SJC SAN JOSE MINETA INTERNATIONAL AIRPORT

CITY OF SAN JOSE CAPITAL OF SILICON VALLEY

Premises Distribution System (PDS)

SJC Tenant Policies and Procedures (2025)

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1. Introduction

San Jose Mineta International Airport's (SJC or Airport) business model allows the efficient utilization of the Airport's technical infrastructure through implementation of a flexible and scalable IT environment. This environment, referred to as the IT Flexible Provisioning Environment (FPE), allows a partnership between the airlines, other Airport tenants, and the Airport that permits the dynamic assignment of Airport physical resources, and provides a common network infrastructure that increases operational efficiency and reduces operating costs for all parties. There are numerous benefits to providing a common IT infrastructure for all tenants. These benefits are applicable to both the initial implementation and ongoing support costs:

Initial Implementation Costs - Provisioning a single, shared infrastructure results in cost savings when compared to the deployment of individual, proprietary networks. If each system or tenant is required to install proprietary conduit, cabling, and network components, the resultant total implementation costs exceed the cost of a shared installation.

Support Costs - The initial capital costs of a system represents only a portion of the total cost of owning and operating the system. By supporting only one network, SJC lowers its operational costs and the resultant costs (through rates and charges) for its tenants.

Lower Future Deployment Costs - A flexible and scalable IT infrastructure allows SJC to cost-effectively implement new technologies as they become appropriate.

2. Definitions:

2.1 PREMISES DISTRIBUTION SYSTEM

The Premises Distribution System is comprised of the Active and Passive Infrastructure installed and maintained by SJC Airport.

2.2 OPERATING SECURITY POLICIES FOR INFORMATION SYSTEMS AND TECHNOLOGY

This policy outlines the requirements for the management of all IT and OT systems related infrastructure at SJC. This policy is provided on an as needed basis.

2.3 SJC PASSIVE INFRASTRUCTURE

The SJC Passive Infrastructure is any data, video and telecommunications cabling infrastructure that includes the physical cabling (copper and fiber), conduits, racks, patch panels that tie the cabling together. This infrastructure is owned and maintained by SJC.

2.4 TENANT PASSIVE INFRASTRUCTURE

The Tenant Passive Infrastructure is any data, video, and/or telecommunications cabling infrastructure that includes the physical cabling (copper and fiber), conduits, racks, patch panels that tie the cabling together. This infrastructure is allowed only in the Tenant Intra-Leased space, or in the space between the Tenant Intra-Leased space and the nearest SJC Telecommunications Room. Cabling within the Tenant Leased space is maintained by the Tenant and the cabling between the Tenant Intra-Leased space and the SJC Communications room is maintained by SJC ATS. Should the Tenant contract expire, SJC will determine whether the Tenant must remove and dispose of all associated components.

2.5 SJC ACTIVE INFRASTRUCTURE

The SJC Active Infrastructure includes all the electronics that are part of the network. This includes all switches, routers, bridges, etc. that allow for the transfer of data across the network. This active infrastructure is owned and maintained by SJC.

2.6 TENANT ACTIVE INFRASTRUCTURE

The Tenant Active Infrastructure includes all the electronics that are part of the Tenant's proprietary IT. This includes all servers, switches, routers, bridges, etc. that allow for the transfer of data across their proprietary network. This infrastructure is owned and maintained by the Tenant. All tenant active components must reside within the tenant leased space unless

other written authorization is granted by SJC. Should the Tenant contract expire and/or the Tenant is no longer able to use this infrastructure, the Tenant shall be responsible for the removal and disposal of all associated components.

2.7 TENANT INTRA-LEASED SPACE

A contiguous space exclusively leased by the tenant in which all the tenant's passive and active networks can be housed. This space does not traverse any common areas such as hallways, stairs, etc.

2.8 TENANT INTER–LEASED SPACE

Two or more non-adjoining locations exclusively leased by the tenant.

2.9 SJC TELECOMMUNICATION ROOM (TR)

This is a room that is used primarily for Airport communications equipment and will not be permitted to house tenant proprietary equipment. It is subject to more stringent access rules due to security requirements as defined in the SJC ATS Security Policy for Information Systems and Technology.

2.10 TENANT INTRA-LEASED SPACE TELECOMMUNICATIONS ROOM

This is a room that is within a Tenant Intra-Leased Space as defined in Section 2.5. This is the location where the tenant would house its proprietary Passive and Active Infrastructure.

2.11 TV MINIMUM POINT OF ENTRY

This is the SJC TR closest to the specific location the television service provider's signal enters Airport property.

3. SJC Tenant PDS Policies

3.1 SJC PASSIVE INFRASTRUCTURE POLICY

3.1.1 All data, video, and telecommunications infrastructure installed by SJC is for the sole use of SJC and its tenants. No sub-letting (with or without compensation) to other parties will be permitted without written authorizations from SJC Properties in consultation with SJC ATS.

SJC will provide installation of all backbone cabling between communications rooms. Horizontal cabling from communications rooms to end devices at wall outlets must be provided by an SJC-approved contractor hired by the tenant. All installations of new cabling must be approved by and scheduled through SJC ATS as described in the PDS Procedures section of this document. All video, data, and telecommunications cabling installed on the SJC campus shall be installed in accordance with these Policies and Procedures and conform to industry standards applicable at the time.

