

Industry Standard Specifications

The District goal is to have certified cable installations at all sites. Cabling Contractors **are required** to be certified by the appropriate manufacturer(s) for the cabling plant that exists at the campus the work is requested. Installation must include a minimum 15-year manufacturer's warranty. PANDUIT brand connectivity products and PANDUIT partner cables or equivalent will be used unless the District specifies different manufacturers. Only equivalents that meet or exceed this standard will be considered.

PART 1 - GENERAL

1.1 REFERENCES

- A. All references should be latest versions. If newer versions exist use current version.
 - 1. ANSI/NFPA-70 (2007; AMD 1 2008) National Electrical Code – 2008 Edition
 - 2. IEEE 1100 (2006) Recommended Practice for Powering and Grounding Electronic Equipment
 - 3. TIA-568-C.0 (2009) Generic Telecommunications Cabling for Customer Premises
 - 4. TIA-568-C.1 (2009) Commercial Building Telecommunications Cabling Standard
 - 5. TIA-568-C.2 (2009) Balanced Twisted Pair Telecommunications Cabling and Components Standard
 - 6. TIA-568-C.3 (2008) Optical Fiber Cabling Components Standard
 - 7. FCC Part 68 Connection of Terminal Equipment to the Telephone Network (47 CFR 68)
 - 8. ADA Americans with Disabilities Act, Title III & IV
 - 9. CFR 29 (2009) Code of Federal
 - 10. International Building Code

1.2 SYSTEM DESCRIPTION

- A. The structured telecommunications cable and pathway distribution and system wiring system shall include permanently installed backbone and horizontal cabling, horizontal and backbone pathways, workstation pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for terminating, and interconnecting.
- B. The horizontal system includes the cabling and pathway between the IDF and the work area telecommunications outlet.
- C. The backbone cabling and pathway system includes the interconnecting cabling, pathway, and terminal hardware to provide connectivity between the MDF's and IDF's.

- D. The backbone system shall be wired in a star topology with the MDF at the center or hub of the star.
- E. Hardware and terminating equipment shall consist of UL approved, Cat 6/6a patch panels, jacks, and fiber optic terminating equipment.
- F. Backbone cable shall consist of Multimode fiber optic cable (OFN) 50/125µm interlocking armor. 10 GIG compliant will be used for all multimode backbone cable.
- G. Inter-building backbone pathways will consist of 2" conduits, except where noted per the drawings.
- H. Horizontal pathways will consist of 1" conduits, existing conduit, cable trays and raceways, Wire mold 5500 raceway or combination of both, as per the drawings unless otherwise approved by HCS Technology. Wire basket cable trays are preferred.
- I. Structured Telecommunications Cabling and Pathways Systems shall be installed in a "neat and workmanlike manner" as specified or recommended by *ANSI/NECA/BICSI 568-2001* and *National Electrical Code*, Sections 110-12 and 800-6.

1.3 DEFINITIONS

- A. Main Distribution Frame (MDF): A physical concentration or central location for terminating backbone cables to interconnect with local exchange carrier (LEC) equipment at the activity minimum point of presence. The MDF generally includes vendor specific components to support voice and data circuits, building surge protector assemblies, main cross connect blocks, equipment support frames, and plywood backboard equipment. Depending upon local site conditions, the MDF and IDF may be identical.
- B. Intermediate Distribution Frame (IDF): An intermediate termination point for horizontal wiring and cross connections normally within another structure separate from the MDF.
- C. BICSI: Building Industry Consulting Service International.
- D. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture/floor box pathways.
- E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- F. EMI: Electromagnetic interference.
- G. IDC: Insulation displacement connector.
- H. LAN: Local area network.

- I. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- J. RCDD: Registered Communications Distribution Designer.
- K. Basket Tray: A type of cable tray made of a rigid structure for housing and protecting cables and conductors with a welded steel wire mesh. Basket tray is not recommended for use inside telecommunications rooms.
- L. Ladder Tray: A type of cable tray made of a rigid structure for housing and protecting cables and conductors with two side rails connected by individual transverse members.

