

DIVISION 27 – COMMUNICATIONS

27 01 00 – Operation and Maintenance of Communications Systems

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27 05 00 – Common Work Results for Communications

1. Introduction
 - a. This document's objective is to provide Architects and other designers with a design requirements and guidelines document that will help plan the telecommunications facilities for the RIT campus including the information necessary to design and specify a Structured Cabling System for projects supporting a wide range of communication systems. These guidelines concentrate on new building environments and existing buildings under construction for renovations. The document also defines minimum requirements but allows for customization to enhance future opportunities to meet future requirements in the categories of voice, data, audiovisual, and security systems. It is a design guide and is not a project specifications document.
 - b. See Appendix 3 for qualified bidders list.
2. Common Requirements for Communications Installation / Regulations and Code Compliance
 - a. All work shall be performed neatly and professionally.
 - b. Comply with current Rochester Institute of Technology Design and Construction Guidelines
 - c. All work included under this heading is subject to the bidding requirements.
 - d. All materials and equipment provided under this contract shall be new except where otherwise noted.
 - e. Comply with NECA, NFPA, and OSHA requirements.
 - f. The Contractor shall comply with the NEC and all other federal, state, local and laws, codes, and ordinances.
 - g. The Contractor shall be responsible for the placement of outside plant cables within RIT-provided pathways without splices.
 - h. For all work in manholes and cable vaults, the Contractor shall be responsible for ensuring that safe operating procedures are followed; work equipment is adequate and personnel have received proper training. Safety equipment shall be inspected and approved by an authorized representative of the Owner.
 - i. The Contractor shall provide the Owner with applicable warranty certification at the time of bid proposal response.
 - j. The Contractor shall be responsible for measuring required cable distances and shall not exceed appropriate cable length standards.
 - k. Product/Materials substitutions require written Owner approval at the time of Proposal response.
 - l. The Contractor shall provide the Owner with a copy of his asbestos insurance before work begins.
 - m. The Contractor shall provide the Owner with a copy of his Confined Spaces Permit.
 - n. The Contractor shall be courteous to all personnel on the project, including students and other contractors.
 - o. Documentation shall be required for all categories and will be specified in the Specific Execution sections of the bid document. Generally, documentation shall be required for all backbone pathway usage, cable pair counts, and building entrance details. Documentation shall be required for horizontal wiring jack numbers, redlined blueprints indicating final locations, and jack numbers. Test results as specified under the testing subsection in this document and shall be required for all categories.
 - p. Subcontractors shall not be accepted without Owner approval. The proposed use of subcontractors shall be indicated as part of the Proposal.
 - q. During construction, the contractor will maintain utilities without any interruption. Should it be necessary to interrupt a utility service the contractor should seek permission for University Staff at least 3 business days in advance and be approved by the RIT project manager.
 - r. All equipment of the same type and capacity shall be by the same manufacturer.
 - s. The locations of switches, receptacles, lights, motors, etc. outlets shown are approximate. The contractor shall use good judgment in placing the preceding items to eliminate all interference with ducts, piping, etc.

The contractor shall check all door swings so that light switches are not located behind doors. Relocate switches as required, with approval from the RIT designated design professional. The University Project Manager may direct relocation of outlets before installation, up to five (5) feet from the position indicated on the original project drawings, without additional cost

- t. The Contractor must read the entire specifications of all divisions because he/she will be responsible for all work described.
- u. Remove and dispose of dirt and debris and keep premises clean. During the progress of work, remove equipment and unused material. Put communication spaces in neat and clean condition and do cleaning and washing required to provide acceptable appearance and operation of equipment, to the satisfaction of the cable plant owner or device owner.
- v. The contractor is responsible for the cleanup of debris daily. Cost of cleanup is the responsibility of the Contractor

3. Products / Cable Plant Overview

a. Backbone Copper Cabling Products

- i. RUS/REA specification PE-89 building entrance cable and/or have the Bell standard designation AFMW
- ii. Circa Tel Building Entrance Terminals
 - 1. Circa Tel 1900A1-100
 - 2. Circa Tel 1880ECT1/NSC-XXX
 - 3. Circa Tel 4B1E gas tube protector module
 - 4. Circa Tel 4B1FS-240 solid-state protector modules
 - 5. Bell standard designation ARMM type riser cable fire-rated or approved equivalent

b. Backbone/Riser Fiber Optic Cable

- i. Fiber Cable
 - 1. BerkTek PDP Premise Distribution Fiber Plenum Rated
 - 2. Corning Cable Systems MIC OFNP or OFNR
 - 3. Approved alternate for backbone applications
- ii. Panduit or Corning Cable Systems LC and SC connectors
- iii. Fiber Optic LIU Enclosures
 - 1. Corning Cable Systems Closet Connector Housings
 - 2. Corning Cable Systems Edge Housings
- iv. Horizontal Wiring
 - 1. CAT 6A UTP copper for data applications, plenum rated, the color yellow
 - a. Belden 10GXS13, BerkTek LM-RDT Cat 6A, CommScope Systimax GigaSPEED X10D or General 10 MTP
 - 2. CAT 6A Outside Plant Cables
 - a. Berk-Tek LANmarkTM-10G Cat 6A OSP
 - 3. Panduit wired outlet assemblies
 - a. Jack: # CJ5E88TGIW or CJ688TGIW (white)for voice applications
 - b. Jack # CJ6X88TGYL (yellow) for Cat 6A wired applications
 - c. CATV F-connectors # CMFAIW
 - d. Blank module: #CMBIW-X
 - e. Faceplates: Panduit Classic Series
 - i. Duplex 2 port CFPE2IW
 - ii. Quad 4 port CFPE4IW
 - iii. Six-Port CFPE6IW
 - iv. 2 Port surface box CBX2IW-AY
 - v. 4 Port surface box CBX4IW-AY
 - 4. Panduit Angled patch panels for voice and data: CPPA48FMWWH
 - 5. Panduit PatchRunner High Capacity Vertical Management: PR2VD10WH
 - 6. Panduit Horizontal Management: NMF2WH
 - 7. American Time AP cage 14" X 14" X 13"D: G2006-J08 (Anixter)
 - 8. 19" x 7' equipment rack:
 - a. Panduit R2PWH
 - b. Equivalent with approval from Owner (RIT ITS Division)
 - c. Panduit hinged wall mount bracket: WBH3
- v. Miscellaneous

- 1. The duct sealant system shall be designed to seal the area between the cable and

conduit to ensure a watertight seal. The duct sealant system shall be Raychem Telecommunications or Electrical duct sealing system Series TDUX or RDSS.

2. The pull rope for empty conduits or inner ducts shall be polyester woven Dandy-line by Arnco or equal.
3. Empty conduit and inner duct plugs shall be nonmetallic, provide watertight seals, and have provisions to tie off a pull rope in the conduit. The acceptable manufacturer shall be Carlon, MAEPG series.
4. Interduct types shall be Flexible Engineered Fabric Interduct by MaxCell.