3.1.2 All SJC Passive Infrastructure installed at SJC will terminate in one of the SJC supplied and provisioned SJC TRs.

3.1.3 All access to SJC TRs will be controlled by SJC ATS. Tenant representatives that have been approved to provide horizontal cabling that will require access to a SJC TR will require escort by a SJC ATS representative. Escorting procedures are outlined in the SJC Data Center – Communications Room Access Policy.

3.1.4 Escorting by an SJC ATS employee may be subject to an hourly charge as defined in the Airport Rate Resolution.

3.1.5 A maximum of 12 drops can be requested by the tenant. Any more drops than this and the tenant will be required to provide their own network equipment in their lease space.

3.1.6 Terminations

All Unshielded Twisted Pair (UTP) and horizontal cabling installed in SJC

telecommunications rooms will terminate in SJC provided patch panels. Terminations will be consistent with appropriate ANSI/TIA/EIA standard(s). Specialty cabling required for specific applications will be terminated per manufacturers' standards.

Each UTP cable installed will support a single device. All horizontal runs shall be point-to-point from the telecommunications room to the outlet *location with all pairs of each cable terminated in a single jack. Splitting* of cable pairs from a horizontal run will not be allowed. LC connectors will be used for all fiber terminations on the campus.

SJC will provide a maximum of 12 existing drops for the tenant's use. Additional drops required by the tenant shall be the tenant's responsibility. The tenant MUST use the Airport's vetted internal vendor for any cable that starts or ends inside an Airport TR.

3.1.7 Labeling

All cables installed in SJC facilities will be labeled per SJC standards. Labeling requirements for tenant or third-party installations will be provided by an SJC ATS representative prior to installation. Tenants must complete the required labeling prior to SJC acceptance of the installation.

3.1.8 Cable Assignments

An SJC ATS representative shall provide cable assignments for all tenants cabling requests.

3.1.8.a Cross-Connections

All cross- connects required to provision specific circuits shall be performed by SJC ATS personnel. In no instance shall any tenant or tenant representative perform any cross-connects involving SJC cabling.

3.1.9 Cabling Standards

The following provides a summary of the standards that have been adopted by SJC in developing the passive portion of the PDS.

3.1.9.1 Horizontal UTP

SJC has standardized on the use of Blue Category 6a cabling for all horizontal

applications at SJC as part of an overall structured cabling solution. The structured cabling solution installed at SJC shall conform to existing solution agreements. This solution will provide complete end-to-end horizontal channels that are certified to meet the ANSI/TIA/EIA Category 6a standard. The channel includes all cabling and termination equipment within the SJC communications rooms.

3.1.10 Riser Copper

The riser copper cabling installed at SJC shall also be part of the agreed upon solution. This copper Unshielded Twisted Pair (UTP) cabling shall consist of Category 3 cabling that is capable of supporting voice applications, as well as legacy data protocols such as RS-232, RS-485, etc. All riser terminations in the SJC communications rooms shall utilize industry standard 110-blocks.

3.1.11 Riser Fiber

The riser fiber installed at SJC shall consist of a flexible system that fully supports a dynamic environment. The system provides single mode fiber. The system is fully compliant with ANSI/TIA/EIA- 568A, Underwriters Laboratories Riser and Plenum Ratings, and ICEA-S-83-596.

3.1.12 Maintenance of the SJC Passive Infrastructure

All maintenance and troubleshooting of the SJC Passive Infrastructure shall be performed by an SJC ATS employee, or SJC designated representative. In no instance shall any tenant or tenant representative perform any modifications to SJC cabling. Requests for maintenance and troubleshooting shall follow the SJC ATS support procedures defined below.

3.1.13 Extension of Television Service Circuits – TV Minimum Point of Entry to Intermediate Point of Entry

Tenant's video services circuits requiring extension from SJC TV Minimum Point of Entry to termination points within the Tenant Intra-Leased Space shall be provided by the tenant.

3.1.13.1 Extension of Video Services Circuits – SJC TR Communications Rooms to Tenant End Point Tenant's video services circuits from SJC TRs to Tenant end point locations within their Intra-Leased

Space shall be provided by the tenant and coordinated with SJC ATS.

3.1.14 Video Service Requirements

Tenants requiring satellite installation for video entertainment services shall submit installation requirements and plans including roof penetration and mounting details, to SJC utilizing the SJC FORM A/B process described in the procedures section of this document, prior to the commencement of installation. SJC retains the right to coordinate all tenant video installations with potential providers and tenants in an effort to streamline the Passive Infrastructure requirements.

3.2 TENANT PASSIVE INFRASTRUCTURE POLICY

3.2.1 Cabling Installation and Ownership

3.2.1.1 All Data, Video, and Telecommunications infrastructure installed by Tenant is for the sole use of that Tenant.

3.2.2 Tenant passive infrastructure is allowed only in the Tenant Intra-Leased space, or in the space between the Tenant Intra-Leased space and the nearest SJC Telecommunications Room. Cabling within the Tenant Intra-Leased space is maintained by the Tenant and the cabling between the Tenant Intra-Leased space and the SJC Telecommunications Room is maintained by SJC ATS.

3.2.3 All Tenant Passive Infrastructure installed at SJC will terminate within the Tenant's Intra-Leased Space, or at the SJC TV Minimum Point of Entry for television services. This applies to intermediate connection needs for signal bifurcation and/or re-amplification.

