

DIVISION 27 – COMMUNICATIONS

Electrical work shall be defined by drawings numbered with the prefix “E-“, the general provision of the Contract including General Conditions and Supplementary Conditions, Division 1 Specification sections, and Division-27 Communication Specifications.

Engineer of Record for Division 27 is W. Allen Cribb, PE, CBHF Engineers, PLLC, 2246 Yaupon Drive, Wilmington, NC 28401.



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SECTION 270500 - DATA AND VOICE COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

Section includes termination devices, racks, and premises wiring for telephone and data communication circuits by certified manufacturers and contract installers with certification and testing of all equipment and cabling.

1.2 RELATED SECTIONS:

- A. Painting
- B. General Electrical
- C. Conduit
- D. Boxes
- E. Wiring Devices

1.3 REFERENCES

TIA/EIA 568 (Telecommunications Industries Association/Electronic Industries Association) - Commercial Building Telecommunication Wiring Standard.

TIA/EIA 569 (Telecommunications Industries Association/Electronic Industries Association) - Commercial Building Standard for Telecommunications Pathways and Spaces.

TIA/EIA 606A Administrative Standard (Labeling).

TIA/EIA 607 - Commercial Building Grounding/Bonding Requirements.

NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

NFPA 70 - National Electrical Code.

UL 969 - Standard for Marking and Labeling Systems.

ISO/IEC 11801 - Information Technology, Generic cabling for customer premises.

BISCI - Building Industries Consulting Services International.

BISCI TDMM - Telecommunications Distribution Methods Manual.

BISCI CO-OSP - Customer Outside Plant Design Manual

1.4 SYSTEM DESCRIPTION

- A. Provide, ready for operation, a complete and operational communication network system that is a manufacturer certified Category 6 system. The system shall include, but not be limited to, cabling (copper and fiber optic), cable protectors, patch panels, racks, faceplates, connectors, hardware, accessories, connections, grounding, and all other material, labor and operations required for a complete system in this building.
- B. Provide, ready for operation, a complete and operational wireless access point communication network system that is a manufacturer certified Category 6a system. The system shall include, but not be limited to, cabling (copper and fiber optic), cable protectors, patch panels, racks, faceplates, connectors, hardware, accessories, connections, grounding, and all other material, labor and operations required for a complete system in this building.
- C. Cabling shall be installed in conduit as shown on the Drawings. Cable support structure shall be as specified hereinafter.
- D. The horizontal wiring shall consist of the wiring from the wall mounted – Thinline IDF cabinet to the information services outlet. (The horizontal wiring includes the wiring termination components in the IDF cabinet, the horizontal wiring itself, and the termination components at the outlet).
- E. Backbone cabling shall consist of fiber (optical fiber cabling) and copper cables to connect data and voice services as required and/or as shown on the Drawings.
- F. The system shall provide for current and future voice and data requirements by a planned end-to-end manufacturers system, while recognizing the need for future bandwidth and fault tolerance. The proposed system shall utilize a network of fiber optic and unshielded twisted pair (UTP), riser, tie and station cables. Fiber cables shall terminate on Fiber Distribution Centers and/or modular patch panels as required and/or as shown on the Drawings. Cables and terminations shall be identified at all locations and cables shall terminate in an alphanumeric sequence at all termination locations. The complete system shall be fully standards compliant with guaranteed AChannel performance. All UTP end-to-end Channel Configurations as defined by TIA/EIA 568B-1,2,3 shall be provided by a single manufacturer.

1.5 SUBMITTALS

- A. Submit under provisions of relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Certifications: Copies of Cable Installation Technician Certifications shall be submitted with the equipment shop drawings. See also Paragraph 2.1.
- C. Product Data: Submit catalog data for each termination device, cable, rack, etc.
- D. Test Reports: Indicate procedures and results for specified field testing and inspection.

- E. Test Cables on receipt at Project site:
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
 - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
 - 3. Test each pair of UTP cable for open and short circuits.