4. Warranty

- a. The Contractor warrants that all services performed under this agreement shall be performed thoroughly and professionally in conformance with the standards of the industry. The Contractor shall correct, at his expense, all defects or deficiencies in the work, which result from the material furnished by the Contractor, workmanship, or failure to follow the plans, drawings, or other specifications made part of this contract. Those defects or deficiencies discovered within five (5) years from the date of acceptance (acceptance of the work by the Owner shall not constitute a waiver of such defects or deficiencies) may be remedied by the Owner and the Contractor shall pay the Owner the cost of making such corrections.
- b. All fiber optic materials and work shall be covered under the applicable manufacturer's warranty. A certificate of project registration shall be on file at the start of work.
- c. All horizontal copper wiring materials and work shall be covered under the Panduit Network Systems Certification Plus System Warranty Program (<https://www.panduit.com/en/legal-information/Certification-Plus-System-Warranty.html>). A certificate of Project Registration shall be on file at the start of work.
- d. The Owner will work with the successful bidder to obtain necessary warranty participation from the manufacturers.
- e. All copper backbone materials and work shall be under warranty for five (5) full years from the date of final acceptance.
- f. All copper horizontal wire materials and work shall be under warranty for five (5) full years from the date of final acceptance.
- g. All other materials and work shall be under warranty for five (5) full years from the date of final acceptance.

5. Restrictions

- a. Access to communication spaces should be directly from hallways or service corridors not through classrooms, offices, or other dedicated spaces.
- b. The communication space must not be located in any place that may be subject to water, steam, humidity, heat, or any other corrosive atmospheric or environmental substance.
- c. The communication space must not share space in boiler rooms, washrooms, janitorial closets, storage rooms, or any such space.
- d. Equipment and piping not related directly to the support of the telecommunications function shall not be installed in, pass through, pass overhead, or enter the telecommunications space. Pipes for sprinkler heads located within the room shall not be located directly above electronic equipment racks and/or cabinets.
- e. Communications space should not be used as a passageway to other equipment rooms, power transformers, custodial equipment, or any other function that would require access for reasons other than service and maintenance of the communications equipment and cabling they house.

6. Design Requirements

- a. Telecommunications Spaces shall be:
 - i. Located above water level and not in a place subject to any corrosive atmospheric or environmental conditions
 - ii. Avoid locations that limit expansion such as structural steel, stairwells, elevator shafts, outside walls, or other fixed building walls.
 - iii. Unlisted building entrance cables shall not be longer than 50-feet once they exit the incoming conduit.
 - iv. The locations and size of the building entrance shall be appropriate for the application and placed no farther than 50 feet from the primary communications space for copper cabling.
 - v. Have easy access to distribution cable pathways
 - vi. Must be a rectangular room with no obstructions or protrusions (beams, columns, etc.) that decrease the usable square footage available in the room.
 - vii. The Owner shall have clear access to the building entrance at all times.
- b. Communications Room Guidelines

- i. Enclosing Walls
 1. Walls shall extend to the structural ceiling above.
 2. All codes listed in Quality Assurance shall apply; space shall be fire-stopped compliant with all codes.
 3. A twelve-inch wide ladder rack should be mounted on the same wall(s) as the plywood backboards.
 4. The walls shall be finished and painted drywall or sealed concrete.
 5. The back wall of the Communications Room, behind the equipment racks, shall be dedicated to low voltage equipment.
- ii. Ceiling
 1. A suspended, false, lay-in or hard lid ceiling shall not be installed over any communications space.
 2. The minimum ceiling height shall be 10 feet.
- iii. Floor
 1. Do not design raised floor systems.
 2. The floor should be floor slab, no raised or false floor.
 3. The floor finish should be smooth, dust-free, and not susceptible to static electricity build-up. Acceptable finishes are low static composition tile, static dissipating tile (SDT), or sealed concrete to avoid dust.
 4. Minimum load rating of 50 lb / sq. ft.
 5. Minimum distributed load rating of 100 lb / sq. ft. and a minimum concentrated load rating of at least 2000 lb / sq. ft.
- iv. Door
 1. A minimum of a 36" x 80" door opening shall be provided; the door shall open outward and be keyed to a key specified by the Owner.
 2. The door shall be fire-rated as dictated by local code requirements.
- v. Windows
 1. Communication spaces shall not have windows.
- vi. Water Infiltration
 1. Measures must be taken to prevent water intrusion
 2. Avoid water, sewer, chemical, or drain piping through communication space
- vii. Sprinkler System
 1. Comply with RIT Division 21 guidelines
 2. Sprinkler piping should not be installed directly above equipment racks
- viii. Wall Plywood Sheeting
 1. Plywood backboard shall be painted with two coats of nonconductive, fire retardant paint of a light color.
 2. A minimum of two walls shall be covered with ¾" fire-rated plywood (8' x 4') vertically oriented located to ensure maximum usable space for mounting hardware.
- ix. Pathways
 1. Pathways entering the space shall enter above or near the plywood backboard.
 2. Pathways entering through the floor shall not protrude more than 2" above finished floor height.
 3. Conduits shall be installed in a clean, neat, and organized fashion.
 4. All open space in the pathway system and empty pathways shall be plugged with a rubber conduit plug, water plug, or duct sealer (appropriate for application).
 5. A ¾" metallic conduit for primary building ground wires, from the entrance location to the primary building ground location, shall be provided.
- x. Lighting
 1. A minimum of (fifty) 50foot candles of light shall be provided; avoid fluorescent lighting.
 2. Lighted areas should include the front and back of all equipment racks in the communications space.
 3. Lighting shall not receive power from the same electrical distribution panel breaker as the telecommunications equipment.
- xi. Electrical
 1. One (1) dedicated 30 amp, 208-volt building circuit
 2. One (1) dedicated 15 amp, 110-volt, ac duplex electrical outlets on separate circuits shall be provided and located on each data rack.

3. One (1) dedicated 30 amp, 208-volt, ac electrical outlet on a separate Emergency circuit shall be provided and located on each data rack, terminated on L6 30 receptacles. A single quad box per data rack is acceptable.
 4. One (1) dedicated 30 amp, 208-volt, ac electrical outlet on separate shall be provided on the separate non-emergency circuit and located on each data rack. A single quad box per data rack is acceptable.
 5. A minimum of one (1) 15 amp, 110-volt wall-mounted convenience outlet shall be provided on each wall in each space.
 6. Sub-panels shall be provided for dedicated electrical service for all communication spaces. The estimated electrical load for the telecommunications space shall not exceed 80% of the panel capacity. No power outlets outside the communication space shall be serviced by this panel.
- xii. Cooling and Ventilation
1. Proper cooling and ventilation shall be provided 24 hours a day, 365 days a year
 2. HVAC may be tied into the building system.
 3. Must comply with RIT design and construction guidelines division 23.
 4. Temperature shall be maintained in the range of 68 deg F to 78 deg F
 5. Humidity shall be non-condensing.
 6. HVAC should provide for a minimum of 1 air change per hour
- c. Communication Space Sizing Guidelines
- i. The communication space shall provide enough space for all planned termination, electronic equipment, and cables installed.
 - ii. The space should be sized with enough length so that a single row of racks is sufficient to house all equipment and cabling.
 - iii. During schematic design, a minimum of 100 square feet of space per floor up to 10,000 square feet shall be provided. A minimum of 70 square feet of space shall be provided for every additional 5000 square feet of space. Final communication space size shall be determined during the design development phase and verified after the communications requirements are known using ITS-approved rack capacities and clearances.
 - iv. Allow a minimum of 36 inches (36") of clear working space in front and 42 inches (42") at the rear of equipment racks measured from the front and rear wire managers.
 - v. Allow for an 8-inch depth off the wall for wall-mounted equipment.
 - vi. If multiple equipment rack rows are required, provide a minimum 36-inch aisle between each row of racks measured from the face of the equipment installed in the racks. In multiple rows, the fronts of each rack shall face each other.
 - vii. A minimum aisle clearance of 36-inches is required at one end of an equipment rack row.
 - viii. Communications spaces shall be located in the central area of a building, vertically aligned if possible, dedicated to telecommunications functions, secured, and provisioned for every 10,000 square feet of the area; ensuring that no wired outlet run exceeds on average 50 meters with a maximum of 100 meters.
- d. Equipment racks, Patch Panels, Fiber Panels, Cable Management design considerations
- i. A 7' tall, 10" wide, double-sided vertical cable manager shall be placed between racks and at the ends of each rack row. Wider vertical wire managers can be utilized if required to accommodate more incoming cabling or patch cord containment and management.
 - ii. 2RU, 48-port angled patch panels shall be used for horizontal cabling.
 - iii. A 2RU horizontal cable manager shall be placed at the top of each rack and another placed lower leaving a 12RU space between them.
 - iv. There will be a minimum of two 2 post 45U racks in each communication room supporting horizontal cabling. The 1st rack shall be used for backbone/riser fiber optic cable and copper cross-over cables that extend between the patch panel in the rack and the wall-mounted 110 blocks. The 2nd rack shall be used for horizontal cabling and switch mounting only. Additional horizontal cabling racks may be required depending on the cable density required.
 - v. The backbone rack left edge with cable management shall be mounted close to the plywood wall that still allows the door on the wire manager to open fully. The rack shall be placed so that when loaded, there will be a 36" clearance between the wall and rack system. From the wall to the rack face, the dimension should be a minimum of 42". To maintain a 36" clearance on the backside of the rack, the distance between the rear wall and the front of the rack shall be a minimum of 60". This makes the minimum depth of the communications room is 102" to maintain a 3' clearance

