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| **Revision History** |
| **Revision Date** | **Section/Nature of Revision** |
| **3/1/17** | Document issued |
| **4/12/23** | 2.12 B. 1): added booted and removed bootless 2.12 B. 1) d) (1): added that classroom mounted phones shall have 6” black bootless cables to be used as the line cord |
| **5/20/24** | 2.1-2.7, 2.10 and 2.11: Updated fiber and horizontal cabling specifications and approved manufacturers |

Structured Cabling

PART 1 GENERAL

1.1 Section Includes

A. Fiber Optic Cabling (OM4).

B. Horizontal Copper Cabling (CAT 6).

C. Wireless Access Points, WAPs (CAT 6A).

D. Racks, Frames.

E. Voice Grade Copper Cabling.

F. Cabling Connectors.

G. Data Jack System.

H. Equipment Mounting and Interconnecting Devices.

I. System Testing.

J. IP Paging Cabling (Pre-Cabling for devices, installation by Division 27).

K. Surveillance Cabling (Pre-Cabling for devices in new construction, installation by others).

L. Audio Microphone and Speaker Cabling (Pre-Cabling for device installation by Division 27).

1.2 Related Sections

1. Section 26 05 10 Basic Electrical Requirements.
2. Section 26 05 29 Supporting Devices.
3. Section 26 05 33.13 Conduit and Raceways.
4. Section 26 05 45 Prefabricated Ground Pull Boxes.

1.3 Scope of Work

A. Contractor shall be responsible for providing a complete, functional data communications system, whether ancillary devices/components are included in this specification or not. The Contractor shall provide equipment for 20% growth on patch panels and punch down locations.

B. The cabling plant shall consist of a Main Distribution Frame (MDF) and multiple Intermediate Distribution Frames (IDFs), as shown in the drawings. All conduit and cable interconnecting the MDF to the IDFs shall be a part of this scope. Intent is to install a 10 GIG fiber optic compliant system (IEEE Std 802.3ae). All network cabling shall be Category 6 rated for horizontal and Category 6A for WAP with a 25-year manufacturer’s performance warranty. This Installing Contractor shall be required to be as specified (or pre-approved equal) and certified Belden or Leviton. Product shall be provided of quality listed in this document. Other substitution requests shall be submitted per these documents.

C. Owner has a VoIP system at this site that utilizes the 50/125 µm, laser optimized fiber optic site cable and Category 6 horizontal cable. This system is implied when referencing data.

D. The installation shall include cable (fiber optic and twisted‑pair copper), connectors (fiber optic and twisted-pair copper), jumpers (fiber optic and twisted‑pair copper), patch panels (fiber optic and twisted-pair copper), wire management, telecommunications outlets, and racks or cabinets, and Owner designated LAN equipment, as required.

E. In addition to material and equipment, Contractor shall provide labor and any incidental material required for installation. All fiber strands shall be terminated with connectors and landed on the fiber interconnect equipment. All copper station cables shall be terminated on patch panels (IDF end) and data communications outlets (workstation end). Upon completion of installation, Contractor shall test all fiber and new copper cable and record the test results, as specified herein.

F. The work performed under this specification shall be of good quality and performed in a professional manner. In this context, "good quality" means the work shall meet industry technical standards and quality of appearance. The Owner/Engineer reserves the right to reject all, or a portion of the work performed, either on technical or aesthetic grounds.

G. Install/terminate fiber and multi-pair UTP cable from the MDF to every IDF in the building. These runs shall all be in star configuration. These backbone cables shall all be dedicated direct links between the MDF and the IDF. Provide rack mount fiber and copper panels in all closets and mount all equipment on a rack, wall, or cabinet, as required by this specification or the drawings.

H. Conduit, ground pull boxes, and cabling (to include pre-cabling for intrusion and access system) to be provided by this Contractor. Coordinate all requirements with other trades prior to submitting shop drawings.

I. This Contractor shall coordinate with utility providers. This shall include setting meeting dates with the providers and resolving the scope and timing of work to be done by each party. Telephone utility demarcation points shall be established and clear prior to submittal of shop drawings.

J. This Contractor shall provide to the Engineer (at least three months ahead of Substantial Completion) AutoCAD drawings with jack numbers reflecting the FISH room numbers as outlined in this specification. Before the Contractor can install any equipment, this Contractor shall have all new cabling terminated and PASS tested for use by the Contractor at least two months ahead of Substantial Completion.

K. Testing of the various systems shall be provided by this Contractor, as stipulated herein.

L. Contractor shall remove the installed, wireless access points (WAPs) and associated equipment for storage and safe keeping; whereby, the system shall be reinstalled at the appropriate time of construction. However, at the District’s discretion, new WAPs could be provided to the Contractor for installation. In this case, the older WAPs would be returned to the District. Contractor to verify prior to reinstallation.

1.4 General (Functional Intent of system)

A. It is the responsibility of the Contractor to verify ALL aspects of the installation. The guidelines used shall include the ANSI/TIA 568-0.D, 1.D, 2.D, 3.D, ANSI/TIA 569-D, ANSI/TIA 606-B. As well as IEEE 802.3ab specification for Gigabit Ethernet over UTP (1000 Base-T), IEEE 802.3ae specification for 10 Gbit/s Ethernet over fiber, and IEEE 802.3z specification for 1000BASE-X Gbit/s Ethernet over Fiber-Optic at 1 Gbit/s.

B. It is the intent that all ANSI/TIA and IEEE standards adopted at the time of bid opening shall be met.

C. Contractor shall provide a fiber optic backbone capable of supporting 10 Gigabit Ethernet as well as Category 6 horizontal cabling and Category 6A Wireless Access Point cabling (WAP).

D. The structured cabling infrastructure is to include all equipment, materials, and labor required to provide, install, and test a complete system, as described herein.

1.5 Applicable Standards (latest version)

A. Refer to Division 27, “Basic Specialty Systems Requirements.”

1.6 Contractor Qualifications

A. This installation Communications Contractor shall be able to submit proof that they meet the following qualifications upon request from the Engineer.

1. PERFORMANCE HISTORY: Contractor must have successfully performed at least three projects of similar scope and size, within two years of the date of this bid, in the local area. Proof of performance shall be in the form of reference sheets which shall include a brief description of the project, the beginning and ending contract price, the project foreman or superintendent's name, and the name, address, and telephone number of a project contact. The Superintendent proposed for the project shall have been responsible for at least two of these projects under the employment of this Contractor.