1.6 CLOSEOUT SUBMITTALS

- A. Submit under provisions of relevant sections of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Project Record Documents: Record actual locations and sizes of pathways and outlets.
- C. Provide a certificate of completion of the installation with verifications that each copper cable pair has been tested to Category 6a standards.
- D. Provide a certificate of completion of the installation with verifications that each fiber optic cable has been tested to industry standards.
- E. Provide a Certified Installation Warranty Certificate.
- F. Provide Test results for each cable and outlet.
- G. Provide marked up Drawings showing additions, deletions, and modifications also identifying cable routs.
- H. Provide electronic copies of marked up final Drawings.
- I. Provide wall mounted copies of the final system Drawings in each telecommunications room.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer: Company specializing in installing products specified in this section with minimum five years documented experience on projects utilizing infrastructure work similar to that required for this project, and with service facilities within 100 miles of project.
 - 1. The Installer shall be an experienced firm regularly engaged in the layout and the installation of cabling infrastructure systems. Documentation shall be provided to show that the Contractor has successfully completed projects of similar size and scope within the previous twelve months.
 - 2. The Telecommunication Project Manager shall:
 - a. be certified as BICSI RCDD
 - b. be experienced in this type of project and provide technical support.
 - c. attend monthly progress meetings and additional meetings as scheduled or required.

- d. be a permanent employee. Use of a temporary employee or sub-contracted employee is not permitted.
- 3. Contractor and authorized sub-contractors shall use manufacturer certified technicians for all cable terminations, use of temporary or un-certified technicians is not permitted.
- C. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum three years documented experience.

1.8 PRE-INSTALLATION MEETING

Convene minimum one week prior to commencing Work of this section.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: New Hanover County Schools (NHCS) require a Structured Cabling Solution. All cabling and hardware shall be compatible with existing system.

2.1 COMMUNICATIONS BACKBONE CABLES

A. UTP Cable

- 1. Description: 100-ohm, 25-pair UTP, covered with a thermoplastic jacket
 - a. Comply with TIA/EIA-568-B. 1 for performance specifications.
 - b. Comply with TIA/EIA-568-B.2, Category 3.
 - c. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - i. Communications, Riser Rated: Type CMR, complying with UL 1666.

B. UTP Cable Hardware

- 1. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- 2. Connecting Blocks: 110-style IDC for Category 6a. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- 3. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - a. Number of Jacks per Field: One for each four-pair UTP cable, plus spares and blank positions adequate to suit specified expansion criteria.
- 4. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- 5. Patch Cords: Factory-made, 4-pair cables in 48-inch (1200-mm) lengths; terminated with 8-position modular plug at each end.

- a. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6a performance. Patch cords shall have latch guards to protect against snagging.

C. OPTICAL FIBER CABLE

1. Description: Single mode, 12 -fiber, nonconductive, tight buffer, optical fiber cable.
 - a. Comply with ICEA S-83-596 for mechanical properties.
 - b. Comply with TIA/EIA-568-B.3 for performance specifications.
 - c. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - i. General Purpose, Nonconductive: Type OFN or OFNG
 - ii. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - iii. Riser Rated, Nonconductive: Type OFNR complying with UL 1666.
 - d. Maximum Attenuation: 0.4 dB/km at 1310 nm; 0.4 dB/km at 1383 nm; 0.3 dB/km at 1550 nm.
2. Jacket:
 - a. Jacket Color: Orange
 - b. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
 - c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

D. OPTICAL FIBER CABLE HARDWARE

1. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
 - a. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
2. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths. Provide quantities required for patch panels installed plus 25% spare.
3. Cable Connecting Hardware:
 - a. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 - b. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

2.2 COMMUNICATIONS HORIZONTAL CABLES

A. UTP Cable

1. Description: 100-ohm, 4-pair UTP, covered with a blue thermoplastic jacket and white thermoplastic jacket for voice.
 - a. Comply with TIA/EIA-568-B. 1 for performance specifications.
 - b. Comply with TIA/EIA-568-B.2, Category 6a.
 - c. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - i. Communications, General Purpose Rated: Type CM or CMG.

B. UTP Cable Hardware

1. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
2. Connecting Blocks: 110-style IDC for Category 6a. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
3. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - a. Number of Jacks per Field: One for each four-pair UTP cable, plus spares and blank positions adequate to suit specified expansion criteria.
4. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
5. Patch Cords: Factory-made, 4-pair cables in 48-inch (1200-mm) lengths; terminated with 8-position modular plug at each end.
 - a. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6a performance. Patch cords shall have latch guards to protect against snagging.

2.3 BUILDING ENTRANCE PROTECTORS

Provide building entrance protectors which shall be 66 IN termination and 66 OUT termination configured as standard 489ACA1-100 fully loaded with 4c1s protector 5-pin protector modules. Provide rack mounted protectors where indicated or where required.