around the rack. The horizontal cable rack shall be placed in line with the backbone racks so that the same clearances are maintained. The horizontal cable racks shall contain no more than 288 horizontal cables.

- vi. The minimum width of a communications room shall be determined as follows. A communications room shall have a minimum of 2 racks with a minimum 36" clearance required on all 3 sides. To enable future growth, for every installed horizontal cable rack, space for an additional future rack shall be required. Therefore the minimum width of a single row 2 rack communications room shall be 133". For every additional rack installed shall require 58" of additional width.
- vii. Racks shall be securely attached to the concrete floor using a minimum of 3/8" hardware or as required by local codes.
- viii. All racks shall be grounded to the telecommunications ground busbar.
- ix. Rackmount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.
- x. Wall-mounted termination block fields shall be mounted on 4' x 8' x .75" void-free plywood. The plywood shall be mounted vertically, 12" above the finished floor. The plywood shall be painted with two coats of white, fire-retardant paint.

7. Construction Removal of ITS Wireless Access Points

- a. When an area is to be removed, renovated, ceilings removed, and wireless access points removed:
 - i. Notify ITS Network Communications at its_net_fte@rit.edu that demolition is starting with the project name, FMS Project Manager and the project site contact responsible for the work.
 - ii. The wireless access points to be removed must be labeled with the complete jack number that it is being removed from.
 - iii. The existing cable if going to be reused, needs to be coiled up and protected.
 - iv. If the existing cable is going to be demolished, it needs to be removed end to end all the way back to its source in the ITS data room. The cable number needs to be documented and communicated to ITS Network Communications.
 - v. The removed access points and associated mounting hardware need to be turned over ITS Network Communications as soon access point removal is complete.
 - vi. If there are any questions, email ITS Network Communications at its_net_fte@rit.edu.

8. Wireless Access Point Layout

- a. In new construction and renovations where walls are added or removed, an ITS created access point layout will be required. To do this, a base floor plan in the CAD format will be required to be sent to ITS Network Communications to facilitate the wireless data layout for the area(s). The CAD layout will be run thru a program that will plot the final access point installation locations for the project. If any changes are required to this ITS layout, they need to be communicated and approved by ITS Network Communications.

27 05 26 - Grounding and Bonding for Communication Systems

1. General

- a. Comply with current Rochester Institute of Technology Design and Construction Guidelines Division 26.
- b. The Telecommunications Bonding Backbone (TBB) shall be designed and/or approved by a qualified PE, licensed in New York State or the state where the work is to be performed. The TBB shall adhere to the recommendations of the TIA/EIA-607 C standard, and shall be installed following best industry practice.
- c. The telecommunications entrance facility's main grounding busbar shall be connected back to earth ground in the electrical entrance facility and building steel as required.
- d. A licensed electrical contractor shall perform installation and termination of the main bonding conductor to the building service entrance ground.
- e. The TBB Grounding Conductors shall be bare or insulated copper, minimum conductor size #6 AWG and sized at 2kcmil per linear foot up to a maximum size of 750kcmil and where uninsulated should be identified with green tape at termination location.
- f. Bonding conductors should be continuous and routed in the shortest possible straight-line path, avoiding changes in elevation and sharp bends.
- g. Primary Bonding Busbar(PBB) shall be located in the entrance facility, near the electrical panel to which it will be bonded but installed to maintain clearances required by applicable electrical codes.
- h. The grounding busbar should be a 4-inch or larger bus bar as defined by NEC (National Electrical Code).
- i. The Busbar must be mounted on plywood and placed to not interfere with communication equipment or

- pathways.
- j. All metallic conduits, racks, cabinets, patch panels, and any other associated device must be bonded to the ground busbar.
- k. Each busbar shall be labeled with the following information.
 - i. Busbar name
 - ii. Source of Ground
 - iii. Room being serviced
 - iv. Standard Warning
- l. When a rack or cabinet supports active equipment or any type of shielded cable or cable termination device requiring a ground connection, add a rack-mount horizontal or vertical busbar or ground bar to the rack or cabinet. The rackmount busbar or ground bar provides multiple bonding points on the rack for rack and rack-mount equipment.
- m. The Contractor shall bond metallic cable trays to vertical metallic conduit and the primary building ground.

27 05 28 - Pathway for Communication Systems

- 1. General
 - a. Quality Assurance
 - i. Strictly adhere to all Building Industry Consulting Service International (BICSI) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
 - ii. All cable and equipment shall be installed in a neat and workmanlike manner.
- 2. Products
 - a. Telecom Outlets
 - i. Where ceilings are accessible, the raceway and entrance-end fitting shall extend above the ceiling and the conduits installed above the ceiling in the room to the nearest hallway distribution system.
 - ii. Where ceilings are partially accessible, or if the drawings and/or specifications indicate installation of access panels, the raceway shall extend above the ceiling and the conduits installed above the ceiling in the room to the nearest hallway distribution system.
 - iii. Where ceilings are inaccessible or no ceilings exist, the raceway shall extend up as close to the ceiling as practical to allow installation of conduits as high as possible to the nearest hallway distribution system.
 - iv. Non-continuous pathways shall keep hallway crossover to a minimum. Pathways shall be routed to follow logical paths parallel and perpendicular to the building structure. Diagonal pathways are unacceptable.
 - b. Horizontal Distribution System
 - i. Corridor Cable Tray System
 - 1. All conduits shall be installed stacked and attached to walls unless conditions exist which prohibit this type of installation.
 - 2. Install entire cable tray system following manufacturer's minimum installation practices and all local governing codes.
 - 3. Coordinate installation of cable tray with other trades to allow a minimum of 12" above, 12" in front, and 12" below of clearance from piping, conduits, ductwork, etc. Allowance must be provided for access to the tray with reasonable room to work. Obstructions to the tray must be minimized and cannot block more than 6 feet of the tray at any point in the run.
 - 4. The cable tray shall not be loaded beyond 60% of the manufacturer's recommended load capacity.
 - 5. Where a new cable tray distribution system encounters a wall, install sufficient 4" EMT sleeves through the wall so cabling does not exceed 20% fill.
 - 6. Install cable tray dropouts where large quantities of cables exit the distribution system.
 - 7. Route cable tray a minimum of 5" clearance from fluorescent light fixtures, 12" clearance from electrically operated equipment, and all wiring at 120 or more volts and 4 ft. from transformers or large motors.
 - 8. Install cable tray a minimum of 3-inches above accessible ceiling T-bars. If possible, install 6-inches above accessible ceiling T-bars.
 - 9. Install cable tray with 12-inches of open space above and to one side of the tray to allow

