

Nampa School District Data Cable Plant Specification

Specification for the implementation of voice and data
network cable plants in the Nampa School District

Revision 4, February 18, 2020

Technical Specification

PART 1 – GENERAL SPECIFICATIONS

1.1 SCOPE

- A. This document describes the products and execution requirements relating to furnishing and installing Telecommunications Cabling at any new or remodeled building. Vertical and horizontal backbone cabling comprised of copper and fiber cabling and support systems are covered under this document.
- B. The Horizontal (workstation) cabling system shall consist of a minimum of (2) 4-pair Unshielded Twisted Pair (UTP) copper cables to each work area outlet unless otherwise noted for specific locations. The cables shall be installed from the Work Area Outlet to the Telecommunications Room (TR) located on the same floor and routed to the appropriate rack serving that area and terminated as specified in this document.
- C. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Telecommunications contractor as detailed in this document.
- D. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types will be provided as an attachment to this document. If the bid documents are in conflict, this specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cable system described in this document.

1.2 REGULATORY REFERENCES:

- A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the local Electrical Code and present manufacturing standards.
- B. All materials shall be UL listed and shall be marked as such. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.
- C. All materials shall be ETL Verified (not just tested) to be category 6 component and channel compliant or better.

1.3 APPROVED CONTRACTOR

- A. The Telecommunications contractor must be an approved Ortronics/Legrand Certified Installer. A copy of certification documents must be submitted with the quote in order for a quote to be valid. The Telecommunications contractor is responsible for workmanship and installation practices in accordance with BICSI standards. At least 30 percent of the copper installation and termination crew must be certified by BICSI and RCDD, with a Technicians Level of training. Also, at least 10 percent of the optical fiber installation and termination crew must be certified by an approved organization in Optical Fiber installation and termination practices.

1.4 APPROVED PRODUCTS

- A. Approved 4 pair UTP Cable: Berk-Tek Lanmark-6 Category 6 Cable (Plenum).
 - a. See cable specification details in appendix A.
- B. Approved high pair count UTP Cable manufacturer: Berk-Tek
- C. Approved UTP connector product manufacturer: Ortronics
- D. Approved Fiber Optic cabinet product manufacturer: Ortronics
- E. Approved Fiber Optic connectors/splices/couplers: Ortronics
- F. Approved Rack and Cabinet manufacturer: Ortronics
- G. Approved Patch Panel manufacturer: Ortronics

1.5 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, and supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with the specifications and drawings. The Telecommunications contractor will provide and install all required materials to form a complete system whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
 - 1. Furnish and install a complete telecommunication wiring infrastructure.
 - 2. Furnish, install, and terminate all UTP and Optical Fiber cable.
 - 3. Furnish and install all wall plates, jacks and patch panels.
 - 4. Furnish and install all required cabinets and/or racks as required and as indicated.
 - 5. Furnish any other material required to form a complete system.
 - 6. Perform link or channel testing (100% of horizontal and/or backbone links/channels) and certification of all components.
 - 7. Furnish test results of all cabling to the owner in both electronic and paper format, listed by each closet, then by cable ID.
 - 8. Conduct a walk-through with owner and provide "As-Built" drawings and documentation.

1.6 SUBMITTALS

- A. Under the provisions of this request for proposal, prior to the start of work, the telecommunication contractor shall:
 - 1. Submit copies of the certification of the company and names of staff that will be performing the installation and termination of the installation to provide proof of compliance of this spec.
 - 2. Submit proof from manufacturer of contractor's good standing in manufacturer's program.
 - 3. Submit appropriate cut sheets and samples for all products, hardware and cabling.
- B. Work shall not proceed without the Owner's approval of the submitted items.
- C. The Telecommunications contractor shall receive approval from the Owners on all substitutions of material. No substituted materials shall be installed except by written approval from the Owner.

