

DIVISION 27
COMMUNICATIONS

27.00.00 COMMUNICATIONS

27.01.00 SCOPE OF WORK

1. This specification covers the furnishing and installation of materials for telecommunications system structured cabling, complete and in operating condition as indicated on drawings and/or as described herein.
 - 1.1. The telecommunication systems herein specified provides for Information outlets and other low voltage signaling functions (such as for energy management and security systems) through twisted pair, fiber optic, and coaxial cable.
 - 1.2. The system shall provide acceptable outlets for any telecommunication device, which requires connection to other devices, networks or information services serving general university needs.
2. Products shall be as listed in this document or as directed by the Owner.
3. Installation procedures shall be in accordance with industry acceptable practices, product manufacturer's recommendations, federal, state and local codes and standards, and shall include demolition and removal of materials as required to support the work.
4. This section includes tools, materials, equipment and labor necessary to complete a turnkey installation, including but not limited to the following items, which will be supplied by contractor unless otherwise noted by the University:
 - 4.1. Cable trays, hangers, and mounting hardware
 - 4.2. Conduit
 - 4.3. Connecting blocks
 - 4.4. Cross connect cable
 - 4.5. Cross connect rings or spools
 - 4.6. Equipment racks, mounting hardware and wire management
 - 4.7. Labels for cables and receptacles
 - 4.8. Modular station receptacles
 - 4.9. Mounting brackets
 - 4.10. Painted Fire Retardant plywood backboards
 - 4.11. Riser cable
 - 4.12. Station blocks
 - 4.13. Station cables
 - 4.14. Velcro Tie wraps, bushings, and miscellaneous

27.02.00 REFERENCES

27.02.10 APPLICABLE CODES and STANDARDS

Telecommunication design shall comply with Federal and State codes, regulations, and standards with variances adopted as standards by Indiana University and the State of Indiana. Applicable state and national standards include the latest editions of:

ANSI/NFPA 70 National Electrical Code with Indiana Amendments, latest edition
 BICSI CO-OSP Customer Owned Outside Plant Manual
 BICSI 12th Edition Telecommunications Distribution Methods Manual
 BICSI 4th Edition Customer Owned Outside Plant Design Reference Manual
 EIA Standard EIA-230 - Color Marking of Thermoplastic Wire
 FCC Rules and Regulations
 Indiana Administrative Code, Title 675, Article 22, Indiana Fire Prevention Codes
 Joint Commission Accreditation of Hospitals Code
 J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
 National Electrical Safety Code
 NFPA 101: Life Safety Code
 REA Standards for Engineering, Construction, and Installation
 TIA 526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7
 TIA 526-14-A Optical Power Loss Measurements for Installed Multimode Fiber Cable Plant – OFSTP-7
 TIA 568-C Commercial Building Telecommunications Cabling
 TIA 569-B Commercial Building Standard for Telecommunications Pathways and Spaces
 TIA 598-C - Optical Fiber Cable Color Coding
 TIA Standard ANSI/TIA/EIA-607-A - Commercial Building Grounding and Bonding Requirements for Telecommunications
 TIA 604 Standards on Fiber Optic Connector Intermateability
 TIA 606-A Administration Standard for Commercial Telecommunications Infrastructure
 TIA 758-A Customer Owned Outside Plant Telecommunications Cabling Standard
 TIA Telecommunication Systems Bulletin TSB67 - Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems
 TSB-140 Additional Guidelines for Field Testing Length, Loss and Polarity of Optical Fiber Cabling Systems

27.03.00 DEFINITIONS

1. **OUTSIDE PLANT:** Transmission facilities used in the distribution of voice, data, or video from point where it leaves one building and enters another, including copper, coax, fiber optics, and microwave.
2. **ENTRANCE CABLE:** The outside plant cable(s) that enter the building from the campus outside plant communication distribution network.
3. **MAIN BUILDING TELECOMMUNICATION EQUIPMENT ROOM (IDF-1):** The main telecommunication room located where the outside plant cabling and backbone cabling (risers) are interconnected.
 - 3.1. This room may also serve as a floor telecommunication equipment room (IDF-2).
4. **FLOOR TELECOMMUNICATION EQUIPMENT ROOM (IDF-2):** A telecommunication equipment room normally provided on every floor of the building.
 - 4.1. Floor equipment rooms must be spaced such that the length of any horizontal cable run shall not exceed 295 feet, wire length, termination to termination.
5. **BACKBONE CABLE (Riser):** Cabling from the Building Telecommunication Equipment Room (IDF-1) to each Floor Telecommunication Equipment Room, including copper, coax, and fiber optics cabling.
6. **STATION OUTLET BOX:** The standard outlet box for telecommunications terminations shall be a double gang 4"x4"x2-1/8" minimum depth box, with mud ring sizes as required.

7. INFORMATION OUTLET: An assembly of interface ports for copper (data), coaxial (campus television), and fiber terminations (data); variations of arrangements are describe elsewhere in this document.

27.04.00 EXECUTION

27.04.10 QUALITY ASSURANCE

1. Contractor's management team shall have demonstrated compliance with all applicable Indiana University UITS installation requirements as a prime contractor or subcontractor on no less than three (3) Indiana University projects.

1.1. The University may, at its discretion, require the names, previous project list, and references for the Contractor's management team and field personnel assigned to this project prior to the start of the work.

1.2. The University maintains the right to ask for replacement of management or field staff at any time during the project.

2. All cabling shall meet ANSI/TIA/EIA-568.

3. Termination and testing of the telecommunication cabling shall be performed by qualified telecommunication installer with at least 5 years experience that can assure the installation and testing parameters are met.

3.1. Experience with Category 6e installation is required.

3.2. Vendors and contractors shall have on staff a Building Industry Consulting Service International (BICSI) Registered Communications Distribution Designer (RCDD).

3.3 The RCDD shall approve construction design and upon completion of installation, certify compliance with the standards and installation practices as specified by this document.

4. Prior to commencing the work of the section, the contractor shall convene a meeting with Construction Manager, University Information Technology Services representative, and Engineering Services representative.

4.1. The meeting will cover Project Specifications, Addendum, Change orders, IDF layouts, labeling, and other project work, documents and site conditions.

4.2. System testing procedures and requirements shall be confirmed at this time.

4.3. Test report forms and schedules shall be provided for University review.

4.4. Inspection milestones will be set and notifications scheduled.

4.5. Meeting minutes will be distributed and will include agreements, action items and responsible party(s), for this meeting and for future meetings when required.

5. Store materials and equipment in dry, environmentally controlled space. Do not install equipment and materials until spaces are enclosed, watertight, and dry. Protect equipment from dust and other airborne materials.

6. Contractor's regular job progress meetings with the Construction Manager and other university representatives shall include a University Information Technology Services telecommunications representative.

7. University *Inspection*: Indiana University will provide advising as requested.

7.1. The Office of University Information Technology Services *may inspect* the job as it progresses.

7.2. Prior to final acceptance of the work, the Contractor shall make arrangements with the appropriate authorized University personnel to *inspect* the construction areas, both to ensure satisfactory completion of

the work and to ensure complete cleanup and restoration of areas affected by the work.

7.3. Temporary protection, coverings, and structures shall be removed at or before time of *inspection*.

7.4. Examine areas and conditions with the Installer present for compliance with requirements and other conditions affecting the performance of telecommunication transmission media.

7.5. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the appropriate University personnel.

27.04.20 SUBMITTALS

1. Submit **shop drawings** and/or **manufacturer's product data** for telecommunications equipment, including termination equipment, copper cables, fiber optic cables, cable routing devices, and associated equipment and materials.

1.1. Include cut sheets with rated capacities, operating characteristics, electrical characteristics and other measurements and descriptions which describe these items in detail.

2. Submit **manufacturer's test reports** and **test data** for each of the fiber optic cables installed.

2.1. The test reports must clearly identify which fiber corresponds with the respective test measurement data so that the results can be verified prior to installation of the cable.

3. Submit a **schedule of material** and an **installation schedule** based on the construction schedule and construction phasing, to the Architect/Engineer, within three (3) weeks after contract award.

4. Submit qualifications data for material installers, supervisors, and the project RCDD (Registered Communications Distribution Designer).

5. Submit completed **cable records**, including floor plans, riser diagrams, manhole diagrams, footages on any cable other than horizontal cabling, and jack id's by location.

6. Submit **test reports** to the Owner's Representative for approval.

6.1. Include in the test reports the test data taken and converted values.

6.2. Prior to submittal for approval, have test reports signed by authorized witnesses present at tests.

6.3. Submit two (2) final copies of approved test reports to the Owner's representative.

6.4. No services shall be installed until verified reports are submitted, reviewed, and found to be acceptable by the appropriate University Information Telecommunication Services (UITS) representative.

27.04.30 DELIVERY, STORAGE and HANDLING

1. Deliver wire and cable properly packaged in factory-fabricated type containers, or wound on NEMA-specified type wire and cable reels.

2. Store wire and cable in clean dry space in original containers, following manufacturer's storage guidelines. Protect products from weather, damaging fumes, construction debris and traffic.

3. Handle wire and cable carefully to avoid abrading, puncturing, kinking, and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance and characteristic impedance integrity of transmission media are maintained.

27.04.40 SEQUENCING and SCHEDULING

1. Coordinate with installation of wires/cables, electrical boxes and fittings, cable trays, and raceways.

2. Sequence installation of optical-fiber cabling systems with other work to minimize possibility of damage during construction.
3. Interruptions to existing voice, data and video systems should be avoided where at all possible.
 - 3.1. If it becomes necessary to interrupt voice and/or data network services, then such interruptions must be approved by and scheduled with UITS Change Management.
 - 3.2. Approval is gained by submitting an MOP (Method of Procedure) to the UITS project contact person, containing the following information:
 - 3.2.1. Detailed account(s) of the work to be performed
 - 3.2.2. Proposed outage time(s)
 - 3.2.3. Estimated service restoral time(s)
 - 3.2.4. A contingency plan in case the work takes longer than anticipated, or doesn't go as scheduled.
 - 3.3. Change Management meetings are held on Wednesday of each week
 - 3.3.1. The MOP should be submitted to the UITS project contact person no later than 4:00 pm on the Tuesday of the week in which the work is to be performed.
 - 3.3.2. Outages and associated work should be performed outside of peak hours, such as on weekends, or after 5:00 pm and before 7:00 am during the week.
 - 3.3.3. Actual time(s) first should be approved by the parties affected by the outage(s).
 - 3.3.4. No outages may be scheduled during the first two weeks of a fall or spring semester, during which time there is a "Change Freeze" period.
 - 3.4. Approval from UITS Change Management must be granted before any scheduled outages can be performed.
 - 3.4.1. If the outage is disapproved, then an updated MOP will need to be resubmitted on the following Tuesday, to be reviewed the following day.
 - 3.5. Contractors are solely responsible for:
 - 3.5.1. making all necessary access arrangements in ample time before the work begins.
 - 3.5.2. notifying the affected parties of the scheduled outage(s).
 - 3.5.3. notifying repair@indiana.edu
 - 3.6. Interruptions to video systems should be coordinated with the IU Building Systems division at http://www.indiana.edu/~phyplant/building_systems.html and reported to repair@indiana.edu.
4. When new IDF's are constructed as part of the project, communications work must be completed, tested and accepted four (4) weeks in advance of the substantial completion date, to ensure that necessary communications circuits will be available for required building systems such as elevator phones, environmental systems monitoring and security systems.
 - 4.1. This includes all IDF associated electrical, HVAC, and door lock systems, as well as riser and outside plant copper and fiber cables, as necessary to allow the permanent installation of voice grade circuits and data network equipment.