2. COMMUNICATIONS FIBER OPTICS EXPERIENCE: Contractor must be able to prove to the satisfaction of the Owner/Engineer that it has significant experience in the installation of fiber optics cable systems and communication systems. Installation must include installation of fiber optics cable, fiber termination, have a knowledge of interconnect equipment and a thorough knowledge of testing procedures.

3. TIME IN BUSINESS: Contractor must have been in business, under the current name, and in the business of installing telecommunications systems, continuously, for a period of at least three years, prior to the date of this bid. Essential installation personnel shall include at least one foreman and two journey level installers or technicians. By submitting the names of these personnel, Contractor is committing them to the execution of the project outlined in this specification.

4. REQUIRED LICENSE: The Contractor shall possess, at a minimum, a State of Florida Low Voltage License.

5. RCDD ON STAFF: The Contractor shall have a (BICSI) Registered Communication Distribution Designer on staff.

6. OFFICE LOCATION: The Contractor shall maintain a permanent office within 75 miles of the project site.

7. MANUFACTURER CERTIFICATION: The Contractor shall be a Belden Partner Alliance (PA) contractor or Leviton Network Solutions Certified Installer who has completed the manufacturer’s contractor training program and is authorized to offer 25-year extended warranties. The Contractor shall provide proof by submitting a valid copy of their Company’s certificate with their bid.

1.7 Definitions

A. COMMUNICATIONS EQUIPMENT ROOM (CER) OR MAIN CROSS-CONNECT (MC or MDF or MXC): The MDF is the location, within a building or complex of buildings, where the entire telecommunications system originates. It includes the physical location, enclosure, wire and cable management hardware, termination hardware, distribution hardware, and equipment racks. ANSI/TIA‑569 refers to the room housing the MDF as the "Equipment Room." The MDF should be located either in proximity to or co-located with the telephone utility demarcation point. A clear working space of 30 inches in front of and behind the equipment racks is required.

B. COMMUNICATIONS CLOSET (CC) OR INTERMEDIATE CROSS CONNECT (IC or IDF or IXC): The IDF is the location in a building where a transition between the backbone or vertical riser system and the horizontal distribution system occurs. It includes the physical location, enclosure, wire and cable management hardware, termination hardware, distribution hardware, and equipment racks. Each IDF in the building shall be such that the station cable route distance to the furthest workstation is within 90 meters. If an IDF is co-located with a power distribution room, observe minimum clearances from power distribution equipment (10 feet) and enclose the cable in metal conduit, and mount the patch panels in a cabinet. A clear working space of 30 inches in front and behind the equipment racks is required.

C. Walls supporting "wall mount" equipment shall be covered with factory-finished, 3/4" fire-treated plywood from 12" above the finished floor to the ceiling shall be provided as manufactured by ReadySPEC Backboards, Inc. or pre-approved equal. Refer to drawings for colors and locations. The MDF and IDF floors must be sealed from the concrete by means of epoxy paint or linoleum as per specification.

D. Provide means to provide and install.

E. For the purposes of this specification: All cabling shall be Category 6 and Category 6A. Category 5, 5E, or 5E+ shall not be accepted.

1.8 Owner Provided LAN Electronics

A. Electronics shall be provided and installed by the Owner. It is necessary for this Contractor to become familiar with the location, space requirements, and specific mounting requirements of the electronics. All requirements and information shall be known before building out the MDF or IDFs.

1.9 Pre-Bid Substitutions

A. Under provisions of Division 01 and Section 26 05 10.

B. Submit any requests for substitutions or deviations prior to bid opening. Only those requests that are complete and approved by the Engineer in written addendum form shall be accepted.

1.10 Shop Drawing Submittals

A. The Contractor shall submit per Division 01. Submission shall be submitted in pdf format with bookmarks to each section and product.

1. The first section shall be the "Index" which shall include the project title and address, and name of the firm. The contents of each section shall be listed on the index.

2. The second section shall include a copy of the Contractor's valid State license, and a list of instrumentation to be used for system testing. Include copy of RCDD certificate.

3. The third section shall contain the product specifications. Product submittal shall include a cover page listing manufacturer, part number and description of each product to be provided.

4. The fourth section shall contain samples of proposed cable markers and labeling.

5. The fifth section shall contain a scaled, complete, detailed MDF and IDF layout with rack elevations, scaled floor plans with equipment locations shown, and a layout of any wall mounted backloads. Within this section, the color of the backboards shall be identified. One, 4'x8' board (i.e., two 4’x4’ ReadySpec boards) shall be ordered red for fire-related devices. Two, 4'x8' boards (i.e., four 4’x4’ ReadySpec boards) shall be ordered green for security-related devices. The rest shall be colored gray for telephone and data. The color scheme shall be approved prior to ordering. These shall follow the District Standard for equipment placement within the rack.

6. Attach: Include disk copy and three hard copies of an AutoCAD drawing showing the jack numbering at each jack location and the patch panel jack numbering per room with FISH room numbers.

B. The Contractor shall provide the shop drawing submittals within 60 days of receipt of contract. No work shall begin, nor equipment be ordered without an Engineer-accepted shop drawing submittal.

1.11 Function and Operation

A. The intended function of the data communications cable system is to transmit data signals from a central location to individual data outlet locations and WAP. Upon completion of the work outlined in this specification, the fiber optic system shall be capable of supporting 10 Gigabit Ethernet data signals per IEEE 802.3ae, IEEE 802.3ac, IEEE 802.3an. The horizontal cabling systems shall be capable of supporting 1 Gigabit Ethernet IEEE 802.3z. Fiber optic cable shall be laser or Vertical Cavity Surface Emitting Laser (VCSEL) optimized.

PART 2 PRODUCTS

2.1 Fiber Optic Cabling

A. It is the intent that the inter-building fiber optic cabling, installed on this project, accommodates the data, fire alarm, and surveillance systems. Fibers dedicated to these systems shall be labeled as to their use.

B. Performance verification and documentation shall be as specified herein. The max distance supported by the TIA-568.0 is 400m for 10GBASE-SR applications when using OM4. Distances beyond 400 meters shall be run with Single Mode. If this occurs, the Contractor shall submit proposed product cut sheets for review and approval prior to ordering any materials.

C. Fiber – Multi-Mode OM4 (and if Single Mode is required)

1. Provide tight buffered, indoor/outdoor plenum rated, multi-strand fiber optic cable. For 400 meter or less runs provide 50/125 OM4 and in quantities indicated on drawing interconnect diagram. Multimode fiber strands shall be optimized for VCSEL based systems. Fiber strands shall exceed ANSI/TIA 568.3-D and IEEE802.3ae specifications. All fiber shall be installed with pull strings for future use. See drawings for number of fiber strands per cable and application.

