

## **DIVISION 27 – COMMUNICATIONS**

### **27 00 00 COMMUNICATIONS**

#### **Design Process**

Telecommunications systems include vertical and horizontal copper and fiber optic wiring as well as the associated termination hardware on both ends. The system includes pathways and conduits; equipment racks; frames; wire management systems; communication rooms; and the electrical, mechanical, and environmental equipment required to support them.

Pricing for voice and data projects that are released for bid should be broken out separately from security, audiovisual, building control and other low voltage systems.

These specifications are intended to allow Office of Information Technology (OIT) to meet the telecommunications requirements of the University over the lifetime of the buildings. OIT shall be consulted and included in meetings with the University of Minnesota Project Manager, architects, and/or consultants and electrical designers prior to and at each stage of the project (i.e. Schematic Design (SD) and Design Development (DD)) to ensure that present and future voice and data service requirements can be met.

Projects must use the products specified by these standards. To that end, any project requesting a non-standard installation of cabling infrastructure, voice/data jacks, or other items not specified in these standards shall submit a written explanation of the requested variance to OIT for review (send request to NTSprojects@umn.edu). OIT **MUST** provide prior written approval for any deviations from these standards. If an exception was not requested and approved by OIT the vendor will be responsible for the cost of replacing the unapproved product.

CPPM, Facilities Management and U of M Construction Project Managers should be the first line to enforce the standards on contractors. These departments are managing projects for the benefit of the University and shall ensure that all bidders to the work are following the same standards and requirements. OIT will provide guidance and investigative effort to help ensure standards are followed, and will provide evidence of issues needing enforcement.

Construction specifications are an important component of an Information Technology system. Information Technology systems shall adhere to these standards in order to be functional in a wide variety of communications applications. Materials and work specified herein shall comply with the applicable requirements of:

- National Electrical Code (NEC-2014)
- Uniform Building Code (UBC)
- Uniform Fire Code (UFC)
- Minnesota State Power Limited Laws
- Federal Communications Commission (FCC)
- Building Industry Consulting Services International (BICSI)
- TIA, EIA, TIA/EIA
- ANSI, CABO/ANSI, ANSI/NFPA
- IEEE
- BICSI TDMM
- NFPA
- OSHA
- NEMA
- ISO/IEC
- BELLCORE
- TIA TSB~88 Bulletin

## \*\* RENOVATIONS \*\*

When an area of a building is undergoing a renovation the standards in their entirety must be followed. The following renovation standards shall be followed, or exceptions shall be drafted to the contrary:

- ❖ The renovation shall install the same brand (manufacturer) of jacks that are currently installed in the building. Project shall also use same brand of jacks on both ends of the cable (example: Panduit, Commscope, Leviton).
- ❖ The renovation shall install the same color of horizontal cabling that is currently installed in the building.
- ❖ All renovations shall include full wireless coverage for the area being renovated. OIT will provide the wireless design for larger renovations, and review for approval designs for smaller renovations. The cost to install the wireless shall be covered by the project.
- ❖ Renovations are unique, and are looked at on a case by case basis. The project manager needs to ask for an exception if the work deviates from the standards.
- ❖ If an area of a building is being remodeled (not the whole floor), and was initially wired with Category 5E cabling, any subsequent wiring shall be done exclusively with Category 5E cable (unless otherwise specified by OIT).
- ❖ In situations where there is more than one (1) IDF in which station cable could be run to, OIT will make the final determination on which IDF to use.
- ❖ OIT will determine the number of network switches to provide service for any project.

### **27 01 00 Operation and Maintenance of Communications Systems**

#### **27 05 00 Common Work Results for Communications**

##### **27 05 13 Communications Services**

Telecommunications rooms are special-purpose rooms that have specific requirements due to the nature, size, and complexity of the equipment and wiring housed in these rooms. There are three types of telecommunications rooms, each supporting critical functions as part of the building wiring and telecommunications systems. The three types of rooms are:

##### **Distribution Equipment Facility**

The Distribution Equipment Facility (DEF) is the main room in a building that holds a PBX Switch and/or Network core node, aggregators and the voice and data networks for this building. This room also provides voice and data services to other University buildings. A DEF is not required in all new buildings. OIT will determine if equipping the building with a DEF is necessary due to the voice and data requirements for the immediate area.

### **Main Distribution Frame (MDF)**

The main equipment room is the main room in a building into which all outside facilities are routed and terminate. This room serves as the primary telecommunications room and entrance facility. All other communications rooms (IDF's) within the building are fed with backbone cables from the MDF.

### **Intermediate Distribution Frame (IDF)**

An IDF is an enclosed and secured space specifically intended for housing telecommunications cables, termination hardware, cross-connect facilities, and equipment for voice and data facilities.

The following standards apply to all telecommunications rooms:

- ❖ **PROHIBITED:** Using telecommunications rooms as a route for other facilities to pass through.
- ❖ **PROHIBITED:** Using boiler rooms, air exchange rooms, janitorial closets, electrical distribution closets, or areas with water heaters and wet sinks for communications. Telecommunication rooms shall be dedicated solely to OIT telecommunications.
- ❖ **PROHIBITED:** Placing telecommunication rooms in or near areas of high electromagnetic interference (EMI) or radio frequency interference (RFI). Both adversely affect the system performance and the reliability of electronic equipment.
- ❖ **PROHIBITED:** Non-OIT resources shall not be located in telecommunications rooms.
- ❖ **The DEF/MDF/IDF must be in its finished stage before any copper or fiber cables are terminated, or before any data switches are installed. This means rooms are free of dust and debris, painting is completed, and floors are treated. Contractor is responsible for dust, debris, and moisture. After switches are installed, the door must be kept closed and locked at all times.**
- ❖ Communications rooms shall be directly accessible from the hallway.
- ❖ Fire suppression systems for all of these rooms shall be two-stage water systems; no Halon or gas systems shall be used. Pipes shall be insulated to prevent condensate formation. Fire suppression system pipes shall not be installed directly over equipment, but rather they shall be placed near the walls with the manifold pipes in ceiling corners.
- ❖ All Distribution Equipment Facility, MDF and IDF rooms shall be secured with an electronic proximity card key access reader approved by University of Minnesota Access Services and OIT.
- ❖ All walls shall be lined with 8-foot high by 4-foot wide by 3/4-inch thick, unpainted, fire-retardant, CD grade or better plywood backboard, mounted with the smooth side out starting at 4" above the finished floor (AFF).

- ❖ OIT shall perform all cross connects and circuit activations in all telecommunications rooms, including Distribution Equipment Facility, MDF and IDF rooms. This includes all associated voice and data hardware and equipment.
- ❖ All floor penetrations shall be sleeved to a height of 2-3” (AFF).

### **Electrical Power Requirements**

Power to terminal rooms shall be installed using dedicated circuits to these areas. UPS system equipment shall be incorporated only if identified and budgeted in the project in consultation with OIT.

Where UPS systems are required, in Distribution Equipment Facilities, the following criteria apply:

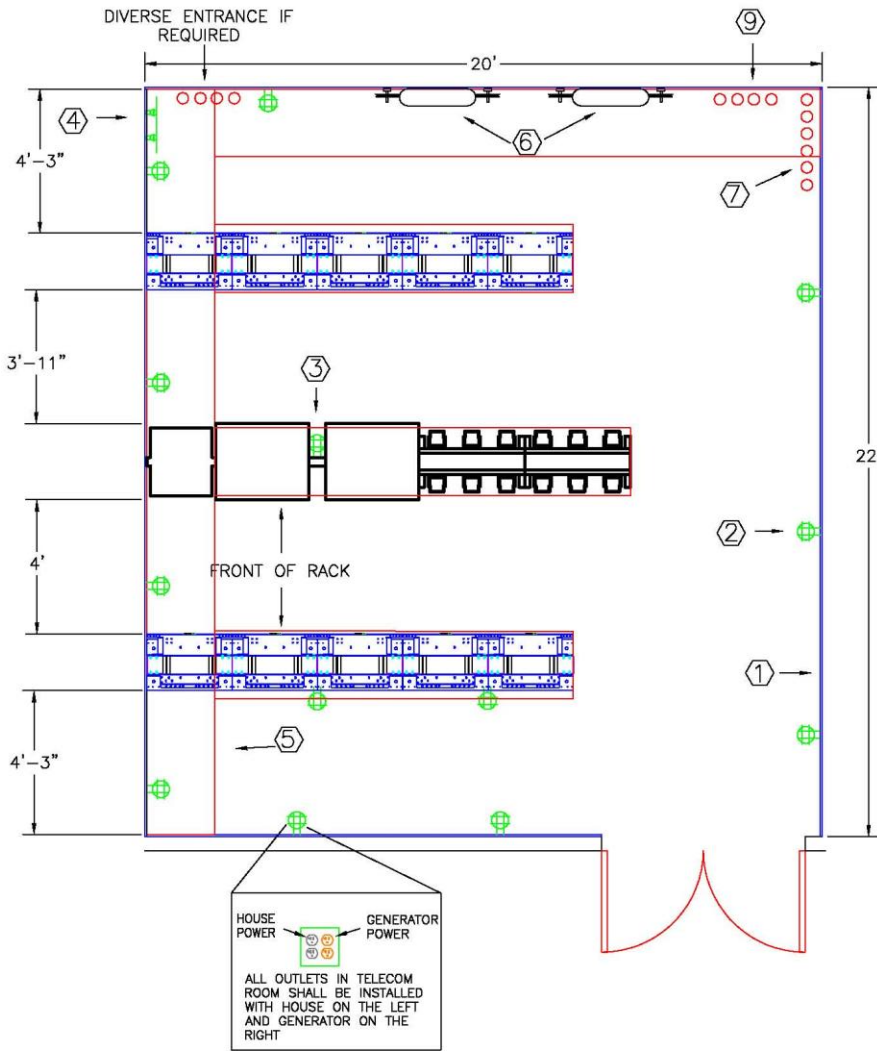
- ❖ The power feed to the Uninterruptible Power Supply (UPS) systems shall be included in the building generator distribution system, and appropriate transfer switches shall be installed. If no generator is provided, emergency generator planning shall be completed. This may include OIT placing a generator on-site or installing an emergency power coupler in a location that is accessible by OIT portable generators. Full-circuit documentation shall be provided prior to starting up the Distribution Equipment Facility. A battery backup system located in a separate room specifically designed for that purpose may also be required. Where there is battery backup in rooms, they shall include the required Occupational Safety and Health Administration (OSHA) containment system for sealed and spill-proof batteries.
- ❖ Space ventilation or air conditioning shall be provided to maintain the recommended operating temperature of UPS equipment.
- ❖ The systems shall be completely isolated from the line. The neutral shall be bonded to ground.
- ❖ Voltage spikes shall have attenuation of 2,000:1 from line for lightning protection. Surges shall be suppressed to safe levels as described by IEEE (Institute of Electrical and Electronics Engineers) 587 A and B (guide to surge voltages).
- ❖ Common mode noise rejection shall be better than 120 dB. Transverse mode noise rejection shall be greater than 60 dB.
- ❖ The wave shape shall be sine. It shall be limited to 3% single harmonic distortion, and 5% total harmonic distortion.
- ❖ Loss of power shall be less than 2 milliseconds in transfer to the UPS and return. The waveform shall remain in phase.
- ❖ The UPS shall be capable of providing a full load without input power for 20 minutes.
- ❖ There shall be a method of bypassing AC so the UPS may be maintained and repaired without loss of power to equipment. It is not necessary to condition power in this mode.

- ❖ The UPS shall be capable of handling a 25% overload for five minutes and a surge overload of 50%.
- ❖ There shall be a delay of more than 15 seconds before the UPS returns to normal line conditioning mode.
- ❖ UPS systems shall be network connected to the BSAC-2 mid and monitored/alarmed via the Metasys™ ADX server, FM/Energy's central monitoring and control server.

## **Distribution Equipment Facility**

### **Introduction**

- ❖ Distribution Equipment Facilities shall be installed in a separate and secure room. The Distribution Equipment Facility room shall serve as the primary copper and fiber-optic cable distribution center for this building and other University buildings.
- ❖ The minimum size for a Distribution Equipment Facility is 22 feet by 20 feet. See Figure A for layout.
- ❖ The DEF shall be rectangular in shape. Triangle, L-shaped, and curved walls are not acceptable.
- ❖ An OIT approved frame system shall be used in this room to accommodate the copper cabling.
- ❖ Distribution Equipment Facilities shall have a minimum of two air conditioners run in a redundant fashion. Each air conditioner shall be able to support the room on its own and shall be sized 50% larger than the BTU rating of the total (designed) installed equipment. The units shall cycle between each other automatically at a 50% rate. Consult OIT for the exact type and capacity of air handling equipment.
- ❖ Environmental and power systems shall be set up to be monitored with Energy Management's standard Metasys™ monitoring software.
- ❖ Building requirements vary. OIT shall certify plans as acceptable prior to finalizing building plans.



KEY NOTES:

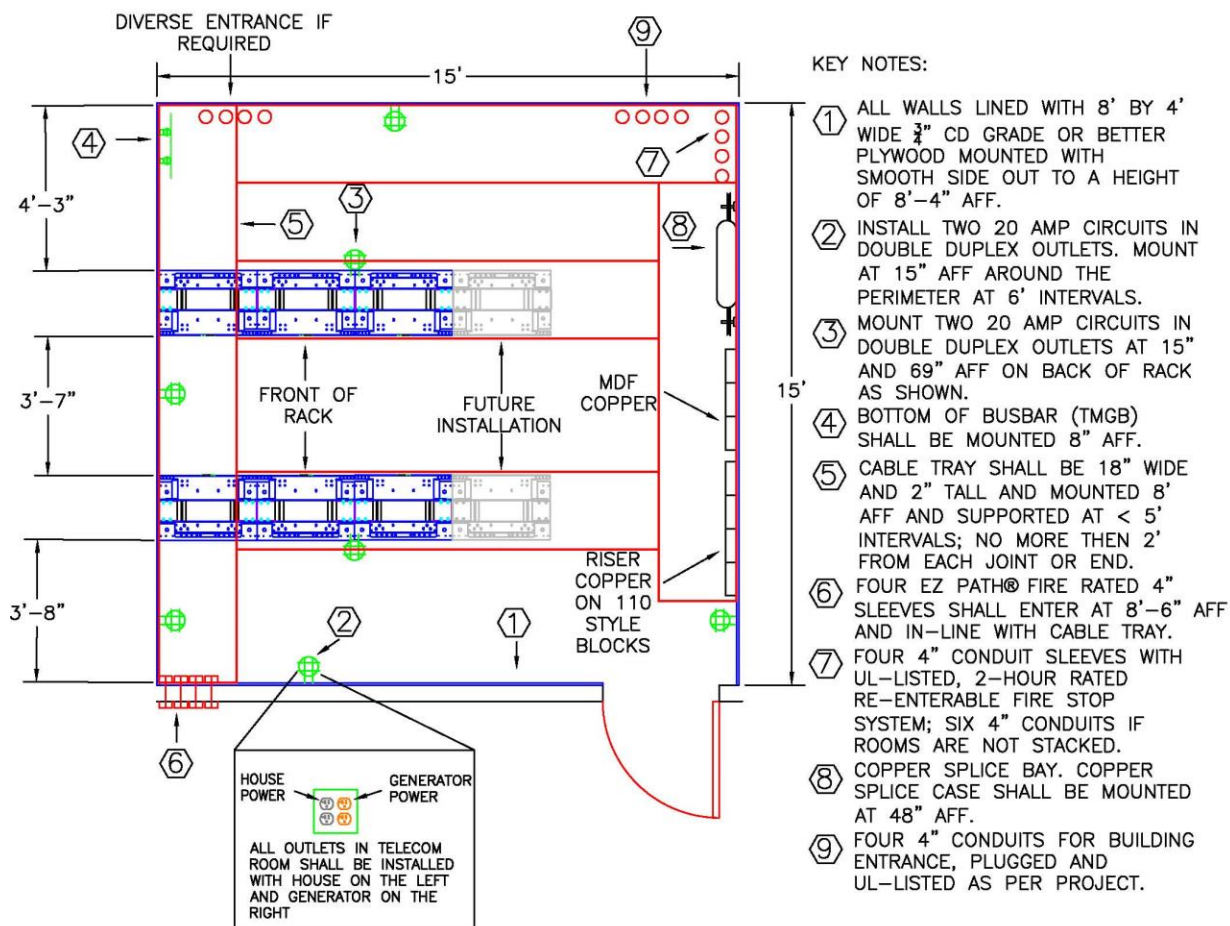
- ① ALL WALLS LINED WITH 8' BY 4' WIDE 3/4" CD GRADE OR BETTER PLYWOOD MOUNTED WITH SMOOTH SIDE OUT TO A HEIGHT OF 8'-4" AFF.
- ② INSTALL TWO 20 AMP CIRCUITS IN DOUBLE DUPLEX OUTLETS. MOUNT AT 15" AFF AROUND THE PERIMETER AS SHOWN FOLLOWING THE NEC REQUIREMENTS
- ③ MOUNT TWO 20 AMP CIRCUITS IN DOUBLE DUPLEX OUTLETS AT 15" AND 69" AFF ON BACK OF RACK AS SHOWN
- ④ BOTTOM OF BUSBAR (TMGB) SHALL BE MOUNTED 8" AFF
- ⑤ CABLE TRAY SHALL BE 24" GRAY LADDER RACK (CHATSWORTH PART # 10250-124) AND MOUNTED TRAPEZE STYLE 8" AFF AND SUPPORTED AT < 5' INTERVALS; NO MORE THEN 2' FROM EACH JOINT OR END.
- ⑥ COPPER/ FIBER SPLICE BAY. FIRST SPLICE CASE SHALL BE MOUNTED AT 48" AFF.
- ⑦ FOUR 4" CONDUIT SLEEVES WITH UL-LISTED, 2-HOUR RATED RE-ENTERABLE FIRE STOP SYSTEM; SIX 4" CONDUITS IF ROOMS ARE NOT STACKED
- ⑧ A MINIMUM OF 4' CLEARANCE SHALL BE MAINTAINED AROUND AND BETWEEN EACH RACK ROW
- ⑨ FOUR 4" CONDUITS FOR BUILDING ENTRANCE, PLUGGED AND UL-LISTED AS PER PROJECT