1.4 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
 - 1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area unless noted otherwise on the drawings.
 - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 - 3. Bridged taps and splices shall not be installed in the horizontal cabling.

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 ACTION SUBMITTALS

- A. If there is an installed based in an existing building other than PANDUIT brand connectivity, the Contractor is to submit the following information to the Horry County Schools Building Technology Coordinator for approval prior to purchasing and installation.
 - 1. Telecommunications cabling, specifications make and model (backbone and horizontal)
 - 2. Fiber optic LC connectors
 - 3. Telecommunications outlet/connector assemblies RJ45 jack
 - 4. Equipment support rack
 - 5. Patch Panels (Copper and Fiber optic)
 - 6. Power Strips
 - 7. Cable Hanger
 - 8. Fire stop material
 - 9. External mounted raceway
 - 10. Cable tray (Wired baskets type is preferred)

B. Drawings

1. Telecommunications Drawings

- i. Show the layout of cabling and pathway runs, MDF, IDF, and group systems.
- ii. Drawings shall depict final telecommunications cabling configuration, including location, gauge, pair assignment, and patch panels after telecommunications cable installation.

2. Distribution Frame Elevations

- i. Provide shop drawings layout of applicable equipment including incoming IDF, racks, panels, and LAN equipment.

C. Test Plan

1. Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the UTP and OFN components and accessories. Include procedures for certification, validation, and testing.

2. Furnish documentation samples for the testing results.

- i. System Labeling Schedules: Electronic copy of labeling schedules, in software and former selected by Owner.
- ii. Cabling administration drawings and printouts
- iii. Wiring diagrams to show typical wiring schematics, including the following:
 - I. Operation and Maintenance Manuals: Telecommunications cabling and pathway systems
 - II. Schedules: Construction Schedules are required for each project and should be coordinated with the General Contractor and Architect. A weekly report shall be furnished in writing to the District detailing project schedule to include start date, project completion date, and a summary of completed work detailing project milestones. This report shall be furnished to Facilities and Technology contacts defined after project award date and prior to project start date.
 - III. As-built Drawings: As-built drawings are to be included for any cabling installed (Section 1.4.2.1). District requires a laminated copy of the final as-built, plus an electronic copy of the CAD/Visio file. Electronic drawings for the site will be provided to the contractor if they exist. If there are no electronic as- built, the contractor will be expected to create an original CAD/Visio drawing. Work added to an existing as-built is to be "clouded" on the drawing and appropriate notes are to be added to the legend indicating the scope, contractor, and date of completion. See Appendix for sample as-built drawing.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector

1.8 QUALITY INSURANCE

- A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings,

Cabling Administration Drawings, and field testing program development by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of RCDD, who shall be present at all times when Work of this Section is performed at Project site.

B. 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.

C. Grounding: Comply with ANSI-J-STD-607-A.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site. Test each pair of UTP cable for open and short circuits.

B. Provide protection from weather, moisture, dirt, dust, and other contaminants for telecommunications cabling and pathway equipment placed in storage.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. UL or third party certified. Provide a complete system of telecommunications cabling and pathway components using star topology and support structures, pathways, and spaces complete with conduits, pull wires, raceways, pull boxes, outlets, cables, and ground boxes, as per the drawings. Fixed cables and pathway systems for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70. Horizontal cable and termination equipment shall be of a manufacturer, installed and certified so as to provide a 15-year warranty.

B. For installations in 'new' buildings and for select renovation/addition projects, the District has standardized on **PANDUIT** brand connectivity hardware and wire management products or equivalent with prior HCS approval. Part numbers suggested are defined in this document. *A list of suggested products is included in Section 2.11 of this document.*

2.2 PATHWAYS (BACKBONE AND HORIZONTAL)

A. TIA/EIA-569-A. Pathway shall be basket-style cable tray, conduit and raceway installations. Provide grounding and bonding as required by TIA/EIA-607-A.