1.7 QUALITY ASSURANCE

- A. The telecommunications contractor shall be a company specializing in communication cabling installation. At least 30 percent of the copper installation and termination crew must be certified by BICSI and RCDD, with a Technicians Level of Training. At least 10 percent of the optical fiber installation and termination crew must be certified by BICSI and RCDD in optical fiber installation and termination practices.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Delivery and receipt of products shall be at the site described in the Scope Section.
- B. Cable shall be stored according to manufacturer's recommendations as a minimum. In addition, cable must be stored in a location protected from vandalism and weather. If cable is stored outside, it must be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection from weather. If air temperature at cable storage location will be below 40 degrees F., the cable shall be moved to a heated (50 degrees F. minimum) location. If necessary, cable shall be stored off site at the contractor's expense.
- C. If the telecommunications contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with the Owner.

1.9 DRAWINGS

- A. It shall be understood that the electrical details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the telecommunications contractor in bidding on the job. The telecommunications contractor shall make allowance in the bid proposal to cover whatever work is required to comply with the intent of the plans and specifications.
- B. The telecommunications contractor shall verify all dimensions at the site and be responsible for their accuracy.
- C. Prior to submitting the bid, the telecommunications contractor shall call the attention of the Engineer to any materials or apparatus the telecommunications contractor believes to be inadequate and to any necessary items of work omitted.

PART 2- PRODUCTS

2.1 EQUIVALENT PRODUCTS

- A. Due to the nature and type of communications all products, including but not limited to faceplates, jacks, patch panels, racks, 110 blocks, and patch cords, for the purpose of this document, shall be manufactured by Ortronics. All copper cable products shall be manufactured by Berk-Tek. There will be no substitutions allowed. All fiber optic cable products shall be manufactured by Owens Corning.

2.2 WORK AREA OUTLETS

- A. Work area cables shall each be terminated at their designated work area location in the connector types described in the subsection below. Included are modular telecommunication jacks. These connector assemblies shall snap into a faceplate.
- B. The Telecommunications Outlet Assembly shall accommodate:
 - 1. A minimum of two (2) modular jacks.
 - 2. Additional accommodations for specific locations as noted in the plans for optical fiber and/or additional copper cables as necessary.
 - 3. A blank filler will be installed when extra ports are not used.
 - 4. A dust cap shall be provided on all modular jacks with the circuit number on the identifier strip.
 - 5. Multiple Jacks that are identified in close proximity on the drawings (but not separated by a physical barrier) may be combined in a single assembly. The telecommunications contractor shall be responsible for determining the optimum compliant configuration based on the products proposed.
 - 6. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Prior to installation, the telecommunications contractor shall submit the proposed configuration for each outlet assembly for review by the Owner.
 - 7. The modular jack shall incorporate printed label strip on the dust cap module for identifying the outlet. Printed labels shall be permanent and compliant with ANSI/TIA/EIA-606-A standard specifications. Labels shall be printed using electromechanical labeler. Hand printed labels shall not be accepted.
- C. Faceplates: The faceplates shall:
 - 1. Be Ortronics TracJack or Series II style as appropriate to fit the modular jack used.
 - 2. Be UL listed and CSA certified.
 - 3. Be constructed of high impact, ABS plastic UL 94V-0 construction (except where noted otherwise).
 - 4. Match the faceplate color used for other utilities in the building or match the color of the raceway if installed in surface raceway.
 - 5. Be compliant with the above requirements along with the following when incorporating optical fiber:
 - i. Be a low profile assembly.

- ii. Incorporate a mechanism for storage of cable and fiber slack needed for termination.
- iii. Position the fiber optic couplings to face downward or at a downward angle to prevent contamination.
- iv. Incorporate a shroud that protects the optical couplings from impact damage.
- 6. Be available as single-gang or dual-gang.
- 7. Provide easy access for adds, moves, and changes by front removal of jack modules.
- 8. Possess recessed designation windows to facilitate labeling and identification.
- 9. Shall include a clear plastic cover to protect labels in the designation window.
- 10. Have mounting screws located under recessed designation windows.
- 11. Comply with ANSI/TIA/EIA 606-A work area labeling standard.
- 12. Allow for the UTP modules to be inverted in place for termination purposes.
- 13. Be manufactured by an ISO 9001 registered company.

