR BENEFICIAL USE

3.10 DEMOLITION/EQUIPMENT REMOVAL

A. Equipment Removal/Maintain Operations

1. Remove existing equipment indicated on the Contract Drawings as "To Be Removed", including all associated support systems (e.g., hangers, threaded rods, header steel, angled support sills, sway bracing), conduits, junction/pull boxes, wiring, control stations, field control components, PDPs, MCPs, impact protection and the like. All conveyor equipment and related components shall be removed with care, to enable the salvaging of components for MDAD's Maintenance Group's spare parts inventory. Inform MDAD that the equipment has been removed and are available for review to determine what shall be salvaged and what shall be disposed; coordinate this process with MDAD's Maintenance Group and MDAD. Maintain operation of unaffected baggage handling equipment through the implementation of temporary electrical connections or the addition of supports to replace connections or supports removed in the demolition process.

2. If the removal of equipment creates unsecured access to a secured area, provide a guard on a 24-hour per day basis until installation of equipment returns the area to secured status.

B. Conduit Removal

1. Remove conduit including junction boxes and control/wiring devices rendered unused by the demolition process in its entirety to the motor control panel. Exception: abandon in

place the imbedded portion only of any imbedded conduit after removing all conductors. Where a conduit passes through a floor or wall, cut the unused conduit flush with both surfaces of such floor or wall and abandon the section within the floor or wall if it cannot be removed without breaking masonry. Ensure that any area where material has been cut away is left in a clean and flush condition with no holes or protrusions showing. Where removal creates an indentation in concrete, chip away the surrounding concrete, cut the material (e.g., anchor bolts, conduit) below floor level and fill flush with cement.

C. Support Steel Removal and Impact Protection Removal

1. Remove support steel including header beams and attachments rendered unused by the demolition process in their entirety. Remove all impact protection and associated attachments, anchors and the like that are rendered unused by the conveyor equipment demolition process in their entirety. Remove anchor bolts flush with floor, wall, or ceiling by burning or cutting.

D. Equipment/Control Device Reuse

1. Reuse existing electrical control stations/devices only on conveyor equipment being reinstalled or reconfigured on a temporary basis and which are not planned for the final works (e.g., to be removed during the course of this contract work).

2. Replace, electrical control stations/devices on equipment being installed or reconfigured on a long-term basis (i.e., Final Works) per the specified requirements.

3.11 SALVAGED EQUIPMENT TO BE TURNED OVER TO MDAD

A. General

1. Remove equipment or other items designated to become the property of MDAD's Maintenance Group with care.

B. Equipment Salvage

1. Remove all existing conveyor segments, with their related supports and components for the existing equipment that are illustrated on the Contract Documents as "To Be Removed". Disassemble such equipment with care by removing nuts and bolts, screws or other fasteners. Cut or burn only those sections welded as part of the initial assembly operation that are too large to move through existing doorways and openings or too large to be moved by stake-body trucks with or without oversize permits.

2. MDAD's Maintenance Group intends to salvage the following types of components for spare parts: motors, gearboxes, bearings, belting, field control components, head rollers, tail rollers, return rollers, control stations, photoeyes and associated mounting brackets, tachometers, and MCP control components. Remove/disassemble such components from their respective conveyor segment assembly (or MCP) with care, box/package each item, label and log it in a master log (i.e., Microsoft Excel log format) for formal turn over to MDAD's Maintenance Group. Prepare a sign-off transmittal indicating what equipment has been turned- over, the BHS Subcontractor's representative who turned the equipment over, MDAD's Maintenance Group's representative who accepted the equipment and the date the equipment was turned over.

3.12 DEMOLISHED MATERIALS TO BE DISPOSED

A. General

1. Remove and dispose of any materials or items demolished and not designated to become the property of MDAD or to be reinstalled.

B. Equipment Disposal

1. Remove from Airport site all debris, rubbish and other materials resulting from demolition and alternation operations on a daily basis as they are removed. Transport and legally dispose equipment off-site in legal landfills or scrap yards.
2. Burning of removed materials is not permitted on the project site.
3. Store materials, which cannot be removed daily in areas specified by MDAD.
4. Do not store or sell removed items on-site.

