



SECTION 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Basic requirements for providing additions to the communications infrastructure as specified and shown on the Contract Drawings.

B. Related Requirements:

1. Drawings and general provisions of the Contract apply to this Section.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. CAD: Computer-aided design.
2. IDF: Intermediate Distribution Frame.
3. ITS: Information Technology System.
4. MDF: Main Distribution Frame.
5. NEC: National Electrical Code.
6. RCDD: Registered Communications Distribution Designer.
7. SCS: Structured Cabling System.
8. TGB: Telecommunications grounding busbar.

B. Definitions:

1. Authority Having Jurisdiction (AHJ): Building Code officials, zoning officials, inspectors, and government and regulatory agencies given the authority to protect the public's health, safety, and welfare.

C. Reference Standards:

1. American National Standards Institute (ANSI):
 - a. ANSI/J-STD-607-A – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
2. Building Industry Consulting Services International (BICSI):
 - a. BICSI TDMM - Telecommunications Distribution Methods Manual.
 - b. BICSI OSPDRM – Outside Plant Design Manual.
3. InterNational Committee for Information Technology Standards (INCITS):
 - a. ANSI/INCITS 231 – Information Systems – Fibre Distributed Data Interface (FDDI) – Physical Layer Protocol (PHY-2).
4. International Standards Organization/International Electrotechnical Commission (ISO/IEC):
 - a. ISO/IEC 11801 – Information Technology – Generic Cabling for Customer Premises.
5. National Fire Protection Association (NFPA):
 - a. NFPA 70 - National Electrical Code (NEC).



6. Telecommunications Industry Association/Electronic Industries Association (TIA/EIA):
 - a. ANSI/TIA/EIA-568-B.1 - Commercial Building Telecommunications Cabling Standard – Part 1: General Requirements.
 - b. ANSI/TIA/EIA-568-B.2 - Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted Pair Cabling Components.
 - c. ANSI/TIA/EIA-568-B.3 – Optical Fiber Cabling Components Standard.
 - d. ANSI/TIA/EIA-606-A – Administration Standard for Commercial Telecommunications Infrastructure.
 - e. ANSI/TIA/EIA-758-A – Customer Owned Outside Plant Telecommunications Infrastructure Standard.
7. Telecommunications Industry Association (TIA):
 - a. TIA-569-B – Commercial Building Standard for Telecommunications Pathways.
 - b. TSB-140 – Additional Guidelines for Field Test Length, Loss and Polarity of Optical Fibers.
8. Underwriters Laboratories, Inc. (UL):
 - a. UL Performance Verification Service Requirements.
 - b. UL Qualification Tests and Follow-Up Service Requirements.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate all communications work with the Program/Project Manager and the approved Contract schedule.
 - a. Adhere to the approved installation schedule.
 - b. Give required notices for items affecting the Contract schedule.
 - c. Coordinate delivery of extra materials, spare parts, and maintenance materials to the Site with the Program/Project Manager and obtain receipts for these materials prior to requesting final payment.
2. Coordinate acquisition of dedicated communications bandwidth and system storage devices with the Owner as necessary.
3. Electrical Subcontractors:
 - a. Coordinate interconnection of the communications equipment and electrical equipment with the electrical Subcontractor.
4. Provide the final coordination and field routing required for completing the communications infrastructure as indicated in the Contract Documents.

B. Pre-Installation Meetings:

1. Contract Planning Meeting:
 - a. The Contractor's project manager and key staff must participate in a Contract Planning Meeting, as required by the Program/Project Manager.
 - 1) The purpose of the Contract Planning Meeting is to ensure proper coordination between the parties responsible for the successful completion of the Work of this Contract.



2. Contract Status Meetings:

- a. The Contractor's project manager must attend weekly and monthly Contract status meetings with the Program/Project Manager to discuss the status of the installation of the communications infrastructure.

C. Scheduling:

1. In the construction schedule, designate system startup periods in conjunction with the initial system performance testing for the communications infrastructure.
 - a. For time dependent testing, include a commissioning period having a minimum duration of 30 days in the construction schedule.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Approvals:

1. Submit the documents required by State Licensure inspectors and other Authorities Having Jurisdiction to the appropriate agencies.
 - a. Secure and pay for plan check fees, permits, fees, and licenses necessary for the execution of the communications infrastructure Work as applicable for this Contract.
 - b. Submit the approval documents from the regulatory agencies to the Program/Project Manager for information.

B. Contractor's Qualifications for communications infrastructure:

1. Firms regularly engaged in the installation of communications systems and 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 required for this project.
4. Provide a BICSI RCDD certified professional for oversight on this project. This person does not have to be working on-site but must be accessible to answer questions and provide status reports.
5. Provide full time project manager with a minimum of five (5) 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 Owner.

C. Certifications:

1. Electrical Listing and Labeling:
 - a. Provide electrical components, devices, and accessories that are listed and labeled for the location the product is installed in, and the application intended, by a Nationally Recognized Testing Laboratory (NRTL), as defined in Article 100 of NFPA 70, acceptable to the Authorities Having Jurisdiction (AHJ), such as Underwriters Laboratories, Inc. (UL), unless products meeting the requirements of these nationally recognized testing laboratories are not available or unless standards do not exist for the products.
 - 1) Provide products marked with their intended use or classification.
 - 2) Submit evidence with the Product Data that the products represented meet testing agency quality verification requirements, including agency listing and



labeling requirements.

- 3) Such evidence may consist of either a printed mark on the data or a separate listing card.
- b. Submit a written statement from those product manufacturers that do not provide evidence of the quality of their products that indicates why an item does not have quality assurance verification.
 - 1) Such statements provided in lieu of quality assurance verification are subject to the acceptance of the Owner and the Program/Project Manager.