2. Acceptable Manufacturers (xxx = fiber count):

a. Belden FiberExpress (OM4) FD4DxxxP9 and (SM) FDSDxxxP9.

b. Corning (OM4) xxxT8P-31190-29 and (SM) xxxE8P-31131-29.

2.2 Fiber Optic Cabling Connectors

A. Provide fiber optic connectors at each end of all fibers installed. The contractor shall own Fusion Splicer equipment. Contractor shall inform Owner, at least 24 hours prior to installing fiber connectors, so that the Owner can be present at time of connector installation. If Owner cannot be present, Contractor shall provide visual evidence (i.e., photos, video, etc.) as proof of proper installation technique.

B. For OM4 (and if SM is required): Provide fused splice-on, field-installable fiber optic connectors at each end of installed, outside plant fibers per manufacturer’s recommendations. The tip material shall be zirconia ceramic and pre-radiused. Terminate fiber on "LC" connectors.

1. Acceptable Manufacturers:

a. Belden FX Fusion:(OM4) FT4LC900FS01 and (SM): FTSLC9000FS01

b. Corning FuseLite:(OM4) SOC-LC-900-OM4 and (SM) SOC-LCU-900-SM

2.3 Fiber Optic Cable Interconnect Devices

A. Fiber Optic Interconnect Cabinets (Rack-Mounted) for OM4 (and if SM is required):

1. Rack mounted fiber interconnect cabinets shall be constructed of 16-gauge cold rolled steel protecting fiber terminations on all sides. Cabinets shall install in a 19" data rack with standard EIA hole spacing.

2. Patching and termination compartments shall be separated by a steel panel supporting the fiber couplers.

3. Patching compartment shall be accessible through a front mount door (swing down to open).

4. Provide fiber adapter panels preloaded with duplex 568 LC type couplers for fiber cross connects. Cover empty slots with blank adapter panels, if applicable.

5. Cabinets shall be equipped with fiber storage management.

6. Acceptable Manufacturers (size, quantities, and blanks, as necessary): Done

a. Belden: FiberExpress Series. ECX-01U (1U), ECX-02U (2U), ECX-04U (4U) rack mount housing with 50/125 µm OM4 rated LC adapter frames FF4X06LD (12-fiber) and FF4X12LD (24-fiber). Single mode OS2 rated LC adapter frames FFSX06LD (12-fiber) and FFSX12LD (24-fiber).

b. Corning: CCH-01U, CCH-02U, CCH-04U rack mount housing with 50/125 µm OM4 rated LC panels CCH-CP12-E4 (12 fiber) and CCH-CP24-E4 (24 fiber). Single mode OS2 rated LC panels CCH-CP12-A9 (12 fiber) and CCH-CP24-A9 (24 fiber).

B. Fiber Optic Interconnect Cabinets (Surface Mounted)

1. Provide surface mounted fiber interconnect cabinets. Cabinets shall be constructed of 16-gauge cold rolled steel to protect fiber terminations on all sides.

2. Patching and termination compartments shall be separated by a steel panel supporting the fiber couplers.

3. Patching and splicing compartment shall be accessible through a front mount steel door with flush lock.

4. Provide six-pack fiber adapter panels preloaded with duplex 568 LC type couplers for fiber cross connects. Cover empty slots with blank adapter panels, if applicable.

5. Mount box on 2' high x 4' wide x ¾" thick, AC-grade, plywood painted on all six sides with two coats of flame-retardant paint, as manufactured by ReadySPEC Backboards, Inc. or pre-approved equal.

6. Approved Manufacturers:

a. Belden: FiberExpress Series Wall-mounted optical fiber patch housing ECX-02WM with 50/125 µm OM4 rated LC adapter frames FF4X06LD (12-fiber) and FF4X12LD (24-fiber). Single mode OS2 rated LC adapter frames FFSX06LD (12-fiber) and FFSX12LD (24-fiber).

b. Corning: Wall-mounted optical fiber patch housing ICH-02P with 50/125 µm OM4 rated LC panels CCH-CP12-E4 (12 fiber) and CCH-CP24-E4 (24 fiber). Single mode OS2 rated LC panels CCH-CP12-A9 (12 fiber) and CCH-CP24-A9 (24 fiber).

2.4 Equipment Racks

A. Free standing racks shall be height, as specified, and provided with EIA 19" mounting. Securely mount to floor (on an isolation pad and utilize non-conductive washers) and provide ladder rack with required front and rear clearances. Racks shall be constructed of extruded aluminum or cold rolled steel with standard EIA hole pattern on front and rear. Finish shall be anodized black. Provide rack with the following accessories/features:

1. Connect separate, solid, #4 AWG, insulated, grounding wire between the ground bus and the building’s grounding system.

2. For four post racks/open equipment frames, provide two equipment shelves per frame, per Owner’s requirements (depth of provided frame – secured at four corners).

3. Provide rack/frame with mounting hardware and all accessories required to complete installation of the rack. Provide support for each rack, as required, and backer board, as indicated on drawings and as manufactured by ReadySPEC Backboards, Inc. or pre-approved equal. Provide one shelf per rack at depth of 15 inches, secured at middle.

4. Provide cable management system for rack. Per rack, provide vertical cable channel guide (both sides) and necessary horizontal cable guide panels (split ring), as necessary, to handle all terminated cables and as per drawings and these specifications (see patch panel requirements). Provide Velcro tie wraps for cable management within racks. Nylon tie wraps shall not be used within racks.

5. Provide one per rack: Rack mounted, twelve position, power strip with circuit breaker, surge suppression, and 15 feet cordage whip. Coordinate electrical service requirements with Division 26 Contractor.

6. Acceptable Manufacturers:

a. Relay Rack (quantities as indicated on drawings)

1) Belden XDR8419-312N.

2) Chatsworth 48353-703 with 32610-703.

b. Four Post Rack/Open Equipment Frame

1) Belden XDR8419-3122836.

2) Chatsworth 15251-703.

c. Swing Gate Wall Rack

1) Belden XHW Series, black with tinted Plexiglass door.

2) Chatsworth 11900-748.