Figure A: Distribution Equipment Facility room

## Main Equipment Room (MDF)

### Introduction

- ❖ Main equipment facilities shall be installed in a separate and secure room. The main equipment room shall serve as the primary copper and fiber-optic cable distribution center for the building. All voice and data distribution shall emanate from this room.
- ❖ The MDF shall be square in shape. Triangle, L-shaped, and curved walls are not acceptable.
- ❖ The minimum size for a MDF is 15 feet by 15 feet. See Figure B for MDF layout.



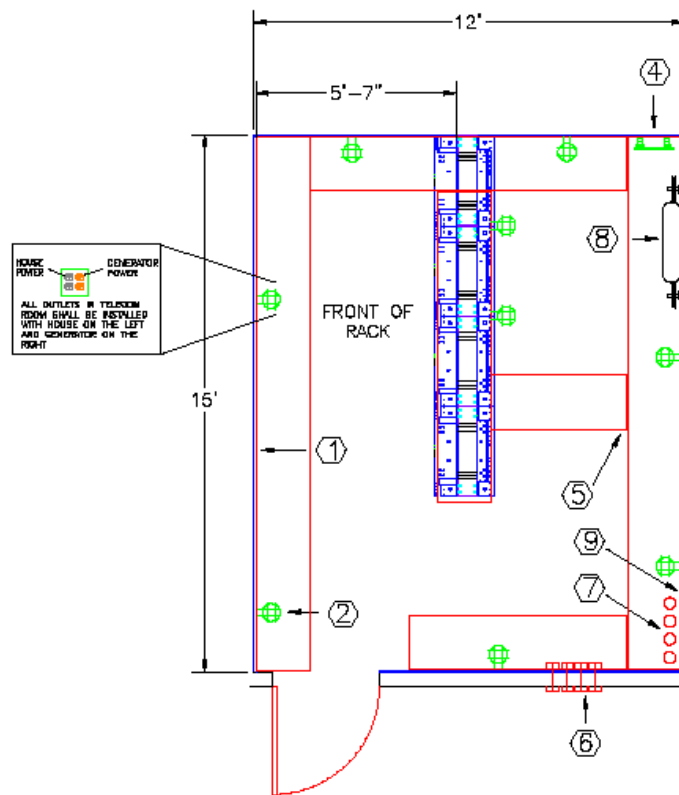
**Figure B: MDF room**

## **Intermediate Distribution Facility (IDF)**

### **Introduction**

- ❖ The minimum size for a communications room is 12 feet by 15 feet.
- ❖ The IDF shall be rectangular in shape. Triangle, L-shaped, and curved walls are not acceptable. There shall be a minimum of one IDF per floor, vertically aligned with the other IDFs. See Figure C for IDF layout.
- ❖ Rooms shall be spaced so that no horizontal communications cabling run exceeds 90 meters.
- ❖ The communications rooms shall be environmentally controlled by HVAC 24 hours a day, seven days a week. The rooms shall maintain a positive pressure with a minimum of one complete air exchange per hour, and a minimum capacity of  $\frac{3}{4}$  ton or 9000 BTU/hr.
- ❖ Riser cables shall be distributed in one or more riser shafts enclosed in a series of vertically aligned closets beginning in the lowest level of the building and extending throughout the height of the building. These shafts shall be aligned vertically to facilitate cable pulling. Communications rooms are intended for exclusive use by OIT.
- ❖ Communications rooms shall be interconnected to each other by four 4-inch sleeves with bushings that extend a minimum of 2 inches to a maximum of 3 inches above the finished floor and are fire-stopped with a UL-classified fire stop system. The sleeves shall be for exclusive use by OIT. The sleeves shall be located at the left edge of the terminal board, as close to the wall as possible. Sleeves shall never be placed in the center of the terminal board. If closets cannot be aligned vertically, six conduits of 4-inch size or 4-inch by 24-inch cable tray shall be placed between them for exclusive OIT use. These conduits must also be fire-stopped with a UL-classified fire stop system.
- ❖ The last 12 rack units (RUs) of every telecomm rack shall be left open and not have any equipment or patch panels installed. The only exception to this rule is for the installation of UPSs, and grounding busbars.
- ❖ See Figure C for IDF room layout.
- ❖ See Figure D for IDF rack layout.