1.5 SUBMITTALS

A. Action Submittals:

1. Submit the following to the Program/Project Manager for approval:
 - a. Product Data:
 - 1) Prepare a Bill of Materials for communications infrastructure which will then function as the Table of Contents for the communications infrastructure Product Data submittal.
 - 2) Obtain Product Data for the products proposed, consisting of, but not limited to, data sheets and catalog cuts which document compliance of the devices and components with the requirements specified in this Section.
 - 3) Any exceptions taken to the specified requirements must be noted and addressed.
 - 4) Submit product data sheets for approval prior to procurement of equipment and software.
 - 5) On the product data sheet, clearly identify what model and part numbers are being proposed and which ones are not.
 - 6) On the product data sheet, clearly identify what optional equipment or functions are being proposed and which ones are not.
 - 7) Furnish a description of any modification or custom design required to meet the Contract requirements that are not covered by the standard software.
 - 8) Include each device's unique identifier, the device function, its manufacturer, and its model/part/catalog number used for ordering.
 - 9) System Schematics:
 - a) Furnish system schematics that shows the control and mechanical devices associated with the system.
 - b) Include a system schematic drawing for each sub-system.
 - 10) Communications System Architectures:
 - a) Furnish complete communication system architectures.
 - 11) System Drawing Index:
 - a) Furnish a system drawing index that shows the name and number of the building or other similar designation; and that lists the system drawings, including the drawing number, sheet number, drawing title, and computer filename when used.
 - b) Furnish a system legend on the system drawings that shows generic symbols and the name of the devices shown.
 2. Within the 2 months after the official Notice to Proceed (NTP), submit the communications infrastructure



Shop Drawings to the Program/Project Manager for approval.

a. Shop Drawings:

1) System Drawing Index:

- a) At the beginning of the shop drawing submittal provide a table of contents or index that clearly identifies the names of the drawings included and page numbers for each of the drawings.
- b) Use the same abbreviations, symbols, nomenclature and identifiers used in the Contract Documents.

2) Furnish each system element shown on a system drawing with a unique identifier.

3) Submit system documents that include all or part of the following as applicable:

- a) Include system descriptions, analyses, and calculations that were used to size the equipment specified.

4) Submit marked up construction drawings showing any deviations.

5) Include more detail, when compared to the project plans and typical details, system configuration information related to each installation.

6) Include coordination details required for between trades.

7) Include conduit pathways, mounting details, space requirements, naming and addressing suggestions.

8) Submit system schematics identifying how each component is interconnected.

B. Delegated and Deferred Design Submittals:

1. Related structural supports, poles, and foundations proposed.
2. Other types of related deferred submittals required.

C. Special Procedure Submittals:

1. System Test Plans.

2. Sequence of Operation Narratives:

- a. Furnish a sequence of operations that reflects the language and format of this Section, and that refers to the devices by their unique identifiers.

1) A description of how the system will operate.

2) A description of any integrations to other systems and how they are interconnected and are programmed to interact.

D. Qualification Statements:

1. Submit the following:

- a. Communications infrastructure installers' qualifications.

E. Informational Submittals:

1. Submit the following to the Program/Project Manager for information:

- a. Manufacturer's Instructions:

1) Installation manuals.



- 2) User manuals
 - 3) Recommended installation procedures and materials.
- b. Site Quality Control Submittals.

F. Closeout Submittals:

1. Submit the following to the Program/Project Manager:

a. Maintenance Contracts:

- 1) Proposal for new service contracts if requested.
- 2) Proposal for modifying existing service contracts if requested.

b. Warranty Documentation:

- 1) Communications infrastructure Materials Warranty.
- 2) Communications infrastructure Installation Warranty.

c. Record Documentation:

- 1) System Commissioning Report.
- 2) Record Drawings showing As-Built conditions with all Shop Drawing development and installation development notated.
- 3) Communications infrastructure proof of licensing.
- 4) Communications infrastructure Inspection and Functional Test Reports.
- 5) Communications infrastructure User Acceptance Test Reports.
- 6) Communications infrastructure Configuration files.
 - a) Immediately following the completion of user acceptance testing, submit electronic copies of all configuration files such that the system can be restored to the accepted state.

d. SPARE PARTS DELIVERY

- 1) Provide transmittal of spare parts delivery.

1.6 SITE CONDITIONS

A. Existing Conditions:

1. All existing underground and aboveground utilities, services, and improvements, if any, are indicated in the Contract Documents to the best of the Owner's and Designer's knowledge and belief; however, the Owner and Designer has not verified this information by on-site verification of available as-built documentation, and the Contractor shall notify the Program/Project Manager of discrepancies discovered in the information provided in accordance with the notification and change procedures of the Contract.

B. Maintenance of Operations Plan (MOP):

1. Work shall include preparation of a Maintenance of Operations Plan (MOP) to keep the existing communications infrastructure functioning during construction.
2. Prepare and submit for approval a Maintenance of Operations Plan (MOP) for communications infrastructure. Each MOP shall provide sufficient detail on the required sequencing to ensure the continuous operation of the existing system. The Contractor is hereby advised that the long term shut



downs, per the discretion of the Owner, of the existing communications infrastructure will not be permitted.

3. The MOP at the minimum include the following:
 - a. Timing and method for each tie-in that may impact the operation of the existing system.
 - b. Method of keeping existing system functioning prior to disrupting the existing system. This may include temporary tie-ins, and temporary connections to back-up system operations.
 - c. Detailed schedule for overall installation, including the preparation of a construction sequencing plan. The schedule for the construction work shall align with the sequencing plans or a revised sequencing plan approved by the Program/Project Manager.
 - d. Timing and method of temporary improvements necessary for maintaining continuous system operations. Detail shall be provided as to the temporary materials/connections used.

C. Working Hours:

1. The Contractor shall work outside the normal working hours, as directed by the Program/Project Manager, to minimize impact to the operations as well as accidental disruptions to the existing communications infrastructure.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:

1. Package each item of the communications infrastructure equipment in its original and individual container, complete with all necessary fastenings, instructions, and templates.
2. Check in and sign for all the communications infrastructure equipment delivered to the Site and take responsibility for the material delivered thereafter until Final Acceptance.
3. Deliver materials and equipment in a clean condition.
 - a. Provide packaging that plugs, caps, or otherwise seals openings both during shipping and temporary storage.
4. Inspect materials and equipment for signs of damage prior to accepting delivery of those items at the Site; and reject, segregate, and remove damaged items.