2.5 Voice Grade Copper Cabling

A. Interbuilding - Twisted Pair

1. Between buildings, twisted pair cable shall be 24 AWG solid conductors and manufactured expressly for telephone use. The individual pairs must be color coded to Bell System/telephone industry standards. Inter-building cable shall be filled, for the purpose of water intrusion prevention and composed of aluminum/steel sheath. Reference drawings for pair count.

a. Acceptable Manufacturers:

1) Belden

2) Berk-Tek

2. Cable shall be sized and installed according to the drawings for twisted pair.

3. Cables shall transition from outside (filled) cable to the “tails” of the protection units with properly equipped and installed splice closure units in quantities necessary to terminate all cable (Porta Systems Series 24 Building Entrance Terminals – 110 Terminations or pre-approved equivalent).

4. Terminate, as indicated on drawings.

5. The telephone service surge protector module block must be connected with a No. 6 AWG or larger solid copper insulted wire to the single point ground on the plywood backboard. The length of this wire shall be kept as short as possible and not have any sharp bends.

6. The interbuilding cable surge protector building entrance terminals must be connected with a No. 6 AWG solid copper insulated ground wire to the grounding terminal bar inside the far end building main service entrance equipment enclosure.

7. Provide Porta Systems - Delta Protector Heat Coil or equivalent 5 pin protector module for the interbuilding cable. A module must be installed on all interbuilding cable runs and must be sufficient in quantity to protect all pairs installed (230 volt for voice and 75 volts for data – quantities as required).

B. Interbuilding Cable Labeling

1. All interbuilding cabling shall be terminated on the 5 pin protector blocks, then connected to patch panels. All protector blocks must be labeled as to the building to which the cable runs. It shall not be permissible to split a protector block between two buildings.

2. Each patch panel shall be labeled with the Building Number and Room Number, as labeled on the drawing, to which the interbuilding cable runs. There shall be a one-to-one relationship for each jack in the panels at both ends.

2.6 UTP Horizontal Cabling

A. HORIZONTAL CABLING: Provide plenum-rated, Category 6 compliant, unshielded twisted pair (UTP) copper cable, blue. Cable shall contain insulated primaries enclosed in a thermoplastic outer jacket.

B. WAP CABLING: Provide plenum-rated, Category 6A compliant, unshielded twisted pair (UTP) copper cable, yellow. Cable shall contain thermoplastic insulated primaries to comply with Article 800 NEC.

C. The Contractor shall inspect all cables prior to installation to verify that it is identified properly on the reel identification label, that it is of proper gauge, that it contains the correct number of pairs, etc. Damaged cable or any other components failing to meet specifications shall not be used in the installation.

D. Provide three feet of “s” coiled cable above ceiling at each outlet location.

E. Provide plenum-rated only where required by the building code. Non-plenum spaces may use standard riser cabling, unshielded twisted pair (UTP) copper cable. Cable shall contain insulated primaries enclosed in a thermoplastic outer jacket. Confirm final colors of cable with Owner prior to installation.

1. HORIZONTAL CABLING: Acceptable Manufacturers:

a. Belden 2413.

b. Berk-Tek LANmark-1000 10032093.

2. WAP CABLING: Acceptable Manufacturers:

a. Belden10GXS13-004.

b. Berk-Tek SST, 11101842.

2.7 Data Jack System (ANSI/TIA T568A Wiring Configuration)

A. Recessed Mount—Provide faceplate and specified number of eight position eight conductor connectors in a four-port configuration. The jacks shall individually snap‑into faceplate. Data outlet shall provide compliance with ANSI/TIA‑568-0.D, 1.D, 2.D, and TIA‑606 specifications. Termination of all jacks shall be 110‑type insulation displacement connectors (IDC), T568A pin/pair assignment and shall utilize lead frame technology or flexible printed circuit board technology.

B. Provide Category 6A for WAPs and Category 6 for all else.

C. Provide a communications outlet outside of the Cafeteria Manager's office for the connection of an overhead speaker. The outlet needs to be located in such a way as to allow a speaker to be connected to it and for the sound to be heard by Food Service staff.

D. For wall mount telephone locations, provide stainless steel wall plates with lugs for flush mounting of modular jack or with jack installed.

1. Acceptable Manufacturers:

a. Belden: AX104126.

b. Leviton: 4108W-1SP.

E. Jacks shall meet Category 6 component specifications per TIA 568-2.D as verified by ETL. Include faceplates (to match jack color and quantities of openings per drop) and matching color blanks, in quantities required.

1. Acceptable Manufacturers:

a. Belden Cat 6, AX101320 and WAPs Cat 6A, AX102282.

b. Leviton: Cat 6, 61110-RW6 and WAPs Cat 6A, 6110G-RW6.

2.8 Labeling

A. Each cable shall be permanently labeled at both ends with the Communications Closet Room Number, Patch Panel Number, and Patch Panel Port Number. All network system components shall be labeled, including rooms, racks, cabinets, patch panels, individual ports in each patch panel, communications outlets, etc. The system identification administration shall meet the requirements of ANSI/TIA 606.

B. Each termination point shall have a recessed designation strip with clear plastic cover for jack identification. Lettering shall be typed – not handwritten. The associated termination shall be permanently labeled according to the following scheme (as labeled on the drawing):

Room Number-Position in Room Clockwise from Main Door

For example, the third jack from the door in Room 01-101 would be labeled: 01-101-3

C. Each patch panel shall be labeled sequentially left to right, top to bottom with the room number and port letter, such that the ports can be located easily on the panel.

D. All fibers in each fiber optic cable shall be identified at each end on the interconnect cabinet with permanent plastic labels. Fiber cabinets shall be identified with the building number and corresponding fiber number for the far end of the cables.

E. Labeling Notes

1. Labels shall be made using a device which produces typewritten print (Brother P-Touch tape marking system is acceptable).

2. Allow more characters if needed (i.e., BB-RRRR).

F. Labeling Copper - Each jack on the Communications Outlet shall be labeled at the faceplate using the following format to indicate its location on the patch panel:

1. Communications Outlet Labeling

Format

BB-RRR

port port

port port

P##-P##-P##-P##

Top Label

BB Building number where the communications closet (servicing that jack) is located.

RRR Room number where the communications closet servicing that jack is located.

Bottom Label

P Patch Panel ID (A, B, C, D, etc.)

## Patch Panel port number (01-48, etc.)

Label indicates jacks left to right, top to bottom, separated by a dash.