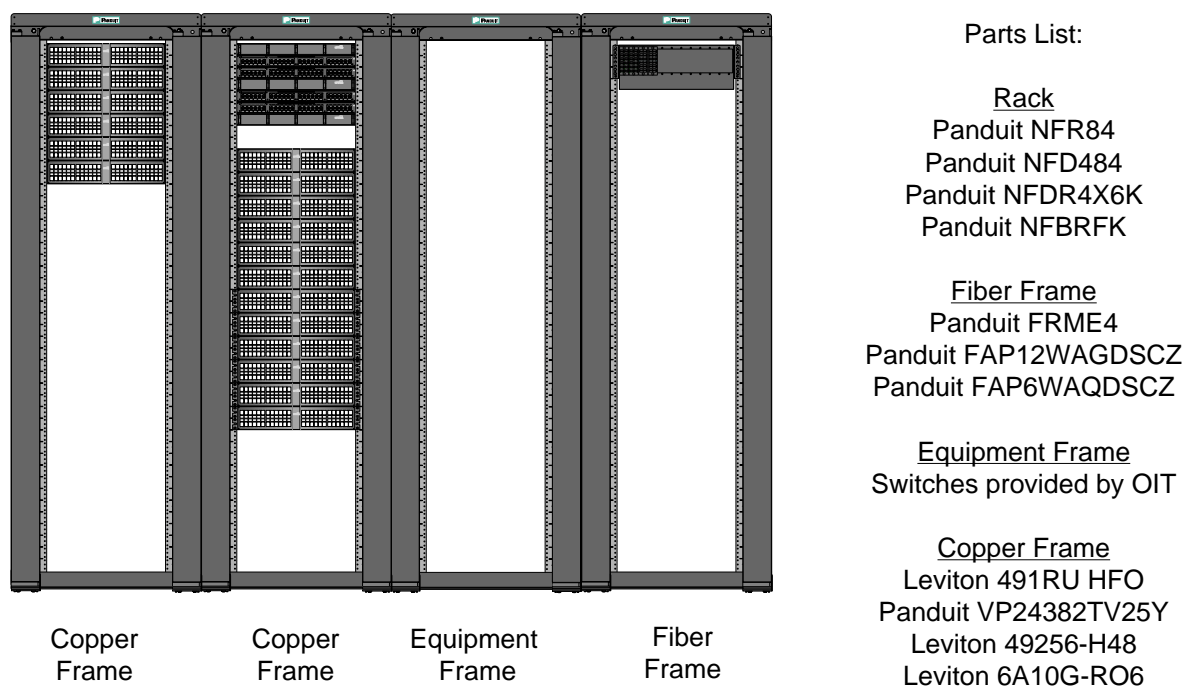




## KEY NOTES:

- ① ALL WALLS LINED WITH 8' BY 4' WIDE 3/4" CD GRADE OR BETTER PLYWOOD MOUNTED WITH SMOOTH SIDE OUT TO A HEIGHT OF 8'-4" AFF.
- ② INSTALL TWO 20 AMP CIRCUITS IN DOUBLE DUPLEX OUTLETS. MOUNT AT 15" AFF AROUND THE PERIMETER AT 6' INTERVALS.
- ③ MOUNT TWO 20 AMP CIRCUITS IN DOUBLE DUPLEX OUTLETS AT 15" AND 69" AFF ON BACK OF RACK AS SHOWN.
- ④ BOTTOM OF BUSBAR (TGB) SHALL BE MOUNTED 8" AFF.
- ⑤ CABLE TRAY SHALL BE 18" WIDE AND 2" TALL AND MOUNTED 8" AFF AND SUPPORTED AT < 5" INTERVALS AND NO MORE THEN 2' FROM EACH JOINT OR END.
- ⑥ FOUR EZ PATH® SERIES 44 FIRE RATED 4" SLEEVES AND MULTIGANG WALL BRACKET SHALL ENTER AT 8'-6" AFF.
- ⑦ FOUR 4" CONDUIT SLEEVES WITH UL-LISTED, 2-HOUR RATED RE-ENTERABLE FIRE STOP SYSTEM; SIX 4" CONDUITS IF ROOMS ARE NOT STACKED.
- ⑧ COPPER SPLICE BAY. COPPER SPLICE CASE SHALL BE MOUNTED AT 48" AFF.
- ⑨ 18" WIDE AND 2" TALL CABLE TRAY MOUNTED TO PLYWOOD. RISER CABLE SECURED TO TRAY AT 3' INTERVALS.

Figure C: IDF room



**Figure D: IDF Rack Layout**

## 27 05 43 Underground Ducts and Raceways for Communications Systems

### Entrance Facilities

The entrance facility is the location where the pathways for communications services penetrate the building to connect to the voice and data systems within the building.

OIT shall designate the shortest practical route for the communications cable to connect from the building to the point of connection with the University telephone and network cabling systems. Conduit shall be installed within the facility from the point of entry to the Distribution Equipment Facility or MDF.

Diverse facilities entrances are required for all new buildings. A diverse entrance shall include a minimum of two 4-inch conduits.

### Underground Conduit

- A. The conduit requirements for entrance facilities are six 5-inch rigid steel conduits that extend from the property line to a Distribution Equipment Facility or four 4" conduits into a telecommunications main equipment room (MDF). Elbows shall be long-sweep rigid steel to prevent abrasion during cable installation. Conduits shall be installed at least 36" below grade. Test all conduits after installation by pulling a full-size test mandrel through the conduit to verify that none are blocked or crushed. Upon completion of testing, install a minimum 300#-test, non-degradable pull line in each conduit. All conduits entering a building must be sloped away from the building.

## Maintenance Holes

Standard pre-manufactured concrete maintenance hole with interior dimensions of 8' by 8' by 7' high shall be product of Oldcastle Precast®, Oldcastle Greenline® (Aircraft Vault), or prior approved equal. The maintenance hole shall include the following features:

1. Knockout slots with conduit terminators as required or pre-drilled holes for cable duct
2. Five to six inch concrete wall thickness
3. Cable racking struts
4. Cable rack hooks (quantity of 48 in each maintenance hole, 7 ½" 32 each and 10" 16 each).
5. Vault ladder
6. 1-1/4" diameter ground rod sleeve located in corner of vault.
7. Vault frame and 32" steel cover (with "Fiber Optic" label). Manhole cover bolt threads shall be compatible with 5/8" bolts supplied by NTS.
8. 12" diameter sump in center of vault floor (note: provide a minimum of 18" of pea-sized screened stones under the floor sump hole to facilitate better drainage).
9. 38" diameter access at top center of vault
10. A minimum of 4 pulling irons
11. Factory end bells shall be used where conduits penetrate maintenance hole walls.
12. Furnish and install an 8' galvanized stainless steel ground rod through the base of the maintenance hole in the ground rod sleeve in the corner of the maintenance hole (leave one foot of rod above floor of maintenance hole).

## 27 05 26 Grounding and Bonding for Communications Systems

### Bonding and Grounding

The grounding system shall be intentional, visually verifiable, and adequately sized to handle expected currents safely.

### Busbars

- ❖ Each communications room in a building shall have a grounding busbar, installed in a lower corner of the plywood backboard at 8 inches above the finished floor.
- ❖ The main equipment and Distribution Equipment Facility rooms shall house the Telecommunications Main Grounding Busbar (TMGB), and each other equipment room shall house a Telecommunications Grounding Busbar (TGB).
- ❖ Busbars shall be TIA 607 pattern, electrotin plated and predrilled to accept standard two-hole lugs. The TMGB shall be a minimum of 20 inches long. The TGB shall be a minimum of 12 inches long. Currently approved busbars are Panduit GB4 series for the Distribution Equipment Facility and MDF and GB2 series for the IDF, or a substitute that has been approved by OIT through the exceptions request process.

### **Telecommunications Bonding Backbone**

- ❖ The telecommunications bonding backbone (TBB) shall be sized according to TIA 607 specifications, and the bend radius on any necessary bends on this cable shall be greater than 8 inches.
- ❖ Connections to the TBB at every floor except the top floor shall be made via copper compression H-TAP and a conductor no smaller than the TBB. On the top floor the connection shall be made with a two-hole lug.

### **Cables**

- ❖ Each metallic armored cable in a building shall be grounded at one end only via a bond attached to the cable armor. The bond shall be Electric Motion Company's EM 2BBx bond or a substitute that has been approved by OIT through the exceptions request process.

### **Rack Grounding (Fiber Optic Building Entrance Cable)**

- ❖ The telecommunications rack that houses the fiber optic building entrance cable shall have a grounding busbar installed on the back side in the bottom rack unit (RU) location. Busbars shall be predrilled to accept standard two-hole lugs and be Panduit part number RGRB19Y or a substitute that has been approved by OIT through the exceptions request process.

### **Pathway Grounding**

- ❖ Any metallic component, including equipment, ladder racks, enclosures, cable trays, etc., shall be bonded to the grounding system. Individual segments of ladder rack and basket tray must be bonded together in order to make them electrically continuous. All bonding and grounding components must be approved by the cable support system manufacturer. Any metallic conduit that carries a grounding conductor and is greater than 3 feet long shall have both ends bonded to the conductor with a bonding jumper no longer than 12 inches, fastened with a compression HTAP to the conductor on one side and to the conduit on the other.

### **Equipment Grounding**

- ❖ Some telecommunications equipment has specific grounding requirements, verify and follow the grounding recommendations of the manufacturer.

### **Compression Fittings**

- ❖ Lugs and HTAPs shall be manufactured of tin plated copper and fastened via irreversible compression (crimped). Lugs shall have spacing to fit Panduit (or a substitute that has been approved by OIT through the exceptions request process.) GB series predrilled busbars and a window to allow for inspection of the crimp. HTAPs shall be contained in clear covers that allow inspection of the die marks to ensure that the proper die was used.
- ❖ Approved lugs:
  - Panduit LCC or LCCX series
  - Burndy YAZ series

- CPI
  - Electric Motion Company CCL Series
  - Or a substitute that has been approved by OIT through the exceptions request process.
- ❖ Approved HTAPS:
- Panduit HTWC series
  - Burndy YH series (when used with clear covers)
  - or a substitute that has been approved by OIT through the exceptions request process.