B. Pathways shall be installed in accordance with NEC Article 314 and Article 800.51 (J), (K), or (L), as applicable, and installed in accordance with Articles 362.24 through 362.56, where the requirements applicable to electrical nonmetallic tubing apply.

2.3 TELECOMMUNICATIONS CABLING

- A. Cabling shall be UL listed for the application and shall comply with EIA TSB-67, TIA/EIA-568-B.1, B.2, and NFPA 70. Cabling shall consist of Cat 6 or Cat6a UTP (TBD project-by-project by the District) and OFNP/FT6. Plenum cables shall comply with UL 910. Provide a labeling system for as stated in Supplemental 1 at the end of this document. Cabling manufactured more than 12 months prior to date of installation shall not be used. OFN shall comply with UL 1581 vertical tray flame test. OFNP may be substituted for OFNR. OFNG and OFN may be substituted for OFNP and OFNR.
- B. Provide and install plenum-rated or non-plenum-rated Cat 6/6a and optical fiber cabling manufactured by companies that are included in the PANDUIT extended warranty program.

2.4 BACKBONE CABLING

- A. Data backbone cabling shall be indoor/outdoor rated, tight-buffered 12 strand 50/125 10 GIG compliant multimode Interlocking armored fiber optic cable or fiber optic cable placed in inner duct within the cable tray. Fiber optic cable placed in inner duct inside cable track must be approved by HCS Technology pre-installation. Terminate with LC connectors.
- B. 1 – Cat **6/6a** cable shall be installed and terminated, RJ45, between the Demark and the MDF in places where the Demark and the MDF are NOT co-located.
- C. Paging applications shall use 12-conductor 18 gauge non-shielded twisted pair backbone cable. Terminate on screw terminals provided by HCS Technology in the IDF and MDF.
- D. A minimum of one 12-pair, Category 3 or Category 5e, 24 gauge, copper backbone cable shall be installed from the MDF to each IDF unless otherwise specified by the District. The pair count to support various applications may vary based on the converged system selected. Provide 20% additional pairs for future growth beyond immediate project requirements. Terminate cable(s) on patch panels in 'new' installations and in 'new' additions to existing facilities. In existing MDF or IDF, terminate cable on wall-mounted blocks matching existing system (66 or 110 type) in use.

2.5 HORIZONTAL CABLING

- A. Comply with NFPA 70, NEMA WC 63, ANSI/ICEA S-80-576 and performance characteristics in TIA/EIA-568-B.1 and B.2 UTP, four-pair 100 ohm.
- B. Ultimate breaking strength shall be minimum 90 pounds.
- C. Four pair cable shall withstand a bend radius of one-inch minimum at a temperature of minus 20° C maximum without jacket or insulation cracking.
- D. Conductors shall be color coded and polarized in accordance with TIA/EIA-568-B.1 and B.2.
- E. Enhanced performance Cat 6a UTP plenum cable for local area networks shall meet or exceed TIA/EIA-568-B.1 and B.2 standards.

- F. Conductor shall be 24 awg solid annealed copper unless otherwise specified.
- G. Primary insulation shall be FEP fluoropolymer resin for each pair.
- H. Cable shall be plenum rated where required and shall comply with NFPA 70, UL 444, and UL 910.

2.6 FIBER OPTIC CABLING (OM3 or better)

- A. 12 – Strands of multimode amour fiber optic cable (50/125µm 10 GIG compliant) shall be pulled from the MDF to each IDFs and terminated with LC connectors on both ends. Cables shall be placed in a proper LC bulkhead.
- B. All fiber optic cable shall be properly labeled and tested bi-directionally at 850 nm and 1300 nm.