2.4 COMMUNICATIONS FACEPLATES AND CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets:
 1. Two-port-connector assemblies mounted in single faceplate.
 2. Four-port-connector assemblies mounted in multigang faceplate.
 3. See drawings for other outlet quantities for number of ports. Mount assemblies in multigang faceplate.
 4. Metal Faceplate: Stainless steel, complying with requirements in Section "Wiring Devices."
 5. Flush mounting snap-in jacks.
 6. Provide blanks for unused portions of faceplates.
 7. Legend: Machine printed, in the field, using adhesive-tape label.
- C. Access Point Outlets: The typical outlet to be installed for almost all locations will be a one port surface mount box (biscuit jack). The will be equipped with the appropriate number of Category 6a cables.

2.5 RACKS, PATCH PANELS AND IDF CABINETS.

- A. Station cable terminations shall be accomplished using patch panels with 66 style IDC connectors. Patch panels will not exceed 2 RU (3.5") in height.

- B. Telephone backbone and station cables shall be terminated on 66 style terminal blocks. The number of blocks will be determined by installed cables plus 20% capacity. Mount blocks on the telephone backboard in accordance with BICSI TDMM specification for telephone backboards.
- C. Fiber Optic cables shall be terminated in rack mount enclosures in each wiring closet. Enclosures shall be sized based on installed cable count plus 10% spare capacity.
- D. Each rack shall have (1) 220 twist-lock outlet installed on a rear post (one above the other) of the data rack approximately 42 inches above the finished floor.
- E. Each rack shall have (1) dedicated 110V 20A circuits installed near the data rack. These circuits shall be installed in a quad-type manner and mounted approximately 42 inches above the finished floor.
- F. Patch Panels: TIA/EIA 568B Category 6a compliant rack-mounted assembly or terminals and accessory patch cords, with adequate capacity for all active and 25% spare circuits.
- G. Patch Cables ER & TR: Provide Category 6 green patch cords for all patch panel jacks, evenly divided between 3, 5 and 7 foot cords, plus 15% spare of each length. Cables shall be of the same manufacturer as that of the patch panels. Patch cables are to be installed by the communications contractor and coordinated with NHCS IT dept.
- H. Patch Cables ER & TR: Provide Category 6a yellow patch cords for the wireless access point communication network for all patch panel jacks, evenly divided between 3, 5 and 7 foot cords, plus 15% spare of each length. Cables shall be of the same manufacturer as that of the patch panels. Patch cables are to be installed by the communications contractor and coordinated with NHCS IT dept.
- I. Outlet Patch Cables: Provide one Category 6 green patch cord for all telecommunications inserts/jacks of appropriate length to ensure proper connectivity to the access point. Cables shall be of the same manufacturer as that of the patch panels. All patch cords supplied shall be from an approved manufacturer. Outlet patch cables will be installed by NHCS.
- J. Access Point Outlet Patch Cables: Provide one Category 6a yellow patch cord for all access point jacks throughout the facility, evenly divided into 7, 10 and 15 foot cords, plus 15% spare of each length. Cables shall be of the same manufacturer as that of the patch panels. All patch cords supplied shall be from an approved manufacturer. Access Point Outlet patch cables will be installed by the contractor.
- K. Communication Cable Management and Ladder Rack
 - 1. Horizontal Cable managers shall be provided for routing of cable between termination points and active components. Provide cable managers for each patch panel and/or fiber enclosure in a rack plus one spare. Provide cable managers for each patch panel and/or fiber enclosure in a rack plus one spare. Example, if an TR rack has three switches it would receive 4 wire managers. The passive rack has three patch panels and one fiber enclosure. It would receive 5 wire managers.
 - 2. Vertical Cable managers shall be provided for routing of cable between termination points and active components. Provide 12" wide vertical cable managers of appropriate height.

Provide one manager for exterior of each rack and one in between racks if more than one rack is installed.