- access for installing and maintaining cable.
- 10. Install cable tray level and straight unless noted on the construction drawings.
- 11. All cable trays shall be a minimum of 12 inches wide.
- 12. Power poles must be 1' in diameter, separate from the electric, stubbed at the ceiling, and provisioned for mounting communications wired-outlet assemblies.
- 13. All interior, horizontal pathways shall be fire-stopped-compliant with all applicable codes.
- ii. All open pathways/trays shall be installed a minimum of six (6) inches away from any light fixture or other source of EMI (Electromagnetic Interference).
- iii. All communications horizontal pathways shall be rigid, metallic, and/or PVC compliant with applicable codes; flex pathway is not compliant with code.
- iv. All communications pathways shall be adequately supported, sized for the application, provisioned for future growth, and in compliance with return air plenum codes.
- c. Vertical Wired Outlet
 - i. Shall be a minimum of 1' rigid galvanized conduit, installed from the wired outlet box, stubbed above ceiling tiles, finished smooth at both ends with bushings, and visible at the ceiling and outlet-box location.
 - ii. Shall be installed with a pull wire that is accessible and visible at the ceiling and outlet box location.
 - iii. Vertical wired outlet pathways shall be provisioned with a minimum 4" x 4" outlet box; 2.5" deep, with cutouts at the back and a mud-ring to accommodate single duplex outlets.
- d. All pathways shall be grounded per NEC Article 250.
- e. Station Conduits
 - i. Provide measured pull line in 12" increments in each empty conduit to the hallway distribution system.
 - ii. The use of 90-degree electrical pulling elbows is prohibited.
 - iii. Do not include more than two 90-degree bends between pulling points when installing station conduit runs. If the path of the station conduits requires more than 180 degrees of total bends, installation of an appropriate sized junction box is required.
 - iv. Place an appropriate sized junction box in each station conduit run that exceeds 100 feet in length.
 - v. 1" conduit runs to station outlet locations will contain no more than 3 horizontal station cables regardless of category specification.
 - vi. 1.25" conduit runs to station outlet locations will contain 4-8 horizontal station cables regardless of category specification.
 - vii. There will be one 4" penetration for every 83 station cables passing through a wall, ceiling, or floor.
 - viii. Backbone and horizontal station cabling will not share penetrations or installed conduit paths.
 - ix. Wired outlet pathways shall comply with EIA/TIA standards and use no floor cores.
- f. Service Entrance Conduits
 - i. On exterior wall penetrations, seal both sides of the wall around the outside of the conduit with hydraulic cement to prevent water from entering the building. Seal the inside of the conduit on both sides with conduit plugs, water plugs, or duct sealers to prevent water, vapors, or gasses from entering the building.
- g. Exterior Communications Pathway
 - i. All exterior communications pathways shall be rigid metallic and/or PVC (not flex), adequately supported, reamed at each end, clean, dry, and free of debris.
 - ii. All exterior communications pathways shall be placed at a minimum depth of 36".
 - iii. All exterior communications pathways shall be sized appropriately for the application, with provisions for future growth. Each must be installed with a non-corrosive pulling wire, with a minimum pulling strength of 200 pounds, which is left in all pathway runs.
 - iv. All exterior communications pathways shall have a tracer wire installed end to end and can be reached with entry to the space.
 - v. All exterior communications pathways shall have a maximum of two (2) 90-degree bends between pulling points.
 - vi. All exterior communications pathways shall protrude no more than 2" into the floor of the building entrance or other communications spaces.
 - vii. All exterior communications pathways shall be bonded/grounded compliant with all codes listed in the Quality Assurance section.

- h. All conduits shall be installed stacked and attached to walls unless conditions exist which prohibit this type of installation.
- i. All pathways shall be grounded per NEC Article 250.
- j. Install cable tray level and straight unless noted on the construction drawings
- k. Indelibly mark station conduit at hallway distribution end with Room # that conduit serves.
- l. The use of 90-degree electrical pulling elbows is prohibited.
- m. Pathways will be accessible for future moves, adds, and changes.
- n. Pathways will be planned assuming a horizontal station cable will have an approximate diameter of .30 inches and no more than a 67% fill ratio.
- o. Cable hooks (J-hooks) are a suitable alternative to cable trays ONLY when the planned capacity of the pathway system is fifty (50) cables or fewer and J-hook fill capacity shall not exceed 70%.
- p. All hangers and support material shall be galvanized or stainless steel, rust-free material.

27 10 00 - Structured Cabling

1. General

- a. To ensure that the installed structure cabling solution meets or exceeds the required performance it must be tested and certified.
- b. System Testing and Documentation
 - i. The calibration and software on all test equipment shall be current.
 - ii. Copper Cabling System Testing
 - 1. Copper cabling shall be tested and certified after the installation as follows and as required for the cable manufacturer's warranty.
 - 2. All existing structured cabling that will be moved or terminated at either the closet or station end, shall be tested using the appropriate cabling category specification.
 - 3. Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity, and pair-reversals crossed pairs and split pairs. Any faults in wiring shall be corrected and cable re-tested before final acceptance.
 - 4. Each installed cable link shall be tested for installed length using a TDR-type device.
 - 5. The cable length shall conform to maximum distances outlined in ANSI/TIA-568-C standards and all other applicable standards
 - 6. Test reports for all factory testing and field test reports for copper cabling installation shall be submitted to the Owner's Representative and manufacturer before commissioning the voice and data system and final contract payment
 - iii. Optic Fiber Cable Testing
 - 1. Optical fiber cabling shall be tested and certified after the installation as described below and as required for the cable manufacturer's warranty.
- c. Labeling of Copper and Fiber Optic Horizontal Cables
 - i. Labeling of all wires and terminations shall be in a manner specified by the Owner at the start of work.
 - ii. Wired outlet assemblies shall be labeled as follows:
 - 1. BB-CC-RRRR-J
 - a. BB 2 or 3 digit building number
 - b. CC 2 character BDF/IDF number
 - c. RRRR 4 character room number
 - d. J 1-4 digit jack number

2. Products

- a. Fiber Connectors
 - i. The connector shall be a duplex-type LC connector on a single-mode fiber optic pigtail.
 - ii. The average insertion loss shall be 0.2dB with a maximum of 0.75dB for a mated pair.
- b. Fiber Connector Panels
 - i. The cabinets shall be capable of being mounted in a standard 19" rack utilizing four units of standard height
 - ii. Connectors shall be shuttered duplex 'LC' unless otherwise noted on Drawings.
- c. Fiber Cabinets
 - i. The cabinets shall be capable of being mounted in a standard 19" rack utilizing one, two, three, or four units of standard height (1.75 inch EIA hole spacing).
 - ii. The cabinets shall utilize a modular connector plate to allow for versatile connector configuration, with panels for LC connectors