2.7 FIBER OPTIC PATCH CABLES

- A. Fiber Optic Patch Cables shall be multimode patch cords pre-made to connect fiber optic equipment with fiber optic cross connects, interconnects, and outlets.
- B. The patch cords (jumpers) shall be impact-resistant multi fiber cables, LC connectors, of the same performance characteristics as the multimode fiber backbone being connected (50/125µm).
- C. These fiber optic patch panel connections shall provide 0.4 dB or less insertion loss and provide connection between the Active LAN devices and the Fiber Optic patch panel. Quantities for 100% population plus 10% Spares.

2.8 DISTRIBUTION FRAMES

- A. Provide 19" x 7' equipment racks in each MDF and IDF.

2.9 COPPER PATCH PANEL

- A. UTP patch panels shall be rack mounted, rated to exceed EIA/TIA Cat 6/6a modular (8 position) patch panels each wired to terminate modular jacks per the EIA/TIA T568A standard.
- B. Quantities of jacks are based on the number of UTP cables originating at wall outlets and terminating at the patch panel.
- C. All patch panels shall be grounded.
- D. 10% growth on Patch Panels shall be provided.

2.10 FIBER OPTIC PATCH PANEL

- A. Provide panel for maintenance and cross connecting of fiber optic cables.
- B. Panel shall be constructed of 0.125-inch minimum aluminum and shall have connectors which interface the inside plant fiber optic jumper cable with the outside plant fiber optic cable.

- C. Fiber Panels should be labeled at both terminated ends.
- D. Rack-mounted fiber patch panels shall be equipped to terminate or splice the incoming inter-building fiber and any required backbone or interconnect cables.
- E. Each cable must be properly dressed.
- F. These units will terminate the fiber optic cables, provide a place for jumper cables, and will provide room to terminate additional optics.
- G. All connectors will be type LC.
- H. The fiber optic patch panel connections shall provide 0.4 dB or less insertion loss.
- I. All patch panels shall be grounded.

2.11 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

- A. Jacks shall comply with FCC Part 68.5, and TIA/EIA-568-B.1 and B.2.
- B. Jacks shall accommodate UTP or OFN and work in concert with Wire mold 5500 raceway.
- C. UTP jacks shall be RJ45 designation T568A type, UL 1863 listed, eight-position constructed of high impact rated thermoplastic housing rated for Cat 6a service.
- D. UTP jacks for data shall be Cat 6a hardware and shall comply with the attenuation requirements contained in TIA/EIA-568-B.1 and B.2.
- E. Telecommunications cover plates shall comply with UL 514C and TIA/EIA-568-B.1 and B.2; flush design constructed of high impact metal material.
- F. Stenciled lettering for voice and data circuits shall be provided using thermal ink transfer process.

2.12 RACEWAY (EXPOSED)

- A. Conceal cable pathways within walls whenever possible.
- B. Raceway shall be international white in color or a color approved by HCS personnel.
- C. Notching or modifications of raceway will not be permitted.
- D. All Raceway and conduit will be provided by the electrical contractor.

2.13 BACKBOARDS

- A. Provide fire rated plywood 3/4 inch thick 4' x 8' lining at least 2 adjoining walls in the MDF and each

IDF for mounting of PA, Video, Security, and other termination equipment. This will be the responsibility of the General Contractor.

- B. Plywood backboards shall be painted with a light color, nonconductive fire-resistant overcoat. Do not paint over the fire retardant marking/stamp of the plywood.

2.14 GROUNDING AND BONDING PRODUCTS

- A. Comply with UL 467, TIA/EIA-607-A, and NFPA 70. Components shall be identified as required by TIA/EIA-606-A.

2.15 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
 1. Factory test UTP cables on reels according to TIA/EIA-568-B.1.
 2. Factory test UTP cables according to TIA/EIA-568-B.2.
 3. Cable will be considered defective if it does not pass tests and inspections.
 4. Prepare test and inspection reports.