3.13 OPERATION AND MAINTENANCE TRAINING

C. General

1. Instruct and train MDAD's Operating and Maintenance (O&M) at the work site per Division 1, Section 01 79 00. Separate training sessions, specific to each group, shall be provided for MDAD's BHS Operating and Maintenance personnel. Conduct this training prior to Beneficial Use of the BHS (operational use of the BHS) and ensure competence in the operation and maintenance of the new equipment and the system/subsystems.
2. Training may be provided by site supervisors, equipment or system designers for the formal training.
3. Furnish all tools, equipment, materials and supplies, and perform all functions and services required to complete the training as specified. With the exception of safety and overview training, training shall be divided into separate categories for operations training and maintenance training.
4. No actual operations training of a piece of equipment will be permitted until the equipment is properly installed and is operational.
5. Training materials and documentation of the proposed training to be conducted shall be submitted to MDAD and the TSA or their representatives for review and approval in accordance with the schedule of submissions prior to the testing of the system and scheduling of the first training session. The training program submittal shall include, at a minimum, the following information for review:
    a. Types and durations of training/classes.
    b. Name and professional credentials for each instructor/trainer.
    c. Max/min number of persons allowed per class.
    d. List of equipment that will be used/provided by the BHS Subcontractor for the training classes (e.g., DVD, TV, Whiteboard or the like). Requirements for classroom/conference room space shall be coordinated with MDAD.
    e. Copies of all training materials, to be used during training. All training binders/materials shall be submitted for review in the format in which they will be used during the on-site training. It should be noted that the O&M manuals will not be allowed to be used for training purposes; however consolidated sections of the O&M manuals which have been tailored for classroom training are permitted.
6. Times and duration of the classes may involve irregular hours in order to provide training of the operational and maintenance personnel on different shifts.
7. All training sessions will be monitored and approved by MDAD or their representatives. Additionally, all training sessions shall be videotaped, copies of which are to be provided

to MDAD. Any session or portion thereof deemed unsatisfactory, based on evaluation of the training, and shall be repeated by the BHS Subcontractor or the BHS Subcontractor's representative at no additional cost to project.

8. Provide MDAD, each with a copy of the video recording of one - (1) complete operational and maintenance training class for this project (one copy for the training in South Terminal and one copy for the training in Central Terminal). The video recording shall be provided in a media acceptable to MDAD (e.g., DVD or other format), prior to beneficial use of the BHS and live baggage screening operations.
9. Develop and maintain a training attendance record for all operation and maintenance training sessions presented. The record is to note the following information in duplicate form. The original copy of the record is to be forwarded to MDAD with the second copy being retained by the BHS Subcontractor for his files. The recorded training information must include for each session:
    a. Date of training session
    b. Name of project
    c. Name of Instructor
    d. Subject of training
    e. Time of training session
    f. Signature and department of each attendee
10. If, at MDAD's discretion, if part of the below training sessions are deemed unnecessary, it shall be discontinued and MDAD shall receive a prorated credit for the unused hours of training.

D. Operational Training

1. Prior to tiurnover of initial phase, Provide a minimum of 2-hours of operational training per shift (3 sihfts) on two days this project, for a minimum of six (6) sessions.
2. Provide formal training of MDAD's maintenance, Airline personnel, MDAD service providers and MDAD's operational personnel at the site who will be charged with operation of the BHS. Include a description and on-site demonstration of the electrical controls and their operation, modes of operation, the operating limitations of the equipment and the safety devices and their functions.
3. Minimum requirements for Operational Training shall include, but not be limited to, the following:
    a. Bag Placement on load conveyors.
    b. Tub usage and loading.
    c. Operating procedures for all BHS conveyance equipment.
    d. Provide description of the BHS Control Interface.
    e. System Safety procedures, including lock-out and Tag-out requirements.
    f. Bag Jam Clearing procedures, as coordinated with MDAD's O&M

E. Maintenance Training

1. Prior to turnover of initial phase, provide a minimum of 2-hours of maintenance training per shift (3 sihfts) on two days this project, for a minimum of six (6) sessions.

2. Provide formal training of MDAD's BHS maintenance personnel with the objective of preparing the employees to perform the required preventive maintenance to minimize breakdown and to perform necessary repairs when work stoppages or breakdowns of the equipment occur. The training shall include, but not limited to the following:

    a. Preventive and corrective maintenance procedures, including replacement of parts; lubrication quantities, types, frequencies and application points; and an estimate of the time to perform such procedures.

    b. Special tools, techniques, or procedures required for either preventative or corrective maintenance of the equipment, or it's auxiliary or support components.

    c. Procedures to perform adjustments required for alignment, wear and calibration for all preventative and corrective maintenance, and an estimate of time required performing such procedures.

    d. Assembly and disassembly procedures, including parts lists required for appropriate and corrective maintenance. Models, "exploded" views, and audiovisual materials shall be used for training. These materials shall be handed to MDAD upon completion of training. Hands on field training shall be provided, subject to the approval of MDAD.

3. The formal training shall consist of classroom and on the equipment training, as required to properly train personnel for each shift, prior to the start of operation. The training must cover all aspects of the electrical and mechanical equipment provided in this project. The electrical aspects shall include but not be limited to, electrical controls and control systems and PLC control systems.

4. On-site training shall be scheduled to commence immediately following classroom training and shall stress hands-on performance based application of the classroom training. Equipment shall be started and relevant systems and components shall be demonstrated.

5. Provide maintenance training for any specialized equipment used in the related system that is not of the BHS Subcontractor's design or manufacture. The qualified representatives will present such training, from the manufacturer of the specialized equipment.