### Testing and documentation

The grounding system shall be documented with an As-Built one-line diagram in AutoCAD format, saved to a CD-ROM and given to OIT design engineer.

To ensure that bonding connections from the busbar to infrastructure within the telecommunications spaces are of low resistance and that the impedance to ground is as low as possible, the following checks shall be performed:

- ❖ **Lugs:** Visually check that the conductor is visible in the window of the lug to ensure that it was fully inserted, and that the lug is properly crimped. Check that the lug is fastened through both mounting holes, that the connection is tight.
- ❖ **HTAPs:** Ensure that the mark left on the HTAP indicates that the appropriate manufacturer-recommended die was used for that HTAP, and that the connection is protected by a clear cover that allows visual inspection.
- ❖ **Racks:** Visually check that the racks have been assembled with paint-piercing washers or are constructed so as to make such measures unnecessary (i.e. welded).
- ❖ **Conduits:** If a bonding conductor is routed through a metallic conduit more than three feet long, ensure that both ends of the conduit are bonded to the conductor with a suitable method, avoiding sharp bends in the cable. **Looping the conductor itself through the conduit bonding collar is prohibited.**

### Measurements:

- ❖ Ensure that the resistance of the following connections is less than 0.1 ohms:
  - Lug to HTAP for any connections to Common Bonding Network
  - Rack bonding lug to any rack section (the paint-piercing washers make good test points)
  - Bonding lugs to busbar, cable tray, and cable bond
- ❖ Measure the resistance to ground of the grounding electrode conductor with a fall of potential ground resistance tester or properly utilized clamp-on ground resistance tester and ensure that measurements of resistance to ground are:
  - Less than 5 ohms to satisfy code, safety and minimum performance requirements
  - Less than 1 ohm to ensure highest performance

## **27 05 28 Pathways for Communications Systems**

### **Raceway/Tray Systems**

The general requirements for raceway/tray systems are as follows:

- ❖ Communication tray systems shall be for exclusive use by OIT.
- ❖ The systems shall be designed for no more than 40% fill.
- ❖ When installing new cable(s) to existing tray, new tray shall be installed beyond 34% capacity.
- ❖ The systems shall be metallic and continuous, and all separate pieces shall be bonded with a connector listed for the purpose wherever they are joined.
- ❖ Cable tray must be properly bonded and grounded.

### **Cable Management**

Designed to support Category 6A cables without compressing or kinking the cables.

Specify Panduit product code number NFBRFK.

## **27 05 28.29 Hangers and Supports for Communications Systems**

### **J-Hooks**

The use of J-Hooks to support horizontal wiring in lieu of continuous conduit or a combination of conduit and wire basket tray will only be considered through the exception process. Proposed J-Hook placement design must be submitted by the exception requestor and include J-Hook specifications and manufacturers statement that the design and materials will not degrade the performance of the cable being supported throughout the life of the cable. When designing the layout for the J-Hooks, the designer shall ensure that other building components (e.g. lighting fixtures, HVAC ducting etc.) do not restrict access for the cabling. A 3-Dimensional AutoCAD view of the proposed J-hook design showing the entire proposed route must be submitted for OIT approval.

Use extra large (minimum of 4" width) Caddy CAT64HP J-hooks to support loose, random cable bundles. J-hooks shall be spaced randomly between 3 and 4 feet apart to prevent system degradation due to sagging.

Buildings designed with an open ceiling design will not be allowed to use J-Hooks. The one exception to this rule would be in mechanical spaces.

## **27 05 28.33 Conduits and Backboxes for Communications Systems**

- ❖ PROHIBITED: Sharing the outlet and conduit pathway with other non-OIT telecommunications facilities.
- ❖ PROHIBITED: Daisy chaining of conduit from outlet to outlet.

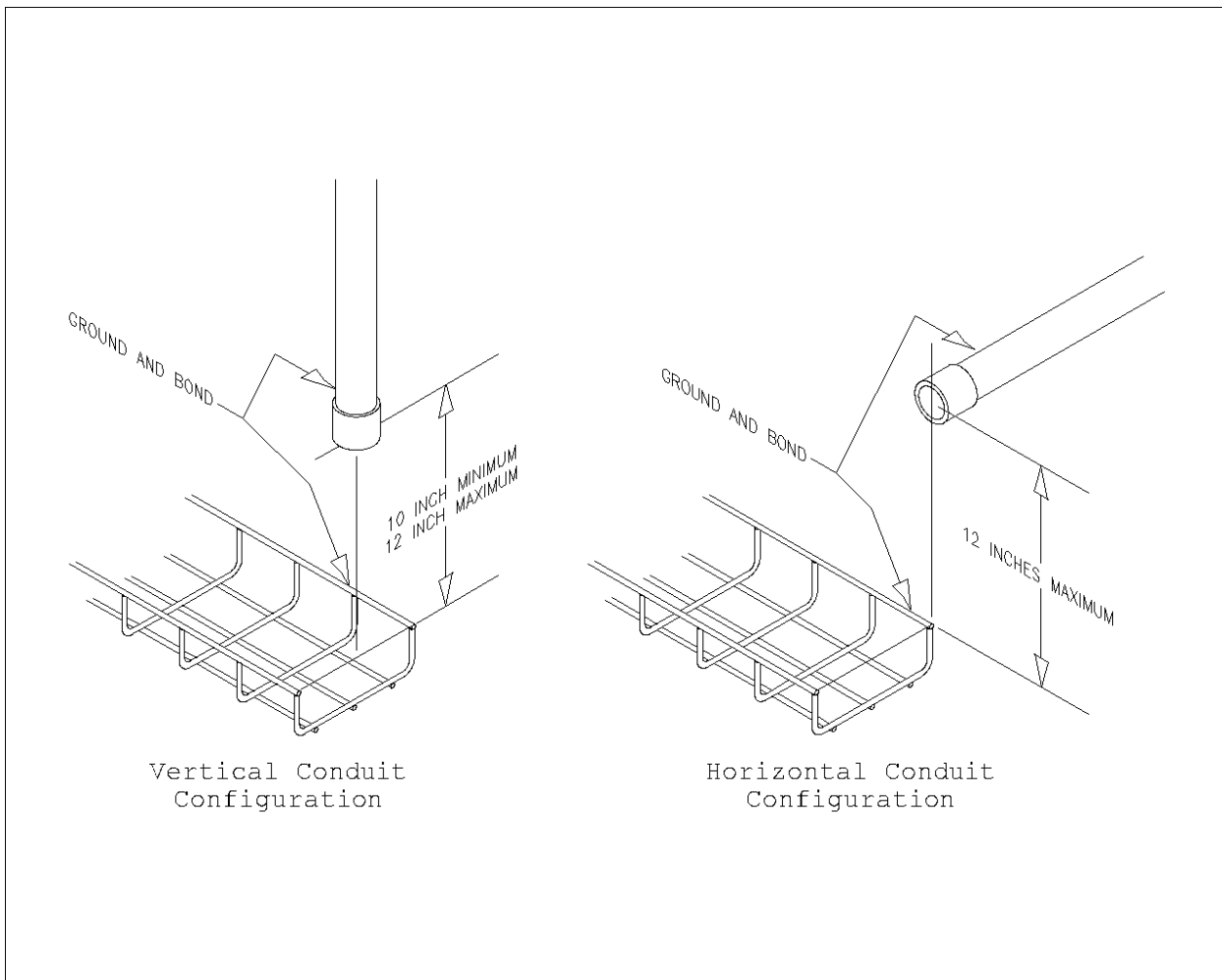
## Conduit

Conduit sizes shall be adequate for the cable needed to serve voice and data instruments. The minimum size for conduit is 1¼-inch.

