

UNIVERSITY OF ARKANSAS®

Communications Infrastructure Specification

*This document defines the communications installation guidelines for
the University of Arkansas.*

Revision Information

Revision Number: Rev 2.2

Issue Date: 02/16/2018

The following information is a guideline relating to the communication systems installation for the University of Arkansas referred herein as the "University". This Communications Infrastructure Specification is comprised of industry standards, University standards and associated typical drawings. This document describes cabling systems components, installation requirements and services associated with the University's communication systems. The work and services specified herein include the coordination with other trades, installation of the cable plant, submittal of testing reports and submittal of as-built documentation. It is expected that all bidding Communication, Electrical and Service Contractors follow the project specific document, which would be informed by this document.

NOTE: The primary purpose of this document is to provide the minimum communications infrastructure standard requirements for all University facilities and is to be utilized as a designer's reference guide to be applied to project specific conditions. It is recommended that this document be reviewed on an annual basis. Technology and component references shall be incorporated into the revisions along with any changes in administration and installation of said technologies.

Table of Contents

| | | |
|----------|--|----|
| Part 1 - | Purpose of this Document | 5 |
| Part 2 - | Roles and Responsibilities | 5 |
| 2.1 | IT Services | 5 |
| 2.2 | Contractor..... | 5 |
| Part 3 - | Recognized Reference Documents and Abbreviations | 5 |
| 3.1 | Standards and Codes | 6 |
| 3.2 | Abbreviations..... | 6 |
| Part 4 - | Performance and General Design..... | 7 |
| 4.1 | Cable Media Performance | 7 |
| Part 5 - | Telecommunications Contractor Requirements | 9 |
| 5.1 | Contractor Qualifications | 9 |
| Part 6 - | Telecommunications Grounding and Bonding | 9 |
| 6.1 | Building Entrance Protection..... | 9 |
| 6.2 | Grounding..... | 9 |
| 6.3 | Bonding..... | 12 |
| Part 7 - | Telecommunication Pathways | 12 |
| 7.1 | Cable Pathways..... | 12 |
| 7.2 | Metallic conduit..... | 13 |
| Part 8 - | Telecommunication Spaces | 13 |
| 8.1 | General Requirements..... | 13 |
| 8.2 | Lighting | 13 |
| 8.3 | Telecommunications Room | 14 |
| 8.4 | Construction and Buildout..... | 14 |
| 8.5 | Sizing Telecommunications Spaces | 15 |
| 8.6 | Environmental Control | 16 |
| 8.7 | Electrical | 16 |
| 8.8 | Local UPS Power | 16 |
| 8.9 | Tag Plan | 16 |
| Part 9 - | Wall Penetrations Firestopping | 17 |
| 9.1 | General | 17 |

| | | |
|-----------|---|----|
| 9.2 | Installation | 17 |
| Part 10 - | Exceptions in Installation | 17 |
| 10.1 | Best Practices in Confined Spaces | 17 |
| Part 11 - | Horizontal Cabling Requirements | 18 |
| 11.1 | Work Area Voice and Data Connectivity Requirements..... | 18 |
| 11.2 | Horizontal Voice/Data Transmission Media | 18 |
| Part 12 - | Termination Hardware | 18 |
| 12.1 | Jacks | 18 |
| 12.2 | Patch Panels..... | 18 |
| 12.3 | Patch Cords..... | 18 |
| 12.4 | Modular Furniture | 18 |
| 12.5 | Access Points | 18 |
| Part 13 - | Patch Cables and Cross-Connect..... | 19 |
| 13.1 | Data | 19 |
| 13.2 | Voice | 19 |
| Part 14 - | Identification and Administration | 19 |
| 14.1 | Labeling and Identification | 19 |
| 14.2 | Administration | 20 |
| Part 15 - | Testing | 20 |
| 15.1 | Twisted Pair | 20 |
| 15.2 | Fiber Optic | 20 |
| 15.3 | Results | 20 |
| 15.4 | UTP Copper Horizontal Cable Testing..... | 20 |
| 15.5 | Fiber Optic Backbone Cable Testing..... | 21 |
| 15.6 | Approved Test Equipment..... | 22 |
| 15.7 | Test Result Submittals | 22 |
| Part 16 - | Support and Warranty | 22 |
| 16.1 | General requirements | 22 |
| 16.2 | SCS Manufacturers Extended Warranty..... | 22 |
| Part 17 - | Appendix A – Drawings | 23 |

Part 1 - Purpose of this Document

- A. The intention of the University by implementing this document is to insure the consistent performance, quality of product and installation of the structured cabling system throughout each facility.
- B. To insure the performance for educational facilities, the University will follow the recommendation set forth by the ANSI/TIA-4966 Telecommunications Infrastructure Standard for Educational Facilities and its referenced documents.
- C. To insure the Standard of Quality and Performance of products, a single manufacturer of structured cabling products will be used for all University facilities. The cabling infrastructure shall be warranted by the manufacturer under a performance warranty and guarantee.
- D. This specification applies to the broadest of University facilities, both new construction and renovations. **While deviations from this document may be appropriate in some situations, they should be exceptional. Contact the IT Services Network Enterprise Systems Team (NEST) for clear guidance to a resolution.**

Part 2 - Roles and Responsibilities

2.1 IT Services

- A. Supports and maintains the University of Arkansas data networks, including all wired and wireless access on a 24/7/365 basis.
- B. Provides network designs for a project when CAD drawings have been released. The design will include specifications and installation instructions for architects, engineers, and contractors for all low-voltage cabling and its uses. Input will be required by building client to determine particulars of use cases that will inform ultimate design schematics.
- C. Manage project from technical perspective to ensure successful implementation of network services after construction activities have completed.
- D. Procures, configures and installs and network-related electronics, equipment, and other accessories including copper and fiber patch cables, uninterruptible power supplies, remote-site Internet connections, power distribution units, point-to-point link antennas, optical transceivers, network switches, routers, security appliances, access points and all associated support contracts.

2.2 Contractor/Architect

- A. Determine project programming by reviewing client (occupant) expectations for space. This is information that the network team can't, or shouldn't dictate on behalf of the client. It may be the responsibility of the architect to capture space use case data.
- B. Provides services to facilitate successful network services installation and performance.
- C. Adheres to and installs infrastructure based on provided network design program unless otherwise negotiated.
- D. Procures and installs infrastructure copper and fiber cables and associated connector components, patch panels, LIUs, race ways, 2- or 4-post racks or lockable wall-mounted enclosures, rack grounding components, access point brackets (provided), ladder or basket trays, surface-mount raceway, wall-plates and point-to-point antenna mounting poles and guy-wires.

Part 3 - Recognized Reference Documents and Abbreviations

3.1 Standards and Codes

The following Standards and code documents will be recognized as references for acceptable installation of the structured cabling system. Active knowledge of these documents is strongly recommended for the communications installer. All listed codes will be the latest adopted versions by the state of Arkansas. This document shall not supersede the Facilities Management A&E Guide in areas not related to telecommunications systems.

- A. NEC-2008, National Electric Code
- B. BICSI TDMM, Telecommunications Distribution Methods Manual
- C. ANSI/ICEA S-83-596, Fiber Optic Premises Distribution Cable
- D. ANSI/TIA-4966, Telecommunications Infrastructure Standard for Education Facilities
- E. ANSI/TIA 568-C, Commercial Building Telecommunications Cabling Standard
- F. ANSI/TIA 606-A, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- G. TIA-526-14-B: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
- H. ANSI-J-STD-607-B, Commercial Building Grounding and Bonding Requirements for Telecommunications
- I. ANSI/TIA-758 A 2004, Customer-owned Outside Plant Telecommunications Cabling Standard
- J. ANSI/TIA-569-C, Commercial Building Standard for Telecommunications Pathways and Spaces
- K. ANSI/IEEE, National Electrical Safety Code
- L. ANSI/NFPA, National Electric Code
- M. ANSI/NFPA, Standard for the Protection of Information Technology Equipment
- N. NFPA/NESC, National Electrical Safety Code
- O. NFPA 101, Life Safety Code
- P. Telcordia GR-63, NEBS™ Requirements: Physical Protection
- Q. Telcordia GR-1089, Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment
- R. BICSI TDMM, Telecommunications Distribution Methods Manual

3.2 Abbreviations

- A. AFF – Above Finished Floor
- B. BEP – Building Entrance Protection
- C. BICSI – Building Industry Consulting Service International
- D. CBB – Common Bonding Backbone, an unbroken continuous copper grounding conductor
- E. Demarc – Point of demarcation, where provider hands off to customer network
- F. EC – Electrical Contractor
- G. EF – Entrance Facility
- H. ER – Equipment Room, aka MDF – Main Distribution Frame
- I. GC – General Contractor or Building Landlord
- J. HTAP – Half Tap, compression style connector used to bond two or more conductors
- K. ITS – Information Technology Systems
- L. LIU – Lightguide Interconnect Units

- M. MC – Mechanical Contractor
- N. N – Need or requirement
- O. N+1 – Need plus one additional element for redundancy
- P. NEST – Network Enterprise Systems Team
- Q. NIC – Not in Contract
- R. NET-POP – Network Point of Presence or Provider Demarcation Point
- S. OM4 – Optical Multi-mode type 4, 50 Micron Laser Optimized Multimode Fiber
- T. OS2 – Optical Single-mode type 2, zero water peak to allow for additional wavelengths
- U. POTS – Plain Old Telephone Service, analog phone line
- V. RCDD – Registered Communications Distribution Designer
- W. SCS – Structured Cabling System
- X. SMB – Surface Mount Box, houses telecommunication jacks
- Y. TBB – Telecommunications Bonding Backbone
- Z. TC – Telecommunications Contractor
- AA. TGB – Telecommunications Grounding Busbar
- BB. TI – Telecommunications Installer
- CC. TMGB – Telecommunications Main Grounding Busbar
- DD. TO – Telecommunications Outlet, one cable terminated with one jack
- EE. TR – Telecommunications Room aka IDF - Intermediate Distribution Frame
- FF. UTP – Unshielded Twisted Pair cable
- GG. UPS – Uninterruptible Power Supply
- HH. WA – Work Area
- II. WO – Work-area Outlet, designated TOs in the same faceplate or surface mount box

Part 4 - Performance and General Design

4.1 Cable Media Performance

- A. To maintain consistency with the ANSI/TIA-4966 the following shall apply:
 1. Category 6A UTP will be the media of choice for horizontal copper cabling applications.
 2. OM4 Laser Optimized Multi-Mode fiber and OS2 Single-Mode fiber will be the media of choice for backbone fiber optic cabling applications.
- B. SCS General Design Considerations
 1. The distance and system performance requirement will determine type of media to be used as defined in the project requirements.
 2. All SCS distribution will adhere to a hierarchical star wiring topology as recommended by TIA standards. Topology shown in Fig 3.3.1.B.2 below.