3. A system of overhead ladder racks shall be installed in each TR to support and distribute all cabling from where it enters the room to its appropriate termination location. Racks shall be 12" wide min. with 9" spacing between support rungs.
 4. Overhead ladder racks shall be installed below finished ceiling, mounted at 7' - 4" and attached to the equipment racks and walls. They shall be supported at least every 6". One cable runway support bracket shall be mounted on top of each equipment rack. Ladder rack shall be bolted to the top of each cable runway support bracket to allow attachment to the equipment rack.
 5. Vertical ladder racks shall be installed to tie into any wireways and conduits that enter the TR above 9' AFF. All vertical ladder racks shall be connected to the horizontal ladder rack system.
- J. IDF Cabinet shall be wall-mounted Thinline II (26" x 26" x 12") or equal.
- K. Station cable terminations shall be accomplished using patch panels with 66 style IDC connectors. Patch panels will not exceed 2 RU (3.5") in height.
- L. Telephone backbone and station cables shall be terminated on 66 style terminal blocks. The number of blocks will be determined by installed cables plus 20% capacity. Mount blocks in IDF Cabinet.
- M. Fiber Optic cables shall be terminated in IDF Cabinet.
- N. Provide receptacle in IDF Cabinet.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. The project manager and crew shall be consistent through out the project. The project manager shall be present when any work is being performed. The project manager shall contact the Owner designated contact at the beginning and end of each day that work is to be performed.
- B. Cable shall be installed and terminated per manufacturer's specifications.
- C. Notify the Owner when ready for Owner-furnished equipment to be installed.
- D. Install wire and cable in accordance with TIA/EIA 568B.1,2,3 and TIA/EIA 569A.
- E. All cable shall be in conduit.
- F. All penetrations through walls and floors shall be sleeved. All sleeves shall have permanently attached bushings. Sleeves shall be sized to accept 50% growth. All sleeves shall be fire-stopped using UL7 approved methods and shall maintain assembly fire ratings. All sleeves between floors shall be supported with a conduit riser clamp installed per the manufacturer direction and shall be installed tight to the ceiling with enough sleeve to attach the bushing and rise up three inches above the floor on the opposite end.

- G. Existing sleeves and wall penetrations may be used provided no sleeve exceeds a 40 percent fill ratio. If using an existing sleeve, it shall have a permanently attached bushing, the contractor shall protect all existing cables and be responsible for any damage to existing cables. All existing sleeves and penetrations shall be firestopped and meet state and local codes at the completion of the installation.
- H. All cable shall be installed in a complete, neat and orderly fashion. Install cable with sufficient bending radius as not to kink, shear or damage binders. Bend radius shall meet manufacturers specifications for horizontal cable, fiber-optic cable, inter- and intra- building cable and copper inter- and intra- building cable. Cables shall be groomed, such that cables to be terminated on the left side of the patch panels are routed down the left side of the rack, and cables to be terminated on the right side of the patch panels are to be routed down the right side of the rack.
- I. Terminate all data and telephone cables at outlet devices. Terminate data cables on specified rack designated by the manufacturer's end-to-end solution equipment. Terminate telephone cables on specified rack using manufacturer's end-to-end solution for Cat 6a.
- J. Install pullwire in each empty telephone or data conduit.
- K. A minimum of three feet of slack should be left in an appropriate tidy fashion in the IDF Cabinet.
- L. All cables shall be installed according to TIA/EIA 568B-1,2,3 /569A standards. Care shall be taken during the installation to prevent nicks, abrasions, burning and scuffing of the cable. Cables found to be damaged will be replaced at the contractor's expense regardless of whether the cable passes Cat 6 Level III testing standards.

3.2 GROUNDING AND BONDING

- A. Ground and bond pathways, cable shields, racks and equipment under the provisions of Section 260526 and TIA/EIA - 607 - Commercial Building Grounding/Bonding Requirements.
- B. Grounding conductors shall be installed neatly, with as few bends as possible, and routed such as to minimize the length of the conductor runs.
- C. The grounding conductors may be wall mounted or fastened to ladder racks with plastic cable ties. While they may be routed adjacent to telecommunications cables, they should not be attached to them in any way.
- D. An acceptable bond between the grounding conductor and painted metal surfaces is required. In these cases, a small area of the paint should be removed by blade or wire brush prior to the attachment of the ground lug. In TRs, this typically applies to the surface of metal wire ways and to the surface of equipment racks.
- E. Definitions
 - 1. Bonding conductor (BC) for telecommunications. This conductor links the
 - 2. telecommunications grounding system to the main electrical power grounding system for the building. It originates in the TR.

3. Telecommunications main grounding bus bar (TMGB). This bar is located in the TR and serves as the hub for the telecommunications grounding system in the entire building. Bond the TMGB to the BC, TBB, and local building steel.
4. Telecommunications bonding backbone (TBB). This conductor links the TGB in each TC back to the TMGB.

F. Required Grounding Configuration

1. TGB. One telecommunications grounding busbar shall be installed onto the plywood on the wall of each TC. It shall be installed at 24" AFF. The bar shall be electrically insulated from its mounting bracket.
2. TBB. One insulated, stranded, #6 copper wire shall be installed from the TGB in the TC to the TMGB in the TR. This conductor shall be routed inside the riser conduit system along side the telecommunications riser cables. It shall be fastened to the TGB.
3. Equipment racks. A #6 grounding conductor shall be installed between one equipment rack and the TGB using the appropriate grounding lug. The remaining equipment racks shall be connected together in series to the first rack to provide a continuous connection to all racks..
4. Ladder racks. A #6 grounding conductor shall be installed between one section of overhead ladder rack to the TGB or to one of the equipment racks.
5. Pathway components. A #6 grounding conductor shall be installed from each distinct wireway or conduit (over 1" in diameter) which exits the TR and houses either horizontal or riser cabling back to the TGB, ladder rack, or equipment rack. As needed, these components may be connected in series to provide a continuous connection to all components. Grounding lugs shall be used to connect the conductor to wireways. Grounding bushings should be installed on conduit ends to connect these conduits to the conductor.