27.04.50 GENERAL INSTALLATION

1. No cable shall be installed in any facilities other than those intended for that use.
 - 1.1. Gas pipe and water pipes must not be used for conduit under any circumstances.
2. Install telecommunication transmission media as indicated, in accordance with manufacturer's written

instructions, in compliance with applicable requirements of NEC, and in accordance with recognized industry practices.

3. CMP (Plenum) type cable will be used for all telecommunications cables.
4. Coordinate transmission media installation work, as necessary to properly interface installation of media with other work.
5. Do not install compressed, kinked, scored, deformed or abraded cable, or allow such damage to occur.
 - 5.1. Damaged materials shall be removed from the job site immediately.
6. Use extreme care in handling, fishing, and pulling-in transmission media to avoid damage to conductors, shielding and jacketing/cladding.
 - 6.1. Use pulling means including fish tape, cable, rope, and basket weave wire/cable grips, which will not damage media or raceway.
 - 6.2. If power equipment is used to pull cable, the pull speed must not exceed 30 meters per minute.
 - 6.3. Use water based lubricant approved by the cable manufacturer to ensure manufacturer's pulling tensions are not exceeded.
 - 6.3.1. Compound used must not deteriorate conductor or insulation.
 - 6.4. Cable bending radii must not be exceeded.
 - 6.5. Pulling methods must not cause cable to twist.
 - 6.6. Cables pulled through pull boxes shall be hand assisted to prevent the cable from being crushed, kinked, or scraped.
7. Provide pull strings in telecommunication conduit.
 - 7.1 To facilitate future cable installations, install a nylon pull cord in each conduit simultaneously with the pull-in of cable.
8. Pull conductors simultaneously where more than one is being installed in same raceway.
10. Splices in building media runs are **NOT** permitted.
 - 10.1. Building wiring must be continuous and undamaged from outlet to connecting block or connecting block to connecting block.
11. Terminations shall be made with the manufacturer's stated tools and in accordance with manufacturer's instructions and guidelines.
12. Tighten connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque-tightening values. Where manufacturers torque requirements are not indicated, tighten connectors and terminals to comply with tightening torque specified in UL Std.
13. When necessary within IDFs, horizontal Station cables shall be secured with Velcro tywraps. Both Fiber and Copper Entrance and riser cable shall be secured with standard tywraps. Observe the manufacturer's recommendations for distances between tywraps and tightening tension from tywraps and as specified in ANSI/TIA/EIA-568.
 - 13.1. Outside of IDFs, horizontal cabling, entrance cables, and riser cables must be installed within industry standard pathways, such as cable tray, J hooks, and conduit.
14. Cables shall be permanently identified at each end with an industry approved label.
15. All wall penetrations for telecommunications cabling must be sleeved, with bushings at each end, and firestopped with removable/reusable material which has a minimum 2 hour rating, or in accordance with other architectural details, unless otherwise noted.

- 15.1. Cables must not be installed through unsleeved holes drilled through walls.
- 15.2. Comply with Division 07 requirements for Firestopping.
- 15.3. Comply with TIA/EIA 569 on Firestopping.
- 15.4. Comply with UL1479 or ASTM E814, and label with the UL1479 or ASTM E814 reference number.

27.04.60 TESTING and DOCUMENTATION

1. General

1.1. Acceptance testing shall be completed and documentation provided to the University as soon as possible in order to permit the installation of networking equipment necessary to bring the building online for security and equipment monitoring systems.

2. Testing

2.1. Acceptance testing by the University shall not occur until all work in the telecommunication closet area is completed, including but not limited to mounting and installation of fiber OSP and riser cables, backboards, terminating boxes and cabinets, and grounding blocks, and termination of fiber riser cables, copper backbone cables, station wires, or any other work necessary for the completion of the installation.

2.2. The University shall have the right to schedule acceptance testing at its convenience.

2.3. A University representative, at the option of the University, shall be present during testing.

2.4. Such acceptance testing shall in no way reduce the Contractors' obligations regarding restoration, cleanup, or warranty.

2.5. Contractor shall perform tests necessary prior to acceptance testing to ensure that the installed cables will pass acceptance testing performed in conjunction with University representatives.

2.6. Contractor shall be responsible for performing, tracking, and recording the results of tests.

2.7. Contractor shall be responsible for providing equipment and materials necessary for as long a period of time as necessary to complete testing to the satisfaction of the University.

2.8. Test record forms shall be agreed to by the University prior to the commencement of acceptance testing.

3. Documentation

3.1. Provide record plant documentation, including jack type (Information outlet), jack location, circuit length, fiber riser cable lengths, and copper backbone cable lengths and any other information deemed to be useful.

3.2. The documentation format(s) will be agreed upon between the campus telecommunication coordinator and the contractor.

3.2.1 Provide all documentation in electronic format.

3.2.2. If it is agreed to use proprietary software to provide testing results, the contractor will be required to furnish licensed system software to run it unless the University already has a licensed version of the contractor's software.

27.04.70 RECORD DRAWINGS

1. Provide updated drawings of telecommunications systems in CAD format.
2. As a minimum, the data provided must include the following elements, where applicable:
 - 2.1. **Inside Plant**
 - 2.1.1. Cable routing.
 - 2.1.2. Riser and OSP cable, pair (count), locations, and final cable lengths.
 - 2.1.3. Supporting structures.
 - 2.1.4. Terminal locations and IDs.
 - 2.1.5. Telecommunications Room and terminal details.
 - 2.1.6. Conduit and cable tray routing, elevations installed at and section lengths.
 - 2.1.7. Pull box locations, elevations installed at and sizes.
 - 2.1.8. Information Outlet locations, label ID's, types, and serving Telecommunications Room
 - 2.1.9. For each change reflected on the Record Drawings, the Change Order Request number shall be shown.
 - 2.2. **Outside Plant** (provide on an accurate and scaled site plan)
 - 2.2.1. Location of underground routes, indicating type (conduit, direct buried, etc.) and quantities.
 - 2.2.2. Location of manholes and handholes.
 - 2.2.3. Deviations from minimum depth requirements.
 - 2.2.4. XYZ coordinates from 'permanent' landmarks.
 - 2.2.5. Footages of conduit between maintenance holes.
 - 2.2.6. Crossings of other utilities uncovered, including type and size of utility.

27.04.80 WARRANTY

1. The warranty on labor and material installed by the Contractor shall be in effect for Five (5) years from the date of acceptance of the work.
2. Contractor shall repair, adjust, and/or replace, whichever the University determines to be in Its best interests, any defective equipment, materials, or workmanship, as well as such parts of the work damaged or destroyed by such defect, during warranty period, at the Contractor's sole cost and expense.
3. In the event that any of the equipment specified, supplied, and/or installed as part of the work should fail to produce capacities or meet design specification as published or warranted by the manufacturer of the equipment involved or as specified in this document, the Contractor shall, in conjunction with the equipment manufacturer, remove and replace such equipment with equipment that will meet requirements without additional cost to the University.
4. In the event that the Contractor does not affect repair within seven (7) days from the date of notification of such defect, the University may secure repair services from other sources and charge the Contractor for such costs without voiding the warranty.
5. Guarantees of material, equipment, and workmanship running in favor of the Contractor shall be transferred and assigned to the University on completion of the work and acceptance of said work by the University.

27.05.00 COMMON WORK RESULTS

27.05.09 RELATED SECTIONS

Section 26.05.00 – Common Work Result for Electrical
Section 26.05.19 – Low-Voltage Electrical Power Conductors and Cables
Section 26.05.26 – Grounding and Bonding for Electrical Systems
Section 26.05.29 – Hangers and Supports for Electrical Systems
Section 26.05.33 – Raceway and Boxes for Electrical Systems
Section 26.05.36 – Cable Trays for Electrical Systems

27.05.26 GROUNDING and BONDING

1. The Building Telecommunication Equipment Room (IDF-1) shall have a Telecomm Main Grounding Bus Bar (TMGB) that is in compliance with J-STD-607, with minimum dimensions of ¼-inch thick and 4 inches wide, length as required to support current needs and future growth.
 - 1.1. The Ground Bus Bar shall be mounted with stand-off insulators that comply with UL 891 for use in switchboards, 600V, made of Lexan or PVC impulse tested at 5000V.
 - 1.2. Mount the Ground Bus Bar with a minimum of 2 inches of clearance behind the bar.
 - 1.3. Provide a solid or stranded copper wire building earth ground bonded to the electric power ground from the Grounding bus bar in the Building Telecommunication Equipment Room (IDF-1).
 - 1.4. Connections to the TMGB shall be made with exothermic welding or two-hole compression lugs with a two-crimp minimum.
 - 1.5. The busbar shall be cleaned and have antioxidant applied before attaching grounding conductors.
 - 1.6. The TMGB shall be bonded to any electrical panelboards that occupy the same room using a minimum #6 AWG copper conductor with a maximum length of 13 feet.
 - 1.7. All ungrounded telecommunications racks and metallic raceways in the same room as the TMGB shall be bonded to the TMGB.
 - 1.8. The TMGB shall be bonded the building ground system ground or building structural steel.
 - 1.9. The TMGB shall be grounded to the Floor Telecommunication Equipment Rooms (IDF-2's) Telecommunications Grounding Bus bars (TGBs), forming the Telecommunications Bonding Backbone (TBB) with copper ground wire solid or stranded, insulated or uninsulated, according to length, as detailed in J-STD-607, shown below:

WIRE LENGTH	WIRE SIZE (AWG)
<4 m / < 13 ft	6
4-6 m / 14-20 ft	4
6-8 m / 21-26 ft	3
8-10 m / 27-33 ft	2
10-13 m / 34-41 ft	1
13-16 m / 42-52 ft	1/0
16-20 m / 53-66 ft	2/0
> 20 m / > 66 ft	3/0

- 1.10. The TMGB shall be bonded to the Alternating Current Electrical Ground (ACEG) with a copper ground wire of not smaller gauge than that used for the TBB.

2. Each Floor Telecommunication Equipment Room (IDF-2) shall be equipped with a Telecommunications Grounding Bus bar (TGB that is in compliance with J-STD-607, with minimum dimensions of ¼-inch thick and 2 inches wide, length as required to support current needs and future growth.
 - 2.1. All ground wires shall be continuous and un-spliced between Equipment Room grounding bus bars.

- 2.2. Locate grounding bus bars to minimize ground wire lengths; location shall be coordinated with University Information Technology Services representative and University electrical engineer.
 - 2.3. The TGB shall be bonded to any electrical panelboards that occupy the same room using a minimum #6 AWG copper conductor with a maximum length of 13 feet.
 - 2.4. All ungrounded telecommunications racks and metallic raceways in the same room as the TMGB shall be bonded to the TGB.
3. In high rise buildings with multiple Telecommunications Rooms per floor, the top floor TGB's and every 3rd floor TGB's shall be bonded together with the same size grounding conductor used in the grounding riser system (TBB).
 4. Telecommunications cables with metallic sheath members shall be bonded together at splices with a #6 solid or stranded copper ground wire and bonded to the TMGB or TGB.
 - 4.1. Cable sheaths shall be grounded to a tested and proven earth ground within 50 feet of entering any building with an independent #6 solid or stranded copper ground wire or other electrically equivalent method as approved by the University.
 5. Test reports shall include the results of ground testing performed according the electrical system ground testing requirements.