## Outlets

- ❖ Telecommunication outlets shall be 5-inch by 5-inch by 2.875 inch boxes made by Randl (part number T-55017) with a minimum 1¼-inch inside diameter continuous metallic conduit provided to the nearest IDF or ceiling raceway system.
- ❖ Standard telecommunications outlets shall be installed at a minimum of 15 inches above a finished floor and at the same height as the electrical. Standard telecommunications outlets for wall phones shall be 48 inches above a finished floor and shall use a Suttle wall jack (part # SE630AD4) All measurements are from the floor to the center of the outlet.
- ❖ Floor-mounted telecommunications outlets used for modular furniture shall be a Walker RCI RC3 flush poke-through unit, or a substitute that has been approved by OIT through the exceptions request process.
- ❖ Telecommunications outlets shall not be placed in a back-to-back location, but shall be separated by a minimum of 12 inches. Telecommunications outlets in fire-rated walls shall be separated by 24 inches.
- ❖ Telecommunications outlet boxes shall be used solely for low-voltage wiring for telecommunications.
- ❖ All wall outlet boxes shall be equipped with two-gang cover plates. Only the following outlets shall be equipped with a one-gang cover plate:
  - Outlets designated for wall telephones
  - Outlets designated for pay telephones
- ❖ In DEFs electrical quad (4x4) outlets shall contain one 20 AMP house duplex outlet (left side) and one 20 AMP generator duplex outlet (right side). Orange or red receptacles shall be used to designate generator outlets. No more than three duplex receptacles shall be dedicated per branch circuit. Circuits will alternate between neighboring outlets, to avoid having the same branch circuits next to each other.
- ❖ Electrical conduit shall be placed in the drywall with a cut out in the plywood backboard to allow for access to the outlets around the perimeter of the room. Electrical outlets will be installed in the plywood backboard at a height of 15 inches above finished floor.
- ❖ Two electrical outlets will be placed on the back side of the 7 foot telecommunications racks. 1900 style boxes containing two duplex receptacles shall be used for this application. They shall be center mounted between the racks to avoid covering the equipment mounting holes. They shall be installed at 15 inches and 69 inches above finished floor.
- ❖ Compliance to this standard requires that the ends of rigid or flex conduit shall:
  - Have a bushing

- Lie within the side and end planes of the cable tray
- Lie within the tolerances illustrated (Figure D)
- Be anchored to a rigid support
- Be grounded and bonded to the cable tray with a minimum 6 AWG copper conductor.
- Use insulated metallic bushings for attached metallic conduits. Ground and bond the conduits to the tray.



**Figure D: Conduit to Cable Tray Configurations**

## 27 05 28.36 Cable Trays for Communications Systems

### Raceway/Tray Systems

- ❖ The tray shall be ladder style in DEFs, and wire basket style in MDF, IDFs, and horizontal pathways.
- ❖ The ladder-style tray shall have a rail on each side, and the rungs shall be enclosed and welded into place.



- ❖ The wire basket-style tray shall be U shaped and constructed of round wire mesh. The basket tray shall be installed trapeze-style or wall-mounted. It shall not be center hung.
- ❖ End-of-tray cable waterfalls shall be used where wire drops down to preserve bend radii and prevent abrasions and cuts from metal tray edges.
- ❖ The tray shall have a minimum of 6-inches of clearance on all sides. Cable tray shall be properly bonded and grounded to avoid EMF and RFI interference.
- ❖ The tray shall maintain 18-inch clearance from sprinkler heads, and shall meet National Fire Code. The complete cable tray system shall meet OIT approval.

### **27 05 28.39 Surface Raceways for Communications Systems**

### **27 06 00 Schedules for Communications**

### **27 08 00 Commissioning of Communications**

### **27 10 00 STRUCTURED CABLING**

### **27 11 00 Communications Equipment Room Fittings**

### **27 11 16 Communications Cabinets, Racks, Frames and Enclosures**

#### **Equipment Racks**

- ❖ The rack system is to be installed per OIT requirements and shall be a Panduit NetFrame NFR84. The D-Rings shall be Panduit NFDR4X6K and the rack doors shall be Panduit NetFrame NFD484.
- ❖ Equipment racks shall be securely mounted to the floor with expansion anchors.

### **27 11 19 Communications Termination Blocks and Patch Panels**

#### **Wall Termination of Copper Wiring**

#### **In Distribution Equipment Facilities**

- ❖ Riser copper cabling shall be spliced using 3M 4005 DPM/TR modules to tip cables connected to riser blocks on the copper frame. Place splices in copper splice case and mount in splice bay on the wall.

#### **In MDF rooms**

- ❖ Riser copper cabling shall be terminated on 110 termination blocks. 110 blocks shall be mounted to the plywood and installed so they are vertically plumb and securely fastened. The top jumper trough, installed above the 110 blocks shall be 5 1/2 feet above finished floor, and the lowest block shall be no lower than 36" above finished floor.

#### **In IDF rooms**

- ❖ Riser copper cabling shall be spliced using 3M 4005 DPM/TR modules to 25 pair male amphenol cables and connected to Panduit voice patch panels VP24382TV25Y on the equipment rack. Place splices in a copper splice case and mount in a splice bay on the wall. Copper splice cases shall be 3M part number R3 or larger if a larger count copper riser cable is installed.

### **Patch Panels for Horizontal Cabling**

- ❖ Patch panels shall be a Leviton 48 Port Angled Quickport Patch Panel 49256-H48. Patch panels must utilize individual jacks, not 110 style punch down.

### **27 11 23 Communications Cable Management and Ladder Rack**

#### **27 11 26 Communications Rack Mounted Power Protection and Power Strips**

Rack Mounted Power Strips shall be Chatsworth part # 12816-703 8 Outlet Surge Suppressor.

### **27 13 00 Communications Backbone Cabling**

#### **Design Considerations**

- ❖ The intrabuilding backbone shall be comprised of both copper and optical fiber.
- ❖ Intrabuilding backbone fiber and copper cables shall be sized to include 50% spare for future use. Consult with OIT for cable sizing requirements on a per building basis.
- ❖ Intrabuilding backbone cables comprised of steel or metallic parts shall be grounded on both ends of the cable to the Telecommunications Main Grounding Busbar (TMGB) and the Telecommunications Grounding Busbar (TGB).

#### **Intrabuilding Backbone Pathways**

- ❖ Intrabuilding backbone cabling shall be distributed using a series of conduits, cable trays, sleeves, and slots. All wall and floor penetrations shall be properly firestopped. Firestopping methods and materials shall meet approval of the Authority Having Jurisdiction (AHJ).

### **27 13 13 Communications Copper Backbone Cabling**

- ❖ The intrabuilding copper backbone cable(s) shall be 100 ohm unshielded, balanced, twisted-pair, Category 3 riser-rated cable with 24 AWG round solid conductors. It shall also be armored. Cable must meet the needs of the building plus capacity for 50% growth.
- ❖ The cable shall be UL® tested and listed.
- ❖ Copper backbone riser cable specifications are as follows:
- ❖ **Communications Riser:** Category 3 Copper Cable ARMM (Alpeth, Expanded polyethylene polyvinyl chloride, 24 AWG, ALVYN)
- ❖ **Communications Plenum:** Category 3 Copper Cable 24 AWG Plenum Rated
- ❖ **Consult with OIT for copper pair count requirements to each IDF.**

### **27 13 13.13 Communications Copper Cable Splicing and Terminations**

- ❖ The cable shall be continuous without splices, unless otherwise specified by OIT.
- ❖ Intrabuilding copper backbone cables shall be properly secured to the walls to prevent horizontal movement.
- ❖ See Section 27 11 19 Communications Termination Blocks and Patch Panels for termination requirements.

### 27 13 13.23 Testing of Copper Backbone Cabling

- ❖ Perform visual inspection to ensure that all cables are terminated on the punch down block in proper color code order.
- ❖ Test all pairs for continuity and tip and ring polarity.
- ❖ Test results shall meet or exceed the appropriate tests requirements as specified in the ANSI/TIA/EIA-568 specifications.
- ❖ Test results shall be stored on a CD and delivered to OIT.