3.3 LABELING

- A. Manufacturers Identification: Each major component of equipment shall have the manufacturers name, address, model number, and rating on a plate securely affixed in a conspicuous place. NEMA code ratings, UL label, or other data which is die-stamped into the surface of the equipment shall be stamped in a location easily visible.
- B. Custom Panel Identification and Nomenclature: Switches, connectors, jacks, receptacles, outlets, cables and cable terminations shall be logically and permanently marked in a manner approved by the Owner. Custom panel nomenclature shall be engraved, etched, or screened. Marking for these items are purposely detailed in the drawings to ensure consistency and clarity. Verify any changes in working type size, and/or placement with the owner prior to marking. Mount on the custom rack panels as described above a designation of each source machine, which correlates to the system architecture. Submit a sample layout for Architect approval.
- C. Terminal Blocks and Rack Mounted Equipment Identification: All terminal blocks, rack mounted equipment, and active slots of card frame systems shall be clearly and logically labeled in a manner acceptable to the Owner as to their function, circuit, or system as appropriate. Labeling on manufactured equipment shall be engraved plastic laminate with white lettering on black background or dark background. Handwritten identification is not permitted. The contractor may substitute metallized polyester permanent identification labels with black printing on silver, white, or another light color background for the phenolic labels above.
- D. Cable Identification: All cable terminations shall be clearly and permanently labeled with appropriate cable number. Labeling of termination system shall be provided on white labels with

black typed lettering. Handwritten labels shall not be permitted. Provide a sample of labeling material and example of the numbering scheme planned for use at the facility with project submittals. The contractor will endeavor to utilize the environmental room number the facility administrators plan to use for new construction projects. If environmental room numbers are not available, the contractor will utilize the most recent set of architectural floor plan room numbers for the cable numbers. Once the contractor has utilized a set of room numbers, those numbers and floor plans showing those numbers must be used for all documentation purposes from that point forward for the project unless changes are approved in writing by the Owners Agent.

- E. The intent of this labeling scheme is to assist in troubleshooting cable problems. Therefore the cables are labeled in a manner that will direct the technician to the opposite end of the cable to allow for testing and troubleshooting.
- F. All fiber backbone cables will be labeled with a unique identifier at each end and at junction / pull boxes. Fiber backbone cables shall be labeled 12” from each end of the cable with a destination tag that identifies each cable’s remote destination and the unique identifier.

Example: A fiber strand from Room 503 to the MDF 500D would be labeled:

In MDF 500D: = ARoom 503-O1≅

In Room 503: = ARoom 500D-O1≅

Example: A fiber cable from Room 617A would be labeled:

In MDF 500D: ARoom 617A-O4≅

In Room 617A: ARoom 500D-O4≅

- G. All telecommunication outlet (TO) cables shall be labeled within 12” of each end of the cable using the above described identifier. TO numbers in each room are determined by numerical sequence starting from the main doorway of each room and continuing in a clockwise manner around the room. Each faceplate containing data ports shall be labeled starting in the upper left hand corner of each 1 gang section and assigned in a left to right and top to bottom direction.
- H. Switch: Ports shall be labeled using the Room ID- Port ID of the TO serviced by the patch panel port. Telecommunication Outlets (TO) that are serviced by a patch panel will be labeled using IDF ID - Patch Panel ID - Port ID. Example: Patch panel AA≅, Port 26 in Room 500D servicing Port #2 in Room 500 = 500D-A-26
- I. All test report documentation will contain a complete circuit identification based on the applicable labeling scheme.

3.4 TESTING

- A. A Certified Cat 6a cable tester, Level III, shall perform the certification test on all Cat 6a cables and adhere to TIA/EIA-568B.
- B. All test equipment shall be consistent throughout the installation. All test equipment shall be available for inspection by the Owner at any time. A valid and current calibration certificate traceable to the National Institute of Standards and Technology for any test equipment to be used shall be provided to the Owner.
- C. Upon substantial completion of the data network, test every data port for the functional requirements as listed in previously. Document, on a contractor generated form, the compliance of every port. The

testing individual will initialize the results of each location. Submit a electronic copy of the reports detailing the results of initial adjustments and verification tests including all relevant drawings, charts, and photographs.