B. Storage and Handling Requirements:

1. Handle materials and equipment in accordance with the manufacturer's written instructions.
2. Follow the manufacturer's written instructions for storing the items.
3. Store all products whether on-site or off-site, indoors on blocking or pallets.
 - a. Provide a room with sufficient space and shelving in which to arrange, securely lockup, and store the electronic communications equipment.
 - b. Except for communications conduit, store communications equipment and products under cover in heated warehouses or in enclosed buildings that provide protection from the weather on all sides and are equipped with auxiliary heat.

C. Packaging Waste Management:

1. Dispose of packaging waste.

1.8 WARRANTY

- A. These warranty requirements represent the minimum requirements for the communications infrastructure. If other sections of the contract documents have additional warranty requirements, then they both shall apply,



and the more stringent warranty requirement shall be provided.

B. Manufacturer Warranty:

1. Materials Warranty for the communications infrastructure:
2. Warrant the communications infrastructure materials against defects within the 1 year period after the Date of Substantial Completion:
3. Submit, to the Program/Project Manager for approval, Equipment Materials Warranty on the communications infrastructure Subcontractor's standard or customized form, without monetary limitation, in which the communications infrastructure equipment Subcontractor agrees to replace equipment materials that fail within the specified warranty period.

C. Special Warranty:

1. Installation Warranty for the communications infrastructure:
 - a. Warrant the communications infrastructure installation workmanship against failures beginning at the Date of Substantial Completion and extending until 1 year after the Owner has conducted a systems acceptance test on all components and provided the Contractor with a Systems Acceptance approval letter:
 - 1) Include the removal and reinstallation of the communications infrastructure in the Warranty.
 - 2) Submit, to the Program/Project Manager for approval, a communications infrastructure Installation Warranty on communications infrastructure Subcontractor's standard or customized form, without monetary limitation, in which installer agrees to repair communications infrastructure that fail within the specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer List:

1. Subject to compliance with the requirements specified herein, provide the Basis-of-Design product indicated in the Contract Documents or a comparable product.

B. Substitution Limitations:

1. No substitutions are allowed for the communications infrastructure components.

2.2 PERFORMANCE:

- A. Install communications infrastructure so that it operates in accordance with its manufacturer's standards and Owner requirements.

2.3 MATERIALS AND EQUIPMENT

- A. All materials and equipment used in carrying out these specifications are to be new and have UL listing, or listing by other recognized testing laboratory when such listings are available.
- B. Model numbers and manufacturers included on the project drawings are listed to establish as standard of product quality.
- C. Other qualified manufacturers may be substituted only with the Owner's written consent. To request a substitution, the Contractor shall submit complete technical data, samples, and if requested, results of independent testing laboratory tests of proposed equipment.



1. If proposed System includes equipment other than specified model numbers, submit a list of major items and their quantities, with a one-line schematic diagram for review.
2. Material not specifically identified within this document, but which is required for the successful implementation of the intended system(s) shall be of the same class and quality as the specified material and equipment.
3. Include a list of previously installed projects using proposed equipment that are similar in nature to specified system.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Insofar as it is possible to determine in advance, Contractor shall review pathway requirements and provide proper chases and openings. Place all outlets, anchors, sleeves, and supports prior to pouring concrete or installation of masonry work. Should the Contractor neglect doing this, any cutting and/or patching required is to be done at this Contractor's expense. Visit site and be informed of conditions under which work must be performed. No subsequent allowance will be made because of error or failure to obtain necessary information to completely estimate and perform work involved.
- B. Carefully coordinate with other divisions to ensure proper power requirements, grounding, fireproofing and interlocking controls between the fire alarm system, security system, and other Owner furnished systems.
- C. Notify other tradesmen of any deviations or special conditions necessary for the installation of work. Interferences between work of various Contractors to be resolved prior to installation. Work installed not in compliance with specifications and drawings and without properly checking and coordinating as specified above shall, if necessary, be removed and properly reinstalled without additional cost to Owner.
- D. The Owner or the Owner's Representative shall be the mediating authority in all deviation and disputes arising on project.
- E. Coordinate with local telephone and cable service providers to assure that proper points of service, demarcation location and grounding requirements are in accordance with contract drawings. This Contractor shall be involved regarding discussions about services to the building.
 1. Coordinate with other trades to provide wall and ceiling access panels wherever required for access to communication equipment.
- F. Intent:
 1. Division 27 specifications and drawings form a complete set of documents for communications systems for this project. Neither is complete without the other. Any item mentioned in one shall be as binding as though mentioned in both.
 2. The intent of these specifications and drawings is to form a guide for a complete systems installation. Where an item is reasonably necessary for a complete system but not specifically mentioned, such as pull boxes, fittings, expansion fittings, support hangers, etc. provide same without additional cost to Owner.
 3. Communication equipment room layouts indicated on drawings are diagrammatical only. Exact location of outlets and equipment to be coordinated and governed by project conditions. The Owner reserves the right to make any reasonable changes (approximately 6 feet) in location of junction boxes, or equipment prior to roughing in of such without additional cost to Owner.
- G. Deviations:
 1. No deviations from specifications and drawings to be made without full knowledge and written consent of Owner.
- H. Should the Contractor find during progress of work that existing conditions make desirable a



modification of the requirements of any item, report such item promptly to the Owner for a preliminary decision and then make a formal submittal for the desirable modification. No modifications to be made without full knowledge and written consent of Owner.

1. Unless otherwise noted on the drawings, all communications/low voltage systems cabling shall be routed above accessible corridor ceilings parallel to room walls and corridors via cable tray or conduit systems. Cabling shall be segregated by function as follows:
 - a. Voice and Data Applications (including IP Paging Microphones and IP Cameras)
 - b. Access Control Applications
 - c. Paging Speakers and AFILS
 - d. All other systems.