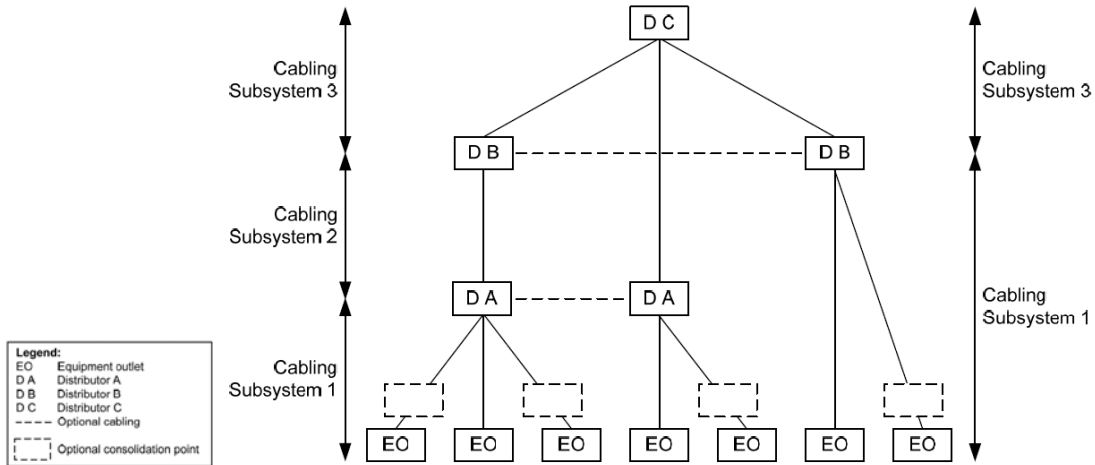


Fig 3.1.B.2

3. There shall be no more than 2 distribution points between the TO and ER.

Part 5 - Telecommunications Contractor Requirements

5.1 Contractor Qualifications

- A. The TC must be certified in the manufacturer solution provided and in good standing with that manufacturer for warranty purposes.
- B. The TC must be able to offer and support the required manufacturer's system warranty.
- C. The TC shall also employ a BICSI certified RCDD and installers with BICSI ITS certification credentials.

Part 6 - Telecommunications Grounding and Bonding

6.1 Building Entrance Protection

- A. BEP for copper cabling shall be installed according to NEC code.
- B. The BEP shall consist of a building entrance terminal utilizing a two (2) foot fuse link between the outside cable plant splice and the protector module with IDC type input and output terminals, 100-pair capacity and female mounting base, equipped with 240-volt solid state protector modules. Provide sufficient protector modules to completely populate all building entrance terminals.

6.2 Grounding

- A. Grounding shall conform to ANSI-J-STD-607-C, NEC code and manufacturer's grounding requirements as minimum. A PBB shall be located at the service entrance. A SBB shall be located in each telecommunications space. The SBB will be grounded/earthed to the PBB.
- B. The PBB shall be bonded to building steel and grounded/earthed to the electrical service ground according to ANSI-J-STD-607-C guidelines. Each SBB shall be bonded to building steel and the electrical panel serving equipment in the telecommunications space. See Figure 5.2.B below.



Figure 5.2.B

- C. The Telecommunications Bonding Backbone (TBB) shall be continuous without breaks. Refer to Table 5.5.2.C for conductor sizing of the TBB.

| Sizing of the TBB | |
|------------------------------------|---------------------------|
| TBB Length in Linear meters (feet) | TBB Size AWG |
| Less than 4 (13) | 6 (13mm ²) |
| 4-6 (14-20) | 4 (21mm ²) |
| 6-8 (21-26) | 3 (26mm ²) |
| 8-10 (27-33) | 2 (33mm ²) |
| 10-13 (34-41) | 1 (42mm ²) |
| 13-16 (42-52) | 1/0 (53mm ²) |
| 16-20 (53-66) | 2/0 (67mm ²) |
| 20-26 (67-84) | 3/0 (85mm ²) |
| 26-32 (85-105) | 4/0 (107mm ²) |
| 32-38 (106-125) | 250 kcmil |
| 38-46 (126-150) | 300 kcmil |
| 46-53 (151-175) | 350 kcmil |
| 53-76 (176-250) | 500 kcmil |
| 76-91 (251-300) | 600 kcmil |
| Greater than 91 (301) | 750 kcmil |

Table 5.2.C

- D. All telecommunications rooms shall have a Telecommunications Grounding Busbar (TGB) that will be bonded via a Half Tap (HTAP) to the TBB. The TGB should provide a central ground attachment point for telecommunications systems, computers and other equipment located in the ER/TR.
- E. Bond and ground all metallic elements in the ER/TR such as equipment racks, housings, messenger cables, raceways, and rack-mounted conduit, cabinets, racks, and frames to the SBB with a minimum size # 6 AWG or greater green insulated copper grounding conductor. Refer to Table 5.2.C for sizing of conductor.
- F. The TMGB and TGB installed in the ER and TR shall be 12 inches long and 4 inches wide by ¼" thick with pre drilled EIA bolt hole sizing and spacing.

6.3 Bonding

- A. Bonding shall be of low impedance to assure electrical continuity between bonded elements.
- B. A # 6 AWG copper conductor with compression style dual hole lugs (NEBS Level 3) will be used to bond the communications components to the ground bar. Any paint shall be removed at bonding surface and antioxidant shall be applied before installation.
- C. The electrical contractor must provide access to a bonding connection at the electrical service ground during new construction (NEC 250-71(b)). A Primary Bonding Busbar (PBB) must be specified in the ER with an approved ground connector back to the electrical service ground point. Dual hole compression lugs are required at the ground bar side to insure NEBS Level 3 compliancy.
- D. All conduits terminating to cable trays, wire ways and racks shall be mechanically fastened. When connected to a cable tray or rack it must be connected with ground bushings, wire bonded to the tray or rack, and grounded to the main building grounding system or telecommunication room grounding bar using a minimum size #6 AWG copper ground conductor. Refer to Table 5.2.C for sizing of conductor.

Part 7 - Telecommunication Pathways

7.1 Cable Pathways

- A. All SCS support systems shall be independent of other trades and contain only Class 2 communications cabling. Pathways shall have at least 18" of clearance from any RFI/EMI sources including any electric motors, transformers or lighting fixtures. All support systems shall be installed according to manufacturer's recommendations.
- B. Cable Tray in Hallways and Main Runs- cable tray is the preferred pathway method and shall be a minimum of 12" x 4" basket style tray but sized to serve the cabling requirements of the area served. It shall provide a continuous main pathway located above corridors and permanent fire exit routes. If supported by threaded rod in a trapeze configuration, the threaded rod shall be covered with a protective sleeve where it may come in contact with the SCS. The cable tray shall be supported a minimum of every 5'.
- C. Cable Tray in Telecommunication Spaces - cable tray is the preferred pathway method and shall be a minimum of 12" ladder type tray, providing a continuous pathway from space entry to the telecommunications rack. It shall attach and provide rigidity to the top of the free standing relay racks. If supported by threaded rod in a trapeze configuration, the threaded rod shall be covered with a protective sleeve where it may come in contact with the SCS. The cable tray shall be supported a minimum of every 5'.

- D. J-Hooks – drop offs from the tray to the telecommunications outlet shall use J-hooks and shall be spaced no further than 5’ apart and have a cable securing mechanism. J-hooks can be attached to walls, metal building framework or independent hanger systems. They shall not use existing ceiling grid wire or other trades support systems.

7.2 Metallic conduit

- A. Although not preferred for main runs due to size restriction, conduit may be used where access to tray is restricted for SCS installation.
- B. Conduit can be an extension of the cable tray but shall maintain the cable capacity of the tray.
- C. Metallic conduit may be used at work area outlets where hollow wall exists or planned. The minimum size for this conduit shall be 1” trade size or larger based upon number of cable drops. The conduit shall terminate in a double gang electrical box with a reducer to accommodate a single gang telecommunications faceplate.

Part 8 - Telecommunication Spaces

8.1 General Requirements

- A. New construction telecommunications spaces will be single use, contain no other equipment and will be keyed to the University standard.
- B. Renovated telecommunications spaces include a variety of rooms and locations that are used to interact with telecommunications equipment and are a location for the placement, termination and interconnection of cabling and telecommunications equipment. These rooms may be a combination of spaces including:
 - 1. Telecommunications room
 - 2. Equipment room
 - 3. Entrance room or space
 - 4. Access provider space
 - 5. Service provider space
- C. A minimum of one wall shall be covered with 19 mm (3/4 in) plywood. The backboard shall be 1.2 m (4 ft.) x 2.4 m (8 ft.) sheets, mounted vertically with the bottom of the plywood mounted 150 mm (6 in.) AFF. Plywood shall be fire treated A/C grade with the A side facing toward the room. A defined pathway shall be in place
- D. Floors, walls and ceiling shall not be left unfinished to prevent dust buildup.
- E. Minimum clear height in the space shall be 2.4m (8ft) without obstructions. The height between the finished floor and the lowest point of ceiling should be a minimum of 3 m (10 ft.).
- F. The space should be located in an accessible area such as access from a common hallway or corridor.
- G. Pathways leading into the space shall be accessible for cable installation from a common hallway or corridor.
- H. All metallic elements in the space shall be bonded to the telecommunications grounding system. This includes but not limited to cable tray, relay racks and cabinets. See Telecommunications Grounding for more detail.

8.2 Lighting

- A. Lighting should be maintained at 500 lux measured at 1 m (3 ft.) AFF in the front and rear of telecommunications racks.
- B. The lighting shall be controlled by switch located immediately inside the door.
- C. Emergency lighting and signs shall be properly placed per AHJ such that an absence of primary lighting will not hamper emergency exit.

8.3 Telecommunications Room

- A. Free standing two-post relay racks are the preferred method for mounting communications hardware and equipment. The rack shall be a 7' tall x 19" wide vertical mounting rails with an EIA hole pattern. The vertical mounting rails shall be at least 6" deep for rigidity.
- B. Racks shall be numbered sequentially, facing the front of the rack from left to right. See Appendix A, Typical Rack drawings for clarification.
- C. Where room restrictions warrant a wall mounted rack or cabinet, it shall be mounted on a 19 mm (3/4 in.) plywood backboard. The backboard shall be 1.2 m (4 ft.) x 2.4 m (8 ft.) sheets, mounted vertically with the bottom of the plywood mounted 150 mm (6 in.) AFF. Plywood shall be fire treated A/C grade with the A side facing toward the room. The wall mounted rack shall be swingable for rear accessibility to cable terminations.
- D. Rack cable managers
 1. Cable managers include rack mounted vertical and horizontal pathways for both the static horizontal cable and patch cord management.
 2. All cable managers shall provide cable pathway in the front and rear of the rack.
 3. All cable managers shall be sized for the full capacity of their purpose, vertical for patch cord slack management and horizontal for routing cords away from ports.
 4. Where angled patch panels are used horizontal cable managers will not be necessary.
 5. Flat patch panels will require horizontal cable managers above and below patch panels for adequate cable management. See Appendix A, Sample Rack Elevation for reference.

8.4 Construction and Buildout

- A. Door shall be minimally 0.9 m (36 in.) wide and 2 m (80 in.) high, with no doorsill, hinged to open outward (code permitting).
- B. Floor loading must be a minimum of 100 lb. per square feet
- C. All conduits/coring should be kept 150 mm (6 in.) or less from walls whenever construction permits.
 1. All cores should be in single row.
 2. All cores should be kept in same proximity in stacked TRs.
- D. No communications room can have any wet pipes within the room's interior space, routing horizontally on the floor directly above the room, or within the floor slab. This does not include fire suppression required for the space.
- E. Doors should lock from outside access, exiting from rooms must always be permissible.
- F. Access control for doors shall be furnished and shall be a part of the base building access control system.