- D. Copper Cable Tests: Test and document results for each four (4) pair UTP data cable for the following conditions. (These tests are minimum requirements for Cat 3 Cable). A wire map test of the cable may be used to demonstrate conformance of the cable to the following parameters where applicable.
- a. Proper polarity
 - b. No reversals
 - c. No transpositions
 - d. Continuity
 - e. No shorts
 - f. No AC voltage
 - g. No DC voltage
 - h. No opens
 - i. Proper numbering at each termination

All Cat 6a (Enhanced Category 5) UTP cable testing shall be in accordance with proposed TIA/EIA TSB-67 Transmission Performance Specification test parameters for the permanent link. Testing shall be performed using Level Iie test equipment and shall meet or exceed the following performance parameters:

- a. Length of cable \leq 90 meters/300 feet
- b. Attenuation @ 100Mhz \leq 24dB
- c. Pair-to-Pair Near-end Crosstalk (P-P NEXT) \geq 30dB
- d. Power Sum Near-End Crosstalk (PS NEXT) \geq 27dB
- e. Far-End Crosstalk (ELFEXT) \geq 19dB
- f. Power Sum Far-End Crosstalk \geq 16dB
- g. Return Loss \geq 10.1 dB
- h. Calculated ACR \geq 6dB
- i. Calculated PS ACR \geq 3dB

E. Fiber Testing

1. Factory Testing: All fiber optic cable shall be factory tested on a reel basis with performance data for each cable supplied to the contractor and to the owner. Tests shall be conducted utilizing an OTDR (Optical Time Domain Reflectometer) at 850nm and 1300 nm with the attenuation in dB/km recorded for each fiber.
2. Post Rough-In Test: Upon completion of the installation of all fiber optic cable and prior to termination, each fiber optic strand shall be tested for light continuity to insure no damage occurred during installation. (The contractor may wish to perform a light continuity test on each fiber optic strand of the cable upon receipt of reel from manufacturer to insure no damage occurred during shipping.
3. Termination Testing: After completion of the installation provide the following tests. An Optical Test Set consisting of an Optical Source (transmitter) and Optical Meter (receiver) shall be used to determine end-to-end attenuation and fiber length. This testing shall be in Accordance with EIA/TIA-526-14 Method B: Optical Power Loss Measurement of Installed Multi-mode Fiber Optic Plant. Each fiber shall be measured in one direction at both 850 and 1300 wavelengths. Record each measurement and provide copies to the Owner. Use of an OTDR for this measurement is acceptable provided the Contractor utilize the appropriate launch and receive jumper cables in front of and behind the cable being tested.

- F. Test parameters shall be verifiable by independent parties. Provide electronic copies of tests for every cable as part of the Verification Test Report.
- G. The Contractor is responsible for bringing any copper or fiber that fails to meet the standards into compliance at the Contractors expense.
- H. An electronic copy of ALL test results related to Voice/Data communication system shall be delivered to the Technology department upon substantial completion of the project.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing shall be performed under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Inspect, test and certify all cabling and equipment and terminations as specified and in accordance with TIA/EIA 568 B.

3.6 WARRANTY

The Contractor shall provide the following minimum warranty:

- A. All materials and equipment shall be new and warranted free of faulty workmanship and damage.
- B. The warranty shall include all parts, labor (including travel), expenses and equipment necessary to perform replacement and/or repairs.
- C. The total system (parts and labor) shall be warranted free of defects for a period of one (1) year from date of final acceptance.
- D. Replacement of defective materials and repair of faulty workmanship shall take place within 48 hours of notification by Owner and shall be guaranteed at no cost to the Owner during the warranty period.
- E. The minimum warranty provisions specified above shall not diminish the terms of individual equipment manufacturers warranties.

END OF SECTION 270500

SECTION 270510 – TELECOMMUNICATIONS PATHWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Equipment and terminal backboards.
- B. Premises wiring raceways and outlets.

1.2 RELATED SECTIONS

- A. Section 260533 – Conduit.
- B. Section 260534 – Boxes.

1.3 REFERENCES

NFPA 70 – National Electrical Code.

1.4 SYSTEM DESCRIPTION

Individual and combination telecommunications/data outlets shall be installed where shown on the contract drawings. Raceways shall be installed as straight as possible and shall contain not more than the equivalent of three quarter bends.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of the General and Supplemental General Conditions and Division 1 Specifications Sections.
- B. Record actual locations and sizes of pathways and outlets.