3.2 CONTINUITY OF SERVICES

- A. Follow the approved Maintenance of Operations Plan (MOP) for the communications infrastructure.
- B. The Contractor shall not take any action that will interfere with, or interrupt, existing building services unless previous arrangements have been made with the Owner's Representative. Arrange the Work to minimize shutdown time.
- C. Owner's personnel will perform shutdown of operating systems. The Owner requires the Contractor submit a request at least fourteen (14) days prior to any system shutdown, and all requests must go through the Owner's approval process.
- D. Should services be inadvertently interrupted, Contractor shall immediately furnish labor, including overtime, material, and equipment necessary for prompt restoration of interrupted service.

3.3 TRENCHING, EXCAVATION, BACKFILLING, AND REPAIRS

- A. Trenching, Excavation, and Backfilling is the responsibility of the Contractor. The Contractor is to coordinate all requirements with any of the Contractor's sub-contractors, where applicable. Failure to properly coordinate this effort resulting in additional trenching, excavation, backfilling, or repairs shall be performed without additional cost to Owner.

3.4 PLYWOOD BACKBOARD AND WALL BACKING

- A. Contractor shall provide 4-foot wide, by 8-foot high, by 3/4-inch thick fire-retardant plywood backboard on each wall in all Communication Rooms. Plywood is to be painted with two coats of fire retardant paint on all six sides and installed 6 inches above finished floor. The fire rating on the plywood shall be masked prior to painting and the mask removed after installation such that the fire rating is always visible.
- B. Contractor is to provide appropriate backing in walls as required for mounting brackets and other wall mounted equipment per manufacturer requirements.
- C. Where work is to be done in an existing Telecommunication Room (TR), the Contractor shall ensure plywood in the TR is flame retardant. If the existing plywood does not comply the Contractor shall replace it with flame retardant plywood.

3.5 FIRESTOPPING

- A. Select appropriate type or types of through penetration firestop devices or systems appropriate for each type of communications penetration and base each selection on criteria specified herein.
- B. Selected systems shall not be less than the hourly time delay ratings indicated in the Contract Documents for each respective fire-rated floor, wall, or other partition of building construction. Firestop for each type of communications penetration shall conform to requirements of an independent testing laboratory design drawing or manufacturer's approved modification when used in conjunction with details shown on the Drawings.



- C. Perform all necessary coordination with trades constructing floors, walls, or other partitions of building construction with respect to size and shape of each opening to be constructed and device or system approved for use in each instance.
- D. Coordinate each firestop selection with adjacent Work for dimensional or other interference and for feasibility. In areas, accessible to public, and other "finished" areas, firestop systems Work shall be selected, installed, and finished to the quality of adjacent surfaces of building construction being penetrated.
- E. Use materials that have no irritating or objectionable odors when firestopping is required in existing buildings and areas that are occupied.
- F. Provide damming materials, plates, wires, restricting collars, and devices necessary for proper installation of Firestopping. Remove combustible installation aids after firestopping material has cured.
- G. All firestops shall be installed in accordance with the manufacturer's instructions in order to maintain the specific rating assigned by the independent testing laboratory.
- H. Existing raceways, cable trays, and cabling that penetrate existing building construction shall be firestopped to the extent necessary to fill cavities that may exist between existing building construction and existing communications penetrations or existing conduit sleeve, and between existing conduits and existing conduit sleeve.
- I. If required by inspecting authorities:
 - 1. Expose and remove Firestopping to the extent directed by inspecting authority to permit his or her inspection.
 - 2. Reinstall new firestopping and restore Work where removed for inspection.

3.6 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, dust, and construction debris and repair damaged finish, including chips, scratches, and abrasions. This includes touching up paint removed for grounding.
- B. Contractor shall provide a clean work environment, free from trash/rubbish accumulated during and after cabling installation.
- C. Maintain construction materials and refuse within the area of work. Clean the work area at the end of each day.
- D. Contractor shall keep all liquids (drinks, Sodas, etc.) off finished floors, carpets, tiles, racks and equipment. If any liquid damage to above finishes or equipment, Contractor shall provide professional services to clean or repair scratched/soiled finishes or damaged equipment at own expense.

3.7 SYSTEM STARTUP

- A. System Performance Verification and User Acceptance Tests:
 - 1. Submit, to the Program/Project Manager for approval, proposed testing plan (procedures and test forms) for the System Performance Verification and User Acceptance Tests. Perform the System Performance Verification and User Acceptance Tests per the approved testing plan.
 - 2. If the system does not pass the Performance Verification and Acceptance Tests due to deficiencies, continue the commissioning period until the Performance Verification and Acceptance Tests are completed and the system is accepted.
 - 3. Note that in order to receive sign off on a completed test, all required stakeholder representatives must have been present to witness the testing and sign the field test sheet. Coordinate with the Program/Project Manager to have all required personnel present.
 - 4. Correct defects as they are detected to put the system into operation.



5. Conclude the commissioning period upon successful completion of all Inspection, Performance Verification and User Acceptance Tests.

3.8 OBSERVATIONS

- A. When field observation services are a part of the project scope, the Owner's representatives will provide periodic observation of the progress of Work specified herein. The purpose of the observation service is to ensure compliance of Contractor's Work with specifications and drawings. The Owner's representatives may also observe tests required of this Contractor as called for in other sections of the specifications.
- B. Specifications and drawings represent Work to be done in view of total project requirements. To eliminate possible conflict with other trades, final location of conduits, jacks, outlets, components, etc., is responsibility of this Contractor. Contractor to provide all supervision required for his personnel to ensure that installation is made in accordance with specifications and drawings and all safety rules and regulations are observed. In event of conflicts of Work on project with other trades, Contractor is to make every reasonable effort to resolve conflict through meetings and discussions with other parties involved, by preparation of drawings, or other appropriate action. Only after this has been done shall the Designer's assistance be requested through the RFI process.
- C. When the Designer is requested to visit the project to aid in resolution of conflicts, or for witnessing tests, they shall be given a minimum of 48 hours notice prior to time their presence is requested at job site.