27.05.28 PATHWAYS

1. Separation from EMI sources:
 - 1.1. Open cables and cables in nonmetallic raceways and unshielded power:
 - 1.1.1. Electrical less than 2 kVa 5 inch minimum
 - 1.1.2. Electrical 2 to 5 kVa 12 inch minimum
 - 1.1.3. Electrical greater than 5 kVa 24 inch minimum
 - 1.2. Cables in grounded metallic raceways and unshielded power:
 - 1.2.1. Electrical less than 2 kVa 2-1/2 inch minimum
 - 1.2.2. Electrical 2 to 5 kVa 6 inch minimum
 - 1.2.3. Electrical greater than 5 kVa 12 inch minimum
 - 1.3. Cables in grounded metallic raceways and shielded power:
 - 1.3.1. Electrical less than 2 kVa 1 inch minimum
 - 1.3.2. Electrical 2 to 5 kVa 3 inch minimum
 - 1.3.3. Electrical greater than 5 kVa 6 inch minimum
 - 1.4. Cables and electrical motors and transformers 5 kVa or larger 48 inches
 - 1.5. Cables and fluorescent fixtures 5 inches

27.05.29 HANGERS and SUPPORTS

1. Hanger and supports must be NRTL (Nationally Recognized Testing Laboratories) labeled for support of Category 6e cabling.
2. J-hooks shall be installed where no provisions for cabling runways.
3. J-hooks shall be installed per ANSI/EIA/TIA 569 Commercial Building Standards for

27.05.33 CONDUITS and BACKBOXES

1. Station conduit: shall be installed from each station outlet box to the cable tray, clamped to the cable tray and terminated with bushing, size per table or as noted on drawings.

<u>Trade Size Conduit</u>	<u>Workstations</u>
1"	1
1 1/4"	2

2. Horizontal distribution conduit: shall be installed from junction box joining each station conduit box to the floor telecommunications equipment room, size per table or as noted on drawings.

<u>Trade Size Conduit</u>	<u>“Standard” Workstations</u>	<u>(Station Cables)</u>
1 “	1	(2)
1-1/4 “	2	(4)
1-1/2 ”	3	(6)
2 ”	6	(12)
2-1/2 “	11	(22)
3 “	16	(32)
3-1/2 “	22	(44)
4 “	28	(56)

3. Junction boxes shall be sized according to NEC 314.28, NEC 314.54, Article 770, and to accommodate bending radiuses as discussed in NEC 300.34 and related TIA/EIA documents.

3.1. In any case, all methods employed for the installation of interior communication cables should not subject the cables to a bend radius less than the following minimums:

3.1.1. Copper communication cables, bending radius not smaller than 8 times the cable diameter.

3.1.2. Fiber optic cables, bending radius not smaller than 20 times the cable diameter.

4. Conduits which will contain interior rated telecommunications cables, such as riser cable and station cable, Conduits for interior grade telecommunication cables, such as riser rated and horizontal station cables, may be placed in a slab-on-grade, but must never be placed below the slab for any reason.

Inside building rated cables are not designed to withstand the moisture and condensation which can occur in underground conduits, which will render the cable(s) unusable in a short period of time. Although such conduits may be placed in the slab, whenever possible, avoid placing conduits for interior grade telecommunication cables inside a slab-on-grade as well.

27.05.36 CABLE TRAYS

1. **Horizontal distribution:** Cable trays are to be installed as low as possible above the ceiling.

1.1. A clearance of 18" shall be maintained above the trays.

1.2. 90° turns shall be made by two (2) 45° turns.

1.3. Cable trays shall not be installed using center point mounts.

2. **Telecommunication Rooms (IDFs):** 12” wide Ladder Type runways are to circle the IDF room at a

minimum 7' height.

2.1. Cable tray systems shall be installed so that installed cables will transition to the ladder rack runway without damage to or strain on the cables.

2.2. Ladder rack also shall be installed perpendicular to and secured to the outward end of the equipment rack(s). (See diagrams)

2.3. Additional ladder rack shall be used where necessary to stabilize equipment racks in the room or as needed to provide reasonable and shortest distance routing of cables.

3. Refer to Division 26.

27.05.39 SURFACE RACEWAYS

1. Cabling must not be subjected to sharp or binding edges.

2. Surface raceways must be large enough to accommodate all intended telecommunications cables as well as allow for 30% growth.

3. Such raceways and pathways shall installed to support horizontal cabling in accordance with the requirements of ANSI/TIA/EIA-569-A.

4. Refer to Division 26.

27.05.43 UNDERGROUND DUCTS and RACEWAYS

1. Manholes shall be precast concrete 12x6x7 A-hole or J-hole type with sump hole.

1.1. Manhole covers and frames shall have 30" diameter clear opening with heavy duty cast iron lids with penta-head bolts and labeled "Communications".

1.2. Manholes shall have all racking hardware and pulling irons installed.

1.3. Beginning from center of side wall, racking shall be installed 24" OC.

1.4. Manholes shall be fitted with a manufacturer's recommended iron ladder.

2. Ducts shall be Schedule 40 PVC, 4" ID nominal trade size, unless noted otherwise.

3. Duct Installation

3.1. Ducts shall be installed with a minimum of 30" of cover.

3.2. Ducts shall be installed a minimum of 12" from electrical conduits.

3.3. Duct shall be installed with as much separation from steam lines as is practical.

3.4. Ducts shall be separated and held in place with duct spacers at intervals of no more than 8 feet.

3.5. Ducts shall be installed with long radius sweeps, encased in concrete.

3.6. Ducts shall be installed with a minimum of 3" of fall per 100' toward maintenance holes and away from buildings.

3.7. Ducts shall be surrounded by a minimum of 3" on all sides with flowable backfill

3.8. Ducts shall then be capped with a minimum 3" concrete no less than the width of the backfilled trench.

3.9. Color top of concrete cap by using Orange chalk dust while still wet.

3.10. An orange magnetically detectable warning tape shall be installed above the top of the ductbank, 18" below ground level.

3.11. Where possible, ducts shall be terminated into precast cutout locations.

3.12. Duct shall NOT penetrate manholes in the collars, in the middle of side walls, or at locations blocked by existing cables in the case of existing manholes.

3.13. Duct penetration should NOT extend beyond the manhole walls.

3.14. Duct penetration locations should allow for easy racking of cables around manhole walls.

2. Otherwise, identify system components according to TIA/EIA 606-A.

See 27.11.16 EQUIPMENT RACKS

7'x19" Equipment Rack	Panduit CMR19x84
Wire Management Vertical 6"	Panduit Patchrunner PRV6
Wire Management Hinged Door 6"	Panduit PRD6
Wire Management Horizontal	Panduit WMPH2E
Wire Management Intermediate 8"	Panduit Patchrunner PRV8
Wire Management Hinged Door 8"	Panduit PRD8
Wire Management Intermediate 12"	Panduit Patchrunner PRV12
Wire Management Hinged Door 12"	Panduit PRD12

Equipment Cabinet (for small buildings) Cooper B-Line VLWM2425PB
Plexiglas door, Black
(use must be pre-approved)

See 27.11.19 TERMINATIONS

Copper backbone Termination	BlockPanduit Pan-Punch 110 Category 5e system
Horizontal Copper Cabling Patch Panel	Panduit CPPLA24WBLY
Patch Panel Jack Modules	Panduit CJ688TGYL TX6 PLUS, yellow
Voice Patch Panel	Panduit VP24382TV25Y with RJ21 connector

1U Fiber Cabinet (requires situational approval)	AFL FM001038-BE 3-slot rack mount patch panel, black, empty
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2U Fiber Cabinet (requires situational approval)	AFL FM001029-BE 6-slot rack mount patch panel, black, empty
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4U Fiber Cabinet, XFM (standard / preferred)	AFL FM001090-BE 12-slot rack mount patch panel, black, empty
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12-fiber LC Cassette, 50 um Multimode	AFL FM000273-B, Black LGX118, Standard Grade
24-fiber LC Cassette, 50 um Multimode	AFL FM000692-B, Black LGX118, Standard Grade
12-fiber LC Cassette, Singlemode	AFL FM001789-B, Black LGX118, Singlemode
24-fiber LC Cassette, Singlemode	AFL FM000691-B, Black LGX118, Singlemode

Adapter, AFL Cassettes in Corning shelf	AFL FM001636 adapter plate
Adapter plate, 6 Duplex LC SM couplers	AFL C215993, loaded with Singlemode LC couplers
Adapter plate, 6 Duplex SC SM couplers	AFL C220853, loaded with Singlemode SC couplers

See 27.11.23 CABLE MANAGEMENT and LADDER RACK

Ladder Rack (in IDF)

Chatsworth 10250-712* (12” or wider, as required)

*associated parts, as required

See 27.13.13 BACKBONE COPPER (Riser)

Category 3 Copper Backbone Cable	OFS Type CMP, #24 AWG, twisted pair, solid copper
Category 3 Copper Backbone Cable	Category 3, suitable for placement in a plenum
Category 3 Copper Backbone Cable	Belden Corporation equivalent
Category 3 Copper Backbone Cable	General Cable, Guardian Products, equivalent
Category 3 Copper Backbone Cable	Mohawk Wire and Cable Corporation equivalent
Category 3 Copper Backbone Cable	Commscope, General Instrument, equivalent
Riser Cable to Patch Panel Tie Cable	Type CMP 25-pair amphenol style cable, #24 AWG twisted pair, solid copper Category 3

See 27.13.23 BACKBONE FIBER

AFL 12 fiber 50 micron Multimode OM4 Riser Cables, MTP/MTP

FTF-FTF-PL-012R-C-0020-PE-METHOD B	Cable, pulling eye one end only, 20 <u>meters</u>
FTF-FTF-PL-012R-C-0030-PE-METHOD B	Cable, pulling eye one end only, 30 <u>meters</u>
FTF-FTF-PL-012R-C-0040-PE-METHOD B	Cable, pulling eye one end only, 40 <u>meters</u>
FTF-FTF-PL-012R-C-0050-PE-METHOD B	Cable, pulling eye one end only, 50 <u>meters</u>
FTF-FTF-PL-012R-C-0060-PE-METHOD B	Cable, pulling eye one end only, 60 <u>meters</u>
FTF-FTF-PL-012R-C-0070-PE-METHOD B	Cable, pulling eye one end only, 70 <u>meters</u>
FTF-FTF-PL-012R-C-0080-PE-METHOD B	Cable, pulling eye one end only, 80 <u>meters</u>
FTF-FTF-PL-012R-C-0090-PE-METHOD B	Cable, pulling eye one end only, 90 <u>meters</u>
FTF-FTF-PL-012R-C-0100-PE-METHOD B	Cable, pulling eye one end only, 100 <u>meters</u>
FTF-FTF-PL-012R-C-0110-PE-METHOD B	Cable, pulling eye one end only, 110 <u>meters</u>
FTF-FTF-PL-012R-C-0120-PE-METHOD B	Cable, pulling eye one end only, 120 <u>meters</u>
FTF-FTF-PL-012R-C-0130-PE-METHOD B	Cable, pulling eye one end only, 130 <u>meters</u>