D. Voice/Data Jacks

- 1. Voice/Data Jacks shall be 8-position modular jacks and shall be Category 6 or higher performance as defined by the references in this document including ANSI/TIA/EIA 568.2-D. All pair combinations must be considered, with worst case measurement being the basis for compliance. Modular jack performance shall be third-party verified by a nationally recognized independent testing laboratory.
- 2. The modular jack shall be one of the following:

Part Number	Description
OR-TJ600-23	Clarity 6 TracJack Lt Orange
OR-TJ600	Clarity 6 TracJack Fog White

- 3. Dust covers shall be used on each termination.

2.3 110 COPPER TERMINATION BLOCK

The voice cross connect shall be a passive connection between the horizontal termination blocks and the backbone termination blocks. The wall mount frames shall be field terminated kits including all blocks, connecting blocks, and designation strips. Management rings shall be mounted between vertical columns of blocks to provide management of cross-connect wire. Backbone and horizontal blocks shall use 4 or 5-pair connecting blocks on each 25-pair row. Blocks shall be oriented so that backbone terminations are located on the left and horizontal frames are located on the right of the termination field when facing the frame assembly.

A. 110 Connecting Blocks shall:

- 1. be manufactured using fire retardant molded plastic.
- 2. be used with 4 pair 110C connecting blocks for field termination.
- 3. support termination of 22, 24, and 26 AWG solid conductor.
- 4. be capable of accommodating a minimum of 200 repeated insertions without resulting in permanent deformation.
- 5. have color-coded tips for installation identification.
- 6. Termination hardware shall maintain the paired construction of the cable to facilitate minimum untwisting of the wires.
- 7. be labeled in compliance with ANSI/TIA/EIA 606-A labeling specifications using permanent labels and Label/Mo software (or other labeling software/printer).
- 8. be manufactured by an ISO 9001 registered company.

B. 110 Wiring Blocks Shall:

- 1. be Ortronics part number OR-110ABC6100.
- 2. be manufactured using fire retardant molded plastic.
- 3. be available in 100 pair and 300 pair sizes.
- 4. be rack mountable.
- 5. be used with 4 pair 110C connecting blocks for field termination.
- 6. support termination of 22, 24, and 26 AWG solid conductor.
- 7. be capable of accommodating a minimum of 200 repeated insertions without resulting in permanent deformation.

- 8. 110 wiring block and 110C connecting block shall have color-coded tips for installation identification.
 - 9. Termination hardware shall maintain the paired construction of the cable to facilitate minimum untwisting of the wires.
 - 10. 110 wiring block and 110C connecting block shall be compliant with ANSI/TIA/EIA 606-A labeling specifications.
 - 11. be manufactured by an ISO 9001 registered company.
- C. 110 Cross-Connect System Backboard Channels shall:
- 1. be available in 300 and 900 pair sizes.
 - 2. allow the mounting of 110 100-pair blocks without legs.
 - 3. include bottom trough and grounding bar.
 - 4. be wall mountable.
 - 5. be of cold roll steel construction.
 - 6. be manufactured by an ISO 9001 registered company.
- D. Wall Mount Vertical Trough Shall:
- 1. be available in single channel or dual channel configurations.
 - 2. in dual channel configuration, be used to provide separation for different wiring media.
 - 3. be available in 300 pair or 900 pair sizes.
 - 4. be wall mountable.
 - 5. be used with wall mountable backboard channels. Acceptable configurations include a 300 pair and a 900 pair.
 - 6. Be of cold roll steel construction.
 - 7. Be manufactured by an ISO 9001 registered company.