3.9 WARRANTY-GUARANTEEE

- A. The Owner reserves right to accept or reject any part of the installation which does not successfully meet requirements as set out in these specifications.
- B. This Contractor shall, and hereby does, guarantee all Work installed under this division shall be free from defects in workmanship and materials for a period of one year from date of final acceptance. This Contractor further agrees to repair or replace any defective material or workmanship which is or becomes defective within the terms of this warranty-guarantee.
- C. 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.

3.10 CLOSEOUT ACTIVITIES

- A. Training:
 1. Perform training, if required.
- B. Record Documentation:
 1. Legibly mark drawings to create Record Drawings that record the final and actual "As-Built" security access and surveillance system installation.
 - a. Mark each edited electronic as-built drawing with the words "Record Document".
 - b. Include all noted and design changes pertaining to the communications infrastructure "as built" conditions, and a set of permitted construction documents for the Owner's records.
 - c. Include communications conduit, cabling, and pathways used; field changes of dimensions and details; changes in details from those indicated on the Contract Drawings; details not on the original Contract Drawings; the make and model of the actual products installed, and the following additional information:
 - 1) Drawing Index and a system legend.
 - 2) A system schematic and equipment schedule.
 - 3) Complete communication-system architectures, including information on applicable



- network addressing and jumpers.
- 4) Floor plans showing the location of key system components, and the routing of the communications system trunk lines.
 - 5) Enclosure drawings, segregated by enclosure, and including the following:
 - a) Bill of material, including required spares.
 - b) Component layout plans.
 - c) Complete wiring schematics having information on applicable network addressing and jumpers.
 - d) Port/connector layout plans for cross-patch termination assemblies.
 - d. Include schedules and related drawings documenting the usage/assignments of each of the following assemblies:
 - 1) Include cable lists specifying the cable, port number, connector type and power type.
 - 2) Operation and Maintenance Data.
 2. 30 days before the date scheduled for the training course, submit the Record Documentation to the Program/Project Manager for review.
 - a. Should additional information or revisions be required, the reviewed documents will be returned to the Contractor for correction and re-submittal to the Program/Project Manager.

END OF SECTION



YUMA COUNTY AIRPORT AUTHORITY
ACCESS CONTROL UPDATES

ISSUE FOR BID
FAA AIP X-XX-XXXX-XXX-2024

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SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding labeling.

B. Related Documents

1. Drawings and general provisions of the Contract apply to this Section.
2. Comply with provisions of Section 27 05 00, Common Work Results for Communications.

1.2 DEFINITIONS

- | | | |
|----|-------|----------------------------------------------------|
| A. | ANSI | American National Standards Institute |
| B. | AWG | American Wire Gauge |
| C. | BCT | Bonding Conductor for Telecommunications |
| D. | BICSI | Building Industry Consulting Service International |
| E. | EMT | Electrical Metallic Tubing |
| F. | IDF | Intermediate Distribution Frame |
| G. | MDF | Main Distribution Frame |
| H. | NECA | National Electrical Contractors Association |
| I. | NEMA | National Electric Manufacturers Association |
| J. | NFPA | National Fire Protection Association |
| K. | RCDD | Registered Communications Distribution Designer |
| L. | RFP | Request for Proposal |
| M. | STD | Standard |
| N. | TGB | Telecommunications Grounding Busbar |
| O. | TIA | Telecommunications Industry Association |
| P. | TMGB | Telecommunications Main Ground Bus Bar |
| Q. | UL | Underwriters Laboratories |

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 Owner.
- 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 Owner.



- C. Strictly adhere to all TIA and BICSI recommended installation practices when installing communications grounding systems.
 - D. 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 notify the Owner in writing prior to commencement of affected work.
- 1.5 SUBMITTALS
- A. Produce Shop Drawings for the grounding and bonding system, to include but not limited to, communications equipment room signal reference grid, plans, elevations, sections, details, and attachments to other work.
 - B. Provide all submittal requirements under this section as a single package.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

- A. Comply with the latest publication of ANSI/TIA-607.

2.2 CONDUCTORS

- 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. Chatsworth Products Inc.
 - 2. Harger Lightning and Grounding.
 - 3. Panduit Corp.
 - 4. Tyco Electronics Corp.
 - 5. Approved Equal.
- B. Insulated Conductors:
 - 1. Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - a. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
 - b. Cable Tray Equipment Grounding Wire: No. 6 AWG.



C. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
5. Bonding Conductor: No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

D. Cable Tray Bonding Connections:

1. Contractor shall utilize cable tray splice connection hardware for bonding of cable tray sections and the cable tray splice connection hardware shall be UL-Listed for this purpose. This hardware shall be installed according to the manufacturer's recommendations (bare metal-to-metal connections, anti-oxidant grease, etc).
2. Where cable tray splice connection hardware cannot be used, such as ladder-rack style cable runway, Contractor shall utilize bonding jumper with conductor not smaller than No. 6 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

2.3 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. 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:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide grounding lug connectors or comparable product by one of the following:
 1. Burndy; Part of Hubbell Electrical Systems.
 2. Chatsworth Products, Inc.
 3. Harger Lightning and Grounding.
 4. Panduit Corp.
 5. Tyco Electronics Corp.
 6. Approved Equal.
- D. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
 1. Electroplated tinned copper, C and H shaped.
- E. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- F. Busbar Connectors: Cast silicon bronze, solderless compression-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.
- G. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.



PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with ANSI/TIA-607.

3.3 APPLICATION

- A. Conductors: Install stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
 - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- C. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches.
- D. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install without splices.
 - 3. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 27 05 28, Pathways for Communications Systems, and bond both ends of the conduit to a TGB.

3.4 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2



inches minimum from wall, 84 inches above finished floor unless otherwise indicated.

- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.5 CONNECTIONS

- A. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- B. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pretwist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- C. Telecommunications Enclosures and Equipment Racks: Bonding of Installed equipment racks shall be performed by the Contractor.
- D. Towers and Antennas:
 - 1. Ground Ring: Buried at least 30 inches below grade and at least 24 inches from the base of the tower or mounting.
 - 2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches below grade.
 - 3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches below grade.
 - 4. Bond metallic fences within 6 feet of towers and antennas to the ground ring, buried at least 18 inches below grade.
 - 5. Special Requirements for Roof-Mounted Towers:
 - a. Roof Ring: Meet requirements for the ground ring.
 - b. Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.
 - c. Connect roof ring to the perimeter conductors of the lightning protection system.
 - 6. Waveguides and Coaxial Cable:
 - a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
 - b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the busbar and the nearest available grounding electrode.



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The maximum acceptable value of this bonding resistance is 100 milliohms.

3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
 - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.
- B. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 1 ohm, notify Owner promptly and include recommendations to reduce ground resistance.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION



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SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Requirements for providing communications pathways.

B. Related Requirements:

1. Drawings and general provisions of the Contract apply to this Section.
2. Comply with provisions of Section 27 05 00, Common Work Results for Communications.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. IDF: Intermediate Distribution Frame.
2. MDF: Main Distribution Frame.
3. NEC: National Electrical Code.
4. PVC: Polyvinyl chloride.
5. TGB: Telecommunications grounding busbar.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the routing and location of the conduits and other raceways with other trades and construction to avoid conflicts.
2. Where conduits pass through the roof, coordinate communications pathway installation with the roofing installer.

1.4 SUBMITTALS

A. Action Submittals:

1. Submit the following to the Program/Project Manager for approval in accordance with the requirements of Section 01 33 00, Submittal Procedures:
 - a. Product Data:
 - 1) Electrical metallic tubing (EMT).
 - 2) Rigid Metal Conduit (RMC)
 - 3) Expansion joint fittings.
 - 4) Thruwall sealing fittings.
 - 5) Fire-seal fittings.
 - 6) Sealing material for sealing fittings.
 - 7) Insulated bushings.
 - 8) Pulling in wire.
 - 9) Thread lubricant/sealant.
 - 10) Wireways and wiring troughs.



- 11) Cable trays.
 - 12) Innerduct.
 - 13) Junction boxes/pull boxes.
 - 14) Conduit
 - b. Shop Drawings:
 - 1) Plan and section drawings detailing the proposed communications pathway routing.
 - c. Certificates:
 - 1) Fire Stopping Manufacturer's Certificate.
 - d. Qualification Statements:
 - 1) Fire Stopping Installer's Certificate.
- B. Informational Submittals:
1. Submit the following to the Program/Project Manager:
 - a. Manufacturer's Instructions:
 - 1) Firestopping manufacturer's instructions.
- 1.5 QUALITY ASSURANCE
- A. Regulatory Agency Sustainability Approvals:
1. Provide only UL listed and labeled conduits.
- B. Qualifications:
1. Fire Stopping Installer's Qualifications:
 - a. Employ a fire stopping installer who has been trained and approved by the fire stopping manufacturer to perform fire stopping work, and who has specialized in the installation of work similar to that required for this Contract.
- C. Certifications:
1. Fire Stopping Manufacturer's Certificate:
 - a. Submit a Fire Stopping Manufacturer's Certificate, signed by the manufacturer and certifying the materials he has supplied comply with the specified performance characteristics and physical properties for fire stopping materials, to the Program/Project Manager for approval.
 2. Fire Stopping Installer's Certificate:
 - a. Submit a Fire Stopping Installer's Certificate, certifying the installer is manufacturer-trained and approved to properly install the fire stopping materials.

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 CONDUITS AND FITTINGS

- A. All conduit systems for shall comply with ANSI/TIA-569-D standard.



- B. All conduit systems shall be appropriately color-coded for the system which they support.

2.3 NON-METALLIC CONDUITS AND FITTINGS

- A. All conduit systems shall comply with ANSI/TIA-569-D standard.

- B. Flexible Conduit

1. Provide flexible non-metallic conduit for protection of cabling from wall feeds into modular furniture.
2. Conduit to be 2-inch diameter and black in color.
3. Conduit to be terminated with liquid tight straight connectors, with NPT threads.
4. Include appropriate wall plates that adapt to the conduit connectors.
5. Acceptable products:
 - a. Heyco 8456 Liquid Tight Tubing, 2-Inch, Black
 - b. Heyco 8642 Nylon Straight Connector, 2-Inch, Black
 - c. Approved Equivalent

2.4 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 in indoor spaces. Pull boxes shall be minimum NEMA Type 3R rated in outdoor conditions. Boxes are to be sized according to the table below 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 |

- 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.
- 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.

2.5 WIRE MESH CABLE TRAY, SUPPORTS, AND ACCESSORIES

- A. Wire Mesh Cable Tray

1. Provide wire mesh cable tray for major cabling pathways as shown on the drawing set.
2. Wire mesh 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 18" (609.6mm) wide, unless shown otherwise on plans, with 4" (101.6mm) high sidewalls.
4. Wire Mesh Cable Tray shall be powder-coated for indoor installations, except where installation is exposed to moisture (such as outdoor environments) in which case the tray shall be appropriately finished.
5. Wire mesh cable tray and splicing hardware shall be UL Classified for grounding purposes, and shall be grounded and bonded per ANSI/TIA-607-C standard and manufacturer's instructions.
6. Cable tray shall be BLACK for City of Phoenix cable tray, and SILVER for Airport Tenant cable tray.
7. Acceptable systems:
 - a. Cablofil CF105/450
 - b. Owner Approved Equivalent.

B. Wire Mesh Cable Tray Supports

1. Supports will be sized at minimum to match the width of the wire mesh cable tray that is supported. The support may be wider than wire mesh cable tray.
2. Support design will allow the support to be placed under a wire mesh 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 mesh 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 mesh cable trays to the support.
6. Supports will be manufactured from steel extrusion and/or sheet.
7. Supports shall be powder-coated to match the cable tray for indoor installations, except where installation is exposed to moisture in which case the hardware shall be appropriately finished.
8. Acceptable products:
 - a. Cablofil FASP 450
 - b. Owner Approved Equivalent.