6. Examples of specialized equipment and other BHS maintenance related training include, but are not limited to those items listed below:

    a. Safety Procedures including Lock out/Tag-out

    b. Operation and Maintenance Manual use

    c. Warranty Procedures

    d. System Preventative Maintenance

    e. Jam Clearance Procedures

    f. Power Turns

    g. Scale/Induct Conveyors

    h. Fire/Security Doors

    i. Problem Resolution Screens

    j. Contingency Plans

    k. MDS and MIS System Reports

F. Supplemental Training

1. Should MDAD require supplemental training beyond that specified above, provide such training at a time and at rates as mutually agreed upon between MDAD and the BHS Subcontractor.

- END OF PART 3 -

4. QUALITY CONTROL

4.1 FIELD QUALITY CONTROL

A. General

1. During the construction and installation of the BHS, cooperate with other contractors who may be working in the immediate area for coordination of right-of- way clearances and verify as-built conditions.

2. Where walls immediately adjacent to conveyor equipment affect maintenance access, advise MDAD of the location and size of the wall opening that needs to be developed to permit access to drive components, bearings, and other equipment that would normally be inaccessible because of the wall.

3. Ensure that the design and installation of all conveyor equipment provides maximum access for operational and maintenance personnel.

B. Quality Control Manual

1. Provide a Quality Control Manual acceptable to MDAD and in compliance with Division 1, Section 01 40 00.

C. Quality Assurance

1. The BHS Subcontractor shall be responsible for all quality control of its Work, including work performed by any of its subcontractors.

2. MDAD shall have the right to reject, and the BHS Subcontractor shall replace at the BHS Subcontractor's cost, any construction, production or installation, or portion thereof, which has not been accomplished or documented as accomplished in accordance with the accepted Quality Control Plan.

D. Quality Assurance Representative

1. Appoint a Quality Assurance Representative acceptable to MDAD who shall be responsible for the overall quality assurance implementation and monitoring of the general requirements.

2. The quality assurance representative may be the site manager.

E. Configuration Management

1. Maintain strict configuration control of all aspects of the design, construction, fabrication and installation of the BHS and related programming changes to existing conditions. Submit a Configuration Management Plan for MDAD's review and approval. The BHS Subcontractor shall be responsible for carrying out all aspects of this Plan during the course of this project.

2. Submit to MDAD for formal review and approval details of every proposed change to any of the operating programs (PLC and computer systems) after conditional acceptance of the BHS, or submit proposed changes for review and approval as requested as part of the acceptance testing procedures

F. Project Management Team and Staffing Plan

1. Submit to MDAD for review and approval, the following listing of key personnel with resumes and qualifications that will be working on the project:

a. Senior Project Executive

b. Site Manager(s)

c. Professional Engineer(s)

d. Safety Manager

2. Include on-site and off-site participating personnel and the percent of anticipated participation on this project. MDAD reserves the right to approve or reject key personnel from the list.

3. The BHS Project Executive and Site Manager(s) shall not be changed without MDAD's written approval.

4. Submit a staffing plan broken out by trade (e.g., number of millwrights, mechanical/electrical technicians and control/computer programmers) for each Phase of this project for review and approval by MDAD.

5. The BHS Subcontractor, individuals or entities constituting the BHS Subcontractor and the officers or directors of the BHS Subcontractor or entities or key members of the Project Management Team shall have records of past performance to assure MDAD that they have the experience, competence and integrity to successfully complete a project of this magnitude.

G. Project Management Office

1. Within one week of the date of commencement initiate the Project Management Office, inform MDAD of the details of the office, and authorize the Project Executive and Site Managers to act as representatives

2. The Project Executive shall be given full authority to make decisions and enter into binding agreements with MDAD for all aspects of the project.

3. The BHS Subcontractor shall provide to MDAD a listing of all key project personnel with 24-hour contact details (cell phone number, pager number and e-mail addresses).

4. The BHS Subcontractor shall be responsible to supply all office equipment (e.g. telephones, copiers, fax, computers, plotters, furniture) required to establish their on-site project management office.

H. Pre-Installation Meeting

1. Prior to the start of the installation; attend meetings on-site as required or requested by MDAD per Division 1, Section 01 32 00. At a minimum, each BHS Construction Phase shall include one (1) pre-installation meeting. MDAD will schedule the Pre-Installation meetings, for the purpose of coordinating the on-site installation for each BHS phase with ongoing airport operations.

I. Pre-Demolition Meeting

1. Prior to the start of any demolition, attend meetings on-site as required or requested by MDAD per Division 1, Section 01 32 00. At a minimum, each BHS Construction Phase shall include one (1) pre-demolition meeting. MDAD shall schedule the Pre-Demolition meetings for the purpose of coordinating the on-site removal of the BHS equipment for each BHS phase with ongoing airport operations.

J. Work Activities Bulletin

1. Submit a detailed work plan for individual subsystem testing, every planned cutover, demolition, and system outage for review/approval and coordination purposes with all concerned.

2. No work should be commenced unless the BHS Subcontractor has a signed "Work Activities Bulletin" in hand, and copies have been distributed to the User Airlines through MDAD and other impacted contractors.