2.4 MODULAR PATCH PANELS

- A. The modular patch panels shall be one of the following:

Part Number	Description
OR-PHD66U24	Clarity 6 Cat6 24-Port Patch Panel
OR-PHD66U48	Clarity 6 Cat6 48-Port Patch Panel

2.5 RACKS

All racks and wire management shall be Ortronics specific. The equipment rack shall provide vertical cable management and support for the patch cords at the front of the rack and wire management, support, and protection for the horizontal cables inside the legs of the rack. Waterfall cable management shall be provided at the top of the rack for patch cords and for horizontal cables entering the rack channels for protection and to maintain proper bend radius and cable support. Wire management shall also be mounted above each patch panel and/or piece of equipment on the rack. The rack shall include mounting brackets for cable tray ladder rack to mount to the top of the rack. Velcro cable ties shall be provided inside the rack channels to support the horizontal cable. Rack shall be black in color to match the patch panels and cable management.

- A. A Free-Standing Rack Shall:
- 1. provide the necessary strain relief, bend radius and cable routing for proper installation of high performance cross-connect products meeting all specifications of ANSI/TIA/EIA 568.2-D.
 - 2. have a top cable trough with waterfall and build-in patch and horizontal cable distribution separator.
 - 3. have EIA hole pattern on front and rear.
 - 4. be available with 6.5” (165 mm) channel depth.
 - 5. be available with hook and loop straps for securing bulk cables inside vertical U-channels.
 - 6. assemble as a 19” (483 mm) rack with no additional hardware.
 - 7. be available with three styles of vertical patch cord management
 - i. Interbay with latches
 - ii. Cable management rings
 - iii. Finger duct with covers
 - 8. provide floor and ceiling access for cable management and distribution.

9. provide pre-drilled base for floor attachment of rack.
10. be available in standard color of black.
11. be manufactured by an ISO 9001 registered company

B. A Wall Mount Rack Shall:

1. provide the necessary strain relief, bend radius and cable routing for proper installation of high performance cross connect products, meeting all specifications of ANSI/TIA/EIA 568.2-D.
2. have top cable trough to route patch and distribution cables between racks.
3. have EIA hole pattern on front and rear.
4. be specified as 4.0 ft (1.22 m) with 22 rack units).
5. be available with a 6.5" (165 mm) or 14" (356 mm) channel depth.
6. be available with hook and loop straps for securing cables inside the vertical U-channels.
7. be available with vertical cable management rings for cord routing, organization and strain relief.
8. be available with vertical U-channels to protect and conceal distribution cables.
9. provide floor and ceiling access for cable management and distribution.
10. have wall mount braces With locator posts for easy wall mounting.
11. have side access points that allow for access to manage/install distribution cables in the vertical channels.
12. be available in standard color of black.
13. be manufactured by an ISO 9001 registered company.

2.6 HORIZONTAL DISTRIBUTION CABLE

All horizontal data station cable and voice cable shall terminate on modular patch panels (copper or fiber), 110 cross-connecting blocks (copper), or patch/splice cabinets (fiber) in their respective Telecommunications Room or Equipment Room as specified on the drawings.

2.7 COPPER CABLE PROTECTION UNITS

- A. All copper circuits shall be provided with protection between each building with an entrance cable protector panel. All building-to-building circuits shall be routed through this protector. The protector shall be connected with a #6 AWG copper bonding conductor between the protector ground lug and the TR ground point. Approved manufacturer of protection units is Porta Systems.

2.8 GROUNDING AND BONDING

- A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all Telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA/EIA-607 Telecommunications Bonding and Grounding Standard.
- B. The main entrance facility/equipment room in each building shall be equipped with a telecommunications main grounding bus bar (TMGB). Each telecommunications room shall be provided with a telecommunications ground bus bar (TGB). The TMGB shall be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.
- C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the TR or ER shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression connectors.

- D. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. All cables and bus bars shall be identified and labeled in accordance with the System Documentation Section of this specification.