- iii. The unit shall utilize a slide-out drawer assembly.
- d. Fiber Cabling
 - i. Fiber optic cables shall be free of material and manufacturing defects and free of dimensional non-uniformities that would seriously impair the functionality of the cables. The fiber optic cables shall also be free from surface imperfections and internal defects that would prevent them from meeting the mechanical and transmission requirements of this Specification.
 - ii. Cables shall be provided in continuous lengths, without splices, from termination to termination.
 - iii. The cable shall be carefully inspected for sheath defects or other irregularities, as it is pulled out from the reel. If defects are detected, pulling shall stop immediately and the cable section shall be repaired or replaced at the discretion of the Owner. A system of communications, visual or otherwise, shall be maintained between pulling and feed locations so that pulling can be stopped instantly, if necessary.
- e. Cat6A Unshielded Twisted Pair
 - i. RIT ITS requires Category 6a UTP, 4 pair horizontal distribution cables shall extend between the device location and designated network access closet. It shall consist of 4 pairs, 23 gauge, UTP and shall terminate all conductors onto an 8 pin modular jack provided at each outlet.
- f. Equipment Racks
 - i. Each communication space shall be equipped with a 19" Aluminum Rack System to the house.
 - ii. Should be manufactured from extruded aluminum. Post dimensions to be 84" tall x 20" wide x 3" deep with anchor plates at the top and bottom.
 - iii. The rack should be a free-standing data rack.
 - iv. The floor should be anchored with a minimum of four (4) floor anchors, anchor top of the rack to either ladder racking/cable tray above rack or backboard using angle iron or uni-strut.
- g. Category 6a Patch Panels
 - i. Patch panels shall be constructed of high-strength steel with satin chrome finish and designed for wall or 19-inch rack mounting.
 - ii. Panels shall be available in 24-port and 48-port configurations, with a height of 1 Rack Unit (RU) of 44.5 millimeters (1.75 inches) for each group of 24 ports.

27 13 13 - Communication Copper Backbone Cabling

- 1. General
 - a. All cable and equipment shall be installed in a neat and workmanlike manner.
 - b. Strictly adhere to all Building Industry Consulting Service International (BICSI) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
 - c. The cable shall meet the requirement of ANSI/TIA-568 series Standards for Category 3 performance.
 - d. Voice backbone cables shall have a minimum 10-foot service loop when terminated in the communication space, and at any splice points in telecommunications manholes.
 - e. All Outside Plant Backbone shall terminate on primary protection (per the NEC) upon entering the building.
 - f. Adequate care shall be exercised when handling and storing reels of cable to prevent damage to the cable. Cable with dents, flat spots, or other sheath distortions shall not be installed. Before placing cable, the Contractor shall verify the structural integrity and clear passage (water, silt) of each conduit by passing a squeeze and slug, test mandrel, or owner-approved projectile through each length, where applicable. All obstructed ducts shall be reported to the Owner immediately.
 - g. Immediately after cable placement, temporary tags with the cable number and pair count shall be attached to each end of each cable section.
 - h. The Owner shall determine conduit assignments as determined before work starts. As a rule, cables having high-pair counts shall be placed in the lowermost corner of the duct bank.
 - i. The Contractor shall not splice any outside cables without the approval of the Owner.
 - j. Backbone Cable Testing
 - i. Complete end-to-end test results for all copper UTP cables installed are required.
 - ii. The owner is to be notified at least 24 hours before testing.
 - iii. All pairs in backbone copper cables shall be tested for continuity and wire-map.
 - iv. All test results shall be submitted to the Owner.
 - k. Cable Support
 - i. Provide cable supports and clamps to attach cables to backboards and walls.
 - ii. Attach horizontal and vertical backbone cables at 2-foot intervals using Owner approved

- supports.
- iii. Attach cables to manhole racks using Owner approved methods.
- iv. Backbone cabling shall be secured to the cable/ladder tray following manufacturer-recommended procedures, and appropriate installation hardware and methods as defined by local code or the authority having jurisdiction (AHJ)
- v. Metallic supports and fasteners shall be hot-dipped galvanized steel in manholes and vaults having metallic cable racks and shall be non-metallic material in manholes and cable vaults having non-metallic cable racks. All cables and equipment installed in exterior locations shall be secured so that they cannot be dislodged or damaged by winds of up to 125 miles per hour.
- vi. Caution shall be used when bending cables to avoid kinks or other damage to the sheath. The bend radius shall be as large as possible with a minimum of not less than 10 times the outer diameter of the cable. Minimum radii shall be increased when necessary to meet the cable manufacturer's recommendations. Bending operations in manholes and vaults shall be performed per the procedures and instructions of the manufacturer. Cable bending shoes shall be used in duct or conduit ends when bending cable exiting a duct or conduit. The bending shoes shall remain in place until racking, splicing, and tying is complete. Cables shall not rest against the edge of the duct or conduit mouth.
- vii. Un-terminated cable ends shall be cleared, capped, and sealed. The lubricant shall be compatible with and intended for use with our specified Essex cables. Soap and grease lubricants are prohibited.
- I. Splicing
 - i. The Contractor shall provide all labor, materials, and equipment to splice cables at termination points within buildings. The Contractor shall provide splice enclosures, cable connectors, splice supports, tape, cleaning materials, cable ties, and other items required for complete installation. All metallic cable shields shall be bonded and connected to building grounds at all termination points.
 - ii. All cable splices shall be protected from damage at sheath openings by mechanically protecting all conductors using 3M KandB Building Vault and Riser closures or equivalent, which shall be approved by the Owner.
 - iii. All cables shall be thoroughly cleaned and scuffed appropriately to ensure a good mechanical bond when splicing. 3M Scotchcast Brand 4435 non-conductive aluminum oxide abrasive strip or Owner-approved equivalent shall be used. All cable shall be thoroughly cleaned with a non-toxic, environmentally safe solvent, 3M Brand 4414, 4415, or Owner-approved equivalent.
 - iv. All cable splices shall be supported by a minimum of two cable hooks or brackets. Where vertical racking is not present, horizontal racking for support may be used utilizing 3M Brand RC-100 rack adapters or Owner-approved equivalent.
 - v. Underground cable splicing shall use 3M 710 Series or 3M-MS2-4000 series supermini modular connectors. This modular splicing shall be used in all splice enclosures. The Contractor shall mark or tag the cable pair counts spliced on the cable splice enclosure.
 - vi. Splicing of cross-connect terminals and secondary cable access stubs not in line, or straight splice or diminis/taper splice locations shall use Scotchlock - ULG splicing connectors or Owner-approved equivalent.
 - vii. All metallic cable shields shall be grounded by a #6AWG minimum ground wire to a low-resistance ground, in compliance with EIA/TIA 607 current standards. The Contractor in each closet shall provide connections to new grounding buss bars. The grounding bus bar shall be connected back to the main grounding busbar in the telecommunications entrance facility, grounded to an earth ground in the electrical entrance facility, and building steel on each floor as required.

27 13 23 - Communication Optical Fiber Backbone Cabling

1. General

- a. Personnel who have had at least three (3) years' experience in placing cables in conduit, cable trays, and underground duct systems shall perform Cable installation work
- b. Cables shall be designed for Point to Point applications and shall provide a high level of protection for optical fiber installed in building applications.
- c. Higher optical fiber counts shall utilize a sub-united design with color-coded subunits for easy identification.
- d. The contractor shall comply with applicable codes, standards and with all local codes and requirements.