- G. Backbone riser cable access into communication rooms shall be via four-inch (4 in.) conduit or sleeved cores. A minimum of 3 four-inch conduits/cores shall feed each communications room. The amount of conduits will be based on N+1. Example: if 3 conduits will be occupied with cables for initial build out then 4 conduits shall be installed.
- H. There should be, at a minimum, one duplex convenience electrical outlet every 6 feet along the walls immediately to the left and right of the door for general-purpose use. All convenience outlets will be non-UPS power (utility).
- I. All floor and wall penetrations must be fire stopped as described within this document and shall meet applicable code.

8.5 Sizing Telecommunications Spaces

- A. Sizing of telecommunications spaces are minimum known requirements for cabling infrastructure and equipment. Final room size will be impacted by cabling density and special requirements set forth by the University. The ITS NEST will coordinate with Architect and provide final room size and location requirements.
- B. Equipment Room (ER)
 - 1. The ER shall be a minimum size of 14 m² (150 ft²) and no wall shall be less than 3 m (10 ft) long. The space surrounding the ER shall be designated for future growth of the ER, up to twice the existing space. This can be storage space that can be later commissioned for this purpose.
- C. Telecommunications Room (TR) will be determined by the number of telecommunication outlets served. See table 7.5.D below.

| Equipment Outlets Served | Minimum Floor space m ² (ft ²) |
|--------------------------|---|
| Up to 200 | 14 (150) |
| 201 to 800 | 37 (400) |
| 801 to 1600 | 74 (800) |
| 1601 to 2400 | 111 (1200) |

Table 7.5.D

8.6 Environmental Control

- A. HVAC should be designed to maintain a room temperature of 68 to 72 degrees with the full complement of equipment in the room.
- B. HVAC systems should not be mounted about the network rack or enclosure.

8.7 Electrical

- A. ER Equipment rack will be required to have the following.
 - 1. One 120 volts 20 amp NEMA 5-20R dedicated double duplex receptacle mounted to the top of the rack. Circuit shall be on emergency generator power/UPS.
 - 2. One 208 volts 30 amp NEMA L14-30P dedicated receptacle mounted to the bottom of the rack. Circuit shall be on emergency generator power only and provide feed for local 6 kVA UPS.
- B. TR Equipment rack will be required to have the following.
 - 1. One 120 volts 20 amp NEMA 5-20R dedicated double duplex receptacle mounted to the top of the rack. Circuit shall be on emergency generator power/UPS.
 - 2. One 208 volts 30 amp NEMA L14-30P dedicated receptacle mounted to the bottom of the rack. Circuit shall be on emergency generator power only and provide feed for local 6 kVA UPS.
- C. Final design and layout approval on number, type, and location of outlets shall be provided by ITS NEST.
- D. There should be, at a minimum, one duplex convenience outlet every 6 feet along the walls immediately to the left and right of the door for general-purpose use. All convenience outlets will be non-UPS power (utility).
- E. All electrical receptacles within the communication equipment room shall be labeled with source panel and circuit number.

8.8 Local UPS Power

- A. ER local UPS shall be rack mounted, specified and installed by ITS NEST to maintain 20 minutes.
- B. TR local UPS shall be rack mounted, specified and installed by ITS NEST to maintain 10 minutes.

8.9 Tag Plan

- A. The 21" W x 15"H plan shall be a labeled "As-Built" plotted floor plan showing the TO locations throughout the area served by the TR/ER.
- B. The tag plan shall be secured to the wall in each TR and ER as designated in Appendix A.
- C. A clear plexiglass sheet 22" W x 19" H shall be secured to the plywood lined wall. Fastener locations shall be on the top and bottom only.
- D. The tag plan shall slide behind the plexiglass from the left or right.
- E. This plan shall be updated to reflect any move, add or change to the area served by the TR/ER.
- F. See Appendix A, TAG Plan drawing for clarification.

Part 9 - Wall Penetrations Firestopping

9.1 General

- A. All wall penetrations shall be fitted with the firestopping system as defined herein and be installed to meet the fire rating of wall.
- B. All smoke and firewall penetration devices shall be of University standard and performance.
- C. Cable tray systems shall not penetrate smoke or fire walls.
- D. The capacity (quantity and size) of the firestopping system must at a minimum equal the capacity of the cable tray system.
- E. If J-Hooks are used, the firestopping system capacity shall meet that of the J-Hooks.
- F. Furnish and install all fire rated wiring devices and associated hardware as shown in Appendix A and as hereinafter specified.

9.2 Installation

- A. Cables passing through fire-rated floors or walls shall pass through a firestopping system, which contain an intumescent inserted material.
- B. The device (per code requirements) shall include both internal and external fire stopping.
- C. Cables penetrating through fire-rated floors or walls shall utilize fire-rated pathway devices capable of providing an F rating equal to the rating of the barrier in which the device is installed.
- D. All wall penetrations for cable shall be mechanically sound and maintain fire rating of wall. They shall be sleeved with a UL Certified system and be fully compliant with NFPA 101 Life Safety Code. The sleeved pathway shall not restrict cable capacity but shall meet the capacity of the cable tray or J-hook system.

Part 10 - Exceptions in Installation

10.1 Best Practices in Confined Spaces

- A. Where existing obstructions or confined spaces restrict or impede the practices described in this document it is the responsibility of the installer to bring these conflicts, in writing, to the attention of the ITS NEST for clear guidance to a resolution.
- B. The ITS NEST shall evaluate the situation and make recommendations based upon:
 - 1. Performance of the system
 - 2. Capacity restrictions
 - 3. Future growth
 - 4. Ease of serviceability
- C. The corrective steps may include using metallic conduit for RFI/EMI avoidance, creating alternate paths or adjusting the size of the communications rack.
- D. The ITS NEST will respond, in writing, recommendations on how to proceed.
- E. These exceptions to the standards and best practices of the University shall be clearly noted in the as built documentation upon completion.

Part 11 - Horizontal Cabling Requirements

11.1 Work Area Voice and Data Connectivity Requirements

- A. Jacks shall be of the same manufacturer as the horizontal cable to insure the highest end to end performance.
- B. Data jacks shall be Cat 6A.
- C. Four port single gang faceplates shall be used for all workstation outlets with the exception of wall mount telephones.
- D. All jacks and faceplates shall be consistent throughout the facility.
- E. Wall mount telephones shall utilize stainless steel plate with a single 8-pin, 8- conductor RJ-45 Cat 6 jack.
- F. All jacks will be RJ-45 modular style at both workstation and communication room termination points utilizing the T568B wiring scheme.

11.2 Horizontal Voice/Data Transmission Media

- A. Cable shall be Category 6A.
- B. Cable shall be marked as either CMP or CMR rated as required by the space.

Part 12 - Termination Hardware

12.1 Jacks

- A. All station cabling shall terminate into modular RJ-45 jacks and be housed in modular patch panels with deep cable strain relief bar. TC shall provide all identification and labeling as specified. Labeling must be in accordance with the University's labeling conventions.

12.2 Patch Panels

- A. All patch panels shall be angled modular rack-mounted panels and have adequate horizontal cable support installed on the back side of the panel.

12.3 Patch Cords

- A. 4-pair patch cords shall be utilized for all network connections including VOIP telephones. Patch cords shall be by the same manufacturer and performance Category as cable and connectivity to ensure the highest end-to-end performance.

12.4 Modular Furniture

- A. Modular furniture shall not have outlets attached to the furniture.
- B. Long work area cords shall extend from the wall outlet to each work area.

12.5 Access Points

- A. Solid ceiling or industrial ceiling environments
 1. A double-gang electrical box shall be used at access point locations.
 2. A two port surface mount box (SMB) shall be used at access point locations.
 3. The SMB shall be mounted on or within a few inches of the double-gang electrical box.

- B. False ceiling environments
 - 1. A double-gang electrical box shall be used at access point locations.
 - 2. A two port surface mount box (SMB) shall be used at access point locations.
 - a. The access point and SMB should be reasonably accessible by staff for maintenance and support for the lifetime of the facility.
 - 3. The box shall "float" above the ceiling for patching to the access point.
- C. Outdoor Areas
 - 1. A double-gang electrical box shall be used at access point location on the inside of the facility.
 - 2. A two port surface mount box (SMB) shall be used at access point location.
 - 3. Flexible conduit should be used to protect the data cable from the penetration on the building to the environmentally hardened access point.

Part 13 - Patch Cables and Cross-Connect

13.1 Data

- A. TR/ER Data Cords
 - 1. Patch cables shall be 4-pair cords, factory manufactured, tested and UL listed. Manufacturer and model number of patch cords must match the cable vendor system rating. The University shall identify port locations and quantities. The patch cords must provide the manufactures end-to-end solution and shall comply with the certification requirements.
- B. Workstation
 - 1. Data workstation cords shall be 4-pair, factory manufactured, tested and UL listed. Manufacturer and model number of patch cords must match the cable vendor system rating. The University shall identify port locations and quantities. The patch cords must provide the manufactures end-to-end solution and shall comply with the certification requirements.

13.2 Voice

- A. TR/ER cross-connect
 - 1. Voice cross-connect jumpers at the ER/TR will be performed by others
- B. Workstation
 - 1. Voice Line Cords at the workstations furnished and installed by the University.

Part 14 - Identification and Administration

14.1 Labeling and Identification

- A. All identifiers and labels shall conform to ANSI/TIA-606-B recommendations.
- B. Work station identification at the faceplate will include "TR- Rack-Patch Panel-Port".
 - 1. Example: 202-1-2-1; TR 202-Rack 1-Patch Panel 2-Port 1.
- C. All terminations shall be clearly identified at both ends with a permanent, self-adhering label.

- D. All work area tags must match the patch panel tags identically. Include individual port labels at all faceplates at each individual port.
- E. All cables shall have a self-laminating label located on the cable jacket within 6" of each termination.
- F. Faceplates will be labeled with computer generated labels installed under the label window.
- G. See Appendix A, Faceplate Detail drawing for labeling and configuration.

14.2 Administration

- A. A tag plan shall be affixed to the wall in each TR and ER as designated in the Appendix A. The plan shall be a labeled "As-Built" floor plan showing outlet locations throughout the area served by the TR/ER.

Part 15 - Testing

15.1 Twisted Pair

- A. All twisted pair cable must be tested by the TC to the latest industry standards (ANSI/TIA-568) to be compliant with performance specifications.

15.2 Fiber Optic

- A. All fiber optic cable must be tested to the latest industry standards (ANSI/TIA-568-D.3 and TIA-526-14-B).

15.3 Results

- A. All test results must be included in the "As-Built" documentation.

15.4 UTP Copper Horizontal Cable Testing

- A. Certification of the UTP horizontal wiring system shall be performed and documented by the TC.
- B. The test to be run must be the most current standard parameters ANSI/TIA-568-D for 100 ohm UTP, 4-pair cable.
- C. Test parameters shall include: wire map, length, attenuation, near-end-cross-talk (NEXT), power sum near end cross talk (PSNEXT), far-end-cross-talk (FEXT), power sum ELFEXT (PSELFEXT), ACR, resistance, propagation delay, delay skew and headroom.
- D. Test result printout shall show each cable tested shall be displayed on a single sheet of the report. The first page of the report shall be a report summary of all test results indicating the following: cable ID, time/date of test, longest pair length and pass/fail.