3. The "Work Activities Bulletin" shall contain the following as a minimum:

   a. The BHS Subcontractor's internal deadlines for completion of pertinent facility interfaces by other disciplines (e.g. permanent system power, support structure, or other facility interface requirements).

   b. Date and time planned activity to take place from start to finish

   c. User Airlines that are impacted

   d. Details of all conveyors to be removed with duration

   e. Details of all conveyors to be installed with duration

   f. Electrical installation duration

   g. The BHS Subcontractors internal testing with duration

   h. Ticket counter/make up device requirements for loading/unloading of test bags. Coordination with Airlines or their representative.

   i. Witnessed system testing with duration

   j. Full details of contingency plans

   k. Details of person(s) overseeing the activity

   l. Details and number of personnel to be present who are qualified to troubleshoot all aspects of their respective equipment during the planned activity, for example:
      1.) Mechanics
      2.) Electricians
      3.) Controls Engineers
      4.) Computer programmers

   i. BHS Subcontractor 2-week look-ahead schedule.

4. Detailed description of activities required when completing overnight changeovers to ensure that disruption to baggage handling system is kept to a minimum. Include all preparatory work by other trades. Provide backup plan for recovery of operations if changeover work will not be completed in time.

5. Coordination and operational interface to ensure on-going airline and airport operation is not disrupted.

6. Submit as part of the submittal process a sample of their proposed "Work Activities Bulletin" format for review and approval by MDAD.

K. Field Quality Control Services

1. Establish and maintain quality control for operations under this Section to ensure compliance with Contract Document requirements per Division 1, Section 10 40 00 and maintain records of quality control for alteration and removal operations.

2. Any work found not to be in compliance with the Contract Documents, shall be promptly corrected in an approved manner, at no additional cost to project.

L. Preparatory Inspection

1. To be conducted prior to commencing work for a specific phase:
    a. Check schedules, project conditions, protection, traffic arrangements, utilities services maintenance, and related preparatory work for conformance to submittals.
    b. Check to assure adequate protection against damage.
    c. Ensure that all workers are qualified.
    d. Review installation; demolition, alteration, removal and disposal procedures to assure coordination of Contract Documents requirements with each person involved in performing the work.
    e. Verify as-built conditions and notify MDAD of conflicts.

M. Initial Inspection

1. To be conducted after a representative sample of the work is complete for a specific phase:
    a. For this project, a representative sample shall be one (1) set of scale and dispatch conveyor, roughed in, with trim, (not functional) as integrated with the ticket counter transport conveyor.
    b. Review the representative sample of the work against the specification and code requirements previously discussed at preparatory inspection.
    c. Check for workmanship.
    d. Check installation, removal and disposal of each item for conformance.
    e. Check for damage and ensure that damaged work is corrected, at no additional cost to project.
    f. Submit documentation for review to MDAD detailing compliance of the above.

N. Follow-Up Inspection

1. Check completed work against results of initial inspection of representative sample of work against items mentioned in the preparatory inspection.
2. Verify that damaged work is corrected properly and approved by MDAD, at no additional cost to project.
3. Submit documentation for review to MDAD detailing compliance of the above.

O. Inspection Results

1. Certify inspection results: This certification shall state that the observations were performed by or under the direct supervision of the BHS Subcontractor's Quality Assurance Representative and that the results are representative of the conditions being certified.
2. Work accomplished shall be considered satisfactory only when the records and inspections show that all variances have been corrected and that the work is in conformance with the Contract Documents.
3. Submit documentation for review to MDAD detailing compliance of the above for a specific phase.

4.2 INSPECTION/TESTING AND ACCEPTANCE

A. Inspection and Testing Procedures

1. General

   a. All inspection and testing shall be performed in compliance with Division 1, Section 01 77 00.

   b. MDAD shall perform inspections and testing of the completed work. If any punch-list items are found, they shall be rectified prior to turning over the conveyor segments for use and/or proceeding to the subsequent testing phase.

   c. In coordination with MDAD, take noise level measurements of the existing and reconfigured BHS conditions.

   d. The System shall be capable of handling the maximum and minimum specified sizes and weights without jamming, damage or toppling of the baggage.

   e. Provide all actual baggage and simulated weighted baggage required for testing. Actual baggage provided shall be representative of the many different types of baggage pieces encountered during live operations, including the maximum sizes and weights as defined in this specification and also summarized in the table below. Simulated weighted baggage used shall be either weighted tubs or boxes. by ensuring the BHS Subcontractor provided bag set contains multiple bag dimensions to mimic stream of commerce. All baggage used for testing purposes shall be approved by MDAD prior to testing. The ratio of actual to simulated test baggage for this project shall be 50% of each. If necessary, during the testing period, replace any simulated or actual test baggage that becomes damaged to the extent that it is no longer useable in order to maintain a minimum of test pieces at all times.

   f. All tests shall be conducted with the above ratio of actual and simulated baggage except for load tests, which shall be acceptable to be performed with simulated baggage only. No sand, dirt, or other abrasive material shall be used for weight while performing load tests.