AFL 12 fiber Singlemode Riser Cables, MTP/MTP

ATF-ATF-PL-012R-Q-0020-PE-METHOD B	Cable, pulling eye one end only, 20 <u>meters</u>
ATF-ATF-PL-012R-Q-0030-PE-METHOD B	Cable, pulling eye one end only, 30 <u>meters</u>
ATF-ATF-PL-012R-Q-0040-PE-METHOD B	Cable, pulling eye one end only, 40 <u>meters</u>
ATF-ATF-PL-012R-Q-0050-PE-METHOD B	Cable, pulling eye one end only, 50 <u>meters</u>
ATF-ATF-PL-012R-Q-0060-PE-METHOD B	Cable, pulling eye one end only, 60 <u>meters</u>
ATF-ATF-PL-012R-Q-0070-PE-METHOD B	Cable, pulling eye one end only, 70 <u>meters</u>
ATF-ATF-PL-012R-Q-0080-PE-METHOD B	Cable, pulling eye one end only, 80 <u>meters</u>
ATF-ATF-PL-012R-Q-0090-PE-METHOD B	Cable, pulling eye one end only, 90 <u>meters</u>
ATF-ATF-PL-012R-Q-0100-PE-METHOD B	Cable, pulling eye one end only, 100 <u>meters</u>
ATF-ATF-PL-012R-Q-0110-PE-METHOD B	Cable, pulling eye one end only, 110 <u>meters</u>
ATF-ATF-PL-012R-Q-0120-PE-METHOD B	Cable, pulling eye one end only, 120 <u>meters</u>
ATF-ATF-PL-012R-Q-0130-PE-METHOD B	Cable, pulling eye one end only, 130 <u>meters</u>

See 27.13.33 BACKBONE COAX

CATV Coaxial Backbone Cable	CommScope Video Series CATVP RG11, Plenum Rated or Belden or General Cable equivalent
CATV Coaxial Backbone Cable	CommScope 2287K, RG11, Plenum Rated or Belden or General Cable equivalent
CATV Amplifier	ACI Communications, Inc. MFT7/37PCS419-1 with North American cord set
CATV Coupler	Tru-Spec
CATV Coupler	TVC
CATV Coupler	Scientific Atlanta
Directional Tap, 4 port	Blonder Tongue SRT-4A, 5-1000 Mhz
Directional Tap, 8 port	Blonder Tongue SRT-8A, 5-1000 Mhz
3-way Splitter	Blonder Tongue SXRS-3, 5-1000 Mhz

See 27.15.13 HORIZONTAL COPPER CABLING

Horizontal Station Cable, Plenum	Mohawk M57415 GigaLAN station wire, Yellow
Horizontal Station Cable, Plenum	Berk-Tek LanMark 2000 #10167309, Yellow
Horizontal Station Cable, Plenum	Superior Essex NextGain Cat6eX station wire, Yellow
Horizontal Station Cable, Plenum	Belden 4813 004 1000 Data Twist 4800, Yellow
Horizontal Station Cable, Plenum	General Cable 7131932 GenSPEED 6500, Yellow
Horizontal Station Cable, Plenum	Commscope UltraPipe 6ECMP, Yellow

See 27.15.33 HORIZONTAL COAXIAL CABLING

RG-6 Coaxial Cable, Plenum	CommScope 2227V RG-6 Quad-shield Plenum, or Belden or General Instrument equivalent
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See 27.15.43 INFORMATION OUTLET

Standard Information Outlet, Single Gang face

Double Gang Electrical Box	4"x4" minimum 2-1/8" deep double gang box
Mud Ring	4" square Double Gang to Single Gang mud ring
Faceplate	Panduit CFPE4IWY Executive Series, 4-port, off-white faceplate
Jack module	Panduit CJ688TGyl Mini-Com TX-6+ module, Yellow
Blank module	Panduit CMBIW-X Mini-Com blank module insert, off-white

Standard Information Outlet, Double Gang face

Double Gang Electrical Box	4"x4" minimum 2-1/8" deep single gang box
Mud Ring	Double gang
Faceplate	Panduit CFPE10IW-2GY Executive Series, 4-port, off-white
Jack module	Panduit CJ688TGYL Mini-Com TX-6+ module, Yellow
Blank module	Panduit CMBIW-X Mini-Com blank module insert, off-white

Standard Information Outlet, Double Gang face, with Video

Double Gang Electrical Box	4"x4" minimum 2-1/8" deep single gang box
Mud Ring	Double gang
Faceplate	Panduit CFPE10IW-2GY Executive Series, 4-port, off-white
Jack module	Panduit CJ688TGYL Mini-Com TX-6+ module, Yellow
Blank module	Panduit CMBIW-X Mini-Com blank module insert, off-white
F-connector	Panduit CMFIW 75-ohm F-connector module, off-white

Wall Phone Outlet

Single Gang Electrical Box	4"x4"xminimum 2-1/8" deep single gang box
Mud Ring, Single gang	
Wall Plate	Panduit KWP5Y stainless steel plate with Category 5e Keystone module

Wireless Access Point Outlet (WAP) Same as Standard Information Outlet, Single Gang face

Biscuit Jack

27.08.00 COMMISSIONING

27.10.00 STRUCTURED CABLING

27.11.00 EQUIPMENT ROOM FITTINGS

27.11.03 WALLS

1. All walls shall be covered with 4' x 8' x 3/4" plywood, mounted 0'-6" above the finished floor with the 8'-0" dimension vertical.

1.1. Backboards shall be painted with two (2) coats of fire retardant paint on all sides, or fire-retardant treated and painted.

1.2. Backboard paint color shall be a light gray / off-white.

27.11.13 ENTRANCE PROTECTION

Not applicable

27.11.16 CABINETS, RACKS, FRAMES and ENCLOSURES

1. Equipment Racks

1.1. The equipment rack shall be installed in the Telecommunication Equipment Rooms (IDFs) according to layout and communication media requirements

1.2. Telecommunication Equipment Room (IDF) layouts shall be coordinated with the appropriate University Information Technology Services representative

1.3. The rack shall be anchored to the floor and braced overhead with ladder racking and grounded to the ground bus bar location in the IDF with a #6 solid or stranded ground wire.

2. Wire management

2.1. **Vertical:** Open ends of racks shall have 8" or 12" vertical wire management with hinged doors.

2.2. Between multiple racks use 12" vertical wire managers and hinged doors.

2.3. **Horizontal:** On the top and bottom of each rack, install one horizontal wire manager with covers.

27.11.19 TERMINATION BLOCKS and PATCH PANELS

1. Copper Equipment

1.1. Unshielded Twisted Pair Riser

1.1.1 Amphenol style cables shall be terminated on 110 type blocks with 110A wiring blocks.

1.1.2. Terminal blocks shall be located so as to be easily cross-connected to feeder pair and the voice cable stations and plugged into the analog voice patch panel.

1.2. Horizontal Cabling Patch Panels

1.2.1. Use Panduit modular 6 port face plate angled patch panels filled with yellow TX-6+ modules

1.2.2. Use a Panduit voice patch panel installed in the rack for analog voice with a 50 pin, 25 pair female amphenol connector

1.2.3. All patch panels, termination panels, and cable managers should be installed so that their fronts, and the front of the networking equipment later provided by owner, shall be visible from the telecommunications room open doorway.

2. Fiber Equipment

2.1. Use cable clamps, breakout kits, mounting bracket(s) and other miscellaneous hardware as necessary to complete a proper installation.

2.2. Breakout kits will be required to terminate all loose tube 250 micron fibers.

2.2.1. NOT needed for 900 micron fiber.

3. Coaxial Equipment

3.1. Amplifiers, couplers, directional taps, splitters, and associated parts shall be mounted on the telecommunication room plywood covered walls as noted on the prints and in following illustration.

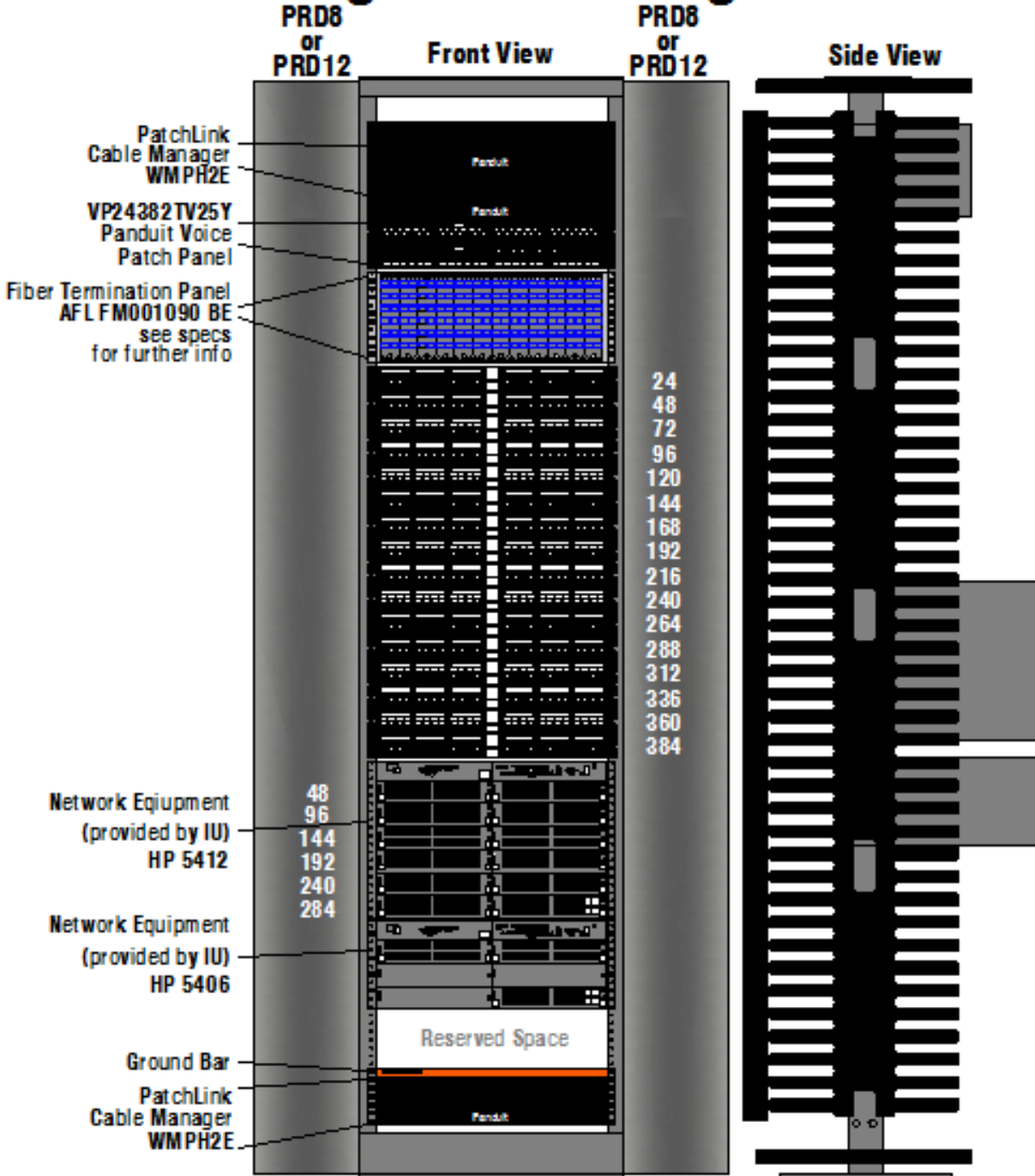


27.11.23 CABLE MANAGEMENT and LADDER RACK

1. A 12" ladder rack shall be installed from the top of and perpendicular to the equipment rack(s) to 4' x 8' wall mounted plywood board, as needed to stabilize equipment racks, and according to room layout and field conditions.