2.9 FIRESTOP

- A. A firestop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.
- B. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly firestopped.
- C. Firestop systems shall be UL Classified to ASTM E814 (UL 1479) and shall be approved by a qualified Professional Engineer (PE), licensed (actual or reciprocal) in the state where the work is to be performed. A drawing showing the proposed firestop system, stamped or embossed by the PE shall be provided to the Owner's Technical Representative prior to installing the firestop system(s).

Part 3 – Execution

3.1 WORK AREA OUTLETS

- A. Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer's bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. No more than 12" of UTP slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
- B. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568.2-D document, manufacturer's recommendations and best industry practices.
- C. Bend radius of the horizontal cable shall not be less than 4 times the outside diameter of the cable.
- D. The cable jacket shall be maintained to within 25mm (one inch) of the termination point.
- E. Data jacks, unless otherwise noted in drawings, shall be located in the bottom position(s) of each faceplate. Data jacks in horizontally oriented faceplates shall occupy the right-most position(s).
- F. Voice jacks shall occupy the top position(s) on the faceplate. Voice jacks in horizontally oriented faceplates shall occupy the left-most position(s).

3.2 HORIZONTAL DISTRIBUTION CABLE INSTALLATION

- A. Cable shall be installed in accordance with BICSI standards and with manufacturer's recommendations and best industry practices.
- B. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- C. Cable raceways shall not be filled greater than the maximum fill for the particular raceway type or 40%.
- D. Cables shall be installed in continuous lengths from origin to destination (no splices).
- E. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
- F. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch {1.2 to 1.5 meter} intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.
- G. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 Cables may cause deformation of the bottom cables within the bundle and degrade cable performance.
- H. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
- I. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.
- J. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
- K. Cables shall be identified by a self-adhesive label. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.

- L. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
- M. Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.

3.3 HORIZONTAL CROSS CONNECT INSTALLATION

- A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA 568.2-D standard, manufacturer's recommendations, and best industry practices.
- B. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
- C. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- D. The cable jacket shall be maintained as close as possible to the termination point.
- E. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.4 BACKBONE CABLE INSTALLATION

- A. Backbone cables shall be installed separately from horizontal distribution cables.
- B. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- C. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits.
- D. Where backbone cables are installed in an air return plenum, riser rated cable shall be installed in metallic conduit.
- E. Where backbone cables and distribution cables are installed in a cable tray or wire raceway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.
- F. All backbone cables shall be securely fastened to the side wall of the TR on each floor.
- G. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
- H. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.
- I. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

3.5 COPPER TERMINATION HARDWARE

- A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA 568.2-D standard, manufacturer's recommendations and best industry practice.
- B. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

- C. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- D. The cable jacket shall be maintained to within 25 mm (one inch) of the termination point.
- E. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.6 RACKS

- A. Racks shall be securely attached to the concrete floor using a minimum 3/8" hardware or as required by local codes.
- B. Racks shall be placed with a minimum of 36 inch clearance from the walls on all sides of the rack. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks and from the wall at each end of the row.
- C. All racks shall be grounded to the telecommunications ground bus bar in accordance with Section 9.0 of this document.
- D. Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.
- E. Wall mounted termination block fields shall be mounted on 4' x 8' x .75" void free plywood. The plywood shall be mounted vertically 12" above the finished floor. The plywood shall be painted with two coats of white fire retardant paint.
- F. Wall mounted termination block fields shall be installed with the lowest edge of the mounting frame 18" from the finished floor.

3.7 FIRESTOP SYSTEM

- A. All firestop systems shall be installed in accordance with the manufacturer's recommendations and shall be completely installed and available for inspection by the local inspection authorities prior to cable system acceptance.

3.8 GROUNDING SYSTEM

- A. The TBB shall be designed and/or approved by a qualified PE, licensed in the state that the work is to be performed. The TBB shall adhere to the recommendations of the TIA/EIA-607 standard, and shall be installed in accordance with industry best practices.
- B. Installation and termination of the main bonding conductor to the building service entrance ground shall be performed by a licensed electrical contractor.