   g. Provide all labor for the specified BHS acceptance inspections and tests, including the necessary support and participation for the required commissioning to demonstrate the systems acceptance to MDAD. The labor / staffing for the BHS acceptance inspections and tests shall include, but not be limited to manual handling of the test bags and appropriate service personnel "on-site" during the testing period to service or adjust, as required, the System equipment as well as to open all control boxes, control station covers, drive assembly chain/V-belt guards, and covers for MDAD's inspection of the system equipment.

   h. Provide all necessary test, measuring, and recording devices required to demonstrate the operational characteristics and performance of the equipment to MDAD (clamp-on type ammeter, direct read FPM digital readout tachometer, and all other required devices).

   i. The BHS Subcontractor, prior to the start of the System's Acceptance Testing shall accomplish all "debugging" and internal testing. In addition, carry out a "dry test run" of all Acceptance Tests to conducting such tests with MDAD and their representatives, to ensure that tests conducted with MDAD or their representatives are successful. The BHS Subcontractor shall submit to MDAD on daily basis any and all records of internal testing and debugging (with corrective action) performed prior to Acceptance Testing.

   j. Upon completion of the BHS installation, all related programming and internal testing/debugging, the BHS Subcontractor shall demonstrate the system's operating

capability to MDAD for specification conformance acceptance inspections/testing,to confirm compliance with the specified requirements as contained in this document. Provide written notice (minimum 7 days) to MDAD prior to acceptance testing that they have completed all “dry test runs” of the acceptance tests and are ready for the witnessed testing. Ensure that MDAD and their repreesentatives witness all Acceptance Tests and shall indicate Acceptance by signing and dating the test data sheet. MDAD reserves the rights to back charge the BHS Subcontractor for the time and expenses of all who attended the Acceptance Testing on MDAD’s behalf should the requested acceptance test(s) be unsuccessful and require re- testing at a later date. The system acceptance inspection / test demonstrations shall be carried out per the following documentation and related tests; note that there shall be separate system acceptance inspections / tests for the separate terminals:

1.) The BHS Test Plans that shall be prepared by the BHS Subcontractor in compliance with the specified requirements.

2.) Local Acceptance Testing - All BHS Subcontractor’s testing (and retesting of failed tests) shall be carried out by the BHS Subcontractor, and witnessed by MDAD and their representatives, using the approved test plans.

2. System Inspection and Test Plan Submittal

   a. Submit an Inspection and Test Plan for this Project based on the information provided below and submitted per the submittal schedule detailed Part 1 of this specification for review and approval by MDAD.

   b. The BHS Subcontractor is to be aware that various subsystems may require testing independent of one another. Therefore, a number of tests will have to be conducted at the various stages of installation.

   c. The test plan shall be submitted in both hard copies for field use during the testing process and a completed (based upon acceptance testing) electronic format agreed upon by MDAD.

   d. The test plan shall include as a minimum the following:

      1.) Description of each Test.

      2.) Pass/Fail Criteria.

      3.) Expected duration of the test.

      4.) Number of test bags required and where they are to be positioned for the start of the test.

      5.) If required, confirm all bag statistics on the MIS reports have been reset.

      6.) Coordination with MDAD will/may be required.

      7.) List all test equipment required.

      8.) Number of personnel required for the test to include:

         a.) Test Supervisor.

         b.) Mechanical. c.) Electrical.

         c.) Controls/computer engineer(s).

         d.) Personnel required to load and remove bags. f.) BHS OCC operator.

9.) List other affected equipment manufacturers (e.g., Fire Alarm, Airport Systems) that may be required for the test. Confirmation that these manufacturers have been notified and will be in attendance.

10.) Details of all reports to be printed after the test. 11.) Pass/Fail and Notes/Comments sections.

11.) Section for witnessed sign off, to include as a minimum the BHS Subcontractor and MDAD.

e. MDAD's inspections and tests shall include the following checklist. This list is included as a reference for the BHS Subcontractor, so that he may perform his own quality assurance/control program. The following is intended to be a guideline, and is not to be construed as all-inclusive:

1.) Mechanical Static Inspection: Submit a comprehensive mechanical equipment inspection plan for every piece of mechanical equipment installed as part of the BHS. This inspection plan shall verify adherence to the Specification for the following items:

a.) Belt Conveyors: Gaps between adjacent head and tail pulleys - Vertical clearance - Angle of incline/decline - 4" conveyor ID - Gaps between adjacent bed sections - Gaps between adjacent side guard sections - Baggage snag points - Sharp edges or shear burrs - Condition of painted surfaces - Tightness of all hardware - Alignment of stainless steel trim and bed section filler plate - Spacing of vertical braces for side guards/back guards - Spacing of conveyor supports - Sway bracing - Trim securement screw type and countersinking - Safety guarding/belly pans - Anchoring/mounting of access ladders - Installation of right angle transfer transition plate - Belting material and splicing - Belt lacing size and cable - 1" V-notch in belting splice - Belt path routing - Belt wrap - Belt tension - Pulley diameter - Pulley shaft diameter - Vertical alignment of head and tail pulleys - Lateral position of pulleys - Return roller diameter - Return roller spacing - Bearing mounting lock washers - Bearing jacking bolts - Bearing grease zerk removal - Bearing caps - Motor and speed reducer mounting lock washers - Speed reducer drip pan - Motor/speed reducer related sprocket/sheave and shaft alignment - Motor/speed reducer related sprocket or sheave key tightness - Motor/speed reducer related chain/V-belt tension - Chain/V-belt safety guard - Speed reducer leakage - Speed reducer lubrication level - Mounting of speed reducer torque arm - Safety finger guards on end pulleys at staffed conveyors (ticket counter conveyors, manual encoding) - 25% take-up pulley position - Installation of strip door type draft curtain - Installation of fire/security doors - Removal of construction related debris - Maintenance access - Protective guard railing installation - Vertical clearance for traffic aisles.

2.) Electrical Static Inspection: Submit a comprehensive electrical equipment inspection plan. For the determination of terminal tightness, all terminals in motor control panels or field mounted devices shall be tightened to the manufacturer's recommended torque specifications utilizing a certified calibrated torque wrench or appropriate tool. The BHS Subcontractor shall be required to demonstrate to MDAD that the screws are set at the proper torque value and the BHS Subcontractor shall include this information in the below referenced electrical static inspection reports. This inspection plan shall verify

adherence to the Specification for the following items:

a.) Belt Conveyors: Control station ID/function tags - control station and disconnect switch accessibility/location - illuminated push button switch protective guard ring - tightness of all hardware - photocell mounting - tach mounting and coupling - control circuit wiring size, type, color, and number tag - power circuit wiring size, type, color, and number tag - wire "whiskers" at terminal points - wiring terminal point screw tightness - splice point wire nuts within junction boxes - conduit routing and mounting - tightness of conduit/sealtite fittings - junction box covers - unused openings in junction boxes or control device boxes - safety disconnect switch lockout capability - lanyard cable supports and limit switch - maintenance access - record motor name plate data, size of motor overload heaters, and size of all fuses.

b.) Motor Control Panels: ID information for MCP and all devices contained within - control station ID/function tags - illuminated push button switch protective guard ring - location of control devices - tightness of all hardware - control circuit wiring size, type, color, and number tag - power circuit wiring size, type, color, and number tag - wire "whiskers" at terminal points - wiring terminal point screw tightness - panduit wire raceway - splices in panduit wire raceway - panduit wire raceway covers - conduit routing and mounting- tightness of conduit fittings - conduit bushings and chase nipples - "air-space" around programmable logic controllers - MCP door(s) mechanical safety interlock - safety shield over line and load terminals of MCP main breaker - orientation of status panel - restraint clips for plug-in type power supply - installation of hour meter - hour meter ID tag.

3.) Dynamic Mechanical Testing: Submit a comprehensive mechanical test plan. This test plan, at a minimum, shall verify the specified functionality of the following:

a.) Belt Conveyors: Conveyor speed - belt tracking - shaft run-out on pulleys - excessive vibration - operation of brake units - lateral movement of speed reducer on shaft during start/stops - abnormal noises - torsion flexing of drive assembly during start/stop operation - operation of controls

4.) Dynamic Electrical Testing: Submit a comprehensive electrical test plan that clearly identifies all installed control devices, the control device locations in the BHS, the function of the control device, all conveyors affected by the control device, and the expected field result with applicable system monitor message/display. The test plan shall be submitted in both hard copy for field use during the testing process and a completed (based upon acceptance testing) electronic format agreed upon by MDAD.

a.) All Control Devices: Photocells - limit switches - status lights - hour meter - start-up alarms - fault warning alarms - fault warning alarms with multiple faults - fault warning alarm silence buttons - timer settings - auto shut-down - motor overloads - motor disconnects - auto start - cascade operation - inch and feed operation - e stop function –overheight/over length function - jam function.

b.) Interface Testing: Test all interfaces with other systems (e.g. security system, fire system). Coordinate with other trades in support of this testing.

5.) Empirical Readings

a.) The Empirical Readings which are to be taken at the time of Conditional Acceptance Testing are to include the following:

(1.) (Main Feeds: Fuse size per phase, actual amperage per phase.

(2.) (Transformers: Fuse size per phase, actual amperage per phase.

(3.) Conveyor/Device Speeds: Actual "center-line" speed of conveyor/device.

(4.) (Motors: Nameplate data, horsepower, listed motor current; fuse size per phase, actual amperage per phase, overload heater size or designation.