RACK LAYOUT

Single Rack Configuration



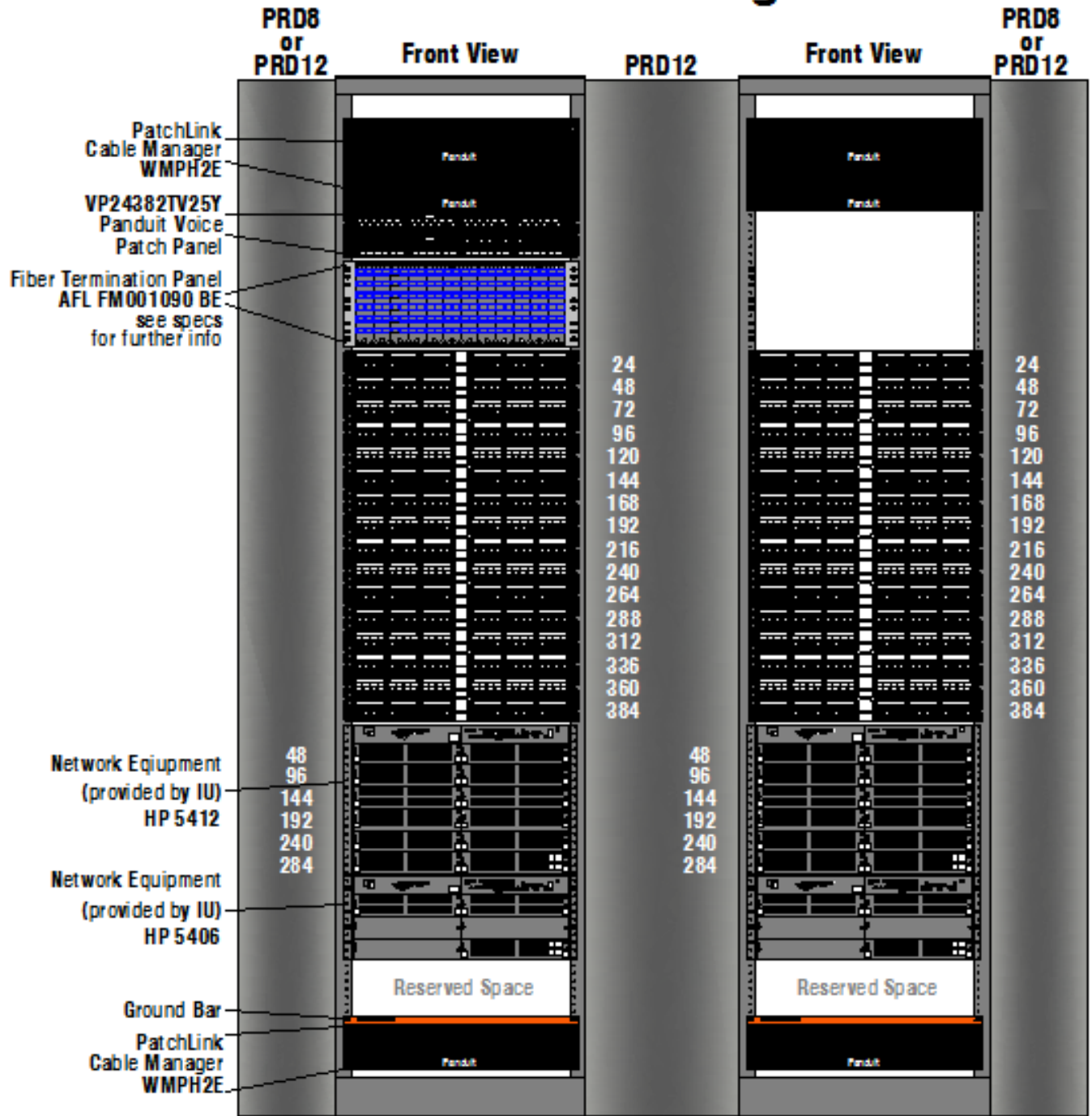
Single Rack Configuration

300 ports maximum, initial

Rev. 05/31/11

RACK LAYOUT

Dual Rack Configuration

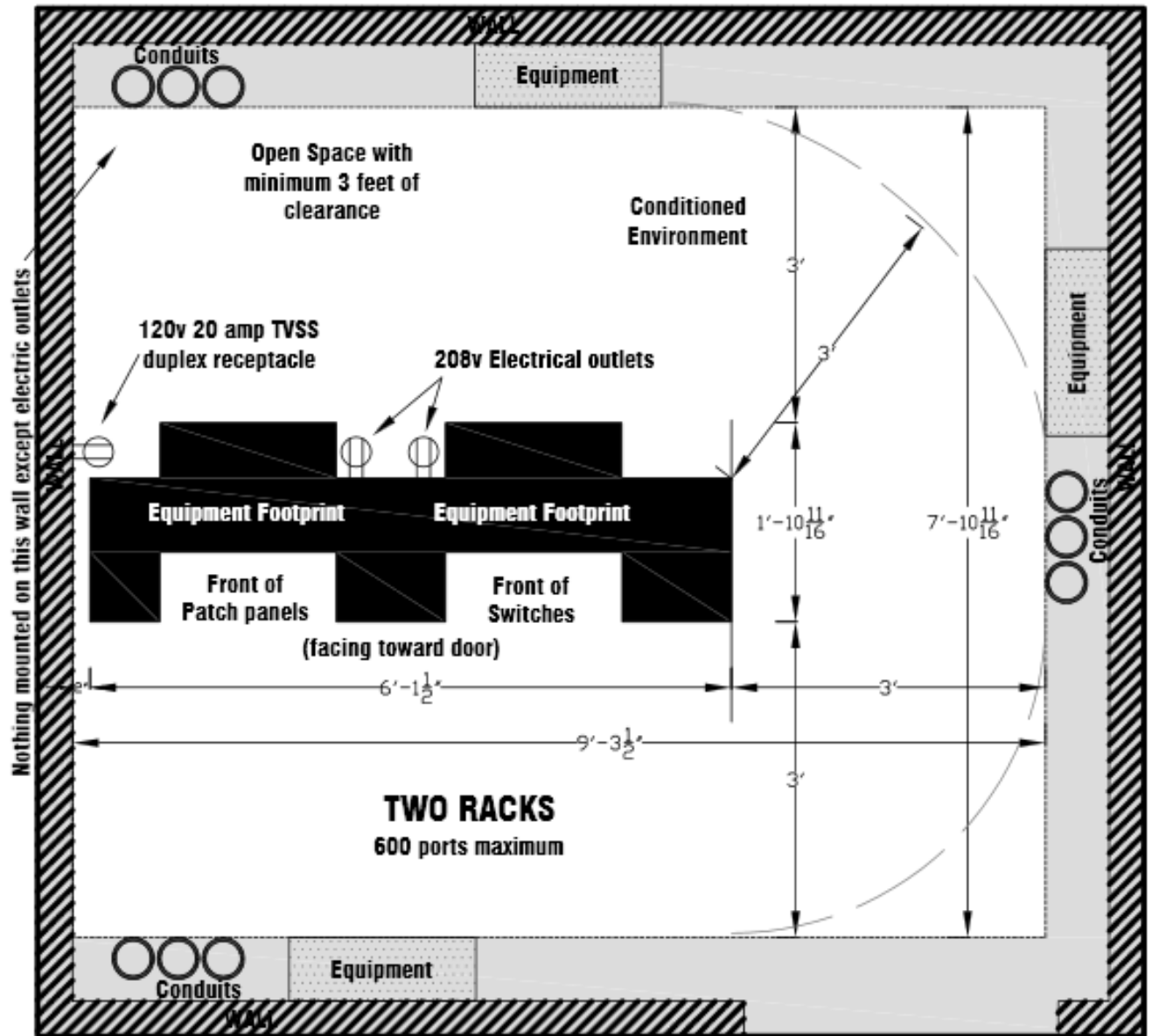


Dual Rack Configuration

600 ports maximum, initial

Rev. 05/31/11

IDF ROOM - RACK LAYOUT

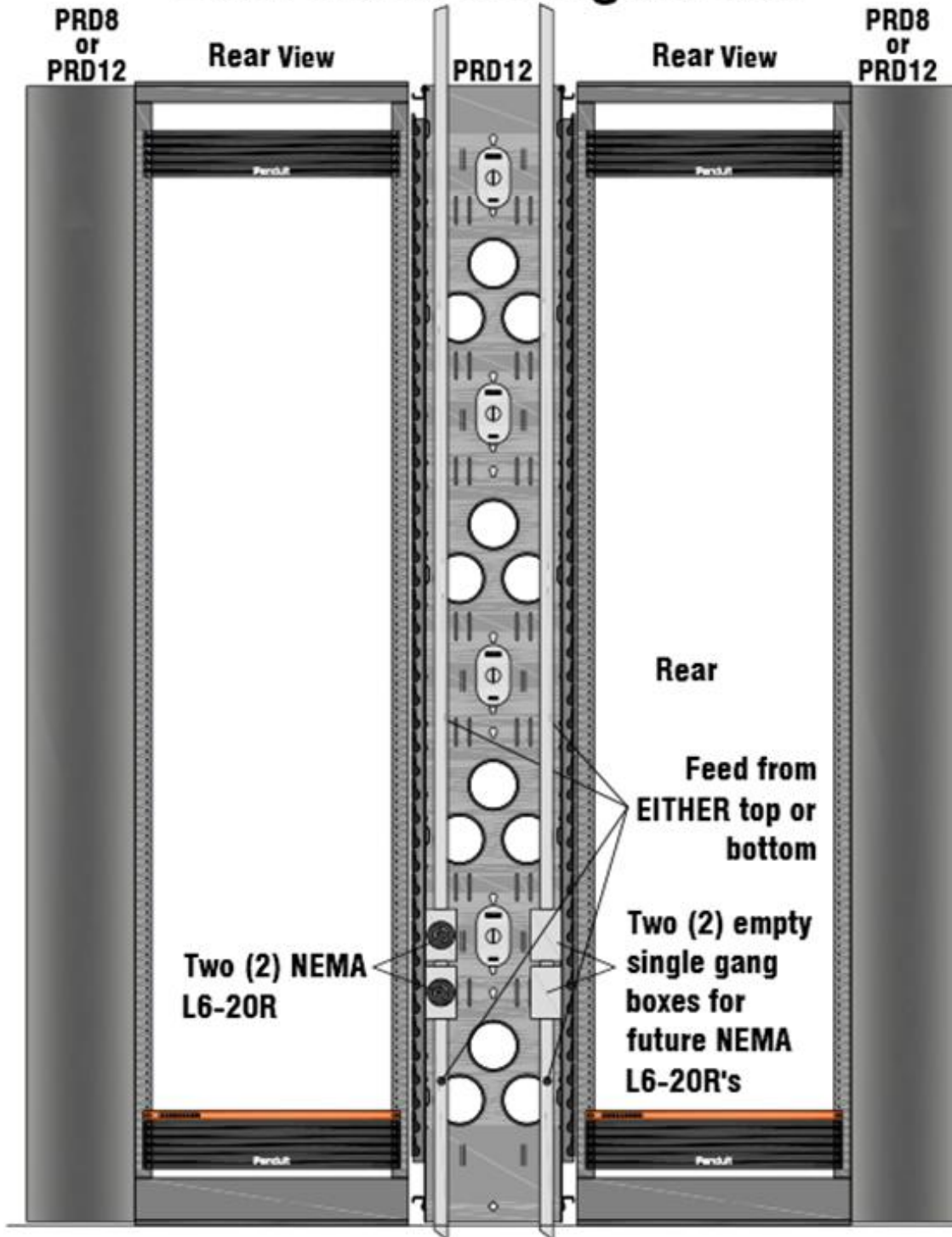


Minimum interior space: 9' x 10'