2.16 WARRANTY

- A. Contractor shall provide a 15 year manufacturer and performance warranty.
 1. The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

2.17 FIRE STOPPING MATERIAL

- A. Contractor shall provide all necessary fire stopping of openings through which cable is installed under this specification, in accordance with NFPA 70 and all local codes. This includes installation in conduits, raceways, or bare penetrations. Provide and install UL 1479 approved (Fire Barrier Caulk) fire stop material.

2.18 TV Mounting Brackets (If required)

- A. TV mounting and brackets shall be determined by the type of flat panel TV purchased. Contact HCS Technology for the type and model of TV's being purchased.

2.19 DISTRICT APPROVED PRODUCTS

Description	Manufacturer	Part Number
Horizontal plenum-rated/non-plenum rated UTP Cable (color specified in Appendix) or equivalent	Panduit Warranty Partner or equivalent	Panduit Warranty Partner or equivalent
50/125 μm Optical fiber Backbone Cable (10 GIG compliant) or equivalent	OCC or equivalent	Dependent on application.

BLUE/RED/YELLOW/GREEN/PURPLE/ BLACK/WHITE Jack – Category 6a	PANDUIT or equivalent	CJ6X88TGXX or equivalent
BLUE/RED/YELLOW/GREEN/PURPLE/ BLACK/WHITE Jack – Category 6	PANDUIT or equivalent	CJ688TGXX or equivalent
BLUE/RED/YELLOW/GREEN/PURPLE/ BLACK/WHITE Jack – Category 5e <i>RETROFITS / RENOVATIONS ONLY</i>	PANDUIT or equivalent	CJ5E88TGXX or equivalent
Hanging Wallphone Kit – Category 6	PANDUIT or equivalent	KWP6PY or equivalent
Stainless Steel Faceplate Single Gang Equipped with label windows & lens covers	PANDUIT or equivalent	2 Port : CFPL2SY or equivalent 4 Port : CFPL4SY or equivalent 6 Port : CFPL6SY or equivalent
Vertical Cable Manager 80.4"H x 6.7" W x 13.8" D	PANDUIT or equivalent	WMPVHC45E or equivalent
Horizontal Cable Manager 3.5"H x 19" W x 9.8" D	PANDUIT or equivalent	NCMH2 or equivalent
48 Port Modular Patch Panel	PANDUIT or equivalent	CPP48FMWBLY or equivalent
24 Port Modular Patch Panel	PANDUIT or equivalent	CPP24FMWBLY or equivalent
LC Fiber Connectors	AFL FASTConnect Corning UniCam or equivalent	FAST-LC-MM50L-6 95-050-99-X or equivalent
Rack Mount Fiber Cabinets – Black, regular density	OCC or equivalent	RTC1U-3APB or equivalent RTCU-6APB or equivalent WTC12/24X or equivalent
Fiber Optic Adapter Plate – 6/12 Port Multimode LC	OCC or equivalent	616DLC50G-6F 6112DLC50G-12F
Fiber Optic Adapter Plate – Blank	OCC or equivalent	600 or equivalent
Copper Patch Cords – Category 5e, 6, 6a	Provided by District	Provided by District
Optical Fiber Patch Cords	Provided by District	Provided by District

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Telecommunications cabling and pathway systems, including the horizontal and backbone cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware shall be installed in accordance with TIA/EIA-568-B.1, B.2, B.3, TIA/EIA-569-A, NFPA 70, and UL standards as applicable.
- B. Cabling shall be connected in a star topology network.
- C. Contractor shall provide all necessary tools and materials not specified (tie wraps, “D” rings, screws, consumables, hardware, J-Hooks, etc.) and equipment (ladders, hydraulic lifts, storage containers, etc.) necessary to provide a complete and operating system.
- D. Installation methodologies shall adhere to manufacturer installation procedures so as to not violate certifications (i.e. UL).
- E. All work shall be performed in a good workmanship-like manner leaving each location in the same or better condition as at the start of each project. Daily housekeeping of cabling site is required.
- F. The designated District representative shall be provided weekly written progress reports. G. Periodic on-site inspections will be done during the course of installation.
- G. The District reserves the right of “local jurisdiction” for final approval.
- H. Cat 6/6a cables shall have all 4 pair punched down. Termination will be on patch panels in MDFs or IDF. In existing communication closets, termination will be blocks or similar to existing termination in existing closet.
- I. Size and quantity of feeder cables plus quantities of Cat 6/6a cables installed determine the number