Example for Room 12, Closet 103

12 Building number of the communications closet.

103 Room number of the communications closet.

port port...............Jacks on this

port port..............communications outlet … A47, A48, B01, B02

2. Patch Panel Labeling

Each patch panel shall be labeled using the following format:

Format

 port port port port

BB-RRR BB-RRR BB-RRR BB-RRR

BB Building number the jack is serving.

RRR Room number the jack is serving.

Label shall be placed just below or above the jack.

Example

 port port port port

12-103 12-103 12-103 12-103

Building number the jacks are serving: 12

Room number the jacks are serving: 103

3. Cable Labeling

Each cable shall be labeled at both ends- at the patch panel and at the communication outlet.

Format at the patch panel end:

BB-RRR

BB Building number the jack is serving.

RRR Room number the jack is serving.

Label shall be attached to the cable within six inches of the cable’s termination point

Example

12-103

Building number the jack is serving: 12

Room number the jack is serving: 103

Format for the communications outlet end

BB-RRR

BB Building number where the communications closet servicing that jack is located.

RRR Room number of communications closet.

Label shall be attached to the cable within six inches of the cable’s termination point.

Example

12-103

Building number where the CC servicing that the jack is located: 12

Room number of the communications closet: 103

G. Fiber Labeling

1. Fiber Patch Panel Labeling

Each Fiber Patch Panel (at both the CER and CC ends) shall be labeled using the following format:

Format

BB-RRR

BB Building number the jack is serving.

RRR Room number the jack is servicing.

Label shall be attached to the cabinet.

Example

12-103

Building number the fiber is serving: 12

Room number the fiber is serving: 103

H. Cable Labeling

Each cable shall be labeled at both ends using the following format.

Format

BB-RRR

BB ..............Building number the fiber is serving.

RRR............Room number the fiber is serving.

Label shall be attached to the cable within six inches of the cable's termination point.

Example

12-103

Building number the jack is serving: 12

Room number the jack is serving: 103

2.9 Building Cable Routing System

A. J-Hooks

1. From cable tray to stubbed up outlet conduits, building shall be supplied cables through Category 6 compliant J-hook system located in the ceiling space. The J-hooks shall be of adequate size to accommodate all cable specified herein plus 50%. Acceptable Manufacturer: Platinum Tools HPH Series or Prior Approved Equal.

2. J-hook system shall be no closer than 18 inches from sources of electromagnetic interference such as fluorescent light fixtures or shall be shielded from such interference by tray sections designed for that purpose.

3. All efforts shall be made to keep transitions smooth and continuous to prevent excessive bending and turning of cables.

4. Cabling shall be supported to the building structure at a maximum of 4-foot intervals with J-hooks. Cabling shall not be supported from the ceiling, ductwork, conduits, piping, or any other non-structural building member.

B. Cable Trays

1. As indicated in the drawings, provide Snake Tray System. Manufacturer’s Part No. No. CM 201-425-D-8. Size to accommodate all cable specified herein plus 50%.

2. Do not locate closer than 18" from all sources of electromagnetic interference such as fluorescent light fixtures.

3. All efforts shall be made to keep transitions smooth and continuous to prevent excessive bending and turning of cables.

C. Tele-Power Poles (Renovations as Pre-Approved by Owner)

1. Provide steel tele-power pole in locations indicated on drawings (coordinate color with Owner, provide grey as default). The tele-power poles shall be provided with an extender, as necessary, to extend above the ceiling. Provide ceiling trim plates, entrance end plate, and associated hardware.

2. Provide data and power connectivity, as specified herein and as indicated on drawings.

3. Acceptable Manufacturer: Legrand Tele-Power Pole, 25DTP-4DG or pre-approved equal, quantities as required.

2.10 Data and Voice Patch Panels (ANSI/TIA 568A Wiring Configuration)

A. Provide 48 port, loaded, UTP patch panels (rack mount) per TIA 568-2.D as verified by ETL. Panels shall be modular panels loaded with eight position eight conductor connectors. Jacks shall be manufactured with lead-frame technology or flexible printed circuit board (PCB) and have T568A pin/pair assignment (unless otherwise noted on the drawings). Contractor shall provide individual port and patch panel labeling identification and shall be labeled consistent with the data jack system labeling outlined in this specification.

B. Contractor shall manage the incoming Category cables to be terminated on the patch panel in a sequential manner such that half enter on one side and the other half enter on the opposite side. The cables shall be terminated so that the minimum amount of crossing over of cables would be achieved. The Owner/Engineer reserves the right to have the Contractor redress the patch panels if this method has not been implemented on the patch panels during construction.

C. Provide quantity to accommodate number of outlets indicated on drawings.

D. Provide rear cable management and horizontal cable management guide either as an integral part of the patch panel or provide as a separate piece and station support bars. Each 48-port patch panel is to have a dedicated horizontal cable guide located adjacent to the patch panel in the rack or as indicated on drawings.

E. The building and room number in which the patch panel resides shall be prominently displayed.

F. Patch panels shall be alphabetically labeled from top to bottom, left to right, beginning with the letter A and proceeding through the alphabet. Each port of each patch panel must be numbered and labeled with the originating jack identification using building, room, and jack designation.

G. Voice designated patch panels may be provided with 24-ports for between building voice cables per these specifications. WAPs shall be terminated on designated patch panels.

H. Acceptable Manufacturers:

1. Belden: Cat 6, AX103255 and Cat 6A, AX103256.

2. Leviton: Cat 6, 69270-U48 and Cat 6A 6910G-U48.

2.11 Fiber Jumpers and Patch Cords

A. Fiber Jumpers

1. Owner Furnished, Owner Installed.

B. Category 6 Patch Cords (Data)

1. Provide booted, Category 6 and Category 6A compliant cords (with an RJ-45 8P8Cjack on each end). Confirm final colors with Engineer/Owner prior to ordering. Cords shall be delivered to the school no later than two months prior to Substantial Completion for installation and testing by this Contractor.

a. One patch cord shall be provided for each end of each Category 6 link (i.e., two per link), quantity as indicated on drawings, plus 10% spares. Provide blue cords (data) in the following lengths:

 Line Cords 50% - 10 feet and 50% - 15 feet.

 Patch Cords 50% - 1 foot, 20% - 3 feet, and 20% - 5 feet. 10% 7 feet.

Provide 30% blue spare cords in equivalent quantities as above.

WAPs 100% - 15 feet.

Provide 10% yellow spare cords.

b. Acceptable Manufacturers:

1) Belden: Cat 6, C6011 Series and Cat 6A, CA211 Series.

2) Leviton: Cat 6, 6D460-xxx Series and Cat 6A, 6ASP0-xx Series.