### 27 13 23 Communications Optical Fiber Backbone Cabling

- ❖ The intrabuilding optical fiber backbone cable(s) shall be a hybrid (singlemode/multi-mode) cable consisting of 8.3  $\mu\text{m}$  singlemode and 50  $\mu\text{m}$  OM4 rated multi-mode optical fiber consisting of a minimum of 24 strands of singlemode and 24 strands of multi-mode, or individual 24 strand cables can be installed. Consult with OIT for final fiber count requirements.
- ❖ All backbone fiber optic cabling shall use Corning glass.
- ❖ Optical fiber riser shall be type OFNR (optical fiber non-conductive riser).
- ❖ Intrabuilding fiber backbone cables shall be properly secured to the walls to prevent horizontal movement.
- ❖ Where used in plenum spaces, optical fiber shall be type OFNP (optical fiber non-conductive plenum).
- ❖ Singlemode cable jackets shall be yellow in color, while multi-mode cable jackets shall be aqua in color.
- ❖ Optical fiber backbone riser cable specifications are as follows:

#### Fiber Riser Cable:

- ❖ Hybrid:
  - Superior Essex (part number 43048HGC1 24SM/24MM 50mic 10G/300 PLN Distribution)
  - General (part number AP024/BL0241PNR)
- ❖ Individual Cables:
  - Superior Essex
    - Singlemode (part number 430243K01 RSR, Distribution)
    - Multimode (part number 43024NK01 50mic, 10G/300 RSR, Distribution)
  - General
    - Singlemode (part number AP0241PNR)
    - Multimode (part number BL0241PNR)

### **Fiber Riser Cable Plenum Rated:**

- ❖ Hybrid:
  - Superior Essex (part number: 43048HGX1 24SM/24MM 50mic 10G/300 PLN Distribution)
  - General (part number AP024/BL0241PNU)
- ❖ **Individual Cables:**
  - Superior Essex
    - Singlemode (part number 440243K01 PLN Distribution)
    - Multimode (part number 44024NK01 50mic 10G/300 PLN Distribution)
  - General
    - Singlemode (part number AP0241PNU)
    - Multimode (part number BL0241PNU)
  -

### **Fiber-Optic Enclosures**

- ❖ Fiber optic enclosures shall be Panduit product FRME4. Fiber adaptor panels shall be Panduit product FAP12WAGDSCZ (SC APC) for singlemode, and Panduit product FAPWAQDSCZ (SC UPC) for OM4 multimode.
- ❖ Enclosures shall be labeled per OIT specifications.
- ❖ Intrabuilding Backbone Riser Cable Testing Any cable that fails shall be re-terminated and tested again.
- ❖ The pass or fail condition for the cable being tested is determined by the results of the required individual tests. Any fail result yields failure for the cable being tested.
- ❖ OIT reserves the right to conduct, using Contractor equipment and labor, a random re-test of up to five percent (5%) of the cable plant to confirm documented test results. For individual installations, provide one of each of the following:
  - As-Built AutoCAD one-line prints in native AutoCAD format files (R2000 or greater)
  - A CD-ROM copy of all copper and fiber optic test results, along with the (licensed) software tools required to view, inspect, and print any selection of the test reports
  - Warranty information and any vendor certification of the installed infrastructure

### **27 13 23.13 Communications Optical Fiber Splicing and Terminations**

- ❖ The intrabuilding optical fiber backbone cable(s) shall be installed with a service loop of 25 feet at each end.
- ❖ Intrabuilding fiber backbone cables shall be properly secured to the walls to prevent movement.
- ❖ **PROHIBITED:** Using traditional nylon cinch-style tie wraps to bundle cables. Only Velcro™-style fasteners are acceptable.

- ❖ All fiber optic cables are to be continuous without splicing from DEF/MDF to IDF, unless otherwise specified by OIT.
- ❖ Fiber optic terminations are to be fusion spliced using AFL SC-style Fuse-connect™ connectors. Splicing of pigtails is not allowed. The singlemode cable shall be terminated with SC Angle Polished Connectors (APC). The multimode shall be terminated using SC Ultra Polished Connectors (UPC).

### **27 13 23.23 Testing of Fiber Backbone Cabling**

- ❖ Testing shall be performed on all fiber strands.
- ❖ Each fiber shall be tested using an OTDR (Optical Time Domain Reflectometer) prior to loss testing.
- ❖ Contractor shall perform loss testing.
  - Multimode fiber wavelength testing shall be at 850nm and 1310nm.
  - Singlemode fiber wavelength testing shall be at 1310nm and 1550nm.
- ❖ Test results shall meet or exceed the appropriate tests requirements as specified in the ANSI/TIA/EIA-568 specifications.
- ❖ Cables that do not meet specifications shall be removed and replaced at contractor's expense.
- ❖ Test results shall be stored on a CD and delivered to OIT.

### **27 13 33 Communications Coaxial Backbone Cabling**

- ❖ All coaxial backbone cables shall be identified and budgeted in the project in consultation with OIT. Backbone coaxial cable shall be homerun from the MDF to each IDF.

### **27 13 43 Communications Services Cabling**

#### **27 15 00 Communications Horizontal Cabling**

##### **Horizontal Wiring Facilities**

- ❖ **PROHIBITED:** Splitting copper pairs within a 4 pair cable between jacks
- ❖ **All horizontal copper terminations are to be to the T568B wiring scheme.**
- ❖ Only Velcro™-style hook and loop fasteners are acceptable.
- ❖ Horizontal wiring technicians and installers shall be certified by the manufacturer of all horizontal wiring and termination components that they will be installing.
- ❖ Telecommunications outlets shall be wired with unshielded, twisted pair (UTP) 24 AWG wire with suitable insulation and sheath material. The wire shall be type communications riser cable (CMR) or communications plenum cable (CMP) (UL) it shall be OIT approved.

- ❖ **The current position of OIT on horizontal cabling is to recommend the installation of Category 6A cable.**
- ❖ Horizontal cabling shall be pulled to the nearest IDF.

### **OIT Outlet Labeling Scheme (Jacks)**

Each jack location in an outlet facility shall be labeled in accordance with OIT jack-labeling practices. The labeling follows a standard format, indicating the room followed by the location within the room.

The general requirements for outlet facilities include the following:

The jack naming standard is:

**-XXXXX-XX**  
*5 characters – 2 characters*

**The first set of characters is the room identifier.** These characters indicate the Room Number that a jack is located within. These should always be 5 characters in length. We use “0” (zero) to fill any unnecessary place holders. For example if the jack is in room 12, the five characters would be entered as 00012. Some of the variations from the numeric room number (according to the database standards) are as follows:

- OS – indicating outside of room \_\_\_\_ (i.e.: OS146 indicates the jack is outside of room 146).
- OC – indicating a cubicle area in room \_\_\_\_ (i.e.: OC210 indicates the jack is in a cubicle in room 210).
- HL or OH – indicating a hallway area near room \_\_\_\_ (i.e.: HL532 indicates the jack is in the hallway outside of room 532).

**The last set of characters is the specific jack identifier.** These two characters specifically identify a jack within a room. The jack labeling scheme begins with AA, incrementing to AB, etc. so that each jack within a room has its own unique identification.

Any time we have to deviate from the Jack Naming Standard (such as payphones or outside phones) typically the floor should be 00.

- ❖ The prefix field is always 5 digits.
- ❖ Rooms within a larger room may be designated as Room 0100A, and their jacks may thus be labeled as 0100A-AA.
- ❖ For larger rooms, it may be necessary to continue the labeling sequence beyond AZ so that the next installed jack would be labeled BA, BB and so on, and if necessary, continued throughout the alphabet (CA, CB and so on).
- ❖ The official U of M Facilities management (FM) room numbers shall be used to determine the labeling.

- ❖ The labeling information that OIT installs upon the voice and data jacks are used within the OIT database and forwarded to the police for location information to the response of emergency 911 staff (police, fire, etc.). Therefore it is imperative that this information be kept current. If the room numbers are to be changed during the course of the project, charges will be incurred to pick up this additional labor and to process the order so as to retain accuracy for the Life/Safety 911 database. Please contact your OIT liaison to coordinate these efforts.
- ❖ Jacks shall be neatly labeled with a printed self-adhesive label that OIT has approved in advance. The labels shall be typed/printed and are not to be drawn by hand.
- ❖ As-Built drawings that show jack numbers and locations shall be submitted to OIT upon completion of the project/building.