of termination blocks required. Termination will be on patch panels in new MDFs or IDFs. In existing communication closets, termination will be blocks or similar to existing termination in existing closet.

- J. All 66-type and screw terminals (Provided by HCS Technology) at the MDF/IDF shall be uniquely labeled and identified. Cat 6/6a, and PA cables shall be uniquely labeled and identified. Cat 6/6a UTP cables for voice shall be uniquely labeled and identified as per Appendix at the end of this document. Termination will be on patch panels in new MDFs or IDFs. In existing communication closets, termination will be blocks or similar to existing termination in existing closet.
- K. CAT 6 cables for telephones.
- L. All cabling shall be installed in separated areas on backboard or data rack as determined by HCS or its consultants. Installation of such cabling shall be in sequential order as related to an appropriate numbering scheme and clearly marked. All racks shall have 3 foot of open/unused rack space available from base of rack. Data shall be placed on rack #1. Phone WAP's, Cameras, and Video shall be placed onto rack #2. Combining racks maybe permitted, ONLY if pre-approved by HCS-Technology. (I.e. All drops in Room XXX shall occupy sequential ports on patch panels.) 3rd rack installed if necessary and approved by HCS Technology.
- M. Speaker wiring shall be terminated on backboard on screw terminals (provided by HCS Technology). 18 gauge stranded pair shall be used for all speakers wiring.
- N. "Loop wiring" IS NOT acceptable with any cabling.
- O. No data connection shall be greater than 295 ft. from a MDF/IDF.
- P. All faceplates shall be metal and shall have windows and lenses to accommodate labels.
- Q. Data Jacks (RJ45) shall be BLUE in color.
- R. Phone/IP Phone jacks (RJ45) shall be RED in color.
- S. Camera Jacks (RJ45) shall be YELLOW in color.
- T. Wireless Jacks (RJ45) shall be GREEN in color.
- U. TV/Panel Jacks (RJ45) shall be PURPLE in color.
- V. POS/Building Controls Jacks (RJ45) shall be WHITE in color.
- W. Installation of speaker cabling, termination of closet end of cables, and labeling of both ends of cables shall be performed by the Cabling Contractor. This shall include the installation and mounting of

speakers.

- X. Installation of camera cabling, termination in surface mounted box with Yellow Jacks in ceiling and termination on patch panels in closets by the Cabling Contractor. Installation of cameras and camera mounts by District. Connection to Network and alignment/adjustment of cameras to be performed by District.

AA. Installation of Data Cable, terminations & labeling on both ends will be done by the cabling contractor.

3.2 CABLING

- A. Install Cat 6/6a UTP and OFN telecommunications cabling and pathway system in accordance with TIA/EIA-568-B.1, B.2, 569-A and the drawings.
- B. Cabling installation shall comply with EIA TSB40-A and EIA TSB-36.
- C. Screw terminals shall not be used except where specifically indicated on plans.
- D. Do not untwist Cat 6/6a UTP cables more than 1/4 inch from the point of termination to maintain cable geometry.
- E. Do not exceed manufacturers' cable pull tensions for copper and fiber optic cables. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables.
- F. Do not chafe or damage outer jacket materials.
- G. Use only lubricants approved by cable manufacturer. Do not over cinch cables or crush cables with staples.
- H. For UTP cable bend, radius shall not be less than four times the cable diameter.
- I. Plenum cable shall be used where required.
- J. Any underground cabling should have transition as readily available.