15.5 Fiber Optic Backbone Cable Testing

- A. Optical power loss shall be tested and recorded on all fiber strands per ANSI/TIA-568-D.3
- B. Multimode fiber strand tested bi-directionally for 850nm and 1300nm wavelengths.
- C. Single mode fiber strand tested bi-directionally for 1310nm and 1550nm wavelengths.
- D. All multimode fiber testing methods shall comply with TIA-526-14-B.
- E. Losses for OM3 fiber
 - 1. Maximum power loss budget for OM3 fiber is 3.75dB/km @ 850 nm and 1.5db/km @ 1300 nm.
 - 2. Maximum insertion loss for LC connectors is 0.75dB per mated pair.
- F. Losses for SM fiber
 - 1. Maximum power loss budget: 1db/km @ 1310 nm and 1550 nm.
 - 2. Maximum insertion loss for LC connectors is 0.75 dB per mated pair.

15.6 Approved Test Equipment

- A. Level IIIe test equipment is required. A standard of quality would include a Fluke DTX-1800 series or approved test equipment. The TC shall provide proof of latest software upgrades and factory calibrations. The TC is required to get written authorization to use test equipment that is not listed as approved.

15.7 Test Result Submittals

- A. The TC shall submit (1) hard copy of all UTP and fiber cable test results/summary report and CD-ROM of test data in .txt or .doc format.
- B. Manufacturer format is acceptable if the manufacturer's viewing software is included to review the test results.

Part 16 - Support and Warranty

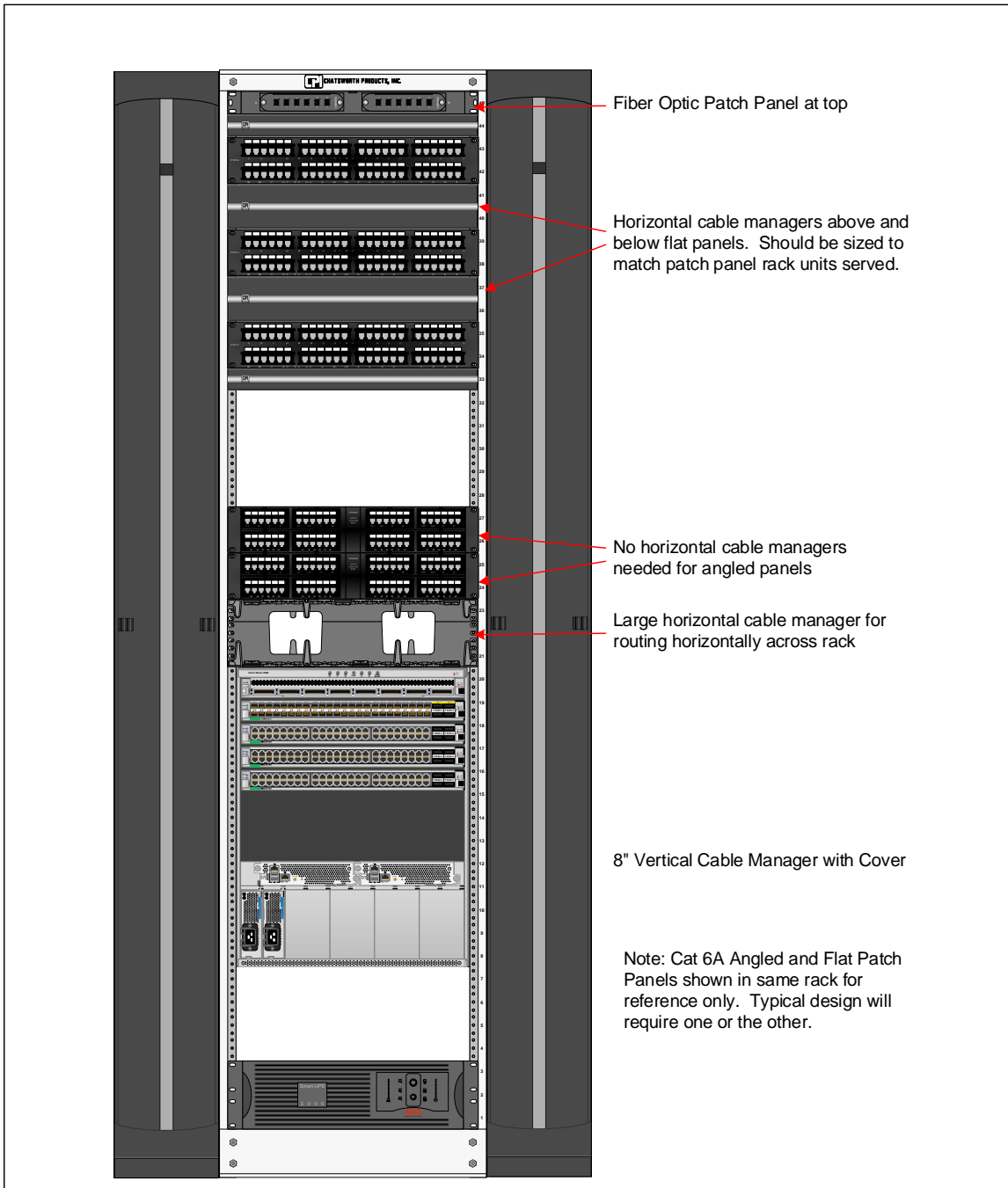
16.1 General requirements

- A. Comply with additional requirements in contract general requirements and extended warranties required in other specification sections. Refer to all other sections of this document for specific additional warranty requirements that exceed or are in addition to those of this section.

16.2 SCS Manufacturers Extended Warranty


- A. SCS will be covered by a two-part certification program provided by a single manufacturer and that manufacturer's certified vendor. Manufacturer shall administer a follow on program through the Vendor to provide support and service to the purchaser. The first part is an assurance program, which provides that the certified system will support the applications for which it is designed, during the 20-year warranty of the certified system.
- B. The second portion of the certification is a 20-year warranty provided by the manufacturer and the vendor on all products within the system (cords, telecommunications outlet/connectors, cables, cross-connects, patch panels, etc.).
- C. In the event that the certified system ceases to support the certified application(s), whether at the time of cutover, during normal use or when upgrading, the manufacturer and vendor shall commit to promptly implement corrective action.
- D. Documentation proving the cabling system's compliance to the End-to-End Link Performance recommendations, as listed in ANSITIA/EIA-568 shall be provided by the Vendor prior to the structured cabling system being installed.
- E. The cabling system must conform to the current issue of industry standard ANSI/TIA/EIA-568. All performance requirements of this document must be followed. As well, workmanship and installation methods used shall be equal to or better than that found in the BICSI (Building Industry Consulting Service International) ITSIM manual.
- F. Manufacturer shall maintain ISO Quality Control registration for the facilities that manufacturer the product used in this SCS.

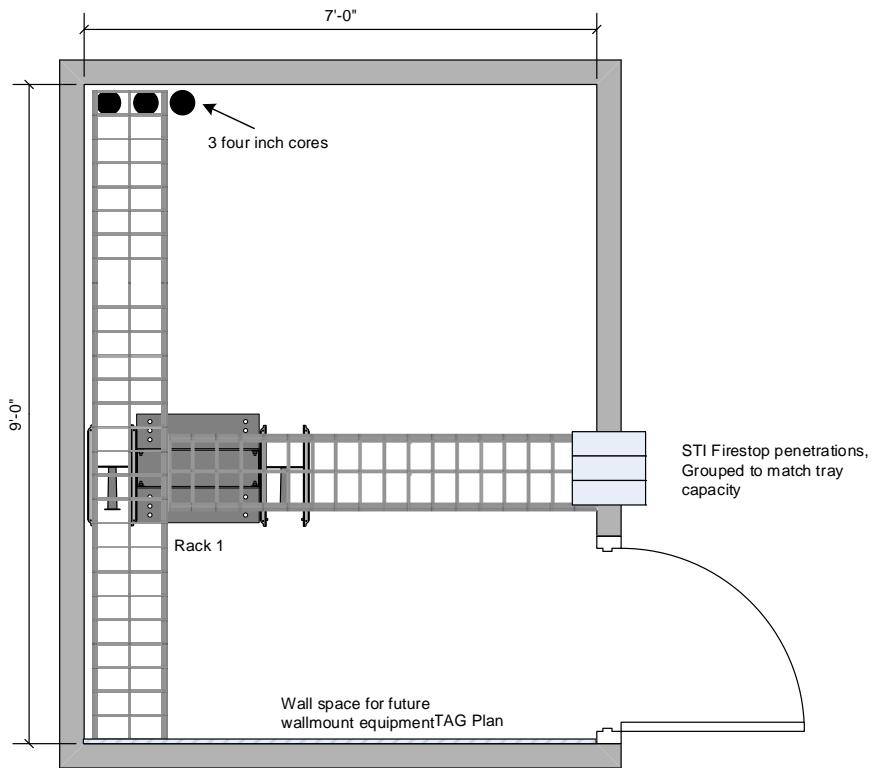
Part 17 - Appendix A - Drawings



Drawings, Bills of Materials (BOM's) or other items provided by Anixter are strictly for conceptual and overview purposes. The customer is responsible for the final design and product selection.

PRELIMINARY
NOT FOR CONSTRUCTION

| | | | | |
|--------------------|-----------------------------------|----------------|---|--|
| DATE 06/14/2017 | FILENAME RACK ELEVATION.VSD | REVIEWED BY | DESCRIPTION Sample Rack Elevation |  2301 Patriot Blvd Glenview, IL 60026 |
| REV A | PAGE 1 OF 1 | DRAWN BY DW | | |

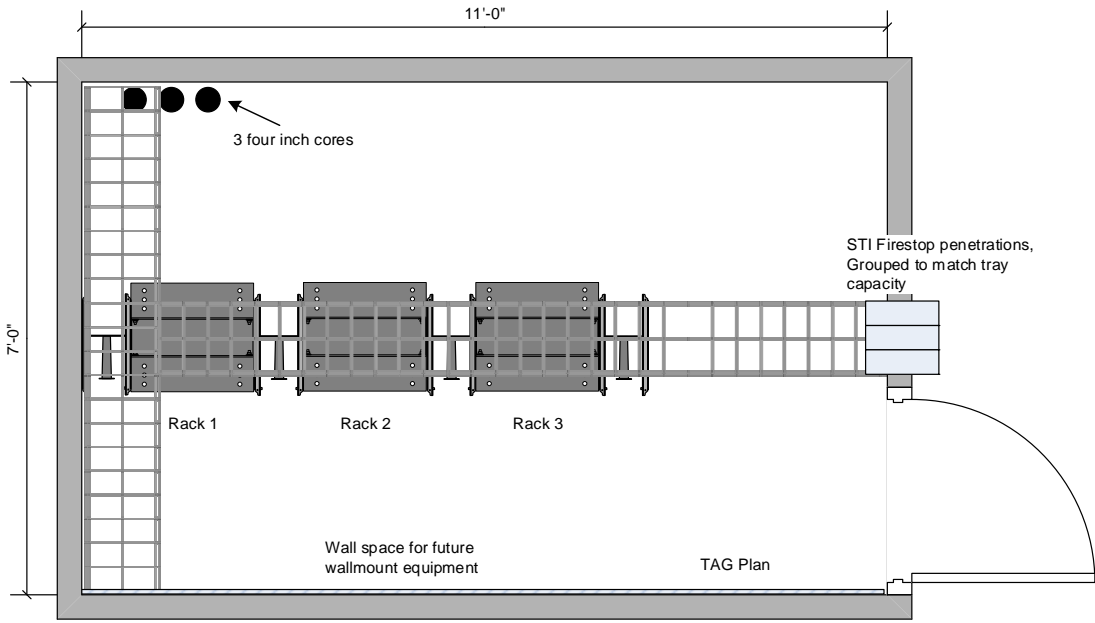


Typical TR Layout, cable entry points will dictate cable tray pathway
 1 wall lined with 3/4" AC grade fire retardant plywood

Drawings, Bills of Materials (BOM's) or other items provided by Anixter are strictly for conceptual and overview purposes. The customer is responsible for the final design and product selection.