3.9 IDENTIFICATION AND LABELING

- A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets, and follow the guidelines as set forth in the TIA/EIA-606-A specification. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

- B. All label printing will be machine generated using indelible ink ribbons or cartridges. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel, and wiring block labels shall be installed on, or in, the space provided on the device.

3.10 TESTING AND ACCEPTANCE

A. General

1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568.2-D specification. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
2. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards, and industry best practices. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

B. Copper Channel Testing

1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using a level IIE or better test unit for category 6 compliance.
2. Continuity- Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
3. Length- Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568.2-D Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded at the length for the cable.
4. Category 6 performance – A Level IIE or better test unit is required to verify Category 6 performance. The basic tests required are:
 - i. Wire Map
 - ii. Length
 - iii. Attenuation
 - iv. NEXT (Near end Crosstalk)
 - v. Return Loss
 - vi. ELFEXT Loss (Equal Level Far-end Crosstalk Loss)
 - vii. Propagation Delay
 - viii. Delay Skew
 - ix. PSNEXT (Power Sum Near end Crosstalk)
 - x. PSELFEXT (Power Sum Equal Level Far-end Crosstalk Loss)

3.11 SYSTEM DOCUMENTATION

- A. Upon completion of the installation, the telecommunications contractor shall provide three (3) full documentation sets to the Engineer for approval. Documentation shall include the items detailed in the sub-sections below.
- B. Documentation shall be submitted within ten (10) working days of the completion of each testing phase (e.g. subsystem, cable type, area, floor, etc.). This is inclusive of all test result and draft as-built drawings. Draft drawings may include annotations done by hand. Machine

generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase. At the request of the engineer the telecommunications contractor shall provide copies of the original test results.

- C. The Engineer may request that a 10% random field re-test be conducted on the cable system, at no additional cost to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by the Engineer, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

3.12 TEST RESULTS

- A. Test documentation shall be provided on disk within three weeks after the completion of the project. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
- B. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568.2-D including applicable TSB's and amendments. The appropriate level IIE tester shall be used to verify Category 6 cabling systems.
- C. Printouts generated for each cable by the wire test instrument shall be submitted as part of the documentation package. The telecommunications contractor must furnish this information in electronic form on digital media.
- D. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

3.13 AS-BUILT DRAWINGS

- A. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner.
- B. The Contractors shall annotate the base drawings and return an electronic copy (same plot size as originals).

PART 4 - WARRANTY AND SERVICES

4.1 WARRANTY

- A. The contractor shall provide a 90 Day warranty on the physical installation.

4.2 CONTINUING MAINTENANCE

- A. The contractor shall furnish an hourly rate with the proposal submittal, which shall be valid for a period of one year from the date of acceptance. This rate will be used when cabling support is required to affect moves, adds, and changes to the system (MACs).

4.3 FINAL ACCEPTANCE & SYSTEM CERTIFICATION

- A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation, and successful performance of the cabling system for a two week period will constitute acceptance of the system.

Appendix A

Cable specification details are as follows:

Electrical Characteristics					
FQ = Frequency (MHz) / TIA = TIA Spec / PG = Product Guarantee					
	RL (dB)	NEXT (dB)	PSNEXT (dB)	ACRF (dB)	LCL/TCL
FQ	TIA / PG	TIA / PG	TIA / PG	TIA / PG	PG
1	20.00 / 20.00	74.30 / 74.30	72.30 / 72.30	67.80 / 67.80	40.00
4	23.00 / 23.00	65.30 / 65.30	63.30 / 63.30	55.80 / 55.70	40.00
10	25.00 / 25.00	59.30 / 59.30	57.30 / 57.30	47.80 / 47.80	40.00
16	25.00 / 25.00	56.20 / 56.30	54.20 / 54.30	43.70 / 43.70	38.00
20	25.00 / 25.00	54.80 / 54.80	41.80 / 52.80	41.80 / 41.70	37.00
31.25	23.60 / 23.60	51.90 / 51.90	49.90 / 49.90	37.90 / 37.90	35.10
62.5	21.50 / 21.50	47.40 / 47.40	45.40 / 45.40	31.90 / 31.80	32.00
100	20.10 / 20.10	44.30 / 44.30	42.30 / 42.30	27.80 / 27.80	30.00
150	18.90 / 18.90	41.70 / 41.70	39.70 / 39.70	24.30 / 24.30	28.20
200	18.00 / 18.00	39.80 / 39.80	37.80 / 37.80	21.80 / 21.70	27.00
250	17.30 / 17.30	38.30 / 38.30	36.30 / 36.30	19.80 / 19.80	26.00
300	— / 16.77*	— / 37.16*	— / 35.16*	— / —	25.20*
350	— / 16.30*	— / 36.20*	— / 34.20*	— / 16.90*	24.60*
	IL (dB/100 m)	ACR (dB/100 m)	PSACR (dB/100 m)	PSACRF (dB/100 m)	EL TCTL
FQ	TIA / PG	TIA / PG	TIA / PG	TIA / PG	PG
1	2.00 / 2.00	72.20 / 72.30	70.30 / 70.30	64.80 / 64.80	35.00
4	3.80 / 3.80	61.50 / 61.50	59.50 / 59.50	52.80 / 52.70	23.00
10	6.00 / 6.00	53.40 / 53.40	51.30 / 51.40	44.80 / 44.80	15.00
16	7.60 / 7.60	48.80 / 48.70	46.70 / 46.70	40.70 / 40.70	10.90
20	8.50 / 8.50	46.40 / 46.40	44.30 / 44.30	38.80 / 38.70	9.00
31.25	10.70 / 10.70	41.40 / 41.30	39.20 / 39.20	37.90 / 34.90	—
62.50	15.40 / 15.40	32.40 / 32.00	30.00 / 30.00	28.90 / 28.80	—
100	19.80 / 19.80	25.20 / 24.60	22.50 / 22.50	24.80 / 24.80	—
150	24.70 / 24.60	16.90 / 17.10	14.90 / 15.10	21.30 / 21.30	—
200	29.00 / 29.00	10.80 / 10.90	8.80 / 8.90	18.80 / 18.70	—
250	32.80 / 32.80	7.30 / 5.50	3.50 / 3.50	16.80 / 16.80	—
300	— / 36.43*	— / 0.73*	— / —	— / —	—
350	— / 39.80*	— / —	— / —	13.90 / 13.90*	—

*Values provided for reference only

Parametric Measurements	
Description	
Mutual Capacitance	5.6 nF/100m max.
DC Resistance	9.38 Ohms/100m max.
Skew	45 ns/100m max.
Pair-to-Ground Unbalance	330 pF/100m max.
Velocity of Propagation	68% nom.
DC Resistance Unbalance	5% max.

Color Code		
Pair-1	White/Blue	Blue
Pair-2	White/Orange	Orange
Pair-3	White/Green	Green
Pair-4	White/Brown	Brown

Supported Category 6 Applications		
Standard	Application	Speed
IEEE 802.3	1000BASE-T	1 Gb/s
ATM	155 Mb/s	155 Mb/s
CDDI		100 Mb/s
IEEE 802.3	100BASE-T	10 Mb/s
IEEE 802.3 af	PoE	1 GB/s
IEEE 802.3 at	PoE+, Type 1 & 2	1 Gb/s

Technical Data - Physical		
Conductor	23 AWG Bare Copper	
Conductor Diameter - in. (mm)	0.022	(0.56)
Insulated Conductor Diameter - in. (mm)	0.045	(1.14)
Cable Diameter - in. (mm)	0.280	(7.11)
Nom. Cable Weight - lb./kft (kg/kft)	36	(16.33)
Max. Installation Tension - lb. (N)	25	(110)
Min. Bend Radius - in. (mm)	3.00	(76.20)