- e. Provide all necessary products for installation of Fiber Backbone cabling.
- f. Backbone cable shall be installed following industry standards practices.
- g. The contractor shall not exceed the maximum pulling tension or the minimum bending radius for fiber cables per the manufacturer's specifications.
- h. Backbone cables shall be installed separately from horizontal distribution cables.
- i. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cables installed in any conduit.
- j. Where cables are installed in an air-return plenum, riser-rated cable shall be installed in a metallic conduit.
- k. Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.
- l. The fiber optic cables shall be terminated into rack-mounted fiber optic patch panels. The final fiber optic patch panel shall consist of the applicable fibers field terminated onto pre-connectorized fiber assemblies (pigtails). Each connector shall exhibit an insertion loss of 0.5 dB or less and a return loss of .30dB or better.
- m. Caution shall be used when bending cable to avoid kinks or other damage to the sheath. The bend radius shall be as large as possible with a minimum of ten (10) inches. The minimum radius shall be increased when necessary to meet the cable manufacturer's recommendation.
- n. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.
- o. A maximum of 12 strands of fiber shall be spliced in each tray.
- p. All installations shall comply with:
 - i. ANSI/TIA-568 Series Commercial Building Telecommunications Cabling Standard
 - ii. ANSI-TIA-569 Telecommunications Pathways and Spaces
 - iii. ANSI/TIA-606 Administration Standard for the Telecommunications Infrastructure
 - iv. ANSI-J-STD-607 Joint Standard for Commercial Building Grounding(Earthing) and Bonding Requirements for Telecommunications
 - v. BICSI Telecommunications Distribution Methods Manual
 - vi. NFPA 70 National Electrical Code
- q. Backbone Cable Testing
 - i. Complete end-to-end test results for all Fiber Optic cables installed are required.
 - ii. All fiber optic cables must be visually inspected and optically tested on the reel upon delivery to the installation site.
- r. Cable Support
 - i. Provide cable supports and clamps to attach cables to backboards and walls.
 - ii. Attach horizontal and vertical backbone cables at 2-foot intervals using Owner approved supports.
 - iii. Attach cables to manhole racks using Owner approved methods
 - iv. Backbone cabling shall be secured to the cable/ladder tray following the manufacturer's recommended procedures and appropriate installation hardware and methods defined by local code.
 - v. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.
 - vi. Vertical runs of the cable shall be supported to messenger strand, cable ladder, or another method to provide proper support for the weight of the cable.
 - vii. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
 - viii. All backbone cables shall be securely fastened to the sidewall of the TR on each floor.
 - ix. Utilizing Panduit J-Mod System (j-hook) or equivalent (no bridal rings) and velcro cable ties shall be used as necessary to properly secure the cable. Exposed cable runs in communications closets shall be protected with inner-duct and secured to walls, cable trays, and racks.

2. Products

- a. Intra Building Backbone (ISP)
 - i. Indoor Cables - All cable shall be listed for use indoors per the National Electrical Code (NFPA-70) and shall meet one of the following:
 - 1. Indoor Rise Rated Tight Buffer
 - 2. Indoor Plenum Rated Tight Buffer
 - 3. Indoor Low Smoke/ Zero Halogen Riser-Rated Tight Buffer
 - 4. Indoor Armored Riser-Rated Tight Buffer

5. Indoor Armored Plenum-Rated Tight Buffer
- b. Inter Building Stranded Backbone (OSP)
 - i. All cable shall be manufactured and constructed for use in the Outside Plant Environment and shall meet one of the following:
 1. Outside Plant (OSP) loose tube all-dielectric
 2. Outside Plant (OSP) loose tube metallic sheath.
 - ii. Buffer tubes and optical fibers
 1. Industry-standard buffer tubes are stranded around a central strength member and compatible with standard hardware, cable routing, and fan-out kits.
 2. Optical fibers shall be industry-standard color-coded and separated into 12-fiber color-coded binder groups surrounded by plastic core tubes
 3. Water blocking
 - iii. OSP Fiber Cables should be either fully dry or dry core with gel in the buffer tubes.
- c. OS2 Single-mode 8.3 Micrometer Fiber Specification
 - i. The OS2 optical fiberglass shall be manufactured from ultra-pure synthetic silica glass. Single-mode fibers manufactured from natural quartz will not be accepted.

27 15 13 - Communication Copper Horizontal Cabling

1. General
 - a. Horizontal cable shall consist of Category 6A copper cable for all Data and Voice Applications.
 - b. At campus facilities, horizontal cabling to typical work area outlets (including offices, cubicles, and conference rooms) shall consist of two Category 6A cables serving each outlet.
 - c. Outlets for wireless access points (APs) shall consist of one Category 6A cable as a minimum.
 - d. All cable and equipment shall be installed in a neat and workmanlike manner.
 - e. Strictly adhere to all Building Industry Consulting Service International (BISI) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
 - f. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
 - i. ANSI/TIA-568 - Series Commercial Building Telecommunications Cabling Standard
 - ii. ANSI/TIA-568-C.1 - Commercial Building Telecommunications Cabling Standard
 - iii. ANSI/TIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling
 - iv. ANSI/TIA-569 - Telecommunications Pathways and Spaces
 - v. ANSI/TIA-606 - Administration Standard for the Telecommunications Infrastructure
 - vi. ANSI-J-STD - Joint Standard for Commercial Building Grounding (Earthing)
 - g. Horizontal cabling shall be installed from the work area outlet location to the nearest Telecommunications Space with no splicing.
 - h. Horizontal cabling shall be terminated on a patch panel in the telecommunication space.
 - i. The contractor shall not exceed the maximum pulling tension or the minimum bending radius for twisted pair cables per manufacturer specifications.
 - j. The contractor shall test all horizontal links per the ANSI/TIA-568 requirements.
 - k. Horizontal cables shall not be spliced, nor shall these cables contain manufacturer splices.
 - l. The maximum total length of horizontal cables from end to end should not exceed 295 ft; 328 ft including patch cords.
 - m. The minimum amount of slack shall be 6 inches for UTP cables and 36 inches for fiber optic cables.
 - n. The cable jacket shall be maintained to within 25mm (one inch) of the termination point.
 - o. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cables installed in any conduit.
 - p. Cable raceways shall not be filled greater than the TIA/EIA-569-A maximum fill for the particular raceway type or 40%.
 - q. Work Area Outlets
 - i. Power receptacles shall be installed near WAO locations. Install WAO at the same height as the power receptacles.
 - ii. For office areas, provide maximum flexibility for change within the work area (i.e. on opposing walls).
 - iii. Wall-mounted courtesy telephony devices shall be mounted per ADA requirements.
 - iv. The wire outlet assemblies shall be a 4' x 4" box with mud ring to reduce the presentation to a single gang box and with a minimum 1" rigid conduit stubbed at the ceiling with a pulling wire.

- v. If the walls cannot be fished, the wire shall be installed in an approved surface raceway following special guidelines for raceway usage.
- vi. Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer's bend radius.
- vii. In hollow wall installations where box- eliminators are used, the excess wire can be stored in the wall.
- viii. No more than 12" of UTP and 36" of fiber slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls.
- ix. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
- r. Tenant Improvement Project
 - i. Abandoned cables, not identified or labeled for future use, increase the fire fuel local and shall be removed following the current approved National Electrical Code.
 - ii. Contact the RIT cable plant owner to survey the existing cable plant. There is a possibility that all or a portion of the existing installed cable may be reused.

27 15 13 - Data Communications Wireless Access Points

- 1. General
 - a. For new construction and renovation projects, the ITS Network Communications Team will provide heat maps.
 - b. Wireless access points consist of one data jack. The wireless device is to be terminated with an 8-position, 8 conductor module and placed into a surface mount box.
 - c. Wireless network equipment shall be provided by the University.