2. Color of patch cords are as follows in the quantities specified above for each category:

a. Data - Blue

b. WAPs - Yellow

c. Voice – Orange

d. Speakers – Purple

e. Cameras – Green

f. Fire – Red

g. HVAC BAS – White

3. Classroom Wall Mounted Phones

a. Provide six-inch, black, bootless cables to be used as the line cord.

2.12 IP Paging Cable – as shown on drawings

A. This Contractor shall furnish and install zoned loudspeaker paging system cable. The paging system speakers/amplifier/control headend shall be provided and installed by Division 27 51 13 Unified Communications System (UCS).

B. The loudspeaker paging system shall be designed to provide a primarily one-way broadcast message system and provide for a classroom panic button to activate a page (at a pre-determined location(s)) upon an emergency.

C. Within the building (in classrooms and as noted on drawings), provide manufacturer recommended Category 6 cabling as specified in this section and indicated on drawings. Provide 10-foot coil of cable at each speaker location shown on drawings and at MDF/IDF prior to termination. The cabling shall be homerun from each speaker location to the appropriate Communications Closet or IDF and terminated on patch panels. Speakers are intended to be installed by the Division 27 51 13 Unified Communication System (UCS) Contractor. The Division 27 Contractor shall cross-connect to LAN equipment (fiber optic cable between buildings) and integrate VOIP and IP Paging systems.

D. Corridors and common areas shall have IP speakers and are intended to be one building zone (provide home run cable from speaker to MDF/IDF). Exterior of building shall have IP speakers and are intended to be one building zone (provide home run cable from speaker to MDF/IDF). Speakers are intended to be installed by the Division 27 51 13 Unified Communications System Contractor.

E. For exterior flush mounted speakers (to be analog), provide a 4” x 4” recessed box without plaster ring and with extension box. Provide an AR adapter ring for any Atlas VTF-152UCN paging horns. For surface mounted VT-152UCN paging horn provide an SEN back box.

F. For corridors/common areas with hard ceilings (plaster), cut in and install backbox, run cable in conduit back to accessible area (Atlas Sound Model 96-8 or pre-approved equal). For tile ceiling, install a 2’x2’ speaker that is on the approved Bid 15-803-094. The backbox shall accept any 8" loudspeaker.

G. The paging system shall be utilized for emergency announcements and must be designed to accommodate all applicable fire and safety codes. All components must meet UL, CSA, and FCC requirements.

2.13 Surveillance System Cabling – as shown on drawings

A. This Contractor shall furnish and install Surveillance (CCTV) system cable. The devices and headend shall be provided by others. Route cable in designated cable tray or J-hooks, as necessary.

B. This Contractor shall terminate cables at MDF or IDFs in patch panel as designated on drawings. Leave a 10-foot cable coil at the MDF/IDF end. Leave an above ceiling coil in the room that would reach to the furthest corner plus five feet. Division 26 contractor shall provide all exterior boxes and raceways.

C. On the wall, adjacent to the door in the SRO’s office, provide a four-square junction box (at 18" AFF) with a blank faceplate and a 1" conduit to above ceiling. Situated adjacent to a duplex power receptacle.

D. In the Administration area, provide a coaxial cable (with adjacent power receptacle), from a location (typically, behind the reception desk at 80" AFF) that visitors can observe the surveillance images. Cable shall be run back to the MDF/IDF’s (whichever is closest) security rack. This connection is intended for a monitor (provided by others).

E. For the devices noted on the drawings, provide the following wire types:

1. Camera—Building-to-Building cable: Multi-Mode fiber optic cable. Cable counts included within fiber specified in this Section and depicted on drawings.

2. Camera—Building to Pole cable: Outside Plant, CCTV RG-6/u coaxial cable (18 AWG, solid copper center conductor with foam polyethylene, dielectric 75-ohm impedance, 95% bare copper braided shield).

3. Fixed Camera cable within building, Siamese type configuration with separation web:

a. Power: One, 18 AWG, power wire.

b. Video: CCTV RG-6/u coaxial plenum cable (18 AWG, solid copper center conductor with foam FEP, dielectric 75-ohm impedance, 95% bare copper braided shield).

c. Homerun from each camera to the local IDF/MDF.

4. PTZ Camera cable within building: Siamese type configuration with separation web:

a. Power/Data: Two pairs, 18 AWG, power wires.

b. Video: CCTV RG-6/u coaxial plenum cable (18 AWG, solid copper center conductor with foam FEP, dielectric 75-ohm impedance, 95% bare copper braided shield).

c. Homerun from each camera to the local IDF/MDF.

2.14 Audio Microphone cabling (Public Address Systems) – as shown on drawings

A. Provide single twisted pair, shielded cable with 20 GA stranded conductors and 22 GA drain wire.

B. Acceptable Manufacturers:

1. Belden 9154.

2. West Penn 25292.

2.15 Audio Speakers Cabling (Public Address Systems) – as shown on drawings

A. Provide 12 GA, two conductors, stranded, unshielded speaker cable.

B. Acceptable Manufacturers:

1. Belden.

2. West Penn.

2.16 Miscellaneous Equipment

A. As per the needs of the installation, miscellaneous equipment shall be required at the Contractor’s expense. It is the Contractor’s responsibility to identify and bid on all miscellaneous equipment necessary to provide a complete and properly functioning system.

B. All backboards shall be ¾" AC Grade plywood painted on all sides with flame retardant paint as manufactured by ReadySPEC Backboards, Inc. or approved equal. Reference drawings and specifications for color coding.

PART 3 EXECUTION

3.1 General

A. Contractor shall follow established guidelines for installation and termination of all cabling and equipment; as established in ANSI/TIA 568-0.D, 1.D, 2.D, 3.D, ANSI/TIA-569; BISCI Telecommunications Distribution Methods Manual; and the National Electrical Code (NEC).

B. Work shall be of professional quality and shall not detract from the aesthetic qualities of the facility. Contractor shall ensure that the site is clean of construction debris prior to leaving the site unsupervised at the end of every workday.

C. This Contractor shall provide to the Division 27 51 13 Unified Communications Systems (UCS) (at least three months prior to Substantial Completion) two complete copies of the systems floor plan drawings documenting the room FISH numbers and the assigned jack numbers. These drawings are to be utilized for designating telephone locations and obtaining the appropriate telephone service to the site.

