SECTION 27 05 28 – PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all labor, materials, and equipment for the complete installation of Work called for in the Contract Documents.

B. This section includes the minimum requirements for the installation of communications cable pathways outside of Telecommunications Rooms.

C. Included in this section are the minimum composition requirements and installation methods for the following:

1. Metallic Ladder Cable Tray
2. Non-Continuous Cable Support Systems
3. Fire-Rated Pathway Devices
4. Multi-Service Poke-Through Devices
5. Conduit Systems
6. Junction Boxes/ Pull Boxes

1.2 DEFINITIONS AND TERMS

A. Trade association names and communications terminology are frequently abbreviated. The following acronyms or abbreviations may be referenced within this Section:

1. AFF Above Finished Floor
2. ANSI American National Standards Institute
3. ASTM American Society for Testing and Materials International
4. BICSI Building Industry Consulting Service International
5. BOCA Building Officials and Code Administrators International,
6. CAN Canada/Canadian
7. CBP US Customs and Border Protection
8. DFW Dallas/Fort Worth International Airport
9. EMT Electrical Metallic Tubing
10. HVAC Heating, Ventilating and Air Conditioning
11. NEC National Electric Code
12. NECA National Electrical Contractors Association
13. NEMA National Electric Manufacturers Association
14. NFPA National Fire Protection Association
15. OAR Owner’s Authorized Representative
16. OD Outer Diameter
17. RCDD Registered Communications Distribution Designer
18. RMC Rigid Metallic Conduit
19. STD Standard
20. TIA Telecommunications Industry Association
21. UL Underwriters Laboratories
22. ULC Underwriters Laboratories of Canada

1.3 QUALITY ASSURANCE

A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the OAR.

B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, or a substitution is requested, equipment shall be equivalent in every way to that of the equipment specified. All substitutions are subject to the control and approval of the OAR.

C. Strictly adhere to all BICSI and TIA recommended installation practices when installing cable pathways.

D. Contractor’s Qualifications:

1. Firms regularly engaged in the installation of Electrical Systems or Data Communications cabling and that have five (5) years of installation experience with systems similar to that required for this project.
2. Provide references to include client names, phone numbers and a summary of project details. These references will be checked, and the clients will be asked questions relative to the performance of your company.
3. Provide verification that installation personnel responsible have been properly trained to install the products described in this Section.
4. Provide a BICSI RCDD certified professional and, if necessary, a master electrician for oversight on this project. This person does not have to be working on-site but must be accessible to answer questions and provide weekly status reports. The RCDD and master electrician shall be a full-time employee of the contractor.
5. Provide full time project manager with a minimum of ten (10) years field experience in installation of communications systems and infrastructures. Project manager shall be assigned for the duration of the project and shall not be replaced without written consent from the OAR.

E. Manufacturer’s Qualifications:

1. Firms regularly engaged in manufacture of products of the types, ratings and capacities required for this project; whose products have been in satisfactory use in similar service for not less than five (5) years, with production capabilities per applicable NEMA standards.

F. Material and Work specified herein shall comply with the applicable requirements of:

1. NECA 1 – Standard Practice of Good Workmanship in Electrical Construction, 2010
2. ANSI/NECA/BICSI-568 – Standard for Installing Commercial building Telecommunications Cabling, 2006
3. ANSI/TIA-568.0-D – Generic Telecommunications Cabling for Customer Premises, 2015
4. ANSI/TIA-568.1-D – Commercial Building Telecommunications Infrastructure Standard, 2015
5. ANSI/TIA-569-D – Telecommunications Pathways and Spaces, 2015
6. ANSI/TIA-606-C – Administration Standard for Telecommunications Infrastructure, 2017
7. ANSI/TIA-607-C – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises, 2015
8. ANSI/TIA-942-B – Telecommunications Infrastructure Standard for Data Centers, 2017
9. NFPA 70 – National Electric Code, 2017
10. BICSI – Telecommunications Distribution Methods Manual, 14th Edition
11. NEMA – VE 1 – Metal Cable Tray Systems, 2009
12. NEMA – VE 2 – Metal Cable Tray Installation Guidelines, 2006

13. DFW Airport Design Criteria Manual
14. Applicable codes and directives of authorities having jurisdiction

G. Work:

1. The Work shall be performed in compliance with the applicable manufacturer's installation instructions, Standards, and certifications listed herein, the Contract Documents, and governing codes and regulations of the authorities having jurisdiction.
2. The drawing and specification requirements govern where they exceed Code and Regulation requirements.
3. Where requirements between governing Codes and Regulations vary, the more restrictive provision applies.
4. Nothing in the Contract Documents grants authority or permission to disregard or violate any legal requirements.

1.4 CONFLICTS

A. This installation shall be made in strict accordance with the Specifications, Drawings, any applicable codes, referenced publications and standards. In case of conflicts between the aforementioned, notify the OAR in writing prior to commencement of affected work.