PRELIMINARY
 NOT FOR CONSTRUCTION

| | | | | |
|--------------------|--------------------------------|----------------|---------------------------------------|--|
| DATE 06/21/2017 | FILENAME TR LAYOUTSINGLERAC | REVIEWED BY | DESCRIPTION Typical Single Rack TR |  2301 Patriot Blvd Glenview, IL 60026 |
| REV A | PAGE 1 OF 1 | DRAWN BY DW | | |



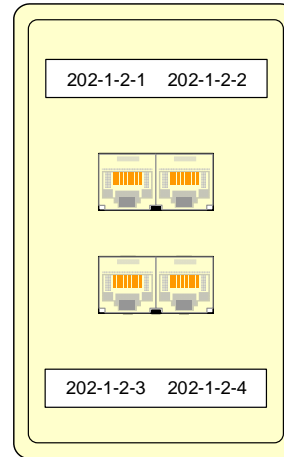
Typical TR Layout, cable entry points will dictate cable tray pathway
 1 wall lined with 3/4" AC grade fire retardant plywood

Drawings, Bills of Materials (BOM's) or other items provided by Anixter are strictly for conceptual and overview purposes.
 The customer is responsible for the final design and product selection.

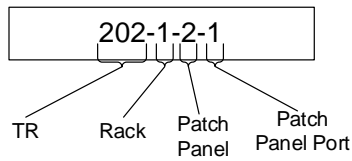
PRELIMINARY
 NOT FOR CONSTRUCTION

| | | | | |
|--------------------|--------------------------------|----------------|--------------------------------------|--|
| DATE 06/21/2017 | FILENAME TR LAYOUTMULTIRACK | REVIEWED BY | DESCRIPTION Typical Multi-Rack TR |  2301 Patriot Blvd Glenview, IL 60026 |
| REV A | PAGE 1 OF 1 | DRAWN BY DW | | |

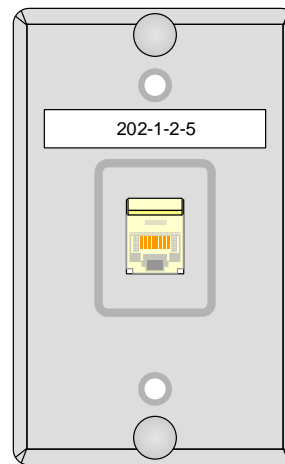
Work Area Faceplate



Label Scheme



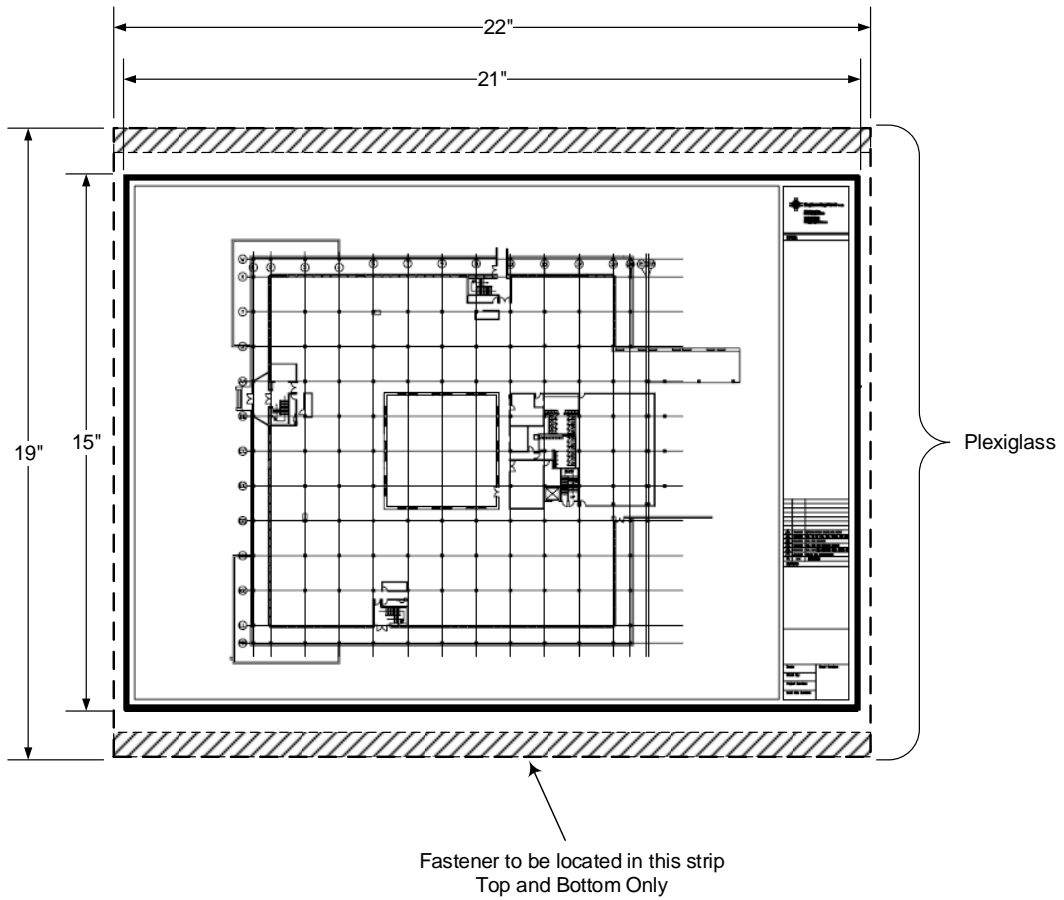
Wall Phone Faceplate



Drawings, Bills of Materials (BOM's) or other items provided by Anixter are strictly for conceptual and overview purposes. The customer is responsible for the final design and product selection.

PRELIMINARY
NOT FOR CONSTRUCTION

| | | | | |
|--------------------|-------------------------------------|---------------|-------------------------------------|--|
| DATE 06/21/2017 | FILENAME FACEPLATE DETAIL VSD | REVIEWED BY | DESCRIPTION Faceplate Detail |  2301 Patriot Blvd Glenview, IL 60026 |
| REV A | PAGE 1 OF 1 | DRAWN BY D | | |

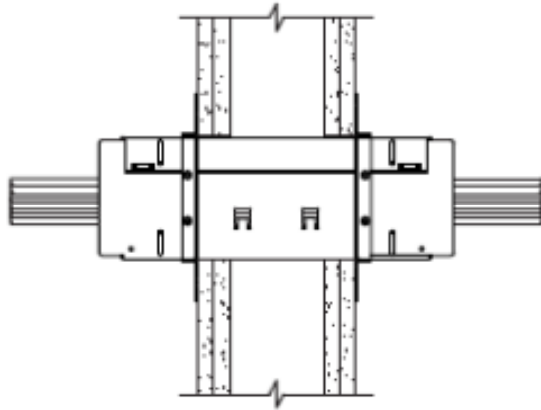


Notes:
Clear plexiglass over print

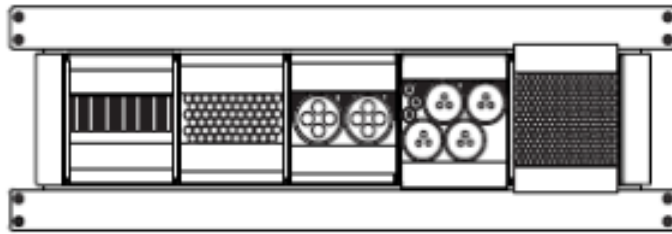
Drawings, Bills of Materials (BOM's) or other items provided by Anixter are strictly for conceptual and overview purposes.
The customer is responsible for the final design and product selection.

PRELIMINARY
NOT FOR CONSTRUCTION

| | | | | |
|--------------------|-------------------------|-----------------|-------------------------|--|
| DATE 06/21/2017 | FILENAME TAGPLAN.VSD | REVIEWED BY | DESCRIPTION Tag Plan |  2301 Patriot Blvd Glenview, IL 60026 |
| REV A | PAGE 1 OF 1 | DRAWN BY DJI | | |




Single installed Raceway shown



Multiple Raceways ganged together to meet capacity of tray

Drawings, Bills of Materials (BOM's) or other items provided by Anixter are strictly for conceptual and overview purposes. The customer is responsible for the final design and product selection.

PRELIMINARY
NOT FOR CONSTRUCTION

| | | | | |
|--------------------|--------------------------------|-----------------|---------------------------------|--|
| DATE 06/12/2017 | FILENAME WALL PENETRATION.V | REVIEWED BY | DESCRIPTION Wall Penetration |  2301 Patriot Blvd Glenview, IL 60026 |
| REV A | PAGE 1 OF 1 | DRAWN BY DJI | | |

End of Document

DIVISION 27 – COMMUNICATIONS

27 00 00 Communications

27 01 00 Operation and Maintenance of Communications Systems

- 27 01 10 Operation and Maintenance of Structured Cabling and Enclosures
- 27 01 20 Operation and Maintenance of Data Communications
- 27 01 30 Operation and Maintenance of Voice Communications
- 27 01 40 Operation and Maintenance of Audio-Video Communications
- 27 01 50 Operation and Maintenance of Distributed Communications and Monitoring

27 05 00 Common Work Results for Communications

- 27 05 13 Communications Services
 - 27 05 13.13 Dial tone Services
 - 27 05 13.23 T1 Services
 - 27 05 13.33 DSL Services
 - 27 05 13.43 Cable Services
 - 27 05 13.53 Satellite Services
- 27 05 26 Grounding and Bonding for Communications Systems
- 27 05 28 Pathways for Communications Systems
 - 27 05 28.29 Hangers and Supports for Communications Systems
 - 27 05 28.33 Conduits and Back boxes for Communications Systems
 - 27 05 28.36 Cable Trays for Communications Systems
 - 27 05 28.39 Surface Raceways for Communications Systems
- 27 05 43 Underground Ducts and Raceways for Communications Systems
- 27 05 46 Utility Poles for Communications Systems
- 27 05 48 Vibration and Seismic Controls for Communications Systems

Seismic Restraint

- 1.01 General: Mechanical systems including ductwork, piping, and equipment shall be equipped with seismic restraints in accordance with the Arkansas Fire Prevention Code and the Arkansas Mechanical Code.
- 1.02 Calculations: All design calculations shall be prepared by a registered professional engineer experienced in seismic design.
- 1.03 Materials
 - 1.03.01 Duct Construction: Duct construction shall conform to SMACNA publications.
 - 1.03.02 Piping Fabrication: Piping shall conform to ANSI / ASME B31.9 Building Services Piping Code.
 - 1.03.03 Angles: Cold-formed angles shall conform to the material and identification requirements of the latest "Specifications for the Design of

Cod-Formed Steel Structural Members” of the American Iron and Steel Institute with a minimum $F_y = 33$ ksi and a minimum F_u of 38 ksi.