3.3 SJC ACTIVE INFRASTRUCTURE POLICY

3.3.1 Active Equipment Installation and Ownership

3.3.1.1 All SJC active network equipment is the sole property of SJC. All SJC active network equipment shall be installed by SJC or its approved network support vendor. All SJC network equipment installed on the SJC campus shall be installed in accordance with SJC ATS procedures and conform to SJC standards for Active Infrastructure.

3.3.1.2 All active network equipment that is part of the PDS and installed by SJC is for the sole use of SJC and its tenants.

3.3.1.3 Any and all exceptions to these policies and procedures will need to be granted in writing by SJC's Director of Aviation. No exceptions will be granted without this explicit written authorization.

3.3.2 Active Equipment Configuration, Maintenance and Troubleshooting

3.3.2.1 All configuration, maintenance, and troubleshooting of the active network equipment of the PDS shall be performed by SJC or their support vendor. In no instance shall any tenant, or tenant representative perform any modifications to SJC equipment. Requests for maintenance and troubleshooting shall follow the SJC ATS Support Procedures.

3.3.2.2 The unique business model of the airport requires that the Local Area Network (LAN) configuration support multiple, independent entities which must remain totally isolated from one another (i.e., airline tenants, concessionaires, CITY, etc.). Each isolated tenant shall have campus-wide LAN connectivity through the assignment of dedicated Layer 2 VLAN(s), shall be able to use their own IP addressing schemes. All VLAN assignments shall be made by SJC ATS. Tenants who require access to their assigned VLANs shall provide their own logical addressing and necessary routing between their assigned Layer 2. SJC ATS will assign IP addressing in situations where tenant requires data connectivity to SJC systems.

3.3.2.3 Configuration, maintenance, and troubleshooting of all tenant end devices and peripherals are the sole responsibility of the tenant. SJC assumes no responsibility for the operation of these devices.

3.3.2.4 SJC does not provide Internet access or private WAN data circuits for tenants. Tenants should be prepared to work with external telecommunications services providers/Internet service providers to acquire and maintain these services. All Tenant WAN services must reside in the Tenant's intra-leased space.

3.3.3 SJC Network Infrastructure and Technology

The following provides a summary describing the SJC network infrastructure and technology that have been adopted by SJC in developing the active portion of the PDS.

3.3.3.1 SJC strives to provide a **high availability 99.999% uptime network**.

3.3.3.2 SJC network is monitored 24x7x365.

3.3.3.3 SJC Network is fully documented and includes all equipment inventory, configuration, and physical, logical network topology diagrams. All provisions of the network are subject to the Operation Security Polices for Information System and Technology

3.3.3.4 The use of remote access through the SJC VPN is only authorized for specific business needs.

3.3.3.5 No dial-in access is allowed to devices connected to the SJC network. VPN access will be provisioned with Multi-factor Authentication (MFA) as required for remote monitoring and support.

3.3.3.6 The SJC network is a PCI-DSS compliant as a service provider. SJC completes an on-site audit on an annual basis to maintain its PCI compliance. The most recent PCI compliance document is located on the SJC website.

3.3.4 WAN Links

All WAN links to the tenant specific VLAN shall be provided and configured by the tenant and shall utilize the passive portion of the PDS as described in this document. The connection to the active portion of the PDS shall be via a standard Ethernet connection and shall be coordinated with the SJC ATS representative.

3.4 WIRELESS POLICY

3.4.1 Applicability

Tenants may install private unlicensed wireless systems within their own exclusively intra-leased space only.

3.4.1.1 Responsibility - Tenant takes full responsibility of their devices; Airport is NOT responsible for any wireless devices belonging to Tenant.

3.4.1.2 Security - Airport is NOT responsible for any detriments to the Tenant's system that occurs as a result of lack of adequate security measures.

3.4.1.3 Tenant is responsible for monitoring their RF spectrum to prevent any sort of passive attacks on their wireless system.

3.4.1.4 SJC ATS will require a RF Channel use plan for any Access Points the tenant plan to deploy.

3.5 RATES AND CHARGES

Consistent with the City's rate and charges resolution for the Airport, SJC may charge tenants for the use of the PDS infrastructure, and the services described herein.

4. SJC Tenant PDS Procedures

4.1 PDS PROCEDURES

4.1.1 New Projects – Tenant Improvement (TI) or Construction

Infrastructure projects that are a part of construction, renovation, or Tenant Improvement (TI) projects typically follow the standard SJC Tenant Improvement procedures outlined in the Tenant Improvement Guidelines Document. SJC ATS is engaged as part of the Airport team for the tenant's requests. This Tenant Improvement Guidelines document is available from the tenant's assigned SJC Property Manager contact or via the Airport's website https://www.flysanjose.com/standards-and-guidelines/tenant-guidelines

4.1.2 New Infrastructure or Telephony Requests

Projects that are not part of a construction, renovation, or TI project addressed in Section 4.1.1 above, will follow the Tenant Design and Construction Guidelines. This process requires the completion of Concept Review Application Form and processing through the SJC Property Manager. They will route the Tenant's request to the correct SJC ATS representative for review. The SJC Property Manager will contact the tenant and advise how to proceed.

4.1.2.1 Standard Process

Tenant will be instructed to provide necessary submittal documents depending on the requirement. Typically, this includes a request to submit four (4) complete sets of documents to SJC ATS for review at least thirty (30) days prior to the anticipated project start date.