3.2 Cabling

A. All cabling shall be installed in conduit only between buildings, open exposed ceiling areas, and within walls, as shown on the drawings and per the Industry Standards as outlined in the BICSI Telecommunications Distribution Methods Manual, ANSI/TIA 568-0.D, 1.D, 2.D, 3.D, ANSI/TIA 569, and the following:

1. Care should be taken to ensure the integrity of the installed cable. Use wide sweep elbows at all right angles.

2. Fire Penetrations: Fire stop penetrations through fire rated or smoke walls I.A.W., UL Standards, and ANSI/TIA 569.

3. Tension: Cable shall be free from tension at both ends, as well as over the length of each run. Pulling tensions shall not exceed manufacturer’s published data.

4. Grounding: Ground shields I.A.W. applicable standards.

5. One pull string shall be left in the ceiling, secured in the same manner as the station cabling, subsequent to installation running from the MDF to each classroom.

6. Cables shall be terminated in order, lowest room number first, station A first, and ports 1-4 in order.

7. Five feet of slack, when within operating limits, shall be neatly coiled in the ceiling directly above the drop for each communication outlet.

8. All fibers shall be installed with pull strings for future use.

9. All cables shall be dressed and permanently labeled at each end using approved labels to ensure a neat and organized appearance.

3.3 Excavation

A. Provide excavation, backfill, and compaction in conformance with industry standards.

B. Provide dewatering as required to ensure proper installation of duct bank or underground pathways.

C. Jack and bore under existing concrete slabs, sidewalks, etc. shall be preferred for underground routing of pathways. Ensure safe re-routing of facility occupants during procedures or perform procedure after occupancy hours of the facility. However, if cutting of existing concrete slabs, sidewalks, etc. is deemed to be required, the cutting shall be from joint to joint (control or expansion). The final surface finish shall match surrounding conditions.

D. Do not cut roots larger than ½" in diameter.

E. Hand trenching is required. Contractor to ensure that there are no open trenches prior to leaving the site unsupervised at the end of every workday.

F. Perform required trenching and backfilling associated with the Work under this Division.

G. Provide all materials necessary and as required by OSHA to protect personnel working in trenches.

3.4 Penetrations

A. Fire penetrations: Fire stops all fire or smoke wall penetrations I.A.W. published UL standards. It is this Contractor's responsibility to identify fire walls.

B. Masonry penetrations: Masonry penetrations to install materials shall be saw-cut for square or irregular penetrations, masonry drilled for round penetrations 1" diameter or less, or core drilled for round penetrations larger than 1" diameter. Under no circumstances shall masonry penetrations be chipped or hammered.

C. Provide necessary sleeves and chases where conduits pass through walls. Wall sleeves shall be installed above the ceiling and be supported on both sides of the wall with strut and beam clamps. Ream and bush both sides of sleeves.

D. Conduit penetrations entering a building from the exterior, perpendicular to the wall, shall be sealed with UV resistant silicone and shall be watertight.

E. Conduit entering the building shall be sealed with an approved duct seal to prevent intrusion of gas, water, or pests from outside the building.

F. Any openings created by or for this Contractor and left unused shall also be sealed as part of this work.

G. Drip loops shall be provided for all exterior connections.

3.5 Concrete Work

A. This Contractor shall be responsible for replacing concrete pads, supports, piers, bases, foundations, and encasements damaged from the installation of the Work under this Division.

3.6 Painting of Damaged Areas

A. Raceways, conduit supports, hangers, and surface raceway, where exposed, shall be painted to match mounting surface or surrounding surfaces. Panels and equipment with damaged painted surfaces shall be refinished to previous conditions.

3.7 Fiber Testing (to be submitted at Substantial Completion)

A. TESTING: Contractor shall test each fiber strand and each pair of each twisted‑pair copper cable. The Owner/Engineer reserves the right to have a representative present during all or a portion of the testing. A testing schedule shall be planned and agreed upon beforehand.

1) FIBER‑OPTIC BACKBONE CABLE: Each fiber in every backbone cable run shall be tested with an optical light source and power meter as manufactured by AEM, Fluke or pre-approved equal. Each multimode fiber shall be tested at both 850 and 1300nm. Maximum fiber strand attenuation shall be determined using the following link attenuation equation:

2) Maximum link attenuation = Connector attenuation + Cable attenuation + Splice attenuation

3) Maximum attenuation per component:

a. Connector attenuation 0.75dB/1 mated connector pair.

b. Cable attenuation 3.5dB/km @ 850nm and 1.5dB/km @ 1300nm.

c. Splice attenuation 0.3dB/splice.

4) Contractor shall calculate the acceptance values for each fiber strand based on the above criteria. The fiber certification report shall be submitted listing the power loss budget dB value, the measured dB loss, and the dB margin of each measured fiber strand to the acceptance values per test limit: TIA Backbone Fiber Standard 568B.

B. Backbone lengths shall be verified with an OTDR or Light Source/Power Meter with length based standard testing as manufactured by AEM, Fluke or pre-approved equal. Per this specification, maximum distance shall not exceed 400 meters to support LAN equipment transmitting 10 GbE. The OTDR or light source/power meter shall have been factory calibrated within 12 months of completing the testing of this project. Per this specification, maximum distance shall not exceed 550 meters for OM4 fiber. For distances beyond 550 meters, single mode fiber to support LAN equipment operating at 850 nm and 1,000 meters to support LAN equipment operating at 1300 nm. Optical power meter and OTDR results shall be in the form of tester report print outs, handwritten results will not be accepted. Photocopies of test results will not be accepted; only original signed printouts will be accepted. These results shall be submitted to the Engineer.

1. Fiber backbone test results shall include:

a. Wavelength

b. Fiber Type

c. Cable Length

d. dB Loss

e. Power Loss Budget for measured cable length

f. Loss Margin

g. Continuity

h. Attenuation Specification

i. Bandwidth Specification

j. Fiber and Cable Number

k. Measurement Direction

l. Reference Set-up

m. Test Equipment Model and Serial #’s

n. Test Date

o. Operator (Crew Members)

3.8 Category 6 - Horizontal Copper Testing (to be submitted prior to Substantial Completion)

A. TESTING: Contractor shall test each horizontal, twisted‑pair, copper channel. The Owner/Engineer reserves the right to have a representative present during all or a portion of the testing. A testing schedule shall be planned and agreed upon beforehand.