1.5 SCHEDULING

A. The Contractor shall comply with all scheduling requests established by OAR, both prior to commencing Work, and during construction. The Contractor shall provide a detailed schedule of work to be performed.

1.6 REQUIREMENTS

A. All references to manufacturers, model numbers and other pertinent information herein are intended to establish standards of performance and quality of construction. The OAR must approve material submittal and substitutions in writing.

B. Verification that all the components specified and installed meet the criteria specified by the respective component manufacturer, supplier and designer is the responsibility of the Contractor.

C. All installation tools, special equipment and testing apparatus required to accomplish field connections and related work as described herein shall be furnished by the Contractor at no additional cost.

D. The requirements as given in this document are to be adhered to unless revised by the OAR in writing.

E. The Owner reserves the right to waive these requirements at any time.

1.7 SUBMITTALS

A. Comply with provisions of Division 01.

B. Comply with provisions of Section 27 05 00.

C. Produce Shop Drawings for ALL horizontal and vertical pathways, to include but not limited to, dimensions/size of pathway, routing placement and its location relative to building structure (columns, floor or ceiling) and its relationship to electrical, mechanical elements as well as vertical and horizontal offsets and transitions.

D. Provide all submittal requirements under this section as a single package.

E. Provide product data for the following:

1. Product data consisting of manufacturers specifications for each type of product to be installed, all applicable certifications and elevation/plan documents supporting compliance with stated Specifications.
2. Proposed format of as-built documentation.

1.8 CONTRACTOR CLOSE OUT SUBMITTALS

A. Submit Closeout documentation in accordance with Division 01 of the Project Manual and any applicable supplements. The number of submittal sets required is the greater of either the requirements of Division 01 of the Project Manual, or a minimum of four (4) sets.

1. Segregate documents into separate binders containing data relevant to operational, maintenance, and warranty issues.
2. Provide above closeout documentation as an electronic file in PDF format.
3. As built documentation of all pathway systems to include cable tray, conduits (horizontal and vertical), and non-contiguous support.

B. Warranty and Maintenance:

1. Record Drawings

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials factory-packaged in containers or reels and handle in accordance with manufacturer’s recommendations. Store in a clean, dry space and protect products from damaging fumes and traffic. Handle materials carefully to avoid damage.

B. Storage space on project site may be limited. Contractor shall coordinate delivery and arrange storage of materials and equipment with the OAR.

C. Components sensitive to damage in a harsh environment shall be stored off-site and delivered as needed.

D. Provide protective covering during construction to prevent damage or entrance of foreign matter.

E. Contractor is responsible for on-site security of tools, test equipment and materials.

F. Replace at no expense to Owner, product damaged during storage, handling or the course of construction.

1.10 PROJECT CONDITIONS

A. Verify conditions on the job site are applicable to this Work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.

B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install Work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the Work may be installed.

1.11 WARRANTY

A. Warrant labor and product to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics, following Contractor Warranty requirements defined in Division 01. Repair or replace defects occurring in labor or product within the Warranty period without charge.

B. All surplus parts and pieces to the installation shall be maintained as a spare parts inventory at the building site. Parts replaced during the warranty period shall have a warranty matching that of the original part from date of replacement.

PART 2 - PRODUCTS

2.1 GENERAL

A. The products specified in this document do not necessarily constitute the exhaustive list of products required to complete the statement of work. Except where described in the SUMMARY subpart of this document, the contractor is responsible for providing any other parts and materials needed to deliver a complete and working system.

2.2 METALLIC LADDER CABLE TRAY

A. Aluminum Cable Tray

1. Provide aluminum ladder cable tray for the main cable pathways on the ramp level of the facility.
2. Cable tray shall consist of two longitudinal members (side rails) with transverse members (rungs), constructed of extruded aluminum alloy 6063-T6, and welded together.
3. Straight tray sections shall have side rails fabricated as I-Beams. All straight sections shall be supplied in standard 20-24-foot lengths, except where shorter lengths are permitted to facilitate tray assembly lengths as shown on drawings.
4. Rungs shall be spaced 12 inches on center. Spacing in radiused fittings shall be 9 inches and measured at the center of the tray's width. Rungs shall have a minimum cable-bearing surface of 7/8 inch with radiused edges. No portion of the rungs shall protrude below the bottom plane of the side rails. Each rung must be capable of supporting the maximum cable load, with a safety factor of 1.5 and a 200-pound concentrated load when tested in accordance with NEMA VE-1, section 5.4.
5. The tray shall be classified as an equipment grounding conductor per NEC 392.7 with a maximum 1200 ampere rating.
6. Except as otherwise noted, provide metal cable tray as indicated: with splice plates, bolts, nuts, and washers for connecting units.
7. The tray width shall be as depicted on drawings with 6” high and 4" high rails, allowing for a loading depth of up to 5” and 3", respectively.
8. Special accessories shall be furnished as required to protect, support, and install a cable tray system. Accessories shall consist of, but are not limited to: section splice plates, expansion plates, blind-end plates, ladder drop outs, etc.