1.6 QUALITY ASSURANCE

- A. Telephone Utility: Field verify.
- B. Perform Work in accordance with telephone utility's rules and regulations.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish Products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.1 TELECOM TERMINATION BACKBOARDS

- A. Material: Grade A/C Fire retardant treated plywood.
- B. Size: 4 x 8 feet (1.2 x 2.4 m), 3/4 inch (19 mm) thick.

2.2 TELECOMMUNICATIONS OUTLETS

Outlets shall consist of standard, square cornered boxes 4-11/16" wide by 4-11/16" high by 2-1/8" deep, minimum, flush mounted at the height indicated on the contract drawings. Provide a single gang plaster ring for the square cornered boxes 4-11/16" wide by 4-11/16" high by 2-1/8" deep.

2.3 TELECOM WIRE AND CABLE

All telephone, data and fiber cable shall be furnished and installed by the contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Finish paint termination backboards with durable white enamel under the provisions of Division 9 prior to installation of equipment.
- B. Support raceways and backboards under the provisions of Section 260529.
- C. Install termination backboards plumb, and attach securely to building wall at each corner.
- D. Install #14 gauge steel or approved, 200 lb. nylon cord pull wire in each empty conduit run. The maximum bends between pull points shall be 180 degrees.
- E. The maximum distance between pull boxes shall be 100 feet.

END OF SECTION 270510

SECTION 275116 - INTERCOM / PUBLIC ADDRESS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes equipment, accessories, and materials to provide a complete and operational system for paging, building wide announcements, bell schedule tones, and life safety warnings

1.3 DEFINITIONS

- A. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.
- B. VU: Volume unit.
- C. Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. The specific item proposed and its area of application shall be marked on the catalog cut sheets.
- B. Shop Drawings: Power, signal, and control wiring.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Wiring Diagrams: For power, signal, and control wiring.
 - a. Identify terminals to facilitate installation, operation, and maintenance.
 - b. Single-line diagram showing interconnection of components.
 - c. Cabling diagram showing cable routing.
 - d. Clearly differentiate between portions of wiring that are manufacturer installed and portions that are field installed.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installing Contractor showing factory authorized certification as an authorized distributor.
- B. Qualification Data: For Installer showing factory authorized training.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For public address systems to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in "Closeout Procedures" and "Operation and Maintenance Data," include the following:

- a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- b. Operating instructions laminated and mounted adjacent to operating console location.
- c. Training plan.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Microphone: One.
 - 2. Microphone Desk Stand(s): One.

1.8 QUALITY ASSURANCE

- A. The system shall be supplied by a manufacturer's authorized contractor who is qualified in the proper installation, operation, and service of the system.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1.9 WARRANTY

- A. The contractor shall warrant the equipment to be new and free from defects in material and workmanship, and will, within one year from date of installation, repair or replace any equipment found to be defective. This warranty shall not apply to any equipment that has been subject to misuse, abuse, negligence, accident, or unauthorized modification.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. The equipment specified is based on equipment as manufactured by Bogen Communications as a Bogen Multicom Quantum IP system. The existing system is a Bogen system and all components installed shall be Bogen.
- B. Where equipment is specified herein or on drawings, by manufacturers' names or numbers, this shall denote the Design Basis for the preferred alternate bid and the minimum requirements as to quality, type, capacity, function, and performance.
 - 1. Where a specific model may have been discontinued, the manufacturer's intended replacement shall be substituted. Such substitutions shall be identified in the submittals.
- C. Source Limitations: Obtain public address system from single source from single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.

2.2 ADMINISTRATIVE PHONE: Design Basis: Bogen Model MCESS.

2.3 LOUDSPEAKERS

- A. Classroom, Corridor, and Administrative Loudspeakers:
 - 1. Flush-Ceiling-Mounted Units: In steel back boxes, acoustically dampened. Metal

ceiling grille with white baked enamel.

2. Design Basis: Bogen Model CSD2X2VR.
3. Design Basis: Bogen Model WBS8T725V for Wall Mount

B. Horn-Type Loudspeakers:

1. Mounting: Integral bracket.
2. Units in Damp, Wet, or Outdoor Locations: Listed and labeled for environment in which they are located.
3. Design Basis: Bogen Model FMH-15T.

2.4 SURGE SUPPRESSION

- A. Provide surge suppression protectors for any intercom cables that enter from outside the building and on all exterior horn circuits.
- B. Provide protectors for any intercom cables that enter the equipment rooms from outside the building. Examples of this would be outside horns and mobile classrooms.
- C. Design Basis: ITW LINX #UP25-39.