## **27 15 13 Communications Copper Horizontal Cabling**

### **Horizontal Copper Wire**

- ❖ Category 3 and Category 5 wiring is no longer recommended for installation. Cables are to be Category 6A.
- ❖ Copper wiring specifications are as follows or OIT-approved substitute:
  - Green Cat6A plenum
    - Superior Essex 10 Gain XP part number 6H-272-5B
  - Green Cat6A PVC
    - Superior Essex10 Gain XP part number 6H-272-5A
- ❖ Each cable in the terminal room from the jack shall be tagged with the current grid designation from the current architectural drawings.
- ❖ Station cables shall be terminated in order according to jack number.
- ❖ All copper cable shall be continuously supported by conduit or cable tray.

### **Category 6A Wiring Testing**

- ❖ Tests shall be conducted according to TIA-568-C.
- ❖ Any cable that fails these tests shall be re-terminated and tested again. If the cable does not meet specifications after being re-terminated, replace the cable, terminate, and test again.
- ❖ The test results for each link shall be recorded in the memory of the field tester upon completion of the test.
- ❖ The test results saved by the tester shall be transferred to a CD-ROM. A guarantee shall be made that the results of the measurement shall be transferred to the CD-ROM unaltered—that is, as saved by the tester at the end of each test. The guarantee shall also specify that the results cannot be modified at a later time.
- ❖ The test results for the completed job shall be stored and delivered to OIT on a CD-ROM, along with the (licensed) software tools required to view, inspect, and print any selection of the test reports.

## Jacks

- ❖ Jacks shall be mounted in a 106-type frame, a mounting frame ( Leviton 41087 QP).The jack cover plate shall be 302 stainless steel. Each copper outlet shall contain the following jacks:
  - Category 6A
  - Leviton product code number 6A10G-RO6(orange)
- ❖ The number of wires installed to each communication outlet shall be determined in consultation with OIT. OIT recommends a minimum of three Category 6A cables at each copper outlet.

## 27 15 23 Communications Optical Fiber Horizontal Cabling

### Horizontal Fiber Optic Wire

- ❖ Each strand of fiber shall be housed in its own buffer tube throughout the length of the fiber cable. Each cable in the terminal room from the jack shall be tagged with the current designation from the current architectural drawings. Consult with OIT to determine the amount of slack in the terminal room from the location of the jack.
- ❖ Fiber optic cable **MUST** be manufactured with Corning Glass.
- ❖ The number of fiber strands installed to each communication outlet shall be determined in consultation with OIT.
- ❖ Labeling shall be performed in consultation with OIT.

### Small Form/Modular Style Fiber Standards

- ❖ Fiber optic terminations are to be fusion spliced using AFL SC-style Fuse-connect™ connectors. Splicing of pigtails is not allowed. The singlemode cable shall be terminated with SC Angle Polished Connectors (APC). The multimode shall be terminated using SC Ultra Polished Connectors (UPC).

## 27 15 33 Communications Coaxial Horizontal Cabling

- ❖ **PROHIBITED:** Sharing the outlet and conduit pathway with other non-OIT telecommunications facilities.
- ❖ **PROHIBITED:** Daisy chaining of conduit from outlet to outlet.
- ❖ **PROHIBITED:** Daisy chaining of horizontal cabling.

### Conduit and Outlets

- ❖ Coaxial outlets shall have a single gang box with a minimum 3/4-inch inside diameter continuous metallic conduit home run to the nearest IDF or ceiling raceway system.
- ❖ Conduits shall have pull boxes at 100 foot intervals and not exceed two 90 degree bends between pull points.
- ❖ All conduits shall have bushings at each end.



- ❖ Standard coaxial outlets shall be installed at a minimum of 15 inches above a finished floor and at the same height as the electrical. All measurements are from the floor to the center of the outlet.
- ❖ To facilitate future cable installations, install a nylon pull cord in each conduit simultaneously with the pull-in of cable.

### **Coaxial Cable**

- ❖ Cable shall be quad shielded RG6, or a substitute that has been approved by OIT through the exceptions request process, that meets all fire codes including plenum space, and is equal to or exceeds Belden 1189A specifications. Cable runs shall not exceed 300 feet from the IDF.
- ❖ Cables shall be terminated into a stainless steel faceplate with the appropriate F barrel extending from the face of the plate.
- ❖ Cables shall be installed and terminated in a neat and workman like manner in the IDFs at the splitter with sufficient length to connect to the wall mounted splitter equipment.
- ❖ Cables shall be labeled at both ends, and on the faceplate following the OIT Labeling Scheme.

### **Faceplates and Connectors**

- ❖ Faceplates shall be stainless steel.
- ❖ Connectors shall be RG6 male compression style F-connectors.

### **Splitters**

- ❖ All video splitters/amplifiers shall be identified and budgeted in the project in consultation with OIT. Video splitters/amplifiers will be installed on a plywood lined wall inside the IDFs.

### **Testing**

- ❖ Cable must be tested for continuity, opens and shorts. Based on the needs of the building, additional testing may be required.

### **27 15 43 Communications Faceplates and Connectors**

### **27 16 00 Communications Connecting Cords, Devices and Adapters**

OIT approved

### **27 20 00 DATA COMMUNICATIONS**

OIT approved

### **27 21 00 Data Communications Network Equipment**

### **27 21 33 Data Communications Wireless Access Points**

OIT is responsible for the installation and maintenance of all wireless access points. The

project is responsible for the installation of the horizontal infrastructure and cable necessary to support the wireless access points. The total number of access points and their locations cannot be finalized until a wireless survey is completed. In addition to providing general coverage, special considerations need to be made for large public areas, classrooms and conference rooms.

- ❖ A 1” conduit shall be run from a closet to a pull-box or cable tray, and from the tray to where the Access Point will be installed.
- ❖ Each floor must be independently designed so wireless is not stacked on top of each other, creating the “silo effect”.
- ❖ The use of wiremold is authorized, as long as it is installed in a neat and workmanlike manner and meets all fire code requirements.
- ❖ Install a 4” square (not round) extension box, Thomas and Betts part # 521711.
- ❖ Install a 4” square 1 gang  $\frac{3}{4}$  rise plaster ring part # 52C14.
- ❖ Two Cat 6A cables shall be installed to each access point location.
- ❖ Mount the Access Point on the underside of the ceiling tile, even with or below fluorescent lights or other obstructions. The Access Point will be installed on the ceiling, never installed on a wall.
- ❖ Every Access Point must be documented on a floor plan with the Jack ID.
- ❖ Indoor access points shall be horizontally mounted on the ceiling, in a standard electrical box mounted to support a 31.7 ounce (0.9 kg) device no more than 20 feet above the intended users and must be mounted closer to the user.
- ❖ Outdoor Access Points require AC power. If not wall mounted they require a 2” mast, height dependent on obstructions. All outdoor installations shall have an appropriate drip loop on connections and shall be grounded with connectors and wire listed for the purpose.
- ❖ Access Points shall not be painted, this voids the warranty.
- ❖ The Cat 6A cabling shall be tested in accordance with TIA-568-C, and tested in the same manner as all other horizontal cabling (see Section 27 15 13)
- ❖ Any installation deviating from these standards must be approved by OIT.

**27 22 00 Data Communications Hardware**

**27 24 00 Data Communications Peripheral Data Equipment**

**27 25 00 Data Communications Software**

**27 26 00 Data Communications Programming and Integration Services**

**27 30 00 VOICE COMMUNICATIONS**

OIT approved

**27 31 00 Voice Communications Switching and Routing Equipment**

**27 32 00 Voice Communications Telephone Sets, Facsimiles and Modems**

**27 33 00 Voice Communications Messaging**

**27 34 00 Call Accounting**

**27 35 00 Call Management**

**27 40 00 AUDIO-VIDEO COMMUNICATIONS**

OIT approved

**27 41 00 Audio-Video Systems**

**27 42 00 Electronic Digital Systems**

**27 50 00 DISTRIBUTED COMMUNICATIONS AND MONITORING SYSTEMS**

**27 51 00 Distributed Audio-Video Communications Systems**

**27 52 00 Healthcare Communications and Monitoring Systems**

**27 53 00 Distributed Systems**

**27 53 19 Internal Cellular, Paging, and Antenna Systems**

Requires consultation with OIT