9. Cable tray supports shall be constructed from 12-gauge steel formed shape channel members 1-5/8” by 1-5/8” with necessary hardware such as trapeze support kits or wall mounted brackets.
10. Refer to the drawing set for the required widths.
11. Acceptable products: ("xx" denotes the width)

    a. Cablofil PW, Part Number 12-4F12-0020-xx, 6" Deep
    b. Cablofil PW, Part Number 12-4D11-0020-xx, 4" Deep
    c. Cooper B-Line, Part Number 26A12-xx-240, 6" Deep
    d. Cooper B-Line, Part Number 34A12-xx-240, 4" Deep
    e. Thomas & Betts, Part Number AH26-24-xx-L12-288, 6" Deep
    f. Thomas & Betts, Part Number AH44-24-xx-L12-288, 4" Deep
    g. Owner Approved Equivalent

B. Cable Tray Hangers

1. Provide threaded rod hangers, in lieu of conventional cable tray supports, in areas with horizontal space restrictions.
2. Hanger shall clamp to the side of the I-beam.
3. Hanger shall be designed for 1/2" threaded rod.
4. Acceptable products:

    a. Cablofil PW, Part Number 4F1-A837-ZN and 4D1-A837-ZN
    b. Cooper B-Line, Part Number 9ZN-5326 and 9Zn-5324
    c. Thomas & Betts, Part Numbers PGW26HRC and PGW44HRC
    d. Owner Approved Equivalent

C. Conduit Adapters

1. Provide conduit adapters for supporting conduits entering the cable tray.
2. Adapters shall come in sizes for supporting conduits from 1/2" to 4" in diameter.
3. Adapters shall clamp to the top of the tray I-beam.
4. Acceptable products: ("xx" denotes conduit diameter)

    a. Cooper B-Line, Part Number 9ZN-1155-xx
    b. Thomas & Betts, Part Numbers 6210 and 6212
    c. Owner Approved Equivalent

2.3 WIRE BASKET CABLE TRAY, SUPPORTS, AND ACCESSORIES

A. Wire Basket Cable Tray

1. Provide wire basket cable tray on the concourse and support spaces shown on the drawing set.
2. Wire basket cable tray shall be manufactured from round steel wire that is a minimum of .196” (5mm) in diameter. Wires shall be welded at intersections to form a 2” x 4” (50.8mm x 101.6mm) grid pattern. The tray shall be U-shaped with equal height sidewalls.
3. Individual tray sections shall be 24" (609.6mm) wide unless shown otherwise on plans, with 4” (101.6mm) high sidewalls.
4. Tray ends will be formed downward at 90° to allow easy drop-in installation with approved supports.
5. Wire basket cable tray shall be black zinc electroplated after fabrication.
6. Wire basket cable tray shall be UL Classified for grounding purposes.
7. Acceptable systems:

    a. Cablofil CF105/600EZ
    b. Chatsworth 34821-524

c. Cooper B-Line FT4X24EG
d. Panduit WYR-Grid WGxEZ10
e. Owner Approved Equivalent.

B. Wire Basket Cable Tray Supports

1. Supports will be sized at minimum to match the width of the wire basket cable tray that is supported. The support may be wider than wire basket cable tray.
2. Support design will allow the support to be placed under a wire basket cable tray at any point mid-span or directly under a pathway splice or intersection.
3. Each support location will utilize a trapeze mounted support bracket in the cable tray, allowing drop-in of installed cabling.
4. Each support will be punched with an alternating obround and round hole-pattern that accepts wire basket cable tray ends which are formed downward at 90° and self-threading splice plate attachment hardware.
5. When placed directly under a splice or intersection, the support will allow drop-in attachment of cable tray. Splice hardware will splice cable trays and secure wire basket cable trays to the support.
6. Supports will be manufactured from steel extrusion and/or sheet.
7. Wire Basket Cable Tray Supports will be zinc electroplated after fabrication.
8. Acceptable products:

a. Cablofil FASP 700
b. Chatsworth 34730-524
c. Cooper B-Line FTB24CT
d. Panduit WGTBSxx**
e. Panduit WGCBxx**
f. Owner Approved Equivalent.