2.5 CONDUCTORS AND CABLES

- A. Jacketed, shielded, twisted pair and twisted multipair, untinned solid copper.
 1. Insulation for Wire in Conduit: Thermoplastic, not less than 1/32 inch thick.
 2. Cables shall be permanently identified at each wire end utilizing a self-laminated wire or cable marker comprised of a white label with black lettering and clear laminate area, in a manner approved by the Owner. Each cable identification shall be a unique number located approximately 1-1/2" from cable connection at both ends of cable. Numbers shall be approximately 1/4" in height. These unique numbers shall appear on the As-Built Drawings provided by the installer and these drawings shall be mounted in each equipment room used to support any part of the entire system.
 3. Design Basis:
 - a. Corridors & Exterior Horns: Belden 5300FE, #18 AWG.
 - b. Classrooms, Admin, & Locations other than Corridors: West Penn 291 #22 AWG.

2.6 PATHWAYS

- A. Conduit, Cable Tray, and Boxes: Comply with Sections "Raceways and Boxes" and "Wire Mesh Cable Trays".
 1. Outlet boxes shall be not less than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters, and except in accessible ceiling spaces where unenclosed wiring method may be used. Conceal pathway and cables except in unfinished spaces.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Cable Installation Requirements:
 - 1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
 - 2. Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
 - 3. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
 - 5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 6. Service Loops:
 - a. Provide 10 foot service loops at each equipment termination so that plates, panels, and equipment can be dismantled for service and inspection.
 - b. Provide 3 foot service loops at each loudspeaker.
 - 7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
- C. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 - 2. Suspend speaker cable not in a wireway or pathway a minimum of 24 inches above ceiling by cable supports not more than 60 inches apart. Cables shall be installed parallel or at 90 degree angles to the building walls. Diagonal, beeline, or non-supported cable routing is unacceptable.
 - 3. Cable may be run through structural members but shall not be in contact with pipes, ducts, or other potentially damaging items.
 - 4. Utilize wall sleeves, dedicated to low voltage cabling, for penetrations through walls.
- D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate pathways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other communication equipment conductors as recommended by equipment manufacturer.

3.3 INSTALLATION

- A. The contractor shall furnish all equipment, accessories, and material required for the installation of a comprehensive communication system in strict compliance with these specifications and applicable contract drawings. Any material and/or equipment necessary for the proper operation of the system, which is not specified or described herein, shall be deemed part of this specification.
- B. Coordinate layout and installation of system components and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire- suppression system, and partition assemblies.

- C. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- D. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.
- E. Equipment Cabinets and Racks:
 - 1. Group items of same function together, either vertically or side by side, and arrange controls symmetrically. Mount monitor panel above the amplifiers.
 - 2. Arrange all inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.
 - 3. Blank Panels: Cover empty space in equipment racks so entire front of rack is occupied by panels.
 - 4. Install cables, combed straight and formed in a neat and orderly manner. Tie as required using Velcro cable ties of appropriate type and size.
- F. Volume Limiter/Compressor: Equip each zone with a volume limiter/compressor. Install in central equipment cabinet. Arrange to provide a constant input to power amplifiers.
- G. Wall-Mounted Outlets: Flush mounted.
- H. Connect wiring according to Section 270500 "DataVoice Communication".

3.4 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Cable shielding shall be connected to common ground at point of lowest audio level and shall be free from ground at any other point. Cable shields shall be terminated in same manner as conductors.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Schedule tests with at least seven days' advance notice of test performance.
 - 2. After installing public address system and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: Perform tests that include originating program and page messages at microphone outlets, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.
 - 4. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
 - a. Disconnect microphone at connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure signal-to-noise ratio.
 - b. Repeat test for each separately controlled zone of loudspeakers.
 - c. Minimum acceptance ratio is 50 dB.

5. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.
 6. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.
 7. Signal Ground Test: Measure and report ground resistance at public address equipment signal ground. Comply with testing requirements specified in Section 270526 "Grounding and Bonding for Communications Systems."
- C. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.
 - D. Public address system will be considered defective if it does not pass tests and inspections.
 - E. Prepare test and inspection reports.
 1. Include a record of final speaker-line matching transformer-tap settings and signal ground- resistance measurement certified by Installer.STARTUP SERVICE
 - F. Engage a factory-authorized service representative to perform startup service.
 1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
 2. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

- A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to four visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the public address system and equipment.
- B. Provide a minimum of eight (8) hours of complete "in service" instructions of system operation to school personnel. Assist in programming of telephone system.
- C. Installer shall provide programming documentation that reflects the relation to each port, station identifier, and physical location of station.

END OF SECTION 275116