(5.) VFDs: record all VFD settings

6.) Load Testing: Submit a comprehensive test plan listing the expected load rating for each device, at a minimum, provide the following:

a.) Individual device identifications with the expected load rating for each device.

b.) Amperage readings per phase under No Load conditions. c.) Fuse Sizes (if applicable) and motor heater settings.

c.) Motor nameplate FLA for each device drive and HP.

d.) Amperage readings per phase under Full Load conditions. f.) Pass/Fail and Notes/Comments sections.

e.) All FLA readings taken during load testing shall be recorded and included in the Final O&M Manual for record. Motor FLA shall be measured with full load during load tests and any motor that draws more than the name plate FLA (after start up in rush current has flattened) shall be replaced with a motor of appropriate size that shall result in no more than the max name plate FLA during load test.

7.) Operational, Functional and System Performance Testing

a.) The Operational, Functional and system performance tests shall verify the installed control devices as described in the Baggage Handling System Description of Operations, and that all the control functions required by the specification are provided. Additionally, the system performance tests shall verify the compliance of the installed BHS with the specified requirements of the contract documents.

b.) These tests shall demonstrate the subsystem's compliance with the specified controls requirements of the contract documents. Tests on controls functionality shall include, but not be limited to, manual start/stop controls, bag overheight/overlength detection and reset controls, emergency stop and reset controls, jam detection and reset functionality, cascade stop controls, overload simulation, auto start/stop functions.

8.) Test Failure

a.) A failure during any test period shall be defined as any design characteristic or malfunction of the furnished equipment or materials that damages product or reduces any operating rate below those "specified".

b.) Conditions resulting from improper loading of product or loading product of

sizes not included in specification requirements will not be considered as failures.

B. Conditional Acceptance

1. Conditional Acceptance for each phase or BHS Activity, as applicable for the specified work, will only be considered after the following are completed:

   a. The individual inspections and tests are performed in the order presented below as applicable on a phase-by-phase basis.

   b. Identified deficiencies (punch list items) shall be corrected prior to proceeding to the next BHS Phase and before performing the subsequent inspections or tests.

   c. Draft Operation and Maintenance Manuals have been delivered with details on the completed portion of the system for that phase.

   d. Operation and maintenance training has been performed for the completed portion of the system for that phase.

   e. The name, address and a 24-hour phone number of a representative who has the authority and experience to make immediate replacements and repairs for the full life of all warranties has been provided.

   f. Upon completion of a given Phase or Activity, as applicable, for the specified work, and once all inspections/tests have been completed and punch-list items have been corrected, the conveyor segments of the given Phase or Activity (or portion thereof) shall be turned over to MDAD for beneficial use. Assume the responsibility of the conveyor equipment maintenance for a minimum of seven

   g. (7) days thereafter for each Phase or Activity (as applicable), upon which time that individual system shall be turned over to MDAD. During the seven-day period the conveyor equipment must not experience any operational disruption/failure; should that occur, it shall be the BHS Subcontractor's responsibility to address and correct the fault and the seven-day period shall then re-start after the correction of the operational disruption / failure.

2. Conditional Acceptance Inspection and Testing of Completed BHS :

   a. The overall new and existing reconfigured system including all upper and lower level controls shall demonstrate compliance with the approved Test Plan. The individual inspections and tests shall be performed in the order presented below on a phase-by-phase basis; however, it should be noted that each phase may not necessarily include all of the below tests associated to that specific phase. System deficiencies (punch list items) shall be corrected before performing the subsequent inspections or tests. The overall system inspections and tests for the complete BHS shall include the following minimum requirements (these tests shall be performed either upon the completion of each phase or activity, as applicable, or upon completion of the entire BHS alterations program):

      1.) Mechanical Static Inspection

      2.) Electrical Static Inspection

      3.) Dynamic Electrical Testing

      4.) Dynamic Mechanical Testing

      5.) Empirical readings

6.) Load Testing

7.) Functional Controls Testing

8.) Rate Testing

9.) Installation Certification

3. Upon successful completion of the specified Inspections and Testing, MDAD will issue a written notice of Conditional Acceptance for each phase.

4. A Conditional Acceptance status will indicate that MDAD has approved the equipment as worthy for operational use and that the given phase is substantially complete.

5. The Conditional Acceptance shall not relieve the responsibility for maintenance, security and insurance on the system. Maintenance shall only be required if the given phase for the BHS has not been conditionally accepted for operation use. If the given phase has been accepted for operational use, maintenance shall be provided for the 7 days specified herein.

6. In no case will Conditional Acceptance relieve the responsibility for performing all the work set forth in the Contract Documents.

7. Conditional Acceptance is applicable to each construction phase or BHS Activity, as applicable, and must be issued in writing, by MDAD, prior to commencement of subsequent construction phase/activity. Final Acceptance of individual construction phases/activities or subsystems shall not apply.