C. Wire Basket Cable Tray Splices and Fasteners

1. Provide a method of simultaneously splicing, bonding and securing intersecting wire basket cable tray sections to supports when supports are placed directly under a wire basket cable tray pathway at a splice point, intersection point, or at the beginning or end of a change in elevation.
2. Provide a method of splicing and bonding wire basket cable tray sections together at a splice point or an intersection point that is not located directly over a support.
3. Provide a method for bonding and securing wire basket cable tray to supports when supports are placed mid-span (in between a splice or intersection point) along a wire basket cable tray pathway.
4. Provide a method for attaching a bonding conductor to the wire basket cable tray.
5. Acceptable products:

a. Cablofil

1) EDRN
2) GNDSB
3) GNDCL

b. Chatsworth

1) 34738-501
2) 34739-501
3) 34838-001

c. Cooper B-Line

1) FSTLCZN
2) GROUND BOLT

d. Panduit

1) WGSPLxx**
2) WGINTSPL**

e. Owner Approved Equivalent

D. Wire Basket Cable Tray Accessories

1. Provide a bend radius to connect the sidewalls of adjoining wire basket cable tray wherever a splice or an intersection in the cable tray pathway results in a 4" or wider gap between the sidewalls. The bend radius should be the same height as the sidewalls of the wire basket cable tray.
2. Provide elevation change hinges to form cable over a smooth curve wherever cable tray changes elevations.
3. Provide conduit adapters for all conduit that transitions into the cable tray.
4. Wire basket cable tray accessories will be manufactured from steel extrusion and/or sheet.
5. Wire basket cable tray accessories will be pre-galvanized before fabrication.
6. Wire basket tray where exposed requires a black tray liner.
7. Acceptable products:

a. Cablofil

1) Part Number RADT90KIT Bend Radius Kit
2) Part Number EAC Elevation Change Kit
3) Part Number CE40CC & CH Conduit Adapter

b. Chatsworth 34740-501 Bend Radius Kit
c. Cooper B-Line

1) Part Number 90 DEGREE KITEG Bend Radius Kit
2) Part Number FTAxxxCCGLV Conduit Connector

d. Panduit

1) Part Number WGIBRCx** intersection bend radius control
2) Part Number WGHRDWKT** Hardware Kit
3) Part Number WGTLxxPG Tray Liner

e. Owner Approved Equivalent

E. Wire Basket Cable Tray Installation Tools

1. Provide cutting and forming tools, as required, for field fabrication of wire basket cable tray pathways without leaving burrs or sharp edges.
2. Provide tools, as required, for pulling cable around turns, bends or intersections in wire basket cable tray pathway.

F. Wire Basket Cable Tray Support – Installation Hardware

1. Provide installation hardware to attach wire basket cable tray supports to building structure.

2.4 NON-CONTINUOUS CABLE SUPPORT SYSTEMS

A. Non-Continuous Cable Supports (J-Hooks)

1. Non-continuous cable supports shall provide a complete horizontal and vertical 1" bend radius control to help prevent degradation of cable performance.
2. Shall be UL 2043 and CAN/ULC S102.2 listed and are suitable for use in air handling spaces.

3. Cable tie channel allows user to easily install 3/4" Panduit Tak-Ty® Cable Ties to retain cable bundle.
4. Approved Products:
    a. Panduit J-PRO Cable Support System
    b. Owner Approved Equivalent

2.5 FIRE-RATED PATHWAY DEVICES

A. Provide through-wall fire-rated pathway devices, as required.

1. Cables penetrating through fire-rated floors or walls shall utilize fire-rated pathway devices capable of providing an F rating equal to the rating of the barrier in which the device is installed.
2. The device shall be tested for smoke leakage (L rating) and shall not require the use of any optional sealing materials to achieve the published rating.
3. The device shall utilize a fire and smoke sealing system that automatically adjusts to the addition or removal of cables.
4. Wiring devices shall be capable of allowing a 0 to 100-percent visual fill of cables.
5. Wire devices shall be of a sufficient size to accommodate the quantity and size of data cables required and shall be suitable for use with new or existing cable installations.
6. The installed device (in normal use) shall require no maintenance and shall accommodate future cable changes without mechanical adjustment and/or removal or replacement of protective materials.
7. Approved Products:
    a. STI EZ-PATH
    b. Hilti CP 653 Speed Sleeve
    c. Wiremold / Legrand FlameStopper
    d. Owner Approved Equivalent

2.6 POKE-THROUGH DEVICES

A. Multi-Service Poke-Through Devices

1. Provide floor poke-through devices for terminating power and communications.
2. The device shall provide up to 4 ports of communications connectivity and power receptacles wired for 2 circuits.
3. Unit shall be equipped with slide covers to protect device and power openings.
4. Device shall be UL Listed and UL Fire Classified under UL514A, UL514C and meet ADA Accessibility guidelines.
5. Coordinate the flange colors and options with the architect.
6. Acceptable products:
    a. Wiremold / Legrand
        1) RC4 Multi-Service Poke-Through Device
        2) COM75 Communications Adapter
        3) RC4APTCBK Abandonment Plate
    b. Owner Approved Equivalent

2.7 CONDUIT SYSTEMS

A. General

1. All conduit system components shall be UL rated.
2. All conduit system components shall comply with the NEC.
3. All conduit fittings, junction and pull boxes shall provide minimum cable bend radius is accordance with ANSI/TIA-569A.
4. All conduit fittings shall have plastic bushings on all exposed conduit ends.