SJC ATS Response – SJC ATS will send written review comments and a PDS utilization plan to the Tenant. This letter will advise Tenant to either forward original drawings or reproducible documents for signature or revise and resubmit the documents. The Response will also contain an SJC plan for PDS usage showing all termination locations, cross-connect points, co-location assignments and related charges. Approximate time required: 15 days from receipt of submittal.

SJC Authorization – When all review comments have been resolved, SJC will sign the Tenant's construction documents and issue an authorization letter.

Record Drawings – Within 30 days of completion of construction, Tenant must provide to SJC ATS record drawings which accurately represent all as-built conditions.

4.1.3 Cable Requests/Assignments

4.1.3.1 Standard Voice

Demarcation – All Public Switched Telephone Network (PSTN) provisioning will terminate in the specified demarcation areas of the campus. Public providers (LEC and CLEC) will be assigned equipment installation and demarcation area(s) within the Minimum Point of Entry (MPOE), Demarcation Point (DMARC), and/or Entrance Facility (EF) in the individual building(s).

Standard voice circuits will be extended over the SJC PDS to tenant intra-leased spaces by SJC personnel. Routing and pair assignments will be performed solely by SJC ATS.

Requests for demarcation extension must be made to SJC ATS through the **Concept Review Application Form** at least ten (10) working days prior to termination of the circuit and should include, at a minimum:

- PSTN provider and anticipated date of circuit provisioning
- Tenant name and contact information
- Circuit identification number
- Specific tenant location (i.e., Room Number) for extension
- Any restrictions on SJC ATS access to tenant space and/or escort requirements.

SJC will provide a service agreement and quote for related PDS circuit provisioning charges within two (2) working days of receipt of request. A service agreement signed by an authorized tenant representative is required prior to demarcation extension.

4.1.3.2 Ethernet Requests/Assignments

All Ethernet transport will be provided via the SJC supplied and managed network. To facilitate requests for services the following procedures shall be adhered to:

Request for Services - Tenant shall submit an initial request for Ethernet services using the Tenant Improvement process described above. The information to be provided shall include the following as a minimum:

- Number of Ethernet drops required
- Location of Ethernet drops
- Minimum bandwidth required
- VLAN requirements
- Tenant contact information

SJC ATS Response - SJC ATS will review the initial request for services and provide a written response. The written response will include a network utilization plan, estimated duration for configuration/implementation, and costs for services.

Pre-implementation conference - Prior to implementing the Ethernet provisioning, a conference will be held with tenant and SJC ATS representatives. The purpose of this conference will be to discuss the implementation plan, configuration requirements, scheduling, and other issues that will affect the implementation.

Configuration records - After implementation, SJC ATS will provide the tenant with configuration records detailing the implementation and specific configurations.

Other - Other customized connectivity requirements will be negotiated and coordinated with individual tenants as required. Provisioning and maintenance of the PDS remains under the sole purview of SJC.

4.1.3.3 WAN Links

Demarcation – Wide Area Network (WAN) links shall only terminate in an SJC Telecommunications Room. WAN links that require tenant leased space must be approved by SJC ATS prior to the installation. Extensions of WAN links into tenant spaces shall be over the SJC structured cabling system. Requests for extension of a WAN link to the tenant leased space should follow the Moves, Adds, and Change (MAC) procedures described below.

SJC will provide a service agreement and quote for related PDS circuit provisioning charges within three (3) working days of receipt of Tenant's request. A service agreement signed by an authorized tenant representative is required prior to demarcation extension.

4.1.4 Moves, Adds, and Changes (MAC)

Requests for Moves, Adds, and/or Changes (MAC) to existing circuit provisioning should be made to the tenant's assigned SJC Property Manager. No tenant employee or representative may perform changes or additions to the PDS including altering the termination of a wall jack. Charges for MAC work will be according to agreements entered into between SJC and Tenant.

4.1.5 Contact Information and Hours

For any service requests, Tenants should call the Airport Help Desk at 408-392-1170. Tenant's service call will be routed to the correct personnel and will be serviced based on agreements entered into between SJC and Tenant. Support personnel will be available on-site between 8:00 AM and 5:00 PM, Monday through Friday. For after hour emergencies, Tenants should call the Airport Communications Center at 408-277-5100 and an SJC ATS representative will be notified.

4.1.6 Site Escort Services

SJC ATS will arrange for escort services, as necessary, when tenant representatives need access to SJC Telecommunications Rooms. Requests for escort to perform routine maintenance or cable installations should be submitted at least two (2) working days in advance. Site escort services for emergency repairs will be provided according to the service level agreement entered into with each tenant.

4.1.7 Service Agreements

If any of the services described in this document are requested or required by Tenant, SJC and Tenant will enter into an agreement setting forth the specific services provisioned, the levels of support, and the associated cost(s).

5 AIRPORT SYSTEMS AND ACCEPTABLE MATERIALS AND METHODS

2.1 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

GENERAL SUMMARY

A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.
4. Grounding rods.
5. Grounding labeling.

DEFINITIONS

BCT: Bonding conductor for telecommunications.

TGB: Telecommunications grounding busbar.

TMGB: Telecommunications main grounding busbar.

Service Provider: The operator of a service that provides telecommunications transmission

delivered over access provider facilities.

ACTION SUBMITTALS

Product Data: For each type of product.

Shop Drawings: For communications equipment room signal reference grid. Include plans,

elevations, sections, details, and attachments to other work.