27 41 16 – Integrated Audio-Visual Systems and Equipment

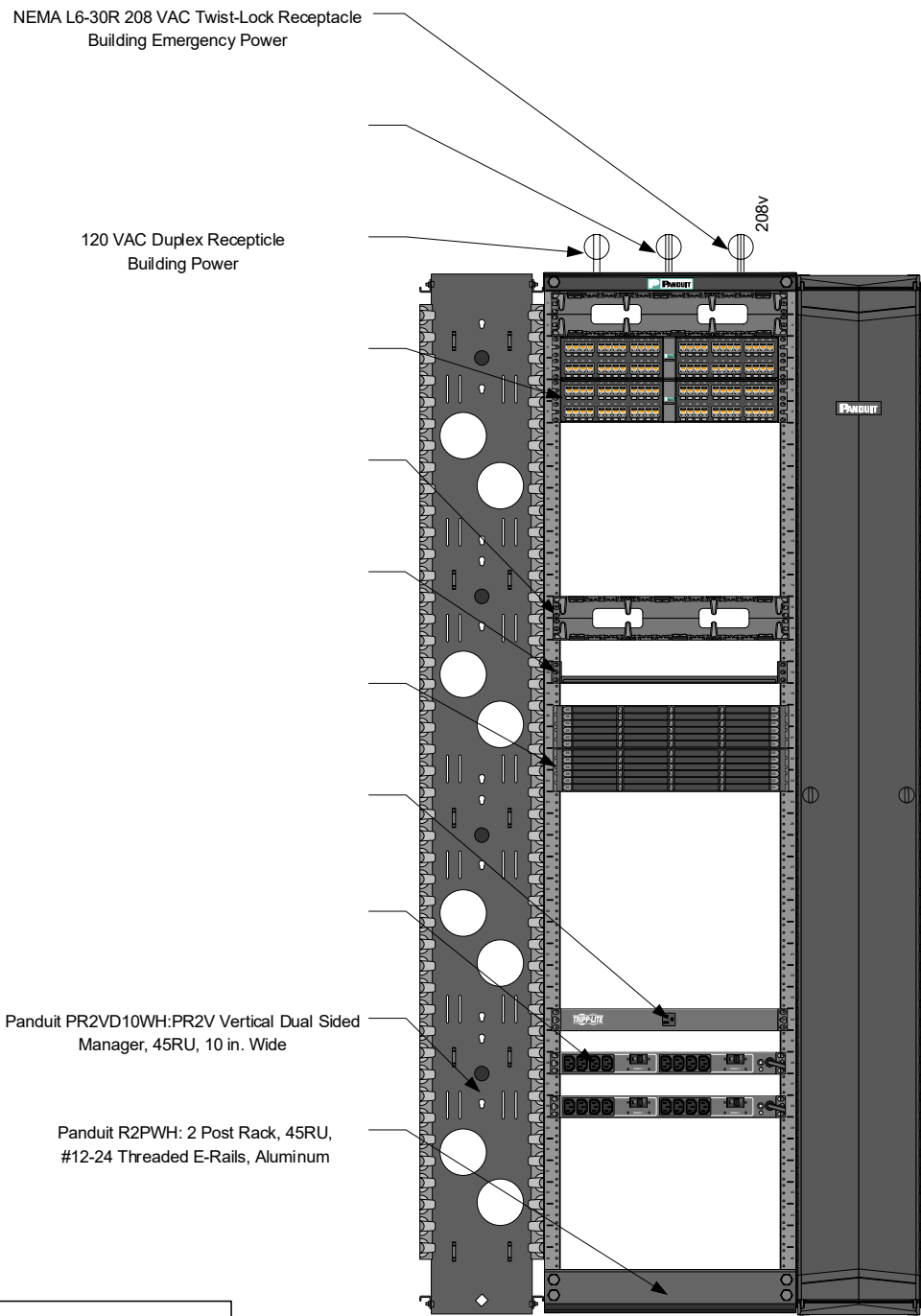
- 1. Scheduling Tablet
 - a. RIT shall furnish and install the tablet and bracket.
 - i. Crestron TSS-1070-W-S-LB KIT (10" screen) screen; white tablet with light bar; no alternates will be accepted.
 - ii. Include security bracket
 - b. Contractor shall provide pathway and hardware as outlined below:
 - i. Coordinate mounting height with RIT prior to installation to accurately locate cabling. See Appendix 4 for standard mounting elevations.
 - ii. For mounting in drywall, provide 4" square old work two-gang low voltage bracket mounted with device screw holes at bottom and top. Provide needed pathway and Cat 6a POE cabling with single jack small biscuit termination connection in ceiling area above tablet location, with jack number labeled. Contractor to provide Cat 6A patch (skinny Cat 6A cable with male connector on each end...Lynn E531228 Mini UTP 6A 28 AWG/4 pair Stranded Type CM or equal) from small biscuit down to tablet. Leave 6 inches of cable where back of tablet box will be in old work bracket. Provide additional jack number label on drywall just above old work bracket.
 - iii. For surface and mullion mount, RIT to provide surface or mullion box. Contractor to provide needed pathway and Cat 6a POE cabling with single jack small biscuit termination connection in ceiling area above tablet location, with jack number labeled. (skinny Cat 6A cable with male connector on each end...Lynn E531228 Mini UTP 6A 28 AWG/4 pair Stranded Type CM or equal) from small biscuit down to tablet. Leave 6 inches of cable where back of tablet box will be. Provide additional jack number label on inside of tablet surface or mullion mount.
 - iv. Leave 6 inches of cable where back of tablet box will be.
 - v. 7" horizontal clearance and 4" vertical clearance from center of mount to nearest obstruction
 - vi. Coordinate mounting height with RIT prior to installation to accurately locate cabling. See Appendix 4 for standard mounting elevations.

27 51 26 – Assistive Listening Devices

- 1. General
 - a. Product specification will vary based on location.
 - b. Provide in locations as identified by RIT.
- 2. Products
 - a. Contacta V34a PRO
 - i. Quantity: 1

- ii. Description: Hearing Loop Driver
 - iii. Provide all required mounting and connection components
- b. Induction Loop Receivers Kits
 - i. Model: Contacta RX-20
 - ii. Quantity: as directed by RIT
 - iii. Description: Induction Loop Listener
 - iv. Accessories:
 - 1. Provide batteries in each unit plus one set of spare batteries
 - 2. Provide headphones with each unit
- c. Induction Loop Tester
 - i. Model: Contacta FSM
 - ii. Quantity: as directed by RIT
 - iii. Description: Field Strength Meter / Tester
 - iv. Accessories:
 - 1. Provide batteries in each unit plus one set of spare batteries
 - 2. Provide headphones with each unit
- d. ListenTech LW-200P-04
 - i. Quantity: 1
 - ii. Description: 4 Channel WIFI ALS Server
 - iii. Provide all required mounting and connection components
 - 1. Provide Dante Input converter