B. Rigid Metal Conduit (RMC) and Fittings Before Coating:

1. RMC shall be UL6 listed and conform to ANSI C80.4 and NEC Article 344.
2. RMC coating shall comply with WW-C-581d.

C. Electrical Metallic Tubing (EMT):

1. EMT shall be UL listed and conform to NEC Article 358.
2. EMT fittings shall be formed steel compression ring type. Die cast fittings are not allowed.
3. Only manufacturer's fittings, adapters, and terminators shall be used.
4. All transition junction and pull boxes, fittings terminators and adapters shall be a metallic material.
5. Shall be used inside buildings only.

D. Flexible conduit is not permitted.

E. Conduit Bodies are not permitted.

F. Non-metallic conduits are not permitted in above ground installations, unless noted otherwise.

G. Conduit Fittings

1. All above ground fittings shall be of metallic material.
2. Conversion fittings are required for non-metallic (below ground) to metallic (above ground) transitions.
3. All fittings shall be compression or threaded.
4. Fittings shall provide a secure connection for pulling communications cables.
5. Setscrew fittings are not permitted.

2.8 JUNCTION BOXES / PULL BOXES

A. All pull boxes shall be constructed with a minimum of 14-gauge Galvanized Steel with an ANSI 61 grey polyester powder finish inside and out over Phosphatized surfaces or Galvanizes Steel unless otherwise specified.

B. All pull boxes shall be minimum NEMA Type 1 rated on concourse level indoor spaces. Pull boxes shall be minimum NEMA Type 3R rated in ramp spaces and outdoor locations. Boxes are to be sized according to the table below unless otherwise specified.

C. All pull boxes shall have flat, removable covers fastened with plated steel screws within unique keyhole screw slots in the cover to permit removal of the cover without extracting screws unless otherwise specified.

Maximum Trade Size of Conduit (inches)	Minimum Box Size (inches)			For Each Additional Conduit Increase Width (inches)
	Width	Length	Depth	
1	4	16	3	2
1.25	6	20	3	3
1.5	8	27	4	4
2	8	36	4	5
2.5	10	42	5	6
3	12	48	5	6
3.5	12	54	6	6
4	15	60	8	8

D. All removable box covers shall be connected to box with a safety strap or chain.

E. All pull boxes shall provide the appropriate provisioning for grounding.

PART 3 - EXECUTION

3.1 GENERAL

A. Raceways shall be mechanically and electrically connected to all boxes and fittings and shall be properly grounded per NEC.

B. The routing and location of all conduits, cable tray, cable hooks and other raceways shall be coordinated with other trades prior to and during building construction to avoid delays and conflicts.

C. Where raceways pass through walls, partitions and floors, seal penetrations to provide a neat installation that will maintain the integrity of the waterproofing or fireproofing, as applicable, of the structure. Coordinate installation requirements with roofing installer where conduits pass through the roof.

D. All Raceways shall be run at least 6-inches from hot flues, steam pipes, hot water pipes and other hot surfaces.

E. All raceways entering a building from underground shall be sealed to prevent water, moisture, gas, or other foreign matter from entering the building. Service conduits shall be sealed in accordance with NEC 230-8.

F. Contractor's on-site RCDD supervisor shall review, approve and stamp all shop drawings, coordination drawings and records drawings.

G. DO NOT route communication pathways under HVAC condensing units.

H. Expansion Fittings:

1. Raceways shall be provided with expansion fitting where necessary to compensate for thermal expansion and contraction.
2. Use expansion-deflection fittings on conduit crossing structural expansion joints and on exposed conduit runs where necessary. Provide bonding jumpers across fittings in metal raceway systems.