C. Wire Mesh Cable Tray Splices and Fasteners

1. Provide a method of simultaneously splicing, bonding and securing intersecting wire mesh cable tray sections to supports when supports are placed directly under a wire mesh 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 mesh 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 mesh cable tray to supports when supports are placed mid-span (in between a splice or intersection point) along a wire mesh cable tray pathway.
4. Provide a method for attaching a bonding conductor to the outer side wall of the wire mesh



cable tray.

5. All splice hardware shall be UL Listed for grounding and bonding applications and installed per manufacturer's recommendations for grounding and bonding applications.
6. Splices and Fasteners shall be powder-coated to match the cable tray for indoor installations, except where installation is exposed to weather in which case the hardware shall be appropriately finished.
7. Acceptable products:
 - a. Cablofil
 - 1) EDRN
 - 2) SWK
 - 3) GNDSB
 - 4) GNDCL
 - 5) Owner Approved Equivalent

D. Wire Mesh Cable Tray Accessories

1. Provide cable tray divider accessory as shown in the drawing set, within all COP cable trays.
2. Provide a bend radius to connect the sidewalls of adjoining wire mesh 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 mesh cable tray.
3. Provide elevation change hinges to form cable over a smooth curve wherever cable tray changes elevations.
4. Provide conduit adapters for all conduit that transitions into the cable tray.
5. Wire mesh cable tray accessories will be manufactured from steel extrusion and/or sheet.
6. Wire mesh cable tray accessories will be pre-galvanized before fabrication.
7. Accessories shall be powder-coated to match the cable tray for indoor installations, except where installation is exposed to weather in which case the hardware shall be appropriately finished.
8. Acceptable products:
 - a. Cablofil
 - 1) Part Number COT 105 Kit
 - 2) Part Number RADT90KIT Bend Radius Kit
 - 3) Part Number EAC Elevation Change Kit
 - 4) Part Number CE40CC & CH Conduit Adapter
 - 5) Part Number C50CC Conduit Adapter
 - 6) Owner approved equivalent

E. Wire Mesh Cable Tray Installation Tools

1. Provide cutting and forming tools, as required, for field fabrication of wire mesh cable tray pathways.
2. Provide tools, as required, for pulling cable around turns, bends or intersections in wire mesh cable tray pathway.

F. Wire Mesh Cable Tray Support – Installation Hardware



1. Provide installation hardware to attach wire mesh cable tray supports to building structure per the cable tray manufacturer's recommendations.

2.6 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. Devices shall be tested and approved with cable capacities ranging from 0 to 100-percent visual fill.
5. Devices shall be of a sufficient size to accommodate the quantity and size of datacables 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. Owner Approved Equivalent

2.7 NON-CONTINUOUS CABLE SUPPORT SYSTEMS

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

1. Non-continuous cable supports (J-Hooks) are NOT allowed within this project.

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 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: IMC
2. Concealed Conduit, Aboveground: IMC
3. Underground Conduit: EPC-40-PVC

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

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: IMC. Pathway locations include the following:
4. Loading dock
5. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units
6. Mechanical rooms.
7. Concealed in Ceilings and Interior Walls and Partitions: EMT
8. Damp or Wet Locations: IMC
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: EMT
11. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT
12. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 nonmetallic in damp or wet locations.

C. Minimum Pathway Size: 1-inch trade size conduit

D. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. 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.
3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.3 INSTALLATION

A. Wire Mesh 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 manufacturer's specifications.
7. Cable tray shall be suspended using manufacturer-approved trapeze type supports.
8. Install cables using techniques, practices, and methods that are consistent with Category 6 or higher requirements and that supports Category 6 or higher performance of completed and linked signal paths, end to end.
9. Install cables without damaging conductors, shield, or jacket.
10. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.
11. Pull cables without exceeding cable manufacturer's recommended pulling tensions. Use pulling means that will not damage media.
12. Do not exceed load ratings specified by manufacturer.
13. Follow manufacturer's recommendations for allowable fill capacity for each size of cable tray section.

B. Conduit Systems

1. Comply with NECA 1, NECA 101, and ANSI/TIA-569 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
2. The inside radius of bends in conduit shall be.
 - a. 6 times the internal diameter for 2-inches or less.
 - b. 10 times the internal diameter for greater than 2-inches.
3. Any single conduit run extending from an MDF/IDF shall not serve more than one outlet.
4. Conduit shall be reamed to eliminate sharp edges and terminated with an insulated bushing.
5. Underground minimum clearances
 - a. Minimum 3 inches when near electrical conduits.
 - b. Minimum 12 inches when running parallel to electrical conduits.
 - c. Minimum 6 inches when crossing petroleum, water and other pipelines.
 - d. Minimum 12 inches when running parallel to petroleum, water and other pipelines.
 - e. Minimum 12 inches when below railroad rails.
 - f. Orange colored, detectable, plastic warning tapes shall be installed to prevent accidental dig-ups.
6. Conduit protruding through the floor shall be terminated at 2 to 4 inches above the floor surface.