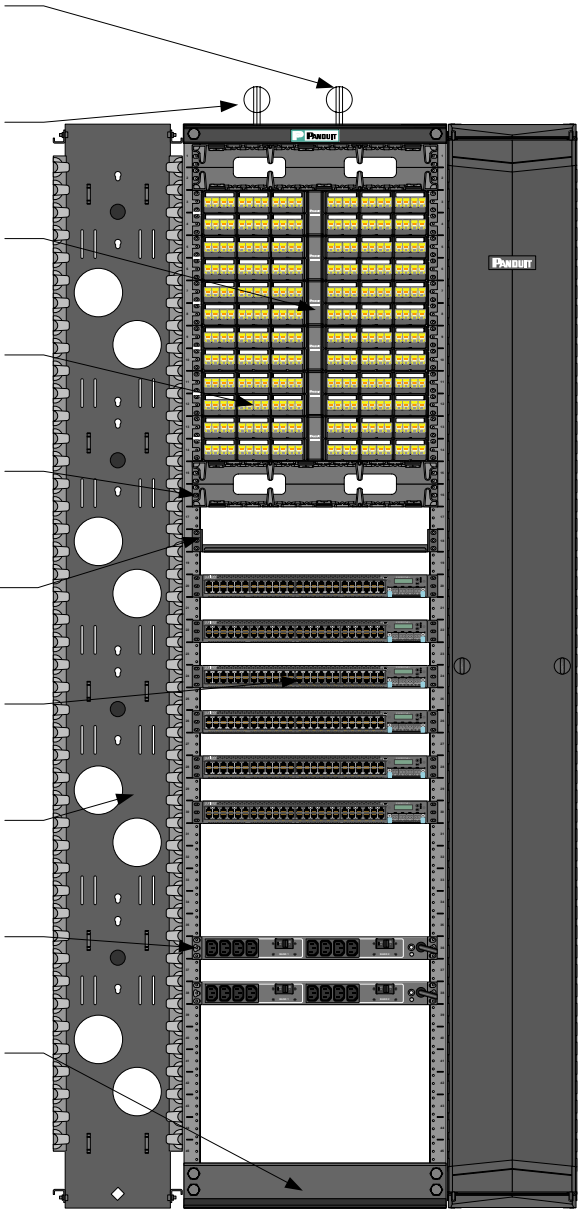
Appendix 1 - Typical Backbone Rack Layout



Typical Backbone Rack		SIZE	FSCM NO	DWG NO		REV
				ITS Rack Layout		2
DRAWN	JE Shanks					
ISSUED	1/12/22	SCALE	1" = 1'-0"		SHEET	1 OF 2

Appendix 2 - Typical Station Rack Layout

RIT Supplied switches



Appendix 3 – Bidders List

Billitier Electric (PCI) (NPI)

Dan Brown
737 Atlantic Avenue
Rochester, NY 14609
585-224-1111
dbrown@billitierelectric.com

O'Connell Electric (PCI) (NPI)

Sean Callaghan
830 Phillips Rd.
Victor, NY 14564
585-924-2176
sean.callaghan@oconnellelectric.com

Tele Data Com (NPI)

Jeremy Moony
90 Air Park Drive
Suite 102
Rochester, NY 14624
585-527-0800 office
JMoody@teledatacom.net

Lantek Communications (PCI) (NPI)

Mark Elliott
3870 Rush Mendon Rd.
Mendon, NY 14506
585-924-8505
melliott@lantekcomcom

Radec Corporation (PCI site)

Nick Anschutz,
100 Rockwood Street
Rochester, NY 14610
585-271-6311
NAnschutz@radec.com

Hoefler Communications (PCI)

John Flynn
5894 East Seneca Turnpike
Jamesville, NY 13078
315-579-2626
jflynn@hoeflercom.com

DDS Utilities (PCI)

Eric Meyris
240 Commerce Drive
Rochester, NY 14623
585-512-7115
emeyris@ddscompanies.com

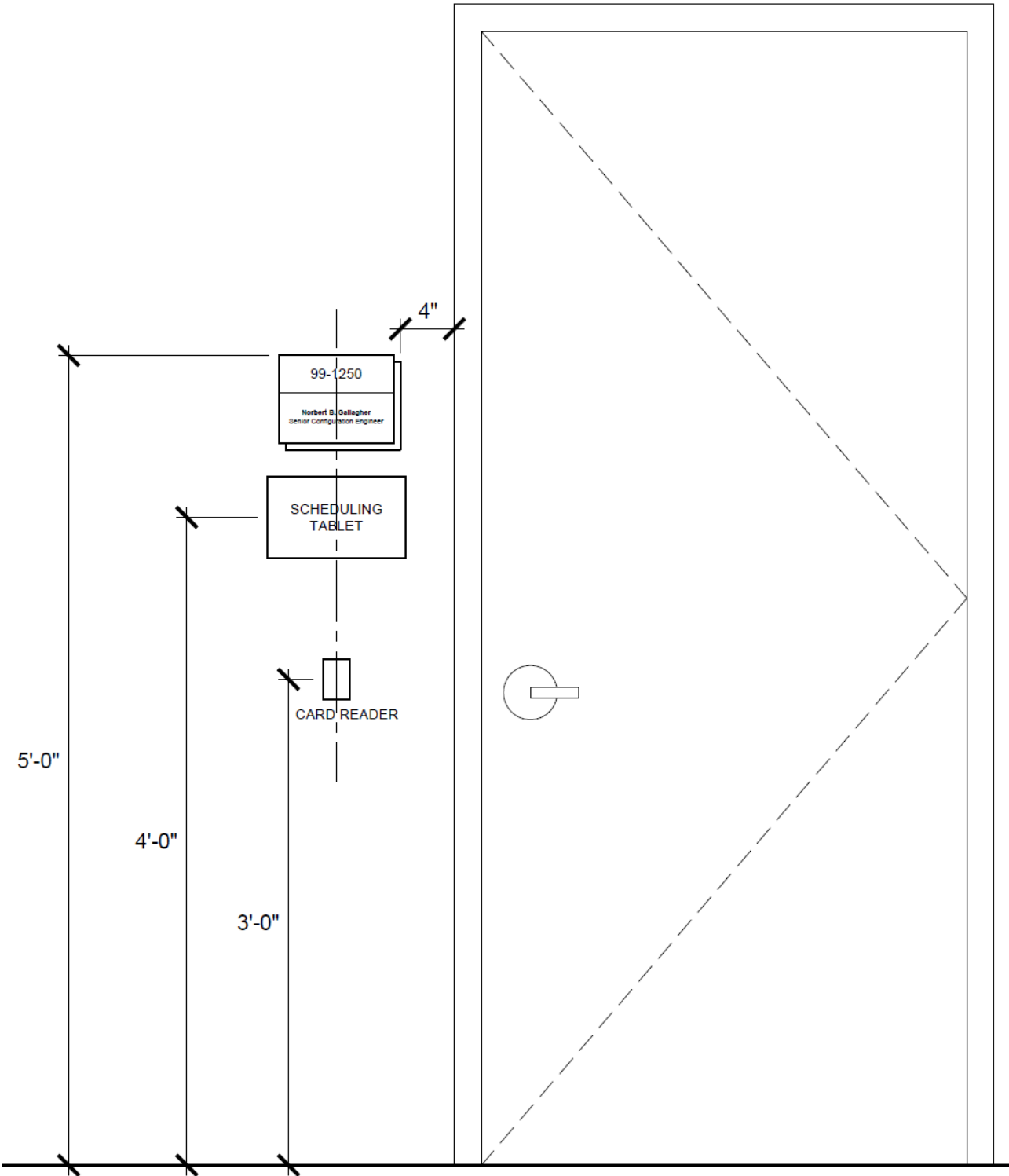
Manchester CS (PCI) (NPI)

Guy Bradley
347 Wheeler Street
Tonawanda, NY 14150
716-743-1455
guyb@manchestercable.com

Schuler-Haas Electric (PCI) (NPI)

Randy Clark
240 Commerce Drive
Rochester, NY. 14623
585-455-8103
rclark@schuler-haas.com

Appendix 4 – Mounting Heights for Door Devices



END OF DIVISION 27