INFORMATIONAL SUBMITTALS

As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure,

Including, but not limited to, the following:

Ground rods.

Ground and roof rings.

BCT, TMGB, TGB(s), and routing of all bonding conductors.

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

Qualification Data: For installation supervisor and field inspector.

Qualification Data: For testing agency and testing agency's field supervisor.

Field quality-control reports.

CLOSEOUT SUBMITTALS

Operation and Maintenance Data: For grounding to include in emergency, operation, and

maintenance manuals.

Result of the ground-resistance test, measured at the point of BCT connection.

Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

QUALITY ASSURANCE

Installer Qualifications: Cabling Installer shall have personnel certified by BICSI on staff.

Installation Supervision: Installation shall be under the direct supervision of ITS

Technician, who shall be present at all times when Work of this Section is performed at Project site.

Field Inspector: Currently registered by BICSI as a Registered Communications Distribution Designer (RCDD) to perform the on-site inspection.

PRODUCTS

SYSTEM DESCRIPTION

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Comply with UL 467 for grounding and bonding materials and equipment.

Comply with TIA-607-B.

CONDUCTORS

Comply with UL 486A-486B.

Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.

Cable Tray Equipment Grounding Wire: No. 6 AWG.

2.2 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

1. Cable Tray Grounding Jumper:

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.

Not smaller than No. 10 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

Bare Copper Conductors:

1. Solid Conductors: ASTM B3
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.
4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or 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.

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. 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.

C. 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.

D. 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.

E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

A. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.

2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.

3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

B. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.

2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.

3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

C. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-B. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.

2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch equipment

racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.

3. Rack-Mounted Vertical Busbar: 72 or 36 inches long, with stainless-steel or copperplated hardware for attachment to the rack.

2.5 IDENTIFICATION

A. Comply with requirements for identification products in PANYNJ EWR Labeling Standards, to be provided.

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. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with TIA-607-B.

3.3 APPLICATION

A. Conductors: Install solid conductor for No. 8 AWG and smaller and 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. Underground Grounding Conductors: Install bare-copper conductor, No. 2 AWG minimum.

C. 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.

D. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches.

E. 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. Support at not more than 36-inch intervals.

4. 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 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 3/0 AWG.

3.5 GROUNDING BUSBARS

A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.

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

3.6 CONNECTIONS

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. 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. Pre-twist the conductor.
3. Apply an antioxidant compound to all bolted and compression connections.

D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.

G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.

H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.

I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted pair cables.

J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

K. Access Floors: Bond all metal parts of access floors to the TGB.

L. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.

1. Install the conductors in grid pattern on 4-foot centers, allowing bonding of one pedestal from each access floor tile.

2. Bond the TGB of the equipment room to the reference grid at two or more locations.

3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.

M. 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 except the conductors shall comply with requirements in Section 264113 "Lightning Protection for Structures."

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.

3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

B. Comply with IEEE C2 grounding requirements.

C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.

D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors' level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.8 IDENTIFICATION

A. Labels shall be preprinted or computer-printed type.

1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.

2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.

3. Label the BCT and each telecommunications backbone conductor at its attachment point:

"WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. 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. 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. Maximum acceptable ac current level is 1A.

D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.

2. Nonmetallic conduits and fittings.

3. Optical-fiber-cable pathways and fittings.

4. Metal wireways and auxiliary gutters.

5. Nonmetallic wireways and auxiliary gutters.

6. Metallic surface pathways.

7. Nonmetallic surface pathways.

8. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

A. ARC: Aluminum Rigid Conduit.

B. GRC: Galvanized Rigid Conduit.

C. IMC: Intermediate Metal Conduit.

D. RTRC: Reinforced Thermosetting Resin Conduit.

1.4 ACTION SUBMITTALS

A. Product data for the following:

1. Surface pathways

2. Wireways and fittings.

3. Boxes, enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

3. Underground ducts, piping, and structures in location of underground enclosures and handholes.

B. Qualification Data: For professional engineer.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2. Comply with TIA-569-D.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated GRC.

1. Comply with NEMA RN 1.

2. Coating Thickness: 0.040 inch, minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.

2. Fittings for EMT:

a. Material: Steel.

b. Type: Compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions when installed, and including flexible external bonding jumper.

4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

A. Description: Non-metallic raceway of circular section with manufacturer-fabricated fittings.

B. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Comply with TIA-569-D.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Rigid HDPE: Comply with UL 651A.

E. Continuous HDPE: Comply with UL 651A.

F. RTRC: Comply with UL 2515A and NEMA TC 14.

G. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.

H. Solvents and Adhesives: As recommended by conduit manufacturer.

2.2 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for riser installation unless otherwise indicated.

B. Optical fiber pathways for backbone cabling shall be GRS conduit above ground, concrete encased RNC Schedule 40PVC underground.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.

B. General Requirements for Metal Wireways and Auxiliary Gutters:

1. Comply with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

3. Comply with TIA-569-D.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 NON-METALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

C. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

2. Comply with TIA-569-D.

D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 SURFACE METAL PATHWAYS

A. Description: Galvanized steel with Snap-On covers, complying with UL 5.

B. Finish: Manufacturer's standard enamel finish in color selected by Architect.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

2.6 SURFACE NONMETALLIC PATHWAYS:

A. Description: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC.

B. Finish: Texture and color selected by Architect from manufacturer's standard colors.

C. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

E. Comply with TIA-569-D.

2.7 BOXES, ENCLOSURES, AND CABINETS

A. Description: Enclosures for communications.

B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-D.