7. All conduit penetrations shall be provided with the proper conduit sleeves.
 - a. Sleeves shall extend three inches AFF or four inches below finished ceiling, with a bushing.
 - b. Sleeves shall be installed in the communications room floor or ceiling a minimum of two to four inches on center from the wall.
 - c. Conduit floor sleeves shall be spaced to allow space for ground bushing and insulated bushing for cable protection.
 - d. 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.
 - e. Cable support anchors shall be installed 18 to 24 inches from the sleeves.
8. All cable (horizontal, riser or backbone) wall or ceiling penetrations shall be provided with the proper conduit sleeves.
 - a. Sleeves shall extend three inches AFF or four inches below finished ceiling, with a bushing.
 - b. Sleeves shall be installed in the floor or ceiling a minimum of two to four inches on center from the wall.
 - c. Sleeves shall be installed in the walls at a minimum of two inches extended on each side of the wall.
 - d. Cable floor, ceiling and wall sleeves shall be spaced to allow space for ground bushing and insulated bushing for cable protection.
 - e. Shall be installed in a single tier or row from left to right horizontally.
 - f. If two tiers or rows are required, the conduits shall be staggered minimum of 2 inches between tiers.
 - g. Cable support anchors shall be installed 18 to 24 inches from the sleeves.
 - h. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot- water pipes. Install horizontal pathway runs above water and steam piping.
9. Complete pathway installation before starting conductor installation.
10. Arrange stub-ups so curved portions of bends are not visible above finished slab.
11. Contractor shall provide pull boxes for all conduit pathways which exceed 100-feet or exceed 180-degrees in bends (two 90-degree, four 45-degree, six 30-degree, or any combination thereof). Support the pathway within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
12. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
13. Support conduit within 12 inches of enclosures to which attached.
14. Pathways Embedded in Slabs:
 - a. Run conduit larger than 1-inch 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-foot intervals.
 - b. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
 - c. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
 - d. Do not embed threadless fittings in concrete unless specifically approved in writing by Architect for each specific location.
 - e. Change from ENT to IMC before rising above floor.



15. Stub-ups to Above Recessed Ceilings:
 - a. Use EMT, IMC, or RMC for pathways.
 - b. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
 16. 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.
 17. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
 18. 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.
 19. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
 20. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- C. Surface Raceways:
1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 2. Install surface pathway with a minimum 2-inch radius control at bend points.
 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- D. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
1. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 100 feet.
 2. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- E. 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.
- F. 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:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service pathway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- G. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- H. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.
 2. Install in each run of aboveground wire mesh cable tray that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100



feet.

3. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
4. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
5. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
6. Install expansion fittings at all locations where wire mesh cable trays and conduits cross building or structure expansion joints.
7. 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 wire mesh cable tray and conduit supports to allow for expansion movement.

I. Junction and Pull Boxes:

1. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
2. 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.
3. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
4. 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.
5. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
6. Set metal floor boxes level and flush with finished floor surface.
7. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.4 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in the project Drawings.
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 of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in the project Drawings.



3. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
4. Underground Warning Tape: Comply with the requirements in the project Drawings

3.5 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 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 above finished grade.
- D. Install handholes with bottom below frost line.
- E. 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.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.7 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.8 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.

END OF SECTION



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SECTION 27 21 00 - DATA COMMUNICATIONS NETWORK EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Requirements for the communications connecting cords, devices, and adaptors to be used for supporting communications and otherspecial systems.

B. Related Requirements:

1. Section 27 05 00 - Common Work Results for communications

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Refer to Specification Section 27 05 00, Common Work Results for Communications.

1.3 QUALITY ASSURANCE

- A. Refer to Specification Section 27 05 00, Common Work Results for Communications.

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. The contractor is responsible for providing any parts and materials needed to deliver a complete and working system.
- B. Provide Communications Network Equipment identified on the Contract Drawings, unless approved otherwise.
- C. Provide the following, as necessary for a complete installation:
1. Patch panels and connector housings.
 2. Fiber splicing and splice closures.
 3. Termination blocks.
 4. Patch cords.
 5. Building entrance protection blocks.
 6. Grounding bars.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Contractor shall install all communications network equipment components in accordance with the manufacturer's recommendations, in accordance with applicable codes and standards referenced in the contract documents, and the approved Maintenance of Operations Plan (MOP).
1. Review the proper installation of each type of communications network equipment device with the equipment Supplier.
 2. Install using best practices and consistent with established preferences within the Owner's systems.
- B. Systems Integration:
1. Fully integrate the communications network equipment provided under this Section into the existing



communications network at the Airport.

2. The communications network equipment, including all subcomponents provided under this Section, will communicate back to the existing head end system core network switches.

3.2 SYSTEM STARTUP

A. Refer to Specification Section 27 05 00, Common Work Results for Communications.

B. Inspections and Functional Tests:

1. Inspections:

a. The communications infrastructure must be inspected for the following:

- 1) Craftsmanship of installation.
- 2) Conformance with approved shop drawings.
- 3) Wiring and component labeling.
- 4) Panel schedule accuracy.
- 5) Compliance with contract documents and best practices.

2. Network Topology Fault Condition Testing:

- a. When a fault tolerant network topology is used, the communications infrastructure must be tested to verify the system is configured correctly to self-heal around the fault conditions, and revert back to the initial case when each fault is removed.
- b. For mesh topologies, test both single-fault condition on each leg, and two-fault conditions to verify the 3rd leg is still operating properly and network traffic has been re-routed around the fault.

3. Communications Infrastructure Test verifying component functionality:

a. The communications infrastructure must be tested by the installer prior to acceptance testing with the Owner or Owner's representative.

- 1) Perform component level testing followed by the system testing per the previously submitted and approved test procedures.
- 2) Installer should successfully conduct all tests prior to inviting the Owner or their representative to official User Acceptance Testing.
- 3) Signed copies of the test are to be presented to the Owner or their representatives prior to User Acceptance Testing.

b. Test Plans shall contain at a minimum:

- 1) The procedures to be followed, including the use of any test or sample data.
- 2) Test equipment used for the test.
- 3) Step-by-step operations.
- 4) Expected results associated with each step.
- 5) Tester's signature.
- 6) Witness's signature.
- 7) Date performed.
- 8) Pass or fail evaluation with comments.
- 9) A copy of the original signed test document with field notes shall be delivered to the Owner



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within 7 days after the testing.

- C. Non-Conforming Work:
 - 1. Correct the discrepancies or problems identified during each test at no increase in Contract Price.
 - D. Within the 30 days after completion of the Communications Infrastructure Performance Verification Test, submit the Test Report to the Program/Project Manager for approval.
 - 1. Include the data collected during the system inspections and the User Acceptance Testing.
- 2.2 CLOSEOUT ACTIVITIES
- A. Refer to Specification Section 27 05 00, Common Work Results for Communications.

END OF SECTION



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