7/18/2011 gls

208v POWER LAYOUT

Dual Rack Configuration



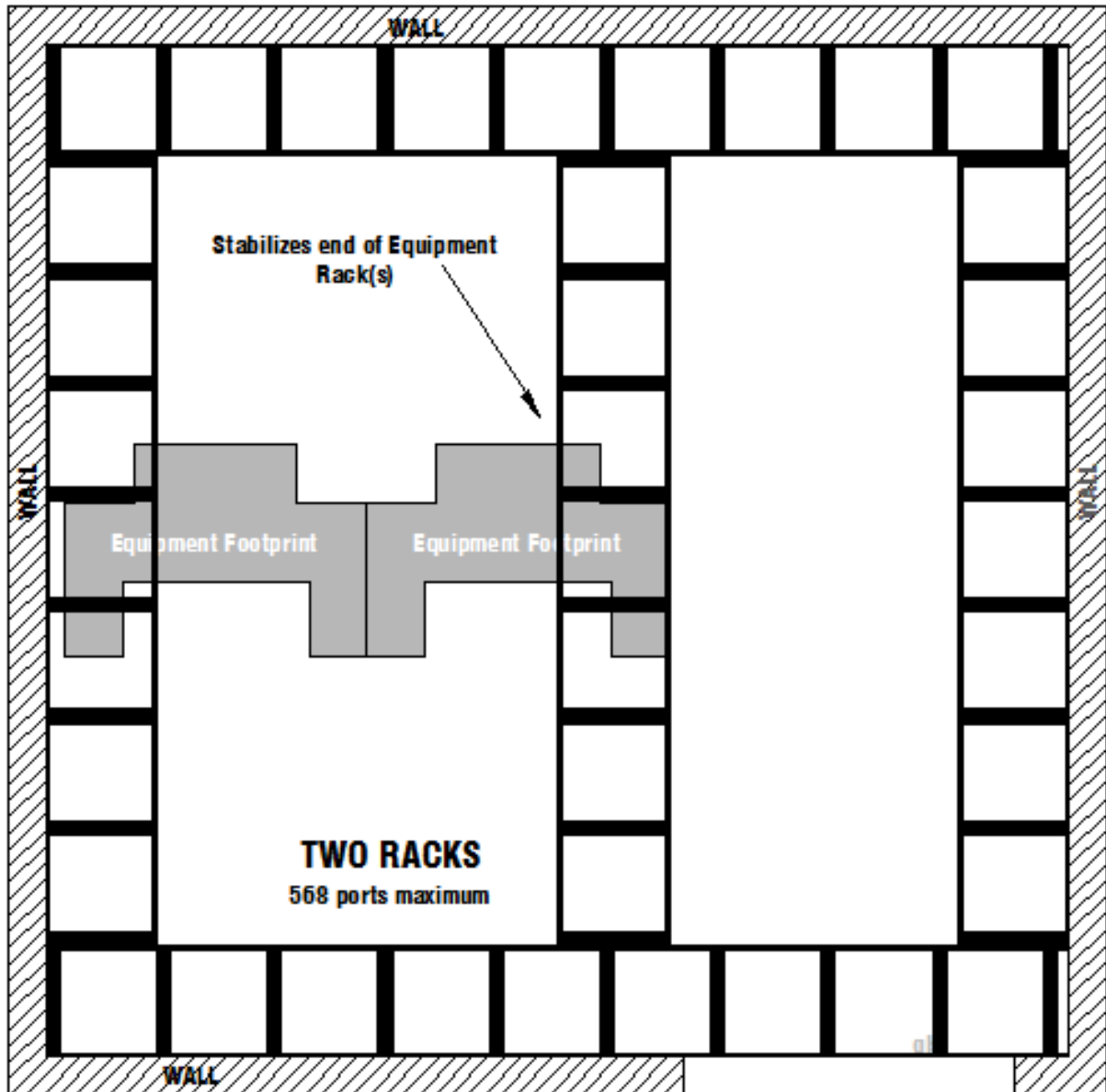
Dual Rack Configuration

Rev. 07/22/11

IDF ROOM - LADDER RACK LAYOUT

Chatsworth Universal Cable Runway

Chatsworth 10250-712



Rev. 05/31/11

27.12.00 TRANSMISSION MEDIA

1. General: Provide telecommunication transmission media of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for applications indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20°C (68°F).
2. Cable Labeling: The National Electrical Code (NEC) requirements dictate that telecommunication cables used within a building are classified as to their use and smoke and flame requirements. Underwriters Laboratories (UL) provides certification that a cable meets the NEC requirements.
3. All cables shall be clearly marked with the proper NEC classification as follows:

<u>RISER CABLES</u>	
<u>CABLE TYPE</u>	<u>NEC CLASSIFICATION CODES</u>
Fiber Optic	OFNP, OFNR
Copper UTP	CMR & CMP, Category 3
Coaxial	CL2R & CL2P, CATVR & CATVP

<u>HORIZONTAL CABLES</u>	
<u>CABLE TYPE</u>	<u>NEC CLASSIFICATION CODES</u>
Fiber Optic	OFN, OFNR & OFNP
Copper UTP	CMG, CMR & CMP, Category 6e
Coaxial	CL2, CL2R & CL2P

27.13.00 BACKBONE CABLING

27.13.13 COPPER BACKBONE CABLING

1. Terminating blocks mounted to the wall.
2. Copper backbone cables shall be extended to the equipment rack with 25 pair male amphenol style cables, terminated at the wall on 110 blocks on one end, with the amphenol end plugged into the analog voice patch panels.
3. Cable pairs and 25-pair binder groups shall be cut down in standard color code order.
4. UTP riser cable will have cable ID and pair count clearly marked on building equipment room and punch down blocks.
 - 4.1. Copper backbone cabling will be labeled in both the building telecommunications equipment room and the floor telecommunications equipment rooms.
 - 4.2. Cable ID's will be building number + an underscore + an incremental two digit cable number.
 - 4.2.1. For example, the cable to IDF-2 would be 023_01, while the cable to IDF-3 would be 023_02.
 - 4.3. Counts shall start from the lowest IDF number and increment with IDF numbers.
 - 4.3.1. For example, the cable to IDF-2 would count 023_01, 1-50, while the cable to IDF-3 would count 023_02, 51-100.
 - 4.4. All labeling must be approved by the appropriate IU UITs personnel.

27.13.13.23 Testing of Copper Backbone Cabling

1. Perform visual inspection to ensure that all cables are terminated on the punch down block in proper color code order.
2. Test all pairs for continuity and tip and ring polarity.
3. Test results shall meet or exceed the appropriate tests requirements as specified in the ANSI/TIA/EIA-568 specifications.
4. Bad pairs shall be limited to a maximum of 1% of the total number of pairs, and with a maximum of two (2) bad pairs per binder group.
5. Test results shall be stored on a CD and delivered to the University Information Technology Services representative.
6. Test results shall be verified by the designated University personnel as part of the *inspection* and acceptance procedure.

27.13.23 OPTICAL FIBER BACKBONE CABLING

1. Installation

- 1.1. Install FO cables and devices in accordance with industry standards and manufactures written instructions.
- 1.2. Install FO cable without damage to fibers, cladding, or jacket.
 - 1.2.1. Ensure that media manufactures recommended pulling tensions are not exceeded.
- 1.3. Do not bend cables to smaller radii than minimums recommended by manufacturer.
- 1.4. Use a pulling means, including fish tape, rope, and basket-weave grips, that will not damage media or raceway. Install FO cable simultaneously where more than one cable is being installed in the same raceway.
- 1.5. Use pulling lubricant where necessary; compound used must not deteriorate cable materials. Do not use soap.
- 1.6. NO splices are allowed. Cable runs to be continuous.
- 1.7. Provide grounding connections for FO cable and other system components as required by specifications and applicable codes and regulations, according to manufacturers written instructions.
- 1.8. Provide termination of cables.
 - 1.8.1. Use AFL fiber optic connectors on singlemode cables.
 - 1.8.2. Use preterminated MTP/MPO connectors on 50 micron multimode cables with pre-connectorized modules with and AFL cabinets.
- 1.9. Fiber optic cable will have cable ID and strand count clearly marked on the fiber cabinet in the IDF.

27.13.23.23 Testing of Fiber Cables

1. General

- 1.1. It will be the contractor's responsibility to provide the test equipment necessary and document the

campus telecommunication coordinator the test equipment available for testing and the last date of certification.

1.2. Cables will have SC (OSP) or LC (riser) connectors installed on singlemode cables prior to testing.

1.3. The tests shall be performed on inter-building and riser fiber cables.

1.3. **Testing equipment:**

1.3.1. Continuity tester

1.3.2. Visible fault detector

1.3.3. Power meter and light source

1.3.4. OTDR (Optical Time Domain Reflectometer)

1.3.5. Appropriate types of fiber jumpers

1.3.6. Equipment for two testers to communicate

1.3.7. Fluke DSP 4000 or equivalent.

1.3.8. Other equipment as approved by designated University personnel and as required to complete the testing to the satisfaction of the University

1.4. Prior to usage, test equipment and components in accordance with manufactures published test procedures.

1.5. All fibers will be tested bi-directionally per TIA-526-7 and TIA-526-14 method A-2.

1.6. Bi-directional attenuation figures in decibel (dB) will be documented.

1.6.1. Before testing, verify with the University Information Technologies representative if raw or referenced readings are preferred.

1.7. All strands shall test good and meet current ANSI/TIA/EIA-568 specifications. Dark fibers and excessive attenuation due to breaks, bends, bad splices, defective connectors and bad installation practices will not be accepted and must be corrected.

1.8. Replacement fiber cables shall be subject to tests and criteria as described in this document.

1.9. All fiber cables shall have NO bad fibers. Fiber cables tested to have bad fibers, and determined to be non-repairable by practices acceptable to the University, shall be replaced at no additional cost to the University.

1.10. Any and all measures taken to correct unacceptable test results will be recorded, along with loss measurements taken before and after corrective measures.

1.11. Documentation will include cable ID, from and to points, strand ID, bi-directional attenuation figures in dB, per TIA Method A-2.

1.12. Use of an OTDR may require that a "launch reel" be used to overcome the OTDR's dead zone, if needed for fault location if the bi-directional tests fail.

1.13. Fiber jumpers used with the OTDR, light source and power meter must be of the same size and type of the fiber being tested.

1.14. Fiber jumpers used with the light source and power meters shall be zeroed out by attaching the jumper from the light source via a coupler to the jumper from the power meter.

1.14.1. This reading noted, will become the reference level to obtain a true attenuation reading (some power meters can be zeroed to allow reading the attenuation level direct).

1.14.2. TIA-526-7 and TIA-526-14 Method A-2 should be used to zero OLTS.

2. Loss Budgets

- 2.1. Average splice loss shall not exceed 0.35 dB attenuation for multi mode, 0.25 dB attenuation for single mode, measured from both directions.
- 2.2. No individual splice, multimode or single mode, shall exceed 0.50 dB attenuation, measured from both directions.
- 2.3. No termination shall exceed 0.40 dB attenuation for multi mode, 0.30 dB attenuation for single mode.
- d. No single mode OSP fiber shall exceed 0.000091436 dB attenuation per foot at 1550 nm. (0.25 dB attenuation per kilometer at 1550 nm).
- 2.4. Acceptable maximum allowable attenuation per spliced and terminated fiber will be determined by the following formula:

$$\text{MAX} = (\text{S} * \text{MS}) + (\text{E} * \text{ME}) + (\text{F} * \text{MF})$$

Where S = number of splices in fiber between end termination points

MS = dB maximum average allowable attenuation per splice

E = number of endpoint terminations (namely, 2)

ME = dB maximum allowable attenuation per endpoint termination

F = number of feet of fiber from endpoint termination to endpoint termination

MF = maximum allowable fiber attenuation per foot of fiber

Manufacturer's specifications (converted from dB/km by formula (dB per km / 3280.8))

3. Riser Fiber Cable Testing

- 3.1. Test multimode riser fiber at 850 nm and 1300 nm in both directions.
- 3.2. Test singlemode riser fiber at 1310 nm and 1550 nm in both directions is to be used.
- 3.3. No multimode riser fiber shall exceed 0.00021336 dB attenuation per foot at 1300 nm, 400 Mhz bandwidth. (0.70 dB attenuation per kilometer at 1300 nm, 400 Mhz bandwidth).