- 1.03.04 Shapes and Plates: Hot-rolled shapes and plates shall conform to ASTM A36. Pipes used as braces shall be standard steel pipes ASTM A120 or A53.
- 1.03.05 Cables: Cables shall be wire-core with minimum breaking strength of 4,940 lbs for ¼” cable, 10,980 lbs for 3/8” cable, and 19,280 lbs for ½” cable.
- 1.03.06 Bolts: Bolts shall conform to ASTM A307. Bolt holes shall be 1/16” larger than the bolt diameter.
- 1.03.07 Expansion Anchors: Expansion anchors and cast-in place concrete inserts shall have sufficient shear and tension capacities for the application.
- 1.04 Duct Supports: Brace ducts with cross sectional areas of 6 SF and larger. Bracing shall occur at the intervals specified in the SMACNA tables. All runs (any length of ductwork without a change in direction) shall have a minimum of 2 transverse braces and 1 longitudinal brace. Bracing is not required if the duct is suspended by hangers 12” or less in length as measured from the top of the duct to the bottom of the support where the hanger is attached.
- 1.05 Pipe Supports: Brace all fuel oil and natural gas piping, 1” diameter and larger. : Brace all piping in mechanical rooms that is 1-1/4” diameter and larger. Brace all piping 2-1/2” diameter and larger. Bracing shall occur at the intervals specified in SMACNA tables. Bracing is not required if piping is suspended by hangers 12” or less in length as measured from the top of the pipe to the bottom of the support.
- 1.06 Equipment Supports: Bracing shall be provided for pumps, heating water converters, control panels, variable frequency drives, water heaters, and expansion tanks. Equipment shall be braced independently of the attached piping and ductwork.
- 1.07 Sample Seismic Support Specifications: Refer to Appendix J for sample seismic restraint specifications.
- 1.08 Sample Seismic Support Details: Refer to Appendix I for sample seismic support details including pipe supports, duct supports, and equipment supports.

INCLUDE IN CONSTRUCTION DOCUMENTS

Please check with Facilities Management for the most current color convention for cabling.

Data Cables shall be blue in color

Data jacks shall be lime green in color

Phone cables shall be white in color

Phone jacks shall be ivory in color

27 06 00 Schedules for Communications

27 06 10 Schedules for Structured Cabling and Enclosures

27 06 20 Schedules for Data Communications

27 06 30 Schedules for Voice Communications

27 06 40 Schedules for Audio-Video Communications

27 06 50 Schedules for Distributed Communications and Monitoring

27 08 00 Commissioning of Communications

27 10 00 Structured Cabling

PART 1 GENERAL

INCLUDE IN CONSTRUCTION DOCUMENTS

1.1 SUMMARY

- A. This Section includes general requirements specifically applicable to Division 27.
- B. The Contractor shall be responsible for:
 - 1. Providing all additional materials, and the necessary labor and services required to ensure all components of the system are completely installed in accordance with the intent of the Contract Documents.
 - 2. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.
 - 3. Coordinating the details of facility equipment and construction for all specification divisions that affect the work covered under this Division.
 - 4. Coordinating all activities with the overall construction schedule.

5. Developing bill of materials, perform material management and efficient use of the materials whether they are issued by the Contractor, the owner or purchased by the Contractor.
6. Ensure materials in excess of those required to complete the project are kept in their original condition and packaging for restocking.
7. Ensure project is properly registered for a warranty.

1.2 WARRANTY

- A. The contractor shall provide a manufacturer's warranty on the horizontal and backbone systems as specified in Section 271300 and 271500.
- B. In addition to the standard warranty requirements, the Certified Contractor shall provide the following during the warranty period:
 1. Within 24 hours after notification of a defect, the Certified Contractor shall start to make the necessary corrections and inform the appropriate Project Manager of the planned corrective actions. The Certified Contractor shall follow this initial contact with continuous effort and complete any required corrective work within 15 days after notification.

END OF SECTION

27 11 00 Communications Equipment Room Fittings

PART 2 GENERAL

2.1 SUMMARY

- A. The communications equipment room will be referred as Telecommunications Room (TR) in this document is intended to house racks, cabinets and equipment necessary for the support of the communications cabling infrastructure.

2.2 REFERENCES

1. All work shall be performed in accordance with the following codes and industry standards, unless noted otherwise:
2. NFPA 70 – National Electrical Code, current version adopted by local or State AHJ.
3. TIA/EIA-568-B – Commercial Building Telecommunications Cabling Standard, current version.
4. TIA/EIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces, current version.
5. TIA/EIA-606-A – Administration Standard for Commercial Telecommunications Infrastructure, current version.

6. J-STD-607-A – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, current version.
7. TIA-310- D Cabinets, Rack, and Associated Equipment

2.3 IEEE 241 - IEEE Recommended Practice for Electric Power Systems in Commercial Buildings” pertaining to communication systems. (SYSTEM DESCRIPTION)

PART 3 PRODUCTS

3.1 APPROVALS AND SUBSTITUTIONS

- A. All products shall be provided as specified, without exception, unless approved in writing prior to the bid as per Section 012500 – Substitution Procedures. All products shall be “NEW”.
- B. Non-compliant products installed as a part of this Contract shall be removed and replaced and all costs for removal and replacement shall be borne solely by the Contractor.

3.2 TELECOMMUNICATIONS BACKBOARDS

- A. AC-rated plywood, fire-retardant treated, 3/4 inches by 48 inches by 96 inches (19 by 1220 by 2440 mm).

3.3 FREE STANDING EQUIPMENT RACKS

3.4 WALL MOUNTED EQUIPMENT RACKS

3.5 EQUIPMENT ENCLOSURES

CONSULTANT DESIGN GUIDELINE

Provide enough space for networking and networking related equipment. Telecommunication closet may house the main distribution frame, PBXs, secondary voltage protection, etc.

3.6 VERTICAL WIRE MANAGERS

3.7 HORIZONTAL WIRE MANAGERS

3.8 TELECOMMUNICATIONS GROUNDING BUSBAR

3.9 CABLE RUNWAY

3.10 WIRE CABLE TRAY

END OF SECTION

- 27 11 13 Communications Entrance Protection
- 27 11 16 Communications Cabinets, Racks, Frames and Enclosures
- 27 11 19 Communications Termination Blocks and Patch Panels
- 27 11 23 Communications Cable Management and Ladder Rack
- 27 11 26 Communications Rack Mounted Power Protection and Power Strips

27 13 00 Communications Backbone Cabling

PART 4 GENERAL

4.1 REFERENCES

- A. All work shall be performed in accordance with the following Codes and industry Standards, unless noted otherwise:
 - 1. NFPA 70 – National Electrical Code, current version adopted by local or State AHJ.
 - 2. TIA/EIA-568-B – Commercial Building Telecommunications Cabling Standard, current version.
 - 3. TIA/EIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces,
 - 4. TIA/EIA-606-A – Administration Standard for Commercial Telecommunications Infrastructure.
 - 5. J-STD-607-A – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, current version.
 - 6. IEEE 241 - IEEE Recommended Practice for Electric Power Systems in Commercial Buildings” pertaining to communication systems.

- B. This Section specifies the requirements necessary to furnish and install an inter-building and intra-building twisted-pair and fiber optic cable distribution subsystem including:
 - 1. Cabling, splice closures, and related components.
 - 2. Placement, splicing, termination, and other required services.

4.2 SYSTEM DESCRIPTION

- A. Interbuilding Backbone: The interbuilding subsystem refers to all twisted-pair and fiber optic backbone communications cabling connecting the Main Building Equipment Room (BER) to each building equipment room (BER) in all buildings on the campus.

- B. Intra-building Backbone: The intra-building subsystem refers to all twisted-pair and fiber optic backbone communications cabling connecting the Main Telecommunications Room (TR) to each Telecommunication Room (TR) in the building.

- C. Backbone cabling consists of copper and optical fiber cables and associated connecting hardware.
- D. Contractor shall furnish and install all materials necessary for a complete and working system.
- E. Field terminated optical fiber jumpers shall not be allowed.

4.3 WARRANTY

- A. Telecommunications contractor shall administer the warranty process with the responsible manufacturer's representative.
- B. All necessary documentation that must be provided to the manufacturer will be furnished by the Telecommunications contractor immediately following 100% testing of all cables.

PART 5 PRODUCTS

5.1 APPROVALS AND SUBSTITUTIONS

- A. All products shall be provided as specified, without exception, unless approved in writing prior to the bid. All products shall be "NEW".
- B. Non-compliant products installed as a part of this Contract shall be removed and replaced and all costs for removal and replacement shall be borne solely by the Contractor(s).

5.2 INTERBUILDING FIBER OPTIC CABLE

- A. Loose Tube dielectric multimode/single-mode Fiber optic cable
 - 1. All-Dry Flame Rated Optical Cable constructed of buffer tubes stranded around a dielectric strength member. Buffer tubes shall use a dry water blocking technology that does not rely upon yarns, binders, or tapes. Must be suitable for underground conduit, direct burial or Aerial applications. Optical fibers shall be laser optimized 50/125- μ m optical fiber having a minimum Effective Modal Bandwidth (EMB) of 2000 MHz•km at 850 nm (ANSI/EIA/TIA-492AAAC-A) or Low Water Peak Dispersion Unshifted Single-mode fiber (ANSI/EIA/TIA-492CAAB).
- B. Outside Plant Loose Tube dielectric multimode Fiber optic cable
 - 1. Outside plant Optical Cable constructed of gel filled buffer tubes stranded around a dielectric strength member. Must be suitable for underground conduit, direct burial or Aerial applications. Optical fibers shall be laser optimized 50/125- μ m optical fiber having a minimum Effective Modal Bandwidth (EMB) of 2000 MHz•km at 850 nm (ANSI/EIA/TIA-492AAAC-A) or Low Water Peak Dispersion Unshifted Single-mode fiber (ANSI/EIA/TIA-492CAAB).