2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as

defined in NFPA 70, by an NRTL, and marked for use in wet locations.

3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

5. Gangable boxes are allowed.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.

2. Type: Fully adjustable.

3. Shape: Rectangular.

4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

H. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures:

a. Material: Plastic.

b. Finished inside with radio-frequency-resistant paint.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

J. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency and marked for intended location and application.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

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

1. Exposed Conduit: GRC.

2. Concealed Conduit, Aboveground: GRC.

3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased.

4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X.

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

1. Backbone fiber optic pathway: GRC.

2. Exposed, Not Subject to Physical Damage: EMT.

3. Exposed, Not Subject to Severe Physical Damage: EMT.

4. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:

a. Loading dock.

b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

c. Mechanical rooms.

5. Concealed in Ceilings and Interior Walls and Partitions: EMT.

6. Damp or Wet Locations: GRC.

7. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.

8. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser type, optical-fiber-cable pathway.

9. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable pathway.

10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch trade size for copper and aluminum cables, and 1 inch for optical-fiber cables.

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 when indicated on Drawings.

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

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101
5. NECA 102.
6. NECA 105.
7. NECA 111.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.

E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.

F. 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.

G. Complete pathway installation before starting conductor installation.

H. Arrange stub-ups so curved portions of bends are not visible above finished slab.

I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches of enclosures to which attached.

L. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. When at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.

2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.

3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

5. Change from nonmetallic conduit and fittings to RNC, Type EPC-40-PVC, and fittings before rising above floor.

M. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

P. 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.

Q. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.

R. 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.

S. 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.

T. 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. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

U. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only when 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.

V. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid, and flexible, as follows:

1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.

2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.

3. 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.

W. 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 like that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.

X. 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.

Y. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

Z. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located when environmental temperature change may exceed 30 Degrees Fahrenheit, and that has a straight-run length that exceeds 25 feet. Install in each run of aboveground RMC that is located when environmental temperature change may exceed 100 Degrees Fahrenheit, and that has straight-run length that exceeds 100 feet.

2. 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.

3. 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.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for

conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

AA. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.

2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.

3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork, and fittings, luminaires, power conduits, power, and telecommunications outlets, and other electrical and communications equipment.

4. Space hooks no more than 5 feet o.c.

5. Provide a hook at each change in direction.

BB. 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.

CC. 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.

DD. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

EE. 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.

FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

GG. Set metal floor boxes level and flush with finished floor surface.

HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in for pipe of less than 6 inches in nominal diameter.

2. Installs backfill as specified per site manager.

3. 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 per site manager.

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

5. 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 around conduit for a minimum of 12 inches on each side of the coupling.

b. For stub-ups at equipment mounted on outdoor concrete bases and when conduits penetrate building foundations, extend steel conduit horizontally at a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches above direct buried conduits, but a minimum of 6 inches below grade. Align planks along centerline of conduit.

7. Underground Warning Tape: Comply with requirements in Section 270553 "Identification for Communications Systems."

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.5 FIRESTOPPING

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

3.6 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.

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COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary

Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Category 3 twisted pair cable.
2. Category 6 twisted pair cable.
3. Category 6a twisted pair cable.
4. Twisted pair cable hardware, including plugs and jacks.
5. Multiuser telecommunications outlet assembly.
6. Cabling identification products.
7. Grounding provisions for twisted pair cable.
8. Source quality control requirements for twisted pair cable.

B. Related Requirements:

1. Section "Conductors and Cables for Communications Systems" for data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

B. EMI: Electromagnetic interference.

C. FTP: Shielded twisted pair.

D. F/FTP: Overall foil screened cable with foil screened twisted pair.

E. F/UTP: Overall foil screened cable with unscreened twisted pair.

F. IDC: Insulation displacement connector.

G. LAN: Local area network.

H. Jack: Also, commonly called an "outlet," it is the fixed, female connector.

I. Plug: Also, commonly called a "connector," it is the removable, male telecommunications connector.

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HORIZONTAL CABLING

J. RCDD: Registered Communications Distribution Designer.

K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

M. S/FTP: Overall braid screened cable with foil screened twisted pair.

N. S/UTP: Overall braid screened cable with unscreened twisted pairs.

O. UTP: Unscreened (unshielded) twisted pair.

1.4 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.

2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.

3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft. and includes the components that extend from the equipment outlets to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: **Reviewed, approved, and stamped by a RCDD**.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.

3. Cabling administration Drawings and printouts.

4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:

a. Telecommunications rooms plans and elevations.

b. Telecommunications pathways.

c. Telecommunications system access points.

d. Telecommunications grounding system.

e. Telecommunications conductor drop locations.

f. Typical telecommunications details.

g. Mechanical, electrical, and plumbing systems.

C. Twisted pair cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For RCDD, installation supervisor, and field inspector.

B. Product Certificates: For each type of product.

C. Source quality-control reports.

D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On USB media or compact disk, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Connecting Blocks: 5% of each type.

2. Faceplates: One of each type.

3. Jacks: Ten of each type.

4. Multiuser Telecommunications Outlet Assemblies: 10% of each type.

5. Patch-Panel Units: 5% of each type.

6. Plugs: 5% of each type.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and cabling administration Drawings by a RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.