4. Entrance / Outside Plant Fiber Cable Testing

- 4.1. Test entrance fiber with an OLTS per TIA-526-7 method A-2, Option 1.
 - 4.1.1. Test with an optical time domain reflectometer (OTDR) if needed per Option 2.
 - 4.1.2. ORL should be -30 dB or higher.
- 4.2. Test singlemode entrance fiber at 1310 nm and 1550.
- 4.3. Test cable segments for faulty connectors and terminations, and for the integrity of the cable and its component parts.
- 4.4. Replace malfunctioning of damaged items with new materials, then retest until satisfactory performance is achieved. Test cable in both directions using the wavelengths described above.

27.13.33 COAXIAL BACKBONE CABLING

1. Design Specifications for Campus Cable Distribution System

Cable specifications	Cable must be 100% shielded
Cable testing	Cable must be 100% sweep tested and certified
System frequency response	50 MHz - 1 GHz (Forward) 5 MHz - 42 MHz (Reverse)
System tilt	10 dbmv MAXIMUM
Maximum system level	+40 dbmv at visual carrier, aural carrier shall be - 10 to - 17 - 6 dbmv in respect to visual carrier
Signal leakage	Maximum signal leakage from the system shall not exceed -40 dbmv at CATV channel 'A' (121.25 MHz), and shall not exceed -53 dbmv at CATV channel 'W' (295.25 MHz)
Spurious output	Spurious output of modulators/processors shall not exceed -70 dbmv
System carrier to noise	Shall exceed -54 dbmv at last tap
System operating range	System shall perform as specified at temperatures 120°F between 32°F
Hum to Noise	System hum and noise shall exceed -50 dbmv at all points
Field rate sync division	5% maximum (FCC requirement)
Cross modulation	-70 dbmv on fully loaded system
K-factor	2% or better
Adjacent carriers	Adjacent channel carriers shall be within 2 dbmv
Receive outlet level	+6 dbmv, +4 dbmv -3 dbmv
Return outlet level	+10 dbmv, +15 dbmv -0 dbmv at the "head-end" equipment with signal injected by modulator (+60 dbmv, +0 dbmv -45 dbmv adjustable) located in technology equipment.

2. **Labeling** of all coaxial cables will have the building equipment room and floor equipment room ends clearly marked with the cable ID number.

3. Testing of coaxial cables

- 3.1. Cables will have connectors installed on ends prior to testing.
- 3.2. Cable must be 100% sweep tested and CERTIFIED to meet with CATV standards.
- 3.3. Frequency response from 50 MHz to 1 GHz will be measured and shall indicate no greater than 7 dbmv system tilt.
- 3.4. Attenuation will be measured end to end using 150 MHz as a test signal and attenuation will be documented in dbmv.
- 3.5. Documentation will include cable ID, from and to points, frequency response, attenuation figures and as built information.

27.15.00 HORIZONTAL CABLING

27.15.13 COPPER HORIZONTAL CABLING

1. Before the installation of Horizontal Cabling will be allowed to begin, the telecommunications subcontractor must provide a mock-up of the labeling and wiring to a sample face-plate and patch panel.

1.1. The mock-ups must be reviewed by an appropriate representative of UITS and approved prior to performing any final wiring required by the project documents.

2. Installation of Horizontal Copper Cabling

2.1. 4-pair UTP cables should withstand 25 foot-pounds of pulling pressure. This number shall be verified by the wire manufacturer.

2.1.1. Maximum cable length is limited to 90 meters (295 feet) from the jack to the patch panels.

2.1.2. Comply with ANSI/TIA/EIA-569 standard regarding the requirements and recommendations for separation of copper telecommunication cabling from sources of electromagnetic interference.

2.1.3. The Contractor shall replace any damaged cable at no expense to the University. No repair will be allowed on damaged cables.

2.2. Cabling shall be terminated at the station jack and at the equipment room as indicated in ANSI-TIA-EIA-568, wiring configuration T568A.

2.2.1. The modular faceplate at the user end shall be equipped with inserts for communication services as indicated on plans.

2.2.2. Station cable in the IDF shall be terminated on Category 6e patch panel located in the equipment racks.

2.2.3. The minimum bend radius of Category 6e UTP cable shall not be smaller than four (4) times the diameter of the jacketed cable, and shall not cause the cable jacket to buckle.

2.2.4. Route cables from the back of the patch panel through its coupler openings and loosely attach them to the wire manager with velcro cable ties, leaving enough slack for re-termination at a future date.

2.2.5. Remove only as much jacketing as needed to terminate properly to the connecting hardware, keeping the amount of jacketing removed to an absolute minimum.

2.2.6. Do not untwist pairs more than 0.5 inches.

2.2.7. Visually *inspect* cable pairs for bare wire and other defects before terminating wires.

2.2.8. Once all of the cables have been terminated, dress the cable slack behind the panel with velcro tie wraps tightened to a snug but not compressing fit.

2.3. Telecommunication cabling for elevator emergency phones shall be provided as follows:

2.3.1. Cabling for the elevator telephone to the elevator control room is by the elevator installer.

2.3.2. Cabling from the elevator control room to the telecommunication equipment room is by the electrical contractor.

2.3.2.1. Jack must be mounted adjacent to, but outside of the elevator electrical panel.

2.3.3. The electrical contractor shall notify campus personnel of the elevator service date.

2.3.3.1. This notification for request of services shall be provided no fewer than **21** days prior to service.

3. Testing of Horizontal Copper Cabling

3.1. Perform visual inspection to ensure that all cables are terminated on the eight position station jacks on both ends in proper color code order.

3.2. All station cables attached between information outlets and floor equipment room patch panels will be link tested with a cable analyzer to ensure compliance with current ANSI/TIA/EIA-568.

3.3. All pairs shall test good and meet Category 6e parameters.

3.3.1. Open, split, miss-terminated pairs, deviations from the manufacturer's installation specifications, defective connections and bad installation practices will not be accepted and must be corrected.

- 3.4. Test 100% of station wire in both directions with a certified handheld tester, such as the Fluke OmniScanner or the Fluke DSP 4000 and other test equipment as necessary to assure proper termination sequences, continuity, and Category 6e compliance. Station wire shall have **NO** bad pairs.
- 3.5. When all station wire is determined to be acceptable, University Information Technology Services will spot test the plant using a certified handheld tester, such as the Fluke OmniScanner or Fluke DSP 4000.
- 3.6. Test results shall meet or exceed the appropriate tests requirements as specified in the ANSI/TIA/EIA-568 specifications.
- 3.7. The approved handheld tester will have the capability to be programmed with current Category 6e requirements as specified in ANSI/TIA/EIA-568 standards.
- 3.8. Documentation will include cable ID (same as jack ID) to be marked on the punch down blocks and patch panels in the telecommunication closet, station jack ID to be marked on the station jack and results of the testing done with the cable analyzer.
- 3.9. Analyzer documentation will need to be in the "csv" or "dat" format that can be read by Fluke's "Linkware" software.
 - 3.9.1. Results must be labeled using the information outlet labeling scheme for the project.
- 3.10. Test results shall be stored on a CD and delivered to the University Information Technology Services representative.
- 3.11. Test results shall be verified by the designated University personnel as part of the inspection and acceptance procedure.

4. Submission of test results

- 4.1. In order to facilitate quicker turn-around for ordering and activating new information outlets in the building, the Telecommunications Subcontractor shall submit partial jack lists that are tested and approved rather than submitting the lists and test results of the entire building.
 - 4.1.1. The details of how the partial lists are created will be determined in the field through coordination between the Telecommunications Subcontractor and the UITS Technical Staff.
 - 4.1.2. As an example, test results could be submitted by IDF as work in an IDF is completed.

27.15.23 OPTICAL FIBER HORIZONTAL CABLING

Not Applicable

27.15.33 COAXIAL HORIZONTAL CABLING

1. All coaxial cables will have the building equipment room and floor equipment room ends clearly marked with the cable ID number.

2. Testing of coaxial horizontal cables

- 2.1. Cables will have connectors installed on ends prior to testing.
- 2.2. Cable must be 100% sweep tested and CERTIFIED to meet with CATV standards.
- 2.3. Frequency response from 50 MHz to 1 GHz will be measured and shall indicate no greater than 7 dbmv system tilt.
- 2.4. Attenuation will be measured end to end using 150 MHz as a test signal and attenuation will be documented in dbmv.
- 2.5. Documentation will include cable ID, from and to points, frequency response, attenuation figures and as built information.

27.15.43 FACEPLATES AND CONNECTORS

1. Termination equipment

1.1. All station cables in the IDF shall be terminated on wall mounted equipment.

2. Information Outlet Rough-In

2.1. Standard Information Outlets (single gang or double gang) shall be located at the same height as 120 volt AC outlets (normally 18" above finished floor).

2.2. Wall mounted telephones require a double gang box with a single gang plaster ring, positioned 54" A.F.F. to the center of the outlet box.

2.3. Information Outlets above counter tops should be installed so that the center of the outlet box will be a minimum of 12" above the counter top.

2.3.1. A counter top with a splash back may require different outlet box locations.

2.4. Wall mounted telephones require a special wall telephone jack that provides mounting lugs for the telephone and an eight position jack.

2.5. No Information Outlet will be installed such that workstations or devices served from it cannot be reasonably reached by a 16 ft cord.

3. Labeling of Horizontal Copper Cabling

3.1. The telecommunications contractor's onsite representative(s) shall schedule a meeting with the UIT'S representative through the IU Project Manager prior to the permanent labeling of Information Outlets and IDF patch panels.

3.2. Information Outlet receptacles, cables, and terminations shall be labeled with a standard identification tag at both the Information Outlet and on the jackfields in the IDF/Wire Closet.

3.1.1. Tags shall be preprinted or computer printed with indelible water proof ink and mechanically secured in a permanent fashion; for example, such as using an appropriate label maker with 3/8" tape.

3.1.2. Handwritten labels are NOT acceptable.

3.1.3. Labels shall be mounted in a manner which permits easy access and viewing.

3.1.4. The station cable serving each receptacle must be labeled at the room receptacle and the IDF rack.

3.3. Information Outlet receptacles in rooms are to be labeled -A through -ZZ in each room beginning with the first receptacle to the left of the main entrance to the room and continuing clockwise around the room.

3.3.1. All labeling will be done in all capital letters.

3.3.2. For example, a jack labeled 246A-A would be because:

3.3.2.1. Room 246A is the room number

3.3.2.2. The Information Outlet designation is "A" (first receptacle in room from the left of the door)

3.3.2.3. Station cables from a given room shall be terminated in sequential order, i.e. - 246A-A, 246A-B, 246A-C, 246A-D, etc. If double letters are needed, the progression would be -AA, -AB, AC, ... -AZ, -BA, -BB, etc.