5.3 INTRABUILDING MULTIPAIR UNSHEILDED TWISTED PAIR

- A. General purpose 4 pair category 3 unshielded twisted pair
 - 1. Twisted-pair cable with 24-AWG solid conductor, 4-pair, 100-ohm unshielded twisted-pair core covered by a PVC outer jacket. CMP Rated.
- B. General purpose 25 pair category 3 unshielded twisted pair
 - 1. Twisted-pair cable with 24-AWG solid conductor, 100-ohm unshielded twisted-pair core covered by a PVC outer jacket. CMP Rated.
- C. General purpose 50 pair category 3 unshielded twisted pair
 - 1. Twisted-pair cable with 24-AWG solid conductor, 100-ohm unshielded twisted-pair core covered by a PVC outer jacket. CMP Rated.
- D. General purpose 100 pair category 3 unshielded twisted pair
 - 1. Twisted-pair cable with 24-AWG solid conductor, 100-ohm unshielded twisted-pair core covered by a PVC outer jacket. CMP Rated.
- E. General purpose 200 pair category 3 unshielded twisted pair
 - 1. Twisted-pair cable with 24-AWG solid conductor, 100-ohm unshielded twisted-pair core covered by a PVC outer jacket. CMP Rated
- F. General purpose 300 pair category 3 unshielded twisted pair
 - 1. Twisted-pair cable with 24-AWG solid conductor, 100-ohm unshielded twisted-pair core covered by a PVC outer jacket. CMP Rated.
- G. General purpose 400 pair Type III unshielded twisted pair
 - 1. Twisted-pair cable with 24-AWG solid conductor, 100-ohm unshielded twisted-pair core covered by a PVC outer jacket. CMP Rated.
- H. Augmented category 6 unshielded twisted pair (NetClear GTX or Leviton)
 - 1. 100 ohm, Category 6a, 23 AWG, 4-pair unshielded twisted pair,
 - a. Maximum insertion loss of 2.0 dB/100M at 1 MHz, 19.0 dB/100M at 100 MHz, 31.0 dB/100M at 250 MHz and 45.3 dB/100m at 500 MHz
 - b. Minimum PSNEXT of 72.3 dB at 1 MHz, 42.3 dB at 100 MHz, 36.3 dB at 250 MHz and 31.2 dB at 500 MHz
 - c. Cable balance: LCL/TCL greater than 50 dB @ 100 m at 1 MHz, 30.0 dB @ 100m at 100 MHz and 26.0 dB @ 250 MHz. EL TCTL greater than 30 dB @ 100m at 1 MHz, and 5.5 dB @ 100m at 31.25 MHz
 - d. Minimum PS-ANEXT of 80.0 dB at 1 MHz, 60.0 dB at 100 MHz, 54.0 dB at 250 MHz and 49.5 dB at 500 MHz.
 - e. Minimum PS-AELFEXT of 77.0 dB at 1 MHz, 37.0 dB at 100 MHz, 29.0 dB at 250 MHz and 23.0 dB at 500 MHz.
 - f. Electrical characteristics must be characterized to 750 MHz.
 - g. Cable must be third party verified by ETL.
 - h. 0.300 inch max cable diameter
 - 2. 100 ohm, Category 6a, 23AWG, 4-pair unshielded twisted pair,

- a. Maximum insertion loss of 2.0 dB/100M at 1 MHz, 19.0 dB/100M at 100 MHz, 31.0 dB/100M at 250 MHz and 45.3 dB/100m at 500 MHz.
- b. Minimum PSNEXT of 72.3 dB at 1 MHz, 42.3 dB at 100 MHz, 36.3 dB at 250 MHz and 31.2 dB at 500 MHz.
- c. Cable balance: LCL/TCL greater than 50 dB @ 100 m at 1 MHz, 30.0 dB @ 100m at 100 MHz and 26.0 dB @ 250 MHz. EL TCTL greater than 30 dB @ 100m at 1 MHz, and 5.5 dB @ 100m at 31.25 MHz
- d. Minimum PS-ANEXT of 80.0 dB at 1 MHz, 60.0 dB at 100 MHz, 54.0 dB at 250 MHz and 49.5 dB at 500 MHz.
- e. Minimum PS-AELFEXT of 77.0 dB at 1 MHz, 37.0 dB at 100 MHz, 29.0 dB at 250 MHz and 23.0 dB at 500 MHz.
- f. Electrical characteristics must be characterized to 750 MHz.
- g. Cable must be third party verified by ETL.
- h. 0.310 inch cable diameter

5.4 INTRABUILDING AND INTERBUILDING FIBER OPTIC CABLE

- A. Loose Tube dielectric indoor/outdoor multimode/singlemode Fiber optic cable
 - 1. All-Dry Flame Rated Optical Cable constructed of buffer tubes stranded around a dielectric strength member. Buffer tubes shall use a dry water blocking technology that does not rely upon yarns, binders, or tapes. Must be suitable for underground conduit, direct burial or Aerial applications. Optical fibers shall be laser optimized 50/125- μ m optical fiber having a minimum Effective Modal Bandwidth (EMB) of 2000 MHz•km at 850 nm (ANSI/EIA/TIA-492AAAC-A) or Low Water Peak Dispersion Unshifted Single-mode fiber (ANSI/EIA/TIA-492CAAB).
- B. Tight Buffer indoor multimode/singlemode Fiber optic cable
 - 1. Tight Buffer Flame Rated Optical Cable. Optical fibers shall be laser optimized 50/125- μ m optical fiber having a minimum Effective Modal Bandwidth (EMB) of 2000 MHz•km at 850 nm (ANSI/EIA/TIA-492AAAC-A) or Low Water Peak Dispersion Unshifted Single-mode fiber (ANSI/EIA/TIA-492CAAB).
- C. Interconnect Tight Buffer dielectric indoor multimode/single-mode Fiber optic cable
 - 1. Flame Rated Optical Cable Optical fibers shall be laser optimized 50/125- μ m optical fiber having a minimum Effective Modal Bandwidth (EMB) of 2000 MHz•km at 850 nm (ANSI/EIA/TIA-492AAAC-A) or Low Water Peak Dispersion Unshifted Single-mode fiber (ANSI/EIA/TIA-492CAAB).

END OF SECTION

- 27 13 13 Communications Copper Backbone Cabling
 - 27 13 13.13 Communications Copper Cable Splicing and Terminations
- 27 13 23 Communications Optical Fiber Backbone Cabling
 - 27 13 23.13 Communications Optical Fiber Splicing and Terminations
- 27 13 33 Communications Coaxial Backbone Cabling
 - 27 13 33.13 Communications Coaxial Splicing and Terminations
- 27 13 43 Communications Servicing Cabling
 - 27 13 43.13 Dial-Tone Services Cabling
 - 27 13 43.23 T1 Services Cabling
 - 27 13 43.33 DSL Services Cabling
 - 27 13 43.43 Cable Services Cabling
 - 27 13 43.53 Satellite Services Cabling

27 15 00 Communications Horizontal Cabling

PART 6 GENERAL

6.1 SUMMARY

- A. Horizontal (distribution) communications wiring and connecting hardware from the Telecommunications Room (TR) to Telecommunication Outlets (TO) throughout the site.

6.2 SYSTEM DESCRIPTION

- A. The horizontal distribution subsystem refers to all intra-building twisted-pair and fiber optic communications cabling connecting Telecommunication Rooms (TR's) to telecommunication outlets (TO's) located at individual work areas.
- B. Horizontal cabling may consist of a combination of the following types of cable from the TR to the TO:
 - 1. Augmented Category 6, Enhanced Category 6, Category 6, Enhanced Category 5e, (100 Ohm, 4-pair, unshielded twisted pair) cables from the TR's to the TO's.) Port 1 or Port 2
 - 2. 62.5/125 μm , 50/125 μm , or 850 nm Laser Optimized 50/125 μm optical fiber cable. Port 2
- C. The Horizontal System includes cables, jacks, patch panels, connecting blocks, patch cords, fiber connectors and jumpers as well as the necessary support systems, such as cable managers and faceplates.

- D. Cables may be routed through conduit, cable trays, spaces below raised floors, open ceiling areas, non-ventilated spaces above ceiling tile, and through plenum air-handling spaces above ceiling tile. Coordinate with General Contractor (GC).
- E. Telecommunications contractor shall furnish and install all materials necessary for a complete and working system.

6.3 WARRANTY

- A. Telecommunications Contractor shall administer the warranty process with the responsible manufacturer's representative. The warranty shall be provided directly to the owner from the manufacturer. Telecommunications contractor shall insure that the manufacturer provides the Owner with the appropriate warranty certification within 30 calendar days of the final project completion.

PART 7 PRODUCTS

7.1 APPROVALS AND SUBSTITUTIONS

- A. All products shall be provided as specified, without exception, unless approved in writing prior to the bid.
- B. Non-compliant products installed as a part of this Contract shall be removed and replaced and all costs for removal and replacement shall be borne solely by the Contractor(s).
- C. All products shall be "NEW".

END OF SECTION

27 15 00.16 Voice Communications Horizontal Cabling
27 15 00.19 Data Communications Horizontal Cabling
27 15 00.23 Audio-Video Communications Horizontal Cabling
27 15 00.39 Patient Monitoring and Telemetry Communications Horizontal Cabling
27 15 00.43 Nurse Call and Intercom Communications Horizontal Cabling
27 15 00.46 Paging Communications Horizontal Cabling
27 15 00.49 Intermediate Frequency/Radio Frequency Communications Horizontal Cabling
27 15 00.53 Antennas Communications Horizontal Cabling
27 15 13 Communications Copper Horizontal Cabling
27 15 23 Communications Optical Fiber Horizontal Cabling
27 15 33 Communications Coaxial Horizontal Cabling
27 15 43 Communications Faceplates and Connections

27 16 00 Communications Connecting Cords, Devices and Adaptors

PART 8 GENERAL

8.1 SUMMARY

- A. This section applies to any device that is a portion of the cabling channel that is connected to a work area outlet/ telecommunication outlet (TO) and at the equipment racks/cabinets.

8.2 REFERENCES

- A. All work shall be performed in accordance with the following codes and industry standards, unless noted otherwise:
 1. NFPA 70 – National Electrical Code, current version adopted by local or State AHJ.
 2. TIA/EIA-568-B – Commercial Building Telecommunications Cabling Standard, current version.
 3. TIA/EIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces, current version.
 4. TIA/EIA-606-A – Administration Standard for Commercial Telecommunications Infrastructure, current version.
 5. J-STD-607-A – Commercial Building Grounding (Earthing) and Bonding requirements for Telecommunications, current version.
 6. IEEE 241 - IEEE Recommended Practice for Electric Power Systems in Commercial Buildings” pertaining to communication systems.

8.3 WARRANTY

- A. Telecommunications contractor shall administer the warranty process with the responsible manufacturer’s representative. The warranty shall be provided directly to the owner from the manufacturer. Telecommunications contractor shall insure that the manufacturer provides the Owner with the appropriate warranty certification within 90 calendar days of the final project completion.

PART 9 PRODUCTS

9.1 APPROVALS AND SUBSTITUTIONS

- A. All products shall be provided as specified, without exception, unless approved in writing prior to the bid. All products shall be "NEW".
- B. Non-compliant products installed as a part of this Contract shall be removed and replaced and all costs for removal and replacement shall be borne solely by the Contractor(s).

END OF SECTION

27 16 13 Communications Custom Cable Assemblies

27 16 16 Communications Media Converters, Adapters, and Transceivers

27 16 19 Communications Patch Cords, Station Cords, and Cross Connect Wire

SECTION 27 20 00 DATA COMMUNICATIONS

CONSULTANT DESIGN GUIDELINE

Provide data drops for each vending machine in a vending area, compatible with the University card system.

Design and installation shall comply with the following:

ANSI/TIA/EIA - 568 B: Commercial Building Telecommunications Cabling Standard.

ANSI/TIA/EIA - 569: Commercial Building Standard for Telecommunication Pathways and Spaces.

ANSI/TIA/EIA - 606: The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

ANSI/TIA/EIA - 607: Commercial Building Grounding and Bonding Requirements for Telecommunications.

TIA/EIA - TSB67: Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems.

ISO/IEC IS 11801: Generic Cabling for Customer Premises>

INCLUDE IN CONSTRUCTION DOCUMENTS

Submit manufacturer's technical data sheets including complete installation information, performance specifications and wiring diagrams for each system.

The Contractor shall provide shop drawing submittal information for review. Do not order materials until the Engineer has approved the shop drawings and submittals. Provide each of the following for review:

Material and equipment submittals for each item.

A cable routing and grouping plan.

Proposed wall termination block/wire management elevations, to scale, for each backboard in each communications closet.

A list of proposed test equipment for use in verifying the installation of the cabling system.

Manufacturer documentation showing date and outcome of last recalibration. Testing device shall have been re-calibrated within the last six months.

Manufacturer documentation showing software revision. Software revision shall be most current version available for device and based upon the most current TIA/EIA testing guidelines.

Proposed Category 6 UTP cable and fiber optic cable test forms.