3.3 OPEN CABLE

- A. Use only where specifically indicated on plans or determined during site surveys.
- B. When not run in surface mounted raceway or conduit, utilize Cable Trays above suspended ceilings and in all ceiling spaces. Cable Trays is the preferred method.
- C. Comply with TIA/EIA-568-B.1 and B.2.
- D. Install cabling above suspended ceilings 6 to 12 inches above ceiling in cable trays and securely attach to structural ceiling.
- E. Do not exceed cable pull tensions recommended by the manufacturer.
 - 1. Plenum cable shall be used in all appropriate areas. Plenum cables shall comply with

flammability plenum requirements of NFPA 70 and shall comply with UL 910.

2. Avoid routing copper cable in areas where there may be high levels of electromagnetic interference (EMI). EMI is caused by AC power lines, broadcast signals, X-ray equipment, motors, generators, and fluorescent lights. UTP cables shall be routed at least 5 inches away from fluorescent lighting fixtures.
3. Cables shall be placed in the support device, Cable Tray, and wrapped using Velcro ties or other ties as approved by HCS.
4. Cabling shall be organized and identified so as to facilitate locating and handling individual sheaths for maintenance functions.
5. Each bundle shall be neatly tied without over cinching or stressing cable.
6. Bundles shall be clearly marked identifying the IDF and room to which routed, the station numbers served by the bundle, and any other information that may assist in administration.
7. Great care shall be taken to protect all cabling from physical damage.
8. A minimum 5' or a maximum 10' service loop shall be installed on each cable installation where possible. Installation shall be above the ceiling on J-Hooks in 3 foot diameter loop.

3.4 BACKBONE CABLE

- A. Fiber Optic Backbone Cable. Install backbone OFN in pathways.
- B. Do not exceed manufacturer's recommended bending radii and pull tension.
- C. Prepare cable for pulling by cutting outer jacket 10 inches leaving strength members exposed for approximately 10 inches. Twist strength members together and attach to pulling eye.
- D. Terminate individual strands into fiber optic type LC connectors.
- E. All fiber shall be armored jacket construction.

3.5 HORIZONTAL CABLING

- A. Install horizontal cabling and pathway as shown on drawings or as determined at site survey between IDF and telecommunications outlet assemblies at workstations, in accordance with TIA/EIA-568-B.1, B.2, and 569-A.

3.6 FEEDER CABLES

- A. TV Cabling (where TV are installed). One Cat 6/ cables terminated with RJ45 connector from each TV location to the MDF/IDF.
- B. Feeder Cables
 - 1 – 12 pair 24 gauge copper feeder (minimum)
 - 1 - 10 conductor 18 gauge (non-shielded) stranded wire for paging
 - 1 - 12 strand 50 μm multimode optical fiber.(10 GIG complian

Provide enough 24 gauge copper feeder (12 pr, 25 pr, 50 pr, etc.) to provide feeder pairs to all required applications (if required). A minimum of one 12 pair to each closet shall be installed. These counts may vary based on the converged system selected. Also there will be 20% additional feeder cable for future growth. Termination will be on patch panels in new MDF's or IDF's and on matching wall- mounted blocks for retrofits/renovations. Coordinate this with HCS-Technology.

3.7 WORK AREA OUTLETS

A. Terminate UTP cable in accordance with TIA/EIA-568-B.1, B.2, and wiring configuration T568A.

3.8 CABLING TESTING

A. Perform cabling inspection, verification, and performance on all cabling.

B. All testing personnel shall be trained on testing equipment tools to assure that complete and accurate testing results are obtained/provided.

3.9 INSPECTION

A. Visually inspect cabling jacket materials for UL or third party certification markings. Visually inspect UTP and OFN jacket materials for UL or third party certification markings.

B. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for tip and ring pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1 and B.2.