3.2 INSTALLATION

A. Aluminum Ladder Cable Tray

1. Installation and configuration shall conform to the requirements of the current revision levels of ANSI/TIA Standards 568 & 569, NEMA VE2 (Cable Tray Installation Guidelines), NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.
2. Coordinate cable tray with other electrical work as necessary to properly integrate installation of cable tray work with other work.
3. Maintain a minimum of 12 inches of clearance above cable tray for cable installation. Maintain a minimum of 3 inches between ceiling tile and cable tray support.
4. Cable tray fitting supports shall be located such that they meet the strength requirements of straight sections. Install fitting supports per NEMA VE-2 guidelines, or in accordance with manufacturer's instructions
5. Cable tray should be free of burrs and sharp edges.
6. Cable tray shall be grounded according to manufacturers specifications.
7. Splice plates shall be made of 6063-T6 aluminum, using four square neck carriage bolts and serrated flange locknuts. Hardware shall be zinc plated in accordance with ASTM B633, SC1. If aluminum cable tray is to be used outdoors, then hardware shall be Type 316 stainless.
8. The resistance of fixed splice connections between adjacent sections of tray shall not exceed .00033 ohms. Splice plate construction shall be such that a splice may be located anywhere within the support span without diminishing rated loading capacity of the cable tray.
9. Cable tray supports shall be placed so that the support spans do not exceed maximum span. Supports shall be constructed from 12-gauge steel formed shape channel members 1-5/8 inch by 1-5/8 inch with necessary hardware.
10. Trapeze hangers shall be supported by 1/2-inch (minimum) diameter rods.
11. Cable tray shall be labeled at every fifty (50) feet with UV rated, chemical resistant 3-inch vinyl labels that are orange in color and are affixed with permanent adhesive. Cable tray should be marked in 2 inch black lettering with a cable tray number and month/year directly underneath.

    a. DFW owned cable tray shall be marked "DFW – COMM – ITS".
    b. All other cable tray shall be marked "COMMUNICATIONS".

B. Non-Continuous Cable Support Systems (J-hooks)

1. Non-continuous cable support systems shall only be allowed to support a single outlet routed above Concourse-level accessible ceilings. Where pathways consist of more than a single outlet or are located in other areas they shall not receive non-continuous cable support systems.

2. Installation and configuration shall conform to the requirements of the current revision levels of ANSI/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.
3. Cable hooks shall be capable of supporting a minimum of 30 pounds with a safety factor of 3.
4. Install cables without damaging conductors, shield, or jacket.
5. Do not exceed load ratings specified by manufacturer.
6. Adjustable non-continuous support sling shall have a static load limit of 100 lbs.
7. Cable Hook spacing maximum 5 feet on center.
8. Maintain maximum cable sag between cable hooks of 12 inches.
9. Follow manufacturer's recommendations for allowable fill capacity for each size non-continuous cable support.

C. Firestopping

1. Comply with manufacturer’s product data, including product technical bulletins, product catalog installation instruction, and product carton instruction for installation.
2. Verify substrate conditions are acceptable for product installation in accordance with manufacturer’s instructions.
3. Install firestopping to comply with performance requirements specified herein.
    a. Install firestopping to comply with listed fire rated assemblies in accordance with ASTM and UL requirements.
    b. Installer shall be trained and approved by the manufacturer.
4. Protect installed products from damage during construction operations until final completions.
5. Inspection: Code official or building inspectors to review proper installation using manufacturer’s guidelines.

3.3 RACEWAY INSTALLATION

A. Raceways shall be mechanically and electrically connected to all boxes and fittings and shall be properly grounded per NEC.

B. The routing and location of all conduits, cable tray, cable hooks and other raceways shall be coordinated with other trades prior to and during building construction to avoid delays and conflicts.

C. Where raceways pass through walls, partitions and floors, seal penetrations to provide a neat installation that will maintain the integrity of the waterproofing or fireproofing, as applicable, of the structure. Coordinate installation requirements with roofing installer where conduits pass through the roof.

D. All Raceways shall be run at least 6-inches from hot flues, steam pipes, hot water pipes and other hot surfaces.

E. All raceways entering a building from underground shall be sealed to prevent water, moisture, gas, or other foreign matter from entering the building. Service conduits shall be sealed in accordance with NEC 230-8.

F. Contractor’s on-site RCDD supervisor shall review, approve and stamp all shop drawings, coordination drawings and records drawings.

G. DO NOT route communication pathways under HVAC condensing units.

H. Expansion Fittings:

1. Shall be utilized in all cases where conduits pass through building expansion joints. Fittings shall be of an approved weatherproof telescopic type bonding jumper around or through the fitting.
2. Raceways shall be provided with expansion fitting where necessary to compensate for thermal expansion and contraction.
3. Use expansion-deflection fittings on conduit crossing structural expansion joints and on exposed conduit runs where necessary. Provide bonding jumpers across fittings in metal raceway systems.

3.4 CONDUIT INSTALLATION

A. Conduit shall be installed with threaded fittings and couplings.

B. All metallic couplings, connectors and fittings shall be malleable iron or Steel and finished with Zinc plating or by Galvanizing.

C. All conduits shall be plugged immediately upon installation to prevent the entrance of construction dirt and debris. All conduits shall be swabbed and cleaned before wires are pulled.

D. Expansion fittings shall be utilized in all cases where conduits pass through building expansion joints. Fittings shall be of an approved weatherproof telescopic type bonding jumper around or through the fitting.