Operating and maintenance instructions for each device in the system. These instructions shall detail how to install and service the equipment and shall include all information necessary for rough-in preparation for the building facilities to receive the materials. At the completion of the project, update the operating and maintenance information to reflect any changes during the course of construction, and shall be provided to the owner in a binder labeled with the project name and description. Provide three copies of the operating and maintenance information.

Prior to bidding the project, the Contractor shall be trained and certified by the manufacturer to install, test, and maintain the systems and shall be certified by the manufacturer to provide the manufacturer's products, performance, and application warranty.

The Contractor shall employ a minimum of one Register Communications Distribution Designer (RCDD) certified by the Building Industry Consulting Service International (BICSI). The RCDD shall be a direct employee of the Contractor. The RCDD shall inspect the work in progress and shall certify the work at the completion of the project.

The Contractor shall have employees directly involved with the supervision, installation, and testing of the data systems trained and certified by the supplier for Communication for installation and testing.

The Contractor shall have a minimum of three years' experience installing data cabling systems.

During construction, the Contractor shall periodically review installation progress for conformation to TIA/EIA and BICSI installation standards. The Contractor shall provide an official, written report to the Engineer that details the work reviewed and verifies that the work conforms to all applicable TIA/EIA and BICSI installation standards.

After substantial completion and prior to Owner's acceptance, the Contractor shall certify in writing on company letterhead that the completed installation meets or exceeds TIA/EIA and BICSI installation standards. The written certification shall be complete with the RCDD's stamp/certification number and shall bear the RCDD's signature across the face of the stamp.

The Contractor shall provide a manufacturer 15-year product, performance, application, and labor warranty. This warranty shall guarantee against defects in materials and workmanship (extended product warranty) for a period of 15 years. All cabling components of the installed systems will meet or exceed the specification of TIA/EIA 568 B and ISO/IEC 11801 (performance warranty) for a period of 15 years.

All shielded and unshielded twisted pair cabling links/channels will meet or exceed the attenuation and NEXT requirements of TIA/EIA TSB 67 and ISO.IEC 11801 (performance warranty) for a period of 15 years.

All fiber links/channels shall meet or exceed the loss and bandwidth requirements of TIA/EIA TSB 67 and ISO/IEC 11801 (performance warranty) for a period of 15 years.

The system shall be application independent and shall support both current and future applications that use the TIA/EIA 568 B or ISO/IEC 11801 component and link/channel specifications for cabling (application warranty) for a period of 15 years.

Supply all labor attributable to and required by the above at no additional cost to the owner for a period of 15 years.

The warranty period shall begin on the date of substantial completion.

Install freestanding EIA standard universal 19" wide equipment racks, sized at 7' at location indicated on Drawings. Install racks with mounting holes on both sides and provide with top angles, self-supporting bases and grounding kit.

Wall mounted racks shall be mounted on a backboard and provided with a ground kit.

Install fiber patch panels to accommodate multimedia fiber optic cable as indicated on the Drawings

Modular equipment manufacturer shall furnish workstation outlets.

All cabling shall bear plenum or riser related markings for the environment in which installed.

Install Category 6 cable for data ports. Install one cable per 8-position communications jacks on a given workstation outlet. Category 6 cables shall meet or exceed TIA/EIA 568 B Category 6 specifications for performance, shall be part of the UL LAN Certification and follow-up program, defined by the manufacturer as an "extended performance Category 6 cable."

Install fiber optic riser cable for data backbones as indicated on the Drawings. Terminate all multimode fiber strands with Duplex SC-style connectors. Fiber optic cables shall meet or exceed standard for 100Mbps transmission. Multimode fiber optic cable shall be 62.5/125 micron graded index, tight buffered.

Label shall be as recommended in TIA/EIA 606. Labels shall be permanent and legible as created by a Brady #LS-2000 label maker or equivalent. Handwritten labels are not acceptable. Labels shall be required for communications closets, riser cables, communication jacks, termination block columns for workstations and riser cables, termination strip pairs, and grounding bus bars.

END SECTION

27 21 00 Data Communications Network Equipment

- 27 21 13 Data Communications Firewalls
- 27 21 16 Data Communications Routers, CSU/DSU, Multiplexers, Codec's, and Modems
- 27 21 26 Data Communications Network Management
- 27 21 29 Data Communications Switches and Hubs
- 27 21 33 Data Communications Wireless Access Points

27 22 00 Data Communications Hardware

- 27 22 13 Data Communications Mainframes
- 27 22 16 Data Communications Storage and Backup
- 27 22 19 Data Communications Servers
- 27 22 23 Data Communications Desktops
- 27 22 26 Data Communications Laptops
- 27 22 29 Data Communications Handhelds

27 24 00 Data Communications Peripheral Data Equipment

- 27 24 13 Printers
- 27 24 16 Scanners
- 27 24 19 External Drives
- 27 24 26 Virtual Reality Equipment
- 27 24 29 Disaster Recovery Equipment

27 25 00 Data Communications Software

- 27 25 13 Virus Protection Software
- 27 25 16 Application Suites
- 27 25 19 Email Software
- 27 25 23 Graphics/Multimedia Software
- 27 25 26 Customer Relationship Management Software
- 27 25 33 Database Software
- 27 25 37 Virtual Private Network Software
- 27 25 39 Internet Conferencing Software

27 26 00 Data Communications Programming and Integration Services

- 27 26 13 Web Development
- 27 26 16 Database Development
- 27 26 19 Application Development
- 27 26 23 Network Integration Requirements
- 27 26 26 Data Communications Integration Requirements

27 30 00 VOICE COMMUNICATIONS

CONSULTANT DESIGN GUIDELINE

Telephone system shall comply with the following:

ANSI/TIA/EIA - 568 B: Commercial Building Telecommunications Cabling Standard.

ANSI/TIA/EIA - 569: Commercial Building Standard for Telecommunication Pathways and Spaces.

ANSI/TIA/EIA - 606: The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

ANSI/TIA/EIA - 607: Commercial Building Grounding and Bonding Requirements for Telecommunications.

TIA/EIA - tsb67: Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems.

ISO/IEC IS 11801: Generic Cabling for Customer Premises>

INCLUDE IN CONSTRUCTION DOCUMENTS

The Contractor shall provide shop drawing submittal information for review. Do not order materials until the Engineer has approved the shop drawings and submittals. Provide each of the following for review:

Cable routing and grouping plan.

Proposed wall termination block/wire management elevations, to scale, for each backboard in each communications closet.

Provide operating and maintenance instructions for each device in the system. These instructions shall detail how to install and service the equipment and include all information necessary for rough-in preparation for the building facilities to receive the materials. At the completion of the project, update the operating and maintenance information to reflect any changes during the course of construction, and provide to owner in a binder labeled with the project name and description.

Provide three copies of the operating and maintenance information.

The Contractor shall provide a manufacturer endorsed and backed extended 15-year product, performance, application, and labor warranty, which shall warrant the following:
Warrant against defects in materials and workmanship (extended product warranty) for a period of 15 years.

All cabling components of the installed systems will meet or exceed the specification of TIA/EIA 568 B and ISO/IEC 11801 (performance warranty) for a period of 15 years.

All shielded and unshielded twisted pair cabling links/channels will meet or exceed the attenuation and NEXT requirements of TIA/EIA TSB 67 and ISO.IEC 11801 (performance warranty) for a period of 15 years.

All fiber links/channels shall meet or exceed the loss and bandwidth requirements of TIA/EIA TSB 67 and ISO/IEC 11801 (performance warranty) for a period of 15 years.

The system shall be application independent and shall support both current and future applications that use the TIA/EIA 568 B or ISO/IEC 11801 component and link/channel specifications for cabling (application warranty) for a period of 15 years.

All labor attributable to and required by the above supplied at no additional cost to the owner for a period of 15 years.

END SECTION

SECTION 27 31 00 Voice Communications Switching And Routing Equipment

27 31 13 PBX/Key Systems

27 31 23 Internet Protocol Voice Switches

27 32 00 Voice Communications Telephone Sets, Facsimiles and Modems

27 32 13 Telephone Sets

27 32 16 Wireless Transceivers

27 32 23 Elevator Telephones

27 32 26 Ring-Down Emergency Telephones

Consultant design guideline

Blue light phones should be Gaitronics or equal. Gaitronics is the only unit we know of equipped to handle duplexing – where the officer can talk to the customer at the same time the customer can talk with them – unlike the communications systems used by others that operate like a radio where one has to stop talking before the other can talk.

End of section

27 32 29 Facsimiles and Modems

27 32 36 TTY Equipment

27 33 00 Voice Communications Messaging

- 27 33 16 Voice Mail and Auto Attendant
- 27 33 23 Interactive Voice Response
- 27 33 36 Facsimile Servers

27 34 00 Call Accounting

- 27 34 13 Toll Fraud Equipment and Software
- 27 34 16 Telemanagement Software

27 35 00 Call Management

- 27 35 13 Digital Voice Announcers
- 27 35 16 Automatic Call Distributors
- 27 35 19 Call Status and Management Displays
- 27 35 23 Dedicated 911 Systems

27 40 00 AUDIO-VIDEO COMMUNICATIONS

27 41 00 Audio-Video Systems

- 27 41 13 Architecturally Integrated Audio-Video Equipment
- 27 41 16 Integrated Audio-Video
 - 27 42 16.25 Integrated Audio-Video Systems and Equipment for Restaurants and Bars
 - 27 42 16.28 Integrated Audio-Video Systems and Equipment for Conference Rooms
 - 27 42 16.29 Integrated Audio-Video Systems and Equipment for Board Rooms
 - 27 42 16.51 Integrated Audio-Video Systems and Equipment for Classrooms
 - 27 42 16.61 Integrated Audio-Video Systems and Equipment for Theaters
 - 27 42 16.62 Integrated Audio-Video Systems and Equipment for Auditoriums
 - 27 42 16.63 Integrated Audio-Video Systems and Equipment for Stadiums and Arenas
- 27 41 19 Portable Audio-Video Equipment
- 27 41 23 Audio-Video Accessories

27 42 00 Electric Digital Systems

- 27 42 13 Point of Sale Systems
- 27 42 16 Transportation Information Display Systems
- 27 42 19 Public Information Systems

27 50 00 DISTRIBUTED COMMUNICATIONS AND MONITORING SYSTEMS

27 51 00 Distributed Audio-Video Communications Systems

- 27 51 13 Paging Systems
 - 27 51 13.13 Overhead Paging Systems
- 27 51 16 Public Address and Mass Notification Systems
- 27 51 19 Sound Masking Systems
- 27 51 23 Intercommunications and Program Systems
 - 27 51 23.20 Commercial Intercommunications and Program Systems
 - 27 51 23.30 Residential Intercommunications and Program Systems
 - 27 51 23.50 Educational Intercommunications and Program Systems
 - 27 51 23.63 Detention Intercommunications and Program Systems
 - 27 51 23.70 Healthcare Intercommunications and Program Systems

27 52 00 Healthcare Communications and Monitoring Systems

27 52 13 Patient Monitoring and Telemetry Systems

27 52 16 Telemedicine Systems

27 52 19 Healthcare Imaging Systems

27 52 23 Nurse Call/Code Blue Systems

27 53 00 Distributed Systems

SECTION 27 53 13

CLOCK SYSTEMS

27 53 16 Infrared and Radio Frequency Tracking Systems

27 53 19 Internal Cellular, Paging, and Antenna Systems