3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as a RCDD.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Plenum Rated: Type CMP complying with UL 1685.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 50 or less.

C. RoHS compliant.

2.3 CATEGORY 3 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission

characteristics of Category 3 cable at frequencies up to 16MHz.

B. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 3 cables.

C. Conductors: 100-ohm, 24 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP).

E. Cable Rating: Plenum.

F. Jacket: Black thermoplastic.

2.4 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

C. Conductors: 100-ohm, 23 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP).

E. Cable Rating: Plenum.

F. Jacket: Blue thermoplastic.

2.5 CATEGORY 6A TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz.

B. Standard: Comply with TIA-568-C.2 for Category 6a cables.

C. Conductors: 100-ohm, 23 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP).

E. Cable Rating: Plenum.

F. Jacket: Gray thermoplastic.

2.6 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper

communications cable.

B. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6, Category 6A.

2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.

3. Cables shall be terminated with connecting hardware of same category or higher.

C. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.

D. Connecting Blocks:

1. 110-style IDC for Category 5e.

2. 66-style IDC for Category 5e.

3. 110-style IDC for Category 6.

4. 110-style IDC for Category 6A.

5. Provide blocks for the number of cables terminated on the block, plus 30 percent spare, integral with connector bodies, including plugs and jacks where indicated.

E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Features:

a. Universal T568A and T568B wiring labels.

b. Labeling areas adjacent to conductors.

c. Replaceable connectors.

d. 24 or 48 ports.

2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.

3. Number of Jacks per Field: One for each four-pair cable indicated.

G. Patch Cords: Factory-made, four-pair cables in 36-inchlengths; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.

2. Patch cords shall have color-coded boots for circuit identification.

H. Plugs and Plug Assemblies:

1. Male; eight positions; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.

2. Standard: Comply with TIA-568-C.2.

3. Marked to indicate transmission performance.

I. Jacks and Jack Assemblies:

1. Female; eight-position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.

2. Designed to snap-in to a patch panel or faceplate.

3. Standard: Comply with TIA-568-C.2.

4. Marked to indicate transmission performance.

J. Faceplate:

1. Up to [Six] port, vertical single gang faceplates designed to mount to single gang wall boxes.

2. Up to Twelve port, vertical double gang faceplates designed to mount to double gang wall boxes.

3. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."

4. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."

5. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.

a. Flush mounting jacks, positioning the cord at a 45-degree angle.

K. Legend:

1. Machine printed, in the field, using adhesive-tape label.

2. Snap-in, clear-label covers and machine-printed paper inserts.

2.7 MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

A. Description: MUTOAs shall meet the requirements of "Twisted Pair Cable Hardware" Article.

1. Number of Terminals per Field: One for each conductor in assigned cables.

2. Number of Connectors per Field:

a. One for each four-pair unshielded or shielded twisted-pair cable indicated.

b. One for each four-pair unshielded or shielded twisted-pair group of indicated cables, plus 25 percent spare positions.

3. Mounting: as indicated in drawings.

4. NRTL listed as complying with UL 50 and UL 1863.

5. Label shall include maximum length of work area cords, based on TIA-568-C.1.

6. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.8 IDENTIFICATION PRODUCTS

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

2.9 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with TIA-607-B.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA-568-C.1.

C. Factory test twisted pair cables according to TIA-568-C.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters. Conceal raceway and cables, except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use

lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS

A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings."

B. Comply with Section 270528 "Pathways for Communications Systems."

C. Comply with Section 270529 "Hangers and Supports for Communications Systems."

D. Comply with Section 270536 "Cable Trays for Communications Systems."

E. Drawings indicate general arrangement of pathways and fittings.

3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.

2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.

3. Install 110-style IDC termination hardware unless otherwise indicated.

4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.

5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

6. MUTOA shall not be used as a cross-connect point.

7. Consolidation points may be used only for making a direct connection to equipment outlets:

a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.

b. Locate consolidation points for twisted-pair cables at least 49 feet from communications equipment room.

8. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

9. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.

10. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.

11. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

12. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.

13. In the communications equipment room, install a 10-foot-long service loop on each end of cable.

14. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5kVA or HP and Larger: A minimum of 48 inches.

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with "Firestopping Systems" Article in BISCI's "Telecommunications Distribution Methods Manual."

3.5 GROUNDING

A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

B. Comply with TIA-607-B and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.

D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Administration Class: Class 1.

2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration, including optional identification requirements of this standard.

C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

E. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.

3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.

4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.

a. Individually number wiring conductors connected to terminal strips, and identify

each cable or wiring group, extended from a panel or cabinet to a building mounted device, with the name and number of a particular device.

b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit

of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords and labeling of all components.

3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test

equipment manufacturer for channel or link test configuration.

F. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

G. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

H. End-to-end cabling will be considered defective if it does not pass tests and inspections.

I. Prepare test and inspection reports.

OPTICAL FIBER HORIZONTAL CABLING

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. 9/125 micrometer, single-mode, indoor-outdoor optical fiber cable (OS2).

2. Optical fiber cable connecting hardware, patch panels, and cross-connects.

3. Grounding.

4. Cabling identification products.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. RCDD: Registered Communications Distribution Designer.

1.4 OPTICAL FIBER HORIZONTAL CABLING DESCRIPTION

A. Optical fiber horizontal cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C and the equipment outlet, otherwise known as "Cabling Subsystem 1" in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.