E. Connection of Conduit to Pull / Junction Boxes and Enclosures:

1. Connection to NEMA 1 type boxes and enclosures:
   a. Rigid conduit: Install insulated bushings and double locknuts.
   b. EMT: Install compression box connectors with insulated throats.
2. Connection to NEMA 3R, 4, 4X, and 12 type boxes: Install insulated bushings and sealing locknuts or hubs.
3. When conduits enter floor mounted enclosures from below and there is no sheet metal to which to attach; install grounding bushings on the conduit. Bond bushings to ground bus using a conductor the same size as required for an equipment grounding conductor sized for the given circuit.
4. Install sealing bushing within all conduits which have entered a building from outside, whether from above or below grade.

F. Each Conduit route shall be installed with the least amount of bends as possible. No section of conduit shall be longer than 30 meters (100 feet) or contain more than two 90-degree bends (offset is considered to be a 90-degree bend) between pull points, pull boxes or reverse bends.

G. The inside radius of bends in conduit shall be.

1. 6 times the internal diameter for 2-inches or less.
2. 10 times the internal diameter for greater than 2-inches.

H. A measured pull tape shall be placed in all installed conduit.

I. Any single conduit run extending from a MCR/CR/IDF shall not serve more than one outlet.

J. All communication conduits shall be identified with color coded orange tape marked “Communications” every 50 feet. Tag conduit termination points (to include J-Box locations) with the origination and destination location.

K. Conduit shall be reamed to eliminate sharp edges and terminated with an insulated bushing.

L. Conduit protruding through the floor shall be terminated at a minimum of 3 inches above the floor surface.

M. All stubbed conduit ends shall be provided with a ground bushing.

N. All conduit penetrations shall be provided with the proper conduit sleeves.

1. Sleeves shall extend three inches AFF or four inches below finished ceiling, with a bushing.
2. Sleeves shall be installed in the communications room floor or ceiling a minimum of two to four inches on center from the wall.
3. Conduit floor sleeves shall be spaced to allow space for ground bushing and insulated bushing for cable protection.
4. Shall be installed in a single tier or row from left to right horizontally. If two tiers or rows are required, the conduits shall be staggered minimum of 2 inches between tiers.
5. Cable support anchors shall be installed 18 to 24 inches above the sleeves.

O. All cable (horizontal, riser or backbone) wall or ceiling penetrations shall be provided with the proper conduit sleeves.

1. Sleeves shall extend three inches AFF or four inches below finished ceiling, with a bushing.
2. Sleeves shall be installed in the floor or ceiling a minimum of two to four inches on center from the wall.
3. Sleeves shall be installed in the walls at a minimum of two inches extended on each side of the wall.
4. Cable floor, ceiling and wall sleeves shall be spaced to allow space for ground bushing and insulated bushing for cable protection.
5. Shall be installed in a single tier or row from left to right horizontally.
6. If two tiers or rows are required, the conduits shall be staggered minimum of 2 inches between tiers.
7. Cable support anchors shall be installed 18 to 24 inches above the sleeves.

P. All conduit and cabinet entrances shall be sealed with an approved, re-enterable sealant material to prevent ingress of water, dust or other foreign materials.

Q. Conduit shall not be embedded in the required fire protective covering of a structural member that is to be individually encased in accordance with BOCA.

R. Install all exposed conduit parallel or perpendicular to lines of existing construction and grouped together where possible, without interfering with use of premises or working areas. Prevent safety hazards and interference with operating and maintenance procedures.

S. Conduit Sizing and supports:

1. Horizontal (station) conduit is defined as the conduit run between the communications outlet and the cable tray or communications room as indicated on Drawings.
2. Each horizontal conduit run shall be a one-inch metallic conduit and shall be home run from each communications outlet box to the equipment room, termination equipment or cable tray, as indicated in Drawings.

3. Each route shall be installed with the least amount of conduit bends. Each single horizontal conduit run shall be provided with a junction or pull box every 30 meters (100 feet) or contain more than two 90-degree bends (offset is considered to be a 90-degree bend).
4. Each dual horizontal conduit run shall be provided with a Junction or Pull Box every 30 meters (100 feet) or contain more than two 90-degree bends (offset is considered to be a 90-degree bend). The quantity of conduits entering the Junction or Pull Box shall equal the number of conduits exiting the Junction or Pull Box.
5. Each terminating (outlet end) conduit connection shall be provided with the proper connecting insulated bushing or fitting.
6. Each originating end (communications room end) shall be provided with the proper connecting insulated ground bushing and properly bonded to ground.

T. Horizontal Conduit Routes:

1. Horizontal (station) conduit is defined as the conduit run between the communications outlet and the cable tray or communications room as indicated on Drawings.
2. Each horizontal conduit run shall be a one-inch metallic conduit and shall be home run from each communications outlet box to the equipment room, termination equipment or cable tray, as indicated in Drawings.
3. Each route shall be installed with the least amount of conduit bends. Each single horizontal conduit run shall be provided with a junction or pull box every 30 meters (100 feet) or contain more than two 90-degree bends (offset is considered to be a 90-degree bend).
4. Each dual horizontal conduit run shall be provided with a Junction or Pull Box every 30 meters (100 feet) or contain more than two 90-degree bends (offset is considered to be a 90-degree bend). The quantity of conduits entering the Junction or Pull Box shall equal the number of conduits exiting the Junction or Pull Box.
5. Each terminating (outlet end) conduit connection shall be provided with the proper connecting insulated bushing or fitting.
6. Each originating end (communications room end) shall be provided with the proper connecting insulated ground bushing and properly bonded to ground.