3.4. Information Outlets for special purposes shall have a unique identifier listed with the jack ID.

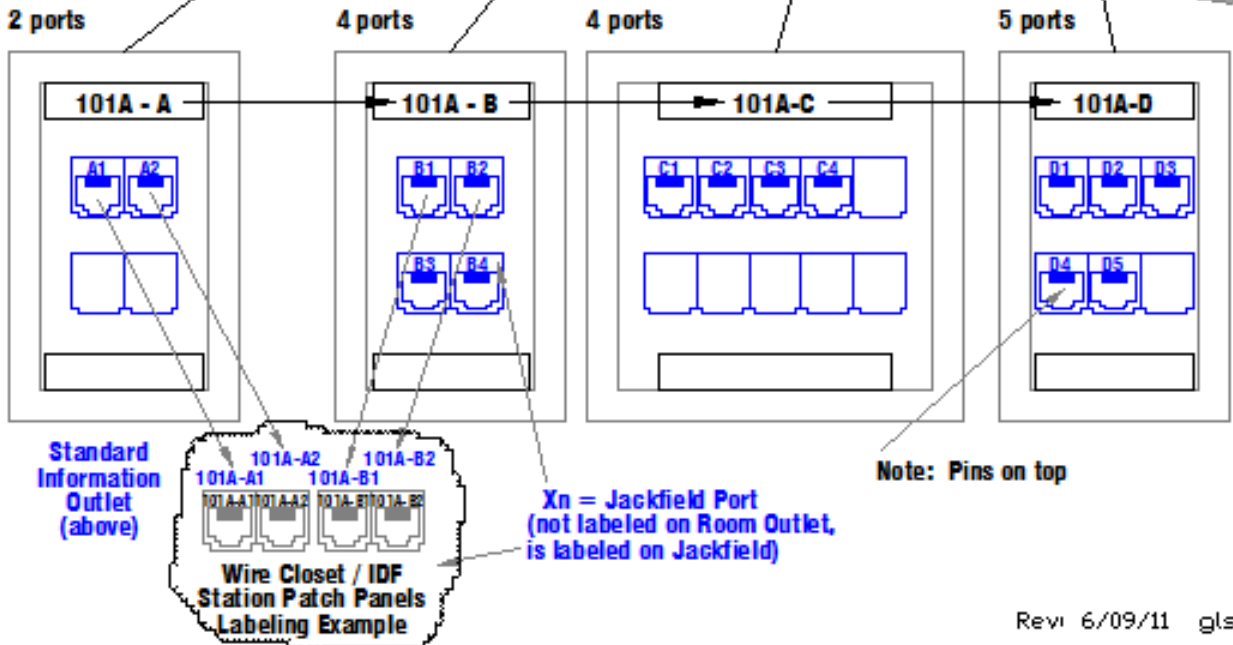
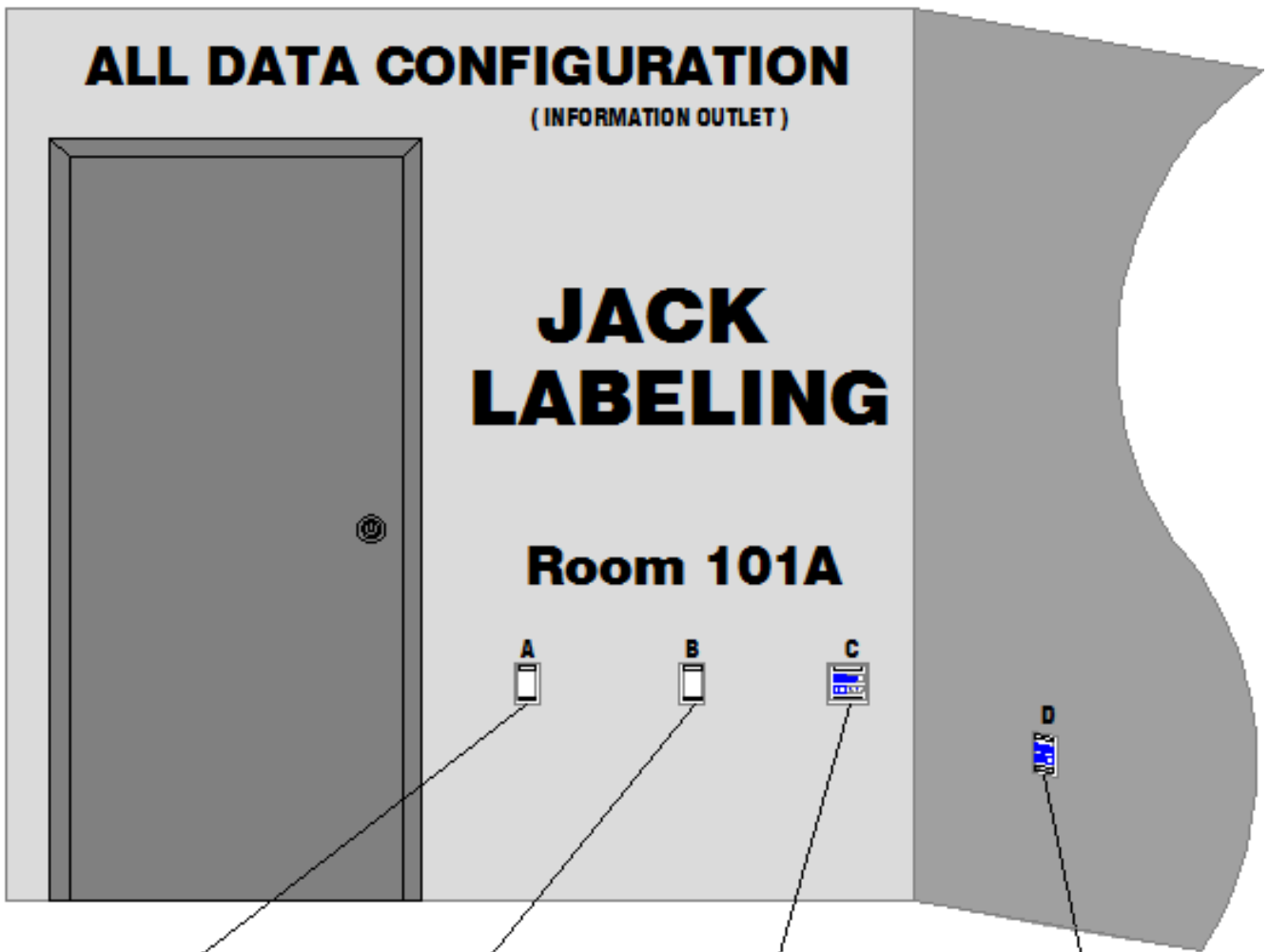
3.4.1. The identifier shall be inserted into the Outlet ID, between the room number and the Outlet designator as indicated in following drawings.

3.4.2. Common identifiers are listed below:

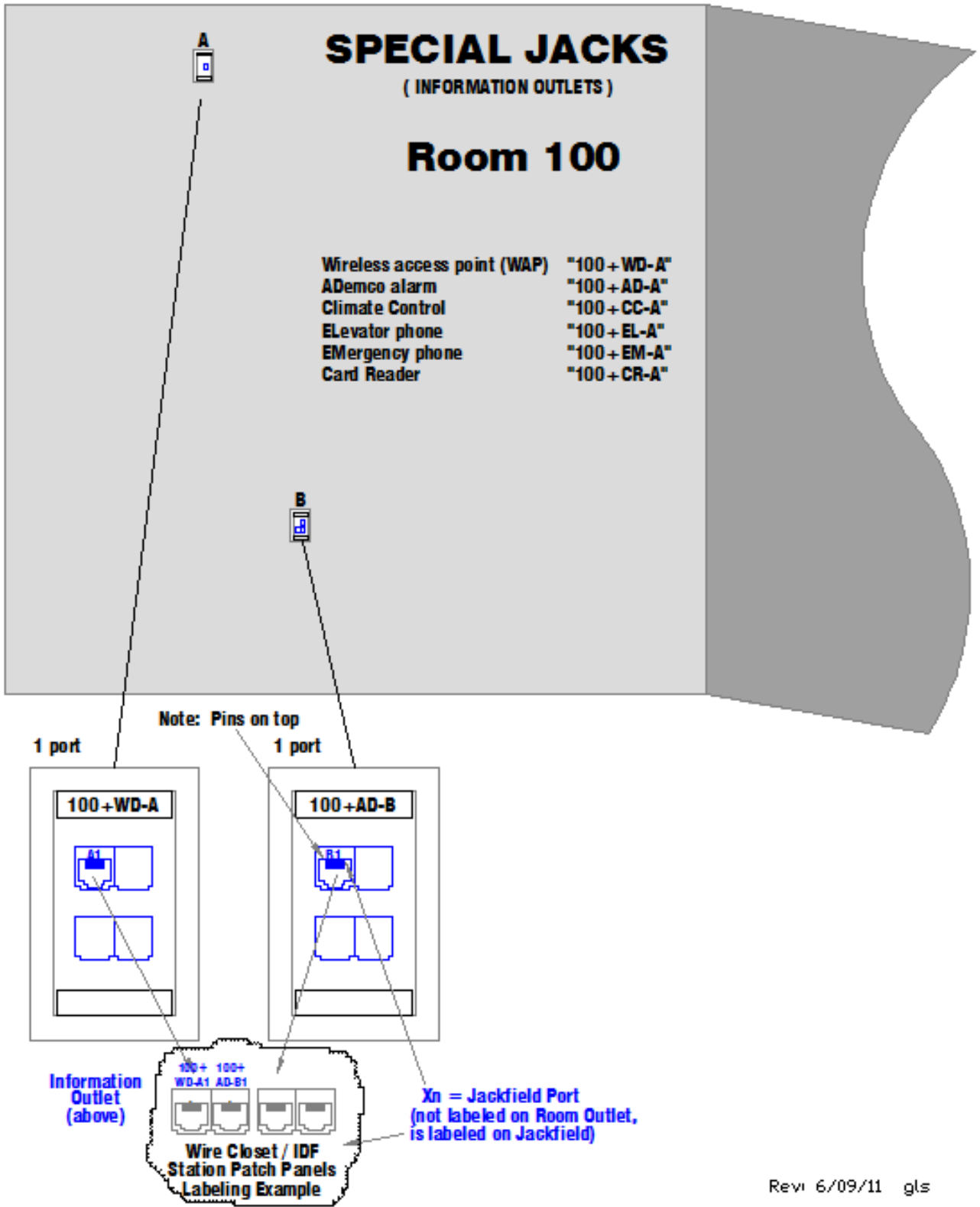
- 3.4.2.1. Wireless access point (WAP) "100+WD-A"
- 3.4.2.2. Ademco alarm jack "100+AD-A"
- 3.4.2.3. ATM jack "100+ATM-A"
- 3.4.2.4. Elevator jack "100+EL-A"
- 3.4.2.5. Emergency phone "100+EM-A"
- 3.4.2.6. Card Reader "100+CR-A"
- 3.4.2.7. Lighting Systems Controls "100+DS-A"

3.5. ALL LABELING SHALL BE COORDINATED WITH AND APPROVED BY AN APPROPRIATE UITS REPRESENTATIVE.

3.5.1. Schedule a meeting with the UITS representative through the IU Project Manager prior to the permanent labeling of Information Outlets and IDF patch panels.



JACK LABELING



Revi 6/09/11 gls

27.20.00 DATA COMMUNICATIONS

Provided by IU

27.30.00 VOICE COMMUNICATIONS

Provided by IU

27.40.00 AUDIO-VIDEO COMMUNICATIONS

27.50.00 DISTRIBUTED COMMUNICATIONS and MONITORING SYSTEMS

27.60.00 WIRELESS TRANSCEIVERS

Provided by IU