C. Visually confirm Cat 6/6a marking of outlets, cover plates, jacks, and patch panels.

3.10 VERIFICATION TESTS

A. Perform copper cabling certification testing to appropriate ANSI/TIA/EIA Standard for category rating of system installed (5e / 6 / 6a).

B. Perform optical fiber backbone end-to-end attenuation tests using a power meter and source. Perform tests bi-directionally and at both 850nm & 1300 nm wavelengths.

3.11 PERFORMANCE TESTS

A. Cat 6/6a Links. Perform UTP Permanent Link tests in accordance with TIA/EIA-568 B.2-1 and manufacturer's guidelines.

B. Tests shall include wire map, length, attenuation, NEXT, FEXT, and propagation delay.

C. OFN Links. Perform OFN end-to-end attenuation tests and reel tests at job site.

D. Speaker cabling will be tested for continuity.

3.12 FINAL VERIFICATION TESTS

- A. Perform verification tests for UTP and OFN systems after the complete telecommunications cabling and workstation jacks are installed.
- B. Provide District representative with written final tests verification within 1 week of completion of installation.
- C. Final test results shall include summary pages for each IDF/MDF as required.
- D. Test results shall be provided in both hard and soft copy. Acceptable format shall be Access database, Excel spreadsheet, or CSV.

3.13 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Division 16 Section "Raceway and Boxes for Electrical Systems."
 - 3. Install outdoor rated cable for cables that route below the slab.
- B. 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.

3.14 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 60 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 7. 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.

8. Cold-Weather Installation: Bring cable to room temperature before Installation. Heat lamps shall not be used for heating. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
- C. Pulling Cable: Comply with BICSI ITSM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- D. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
 2. Do not untwist UTP cables more than 1/4 inch from the point of termination to maintain cable geometry.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wire way or pathway a minimum of 8 inches above ceilings by cable supports not more than 48 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Group connecting hardware for cables into separate logical fields.
- G. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - i. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - ii. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - iii. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - i. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - ii. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - iii. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - i. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - ii. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - iii. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5

Inches.

3.15 FIRESTOPPING

- A. Contractor must fire stop the inside of the pipes that they use. The exterior of the pipes will be fire stopped by the electrical contractor.

3.16 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
- E. The No.4 AWG to the communicator room will be provided by the electrical contractor
- F. The cabling contractor must provide a ground bar in each communication room.

3.17 IDENTIFICATION

- A. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- B. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - 4. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - 5. Label each unit and field within distribution racks and frames.

- C. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
 - 1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.18 DATA SYSTEMS LABELING PROCEDURES

- A. The labeling shall be in accordance with the TIA/EIA-606-A standards for data.
- B. The labeling shall be computer software generated and printed with readable fonts and black ink.
- C. The ink and label shall be water and smear-proof for both indoor and outdoor use.
- D. Samples of each type of media showing label type, labeling format, font size, and ink shall be submitted for HCS approval prior to application.
- E. Hand written labels are unacceptable.
- F. Room numbers will be assigned by the District's Energy Management Department. The room numbers on the architectural plans are not to be used. Translation between architectural drawing and formal room numbers will be done by District's Energy Management Department.

3.19 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Visually inspect UTP cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 - 2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
 - 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - 5. UTP Performance Tests:
 - i. Test for each outlet with a level 3 cable analyzer.
 - 1. Wire map.
 - 2. Length (physical vs. electrical, and length requirements).
 - 3. Insertion loss.
 - 4. Near-end crosstalk (NEXT) loss.
 - 5. Power sum near-end crosstalk (PSNEXT) loss.
 - 6. Equal-level far-end crosstalk (ELFEXT).
 - 7. Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8. Return loss.
 - 9. Propagation delay.
 - 10. Delay skew.

B. Document data for each measurement. Data for submittals shall be printed in a summary report. An electronic copy shall be provided.

C. Prepare test and inspection reports.

3.20 SCHEDULE

A. Install cabling between all data, telephone, television, cameras and wireless access outlets and MDF and/or IDF's unless noted otherwise.