1. HORIZONTAL UTP CABLE: Each horizontal cable run shall be tested for all frequencies from 1 MHz to 250 MHz. with a tester as manufactured by AEM, Fluke or pre-approved equal. The test shall be a channel configuration which includes the patch cord, patch panel, UTP cable, workstation jack, and workstation cord. The cable tester shall be set for channel parameters before testing. Each Category 6 cable shall be tested using a Level III tester compliant with TIA specifications for testing Category 6 configurations with the latest software upgrade available at time of bid. Tester shall be consistent with the manufacturer’s requirements for hardware and software for a certified system and shall be based on compliance with TIA-1152A requirements. No tester shall be approved without meeting these requirements. Prior to testing UTP runs, the tester shall be calibrated per manufacturer's guidelines. The cable tester shall have been factory calibrated within 12 months of completing the testing of this project. Contractor to submit documentation of calibration upon request. The correct cable NVP shall be entered into the tester to assure proper length and attenuation readings. Category 6 test results shall be in the form of tester software printouts. Photocopies shall not be accepted; only original signed reports shall be accepted. Test results shall be furnished to the Engineer.

2. Category 6 UTP cable testing shall include:

a. Cable Length

b. Wire Map

c. Insertion Loss

d. Pair-to-Pair Near End Cross Talk (NEXT) Loss

e. Power Sum NEXT Loss

f. Pair-to-Pair Equal Level Far End Cross Talk (ELFEXT)

g. Connecting Hardware Pair-to-Pair FEXT loss

h. Power Sum ELFEXT

i. Return Loss

j. Propagation Delay

k. Propagation Delay Skew

l. LCL (Longitudinal Conversion loss)

3. MULTI‑PAIR UTP BACKBONE CABLE: Each pair shall be tested from termination block in MDF to termination block in IDF for continuity.

3.9 Category 6A - Horizontal Copper Testing (to be submitted at Substantial Completion)

A. TESTING: Contractor shall test each horizontal, twisted‑pair, copper channel. The Owner/Engineer reserves the right to have a representative present during all or a portion of the testing. A testing schedule shall be planned and agreed upon beforehand.

1. HORIZONTAL UTP CABLE: Each horizontal cable run shall be tested for all frequencies from 1 MHz to 500 MHz. with a tester as manufactured by AEM, Fluke or pre-approved equal. The test shall be a channel configuration which includes the patch cord, patch panel, UTP cable, workstation jack, and workstation cord. Tester shall be set for channel parameters before testing. Each Category 6A cable shall be tested using a Level IV or higher tester. The tester shall be compliant with TIA specifications for testing Category 6A configurations with the latest software upgrade available at time of bid. Tester shall be consistent with the manufacturer’s requirements for hardware and software for a certified system and shall be based on compliance with TIA-1152A requirements. No tester shall be approved without meeting these requirements. Prior to testing UTP runs, the tester shall be field calibrated according to the manufacturer's guidelines. The cable tester shall have been factory calibrated within 12 months of completing the testing of this project. Contractor to submit documentation of calibration upon request. The correct cable NVP shall be entered into the tester to assure proper length and attenuation readings. Category 6A test results shall be in the form of tester software printouts. Photocopies shall not be accepted; only original signed reports shall be accepted. Test results shall be furnished to the Engineer.

2. Category 6A UTP cable testing shall include:

a. Wiremap

b. Length

c. Propagation delay

d. Delay skew

e. Loop resistance

f. DC Resistance Unbalance for both Pair to Pair and Wire to Wire

g. Return Loss

h. Impedance

i. Insertion Loss

j. NEXT

k. PSNEXT

l. ACRF

m. PSACRF

n. TCL

o. ELTCTL

p. Cable Length

2. MULTI‑PAIR UTP BACKBONE CABLE: Each pair shall be tested from termination block in MDF to termination block in IDF for continuity.

3.10 Documentation

A. Contractor shall provide documentation to include test results and as-built drawings. Drawings shall be developed in CAD (i.e., AutoCAD 2021 or higher). The following documents shall be provided to the Owner and the Engineer:

1. Each MDF and IDF shall contain a copy of that building's as-built drawing affixed to an adjacent wall or located in an interior pouch for quick reference. Revised rack and equipment cabinet elevations shall be provided including serial numbers of all installed equipment.

2. Three sets of black line, as-built drawing sets.

3. Provide CD-ROM or USB drive reflecting all the work with actual device and equipment locations. Drawings to be submitted in .dwg or .dxf format and pdf format.

B. Provide the testing results database on CD-ROM or USB drive for the completed job (i.e., fiber and copper). The CD-ROM or USB drive shall include the software tools required to view, inspect, and print any selection of test reports.

1. Additionally, provide one hard copy of the fiber optic cabling test results and one hard copy of UTP cabling results. These results shall be submitted to the Engineer prior to the Contractor calling for substantial completion inspection.

2. Provide each communications room with its own notebook containing the corresponding test reports for both the fiber and copper cabling. Each notebook shall have a clear front pocket and be labeled with that communications room’s designation.

C. Provide a bill of materials of all installed equipment and wiring, rack, and backboard equipment layouts showing placement of support equipment, and model and serial numbers of all installed equipment.

3.11 Acceptance

A. Acceptance of the Data Communications System, by the Owner, shall be based on receiving the following:

1. Copy of all test results.

a. All fiber segments and all workstation data cables must meet the criteria established in the section above. The Contractor is responsible for additional fiber strands and UTP cable to be installed if any show defective during testing.

2. Copy of as‑built drawings shall contain the following.

a. Changes and/or deviations from the construction (bid) prints.

b. All communication outlet addresses and locations.

c. Horizontal cable routing.

d. Backbone cable routing.

3. Copy of Manufacturer’s 25-year Cabling Plant Performance Warranty.

3.12 Project Completion

A. Upon completion of the work of this Section, thoroughly clean all exposed portions of the installation, removing all traces of soil, labels, grease, oil, or other foreign material, and using only the type of cleaner recommended by the manufacturer of the item being cleaned. Cover all exposed cabling and termination devices.

3.13 Training

A. Provide a minimum of two site personnel with training on the network cabling system for up to two hours on site. Training shall cover the location labeling scheme, documentation structure and contents, documentation orientation, and system reconfiguration (i.e., reassignment of Communication Outlet function via patching). Training shall take place at the time of Substantial Completion before building is occupied by the Owner.

3.14 Warranty

A. As part of the Manufacturers extended warranty the Contractor shall and does hereby warrant all materials, equipment and quality of installation furnished under this scope of work to be free from defects and function or operate satisfactorily for a period of 25 years or more from Substantial Completion of this project.

\*\*\* END OF SECTION \*\*\*

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