2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the equipment outlet.

3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft. and includes the components that extend from the equipment outlets to the equipment.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.

3. Cabling administration Drawings and printouts.

4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:

a. Telecommunications rooms plans and elevations.

b. Telecommunications pathways.

c. Telecommunications system access points.

d. Telecommunications grounding system.

e. Telecommunications conductor drop locations.

f. Typical telecommunications details.

g. Mechanical, electrical, and plumbing systems.

C. Fiber optic cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For RCDD, installation supervisor, and field inspector.

B. Product Certificates: For each type of product.

C. Source quality-control reports.

D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On USB media or compact disk, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

B. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.

3. Testing Supervisor: Currently certified by BICSI as an RCDD.

B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight.

2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 9/125 MICROMETER, SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS2)

A. Description: Single mode, 9/125-micrometer, fibers as indicated on drawings, tight buffered, nonconductive optical fiber cable.

B. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.

C. Jacket:

1. Jacket Color: Yellow.

2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.

3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

D. Standards:

1. Comply with TIA-492CAAB for detailed specifications.

2. Comply with TIA-568-C.3 for performance specifications.

3. Comply with ICEA S-104-696 for mechanical properties.

E. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

2. Plenum Rated, Nonconductive: Type OFNP in listed plenum communications raceway.

3. Plenum Rated, Nonconductive: Type OFNP or Type OFNR in metallic conduit.

4. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262; Type OFNP in listed plenum

communications raceway; or Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit.

5. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.

6. Plenum Rated, Conductive: Type OFCP or Type OFNP in listed plenum communications raceway.

7. Plenum Rated, Conductive: Type OFCP, Type OFNP, Type OFCR, or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

2.3 OPTICAL FIBER CABLE HARDWARE

A. Standards:

1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.

2. Comply with TIA-568-C.3.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, single-fiber cables in 36-inch lengths.

D. Connector Type: Type LC complying with TIA-604-10-B, connectors.

E. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.

2. Insertion loss not more than 0.25 dB.

3. Marked to indicate transmission performance.

F. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.

2. Insertion loss not more than 0.25 dB.

3. Marked to indicate transmission performance.

4. Designed to snap-in to a patch panel or faceplate.

G. Faceplate:

1. Up to 6 -port, vertical single-gang faceplates designed to mount to single-gang wall boxes.

2. Up to 12 -port, vertical double-gang faceplates designed to mount to double-gang wall boxes.

3. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."

4. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."

5. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.

a. Flush mounting jacks, positioning the cord at a 45-degree angle.

2.4 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with TIA-607-B.

2.5 IDENTIFICATION PRODUCTS

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

2.6 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.

C. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA568-C.3.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors when possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools, as applicable.

3.2 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 1, NECA 301 and NECA/BICSI 568.

B. General Requirements for Optical Fiber Cabling Installation:

1. Comply with TIA-568-C.1 and TIA-568-C.3.

2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."

3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

5. Install lacing bars, as applicable, to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's

limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.

7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

8. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.

9. In the communications equipment room, provide a 10-foot-long service loop on each end of cable.

10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.

2. Install cabling after the flooring system has been installed in raised floor areas.

3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

E. Group connecting hardware for cables into separate logical fields.

3.3 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.4 GROUNDING

A. Install grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.

B. Comply with TIA-607-B and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Administration Class: Class 1.

2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration.

C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing

cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, horizontal pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

E. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.

4. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords and labeling of all components.

3. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Link End-to-End Attenuation Tests:

1) Horizontal and Multimode Horizontal Link Measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.

2) Attenuation test results for horizontal links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.

F. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is

formatted like Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

G. Remove and replace cabling where test results indicate that it does not comply with specified requirements.

H. End-to-end cabling will be considered defective if it does not pass tests and inspections.

I. Prepare test and inspection reports.

Notice: Communications Infrastructure Policy Update

This notice serves to inform all stakeholders, contractors, and tenant organizations of forthcoming changes to the communications infrastructure requirements at the Airport, effective **January 1, 2025**.

1. Requirement for Packetized and Converged Communications Systems

Effective **January 1, 2025**, all newly installed communications systems shall be **packet-based** and **converged with the Airport's existing software-defined data infrastructure**. This policy is intended to support a unified, scalable, and efficient network environment, aligning with industry best practices for modern communications systems.

2. Discontinuation of Analog and Digital Carrier Circuits

Legacy systems currently utilizing **analog or digital carrier services** to connect to the Public Switched Telephone Network (PSTN) may continue operation for a limited time, provided they are integrated with the packetized infrastructure through the use of **Analog Telephone Adapters (ATAs)** or comparable bridging technologies.
Please note, however, that the use of such analog and digital carrier circuits has been **discontinued after December 31, 2024**, except in instances where continued use is mandated by applicable regulatory requirements.

3. Grandfathering of Category 3 Cabling

Installations utilizing **Category 3(Cat3) cabling** will be **grandfathered**, subject to a final cutoff installation date to be issued by **Airport Technical Services (ATS)**. This date shall be no later than **June 30, 2025**. Following this date, Cat3 cabling will no longer be accepted for new installations within Airport facilities.

All relevant personnel are expected to take the necessary steps to ensure adherence to these updated infrastructure standards. Questions regarding compliance, technical specifications, or exceptions should be directed to **Airport Technical Services (ATS)** for further guidance.