8. Conditional Acceptance Operational Period

   a. Upon issue of a Certificate of Conditional Acceptance for the final, a 30 day Operational Period per ticketing line will commence in which MDAD will put all systems into on-line operations processing the daily flow of baggage.

   b. During the 30 day Operational Period, provide full-time technical site representation during the actual hours of operation with a minimum of 16 hours per day, 7 days per week. Ensure that the representatives shall be capable and duly qualified to provide service for any problems, which occur during this period. At a minimum, the BHS Subcontractor will have two qualified personnel per shift to trouble shoot and immediately resolve any problems, which may arise. The BHS Subcontractor's on site personnel shall be capable of troubleshooting and resolving all electrical and controls related issues.

   c. During the 30 day Operational Period, the BHS Subcontractor will be responsible for ensuring that the BHS is fully operational during Airport Operational hours by supporting MDAD's Maintenance staff with all necessary troubleshooting assistance and assistance in correcting encountered issues.

   d. Should any downtime occur during these hours due to major faults in the BHS (i.e., PLC fault, motor overloads, motor faults, Sort Controller Fault or any other faults deemed major by MDAD) the BHS Subcontractor will be responsible to assist the MDAD's Maintenance staff in the immediate rectification of the major fault in any way so that Operations is not impacted in any way.

   e. During the 30 day Operational Period, keep a detailed Computer Log.

   f. If, at MDAD's discretion, site representation is deemed unnecessary, it shall be discontinued and MDAD shall receive a prorated credit.

g. If a problem occurs within the BHS and MDAD has elected to not require full- time technical site representation during the 30 day Operational Period, supply the name(s), address(s) and a 24-hour phone number of representative(s) that can be contacted who have the authority and experience to make immediate recommendations and assist MDAD or MDAD's Maintenance Contractor to return the system to a fully on-line state in the shortest possible time frame.

C. Conditional Acceptance With Defects

1. If the System is found to be unacceptable at the time of Conditional Acceptance Inspection and Testing, MDAD will issue a written "Defects List" report containing information about the particular defects that must be remedied before Final Acceptance will be granted. At this time, if the defects do not affect the functionality of the System, MDAD may elect to advise in writing that "Conditional Acceptance with Defects" has been granted. All terms presented in the "Conditional Acceptance" portion of this Specification shall apply.

2. A "Conditional Acceptance with Defects" status, if issued, will indicate that MDAD has approved the equipment as worthy for operational use. Subsequent to "Conditional Acceptance with Defects" issuance, the 30 day Operational Period will commence in which MDAD will put the System into on-line operations processing the daily flow of baggage. MDAD will maintain the right to judge whether any hazard may exist to personnel or equipment due to unacceptable inspection results and revoke this approval. In the event the approval is revoked, the 30 day Operational Period will be suspended until the hazard is remedied.

3. All outstanding work must be performed at times during periods convenient to MDAD and to the requirements of a fully operating system.

4. The BHS Subcontractor must notify MDAD within the 30 day Operational Period that all outstanding items on the "Defects List" have been corrected and that Inspection and Testing may continue. When all items have been approved in accordance with the Specifications, this shall conclude Inspection and Testing of the BHS. Only the remaining time of the 30 day Operational Period will be required prior to application of the Final Acceptance conditions.

D. Delayed Conditional Acceptance With Defects List

1. If the System is found to be functionally unacceptable at the time of Conditional Acceptance Inspection and Testing, MDAD will issue a written "Defects List" report containing information about the particular defects that must be remedied before the 30 day Operational Period will begin.

2. Items appearing on the "Defects List" will be considered incomplete, defective or not in conformance with the Specifications. The failure to include certain items does not alter the responsibility to complete the System in accordance with the Contract Documents.

3. A maximum period of 15 days will be allowed to correct the outstanding items on the "Defects List".

4. After all the items on the "Defects List" have been corrected, notify MDAD that the System is ready for continuing Conditional Acceptance Inspection and Testing.

5. Upon completion of "Conditional Acceptance Inspection and Testing", the terms presented in the "Conditional Acceptance" or "Conditional Acceptance with Defects List" portions of this Specification will apply, as appropriate.

E. Final Acceptance

1. Final Acceptance will only be considered after all phases have conformed to the Conditional Acceptance terms, all phases have successfully completed the 30 day Operational Period, and the following criteria is met:

   a. The System has not experienced repeated repairs and adjustments and is achieving the specified rate, accuracy and availability standards as required by this Specification.

   b. The System has successfully completed the specified Inspections and Testing, with no outstanding punch list items.

   c. The System is in full compliance with the Contract Documents.

   d. MDAD and all other governing agencies have made their inspections and given their approvals.

   e. Certificates of Installation and Testing Compliance have been issued to MDAD.

   f. Warranties for all materials and equipment received from Subcontractors and Suppliers have been assigned to MDAD per Division 1, Section 01 40 00.

   g. A spare parts and tools audit has been conducted and all tools have been turned over to MDAD. All spare parts purchased by MDAD have been delivered.

   h. The PLC and source codes for all programs in the BHS Computer System have been provided to MDAD.

   i. Accurate "As-built" drawings and all manuals as specified in this Specification have been delivered.

   j. Operation and maintenance training have been completed.

   k. Final Operation and Maintenance Manuals have been delivered, for the complete system.

- END OF PART 4 –