U. Horizontal conduit entrance in communications rooms – wall entry

1. Horizontal conduits shall enter the communications room wall 12 to 18 inches above the top of the cable tray. Maintain cable bend radius with supporting device as required.
2. Conduit wall stubs shall be spaced in increments equal to the conduit outside diameter (OD) from each other.
3. All conduit wall stubs shall be extended to the terminating equipment, electronics, or cable tray, as noted in Drawings.
4. Conduit crossovers are not permitted.

V. Horizontal conduit entrance in communications rooms – ceiling entry

1. Horizontal conduits shall enter or be extended from the equipment room ceiling 12 to 18 inches above the top of the cable tray.
2. Ceiling conduit stubs shall be spaced in increments equal to the conduit outside diameter (OD) from each other.
3. All ceiling conduit stubs shall be extended to the terminating equipment, electronics, or cable tray, as noted in Drawings.
4. Conduit crossovers are not permitted.

W. Horizontal conduit entrance in communications rooms – floor entry

1. Horizontal conduits shall enter the communications room floor 2 to 4 inches on center from the wall and shall be stubbed 3 inches AFF.
2. Conduit floor stubs shall be spaced in increments equal to the conduit OD from each other.
3. Conduit crossovers are not permitted.

4. Provide vertical ladder rack or d-hooks properly secured to wall to transverse cable to cable tray over-head.

X. Horizontal conduit to cable tray

1. Non-communications conduit shall NOT be attached to the cable tray in any fashion.
2. Conduit terminating end shall be attached to cable tray side rail with “conduit-to-cable tray” clamps. No other form of attachment shall be permitted.
3. Top or bottom cable tray conduit feeds and attachments are not permitted.

Y. Horizontal Junction/Outlet Boxes

1. Each horizontal conduit shall be terminated into an outlet box.
2. Each outlet box shall be a deep 4 11/16-inch square junction box with a minimum of two 1-inch knockouts on each of the sides.
3. Each conduit home run shall be provided with a deep 4 11/16-inch square junction box (w/cover) at 100-foot intervals and 6 inches above each ceiling and wall intersection.

Z. Riser conduit entrance in communications rooms – wall entry

1. Riser conduits shall enter the communications room wall a minimum of 24 inches above the top of the cable tray.
2. Conduit wall stubs shall be spaced in increments to equal the conduit OD from each other.
3. Riser conduits shall be installed in a single tier or row from left to right horizontally.
    a. If two tiers or rows are required, the conduits shall be staggered between tiers.
    b. No more than two tiers or rows are permitted.
4. All conduit wall stubs shall be extended to and over the cable tray to access cable tray pathway.
5. All rise conduit stubs shall be provided with the proper universal drop-out/waterfall cable exit runway, which shall be supported by and mounted to channel strut.
6. Conduit crossovers are not permitted.

AA. Riser conduit entrance in communications rooms – floor entry

1. Riser conduits shall enter the communications room floor 2 to 4 inches on center from the wall and shall stub up 6 inches AFF.
2. Conduit floor stubs shall be spaced in increments to equal the conduit OD from each other.
3. Riser conduits shall be installed in a single tier or row from left to right horizontally.
    a. If two tiers or rows are required, the conduits shall be staggered between tiers.
    b. No more than two tiers or rows are permitted.
4. Exiting cable shall be extended to the bottom of the cable tray and be provided with cable support anchors and secured with supporting hardware every six inches above the conduit bushings.
5. Conduit floor stubs shall be extended 2 to 4 inches from wall on center and 3 inches above AFF.
6. The riser cable shall be extended in the cable tray to the terminating equipment, as noted in the Drawings.
7. Conduit crossovers are not permitted.

3.5 MISCELLANEOUS PATHWAY DEVICES

A. Coordinate 4-inch core drill final locations with structural engineer.

B. Install poke-thru devices in accordance with manufacturer's instructions where indicated on floor plans.

3.6 TESTING

A. Test cable trays to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. See NFPA 70B, Chapter 18, for testing and test methods.

B. Manufacturer shall provide test reports witnessed by an independent testing laboratory of the "worst case" loading conditions outlined in this specification and performed in accordance with the latest revision of NEMA VE-1; including test reports verifying rung load capacity in accordance with NEMA VE-1 Section 5.4.

END OF SECTION 27 05 28