

## SECTION 27 1000 - STRUCTURED CABLING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENT

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

#### 1.2 SUMMARY

- A. The Section defines the requirements for the installation of the structured cabling system. As described elsewhere in these Documents the system consists of twisted pair cabling and hardware, and related hardware. In addition to the basic cable plant requirements, the testing and identification requirements are also defined. Racks, enclosures, and pathway hardware is also defined herein
- B. This Section includes the following:
  - 1. Fiber optic Cable
  - 2. High Pair Count Twisted Pair Cable
  - 3. Twisted Pair Cable
  - 4. Patch Panels
  - 5. Jacks
  - 6. Faceplates
  - 7. Racks
  - 8. Wire Management
- C. Related Sections
  - 1. Section 27 05 00 – Communications Common Work Results
  - 2. Section 27 05 26 – Technology Grounding System
  - 3. Section 27 05 28 – Pathways for Communications Systems

#### 1.3 QUALITY ASSURANCE

- A. NFPA 70 – The National Electrical Code
- B. ANSI/TIA 568-C.0 – Generic Telecommunications Cabling for Customer Premise
- C. ANSI/TIA/EIA 568-C.1 – Commercial Buildings Telecommunications Cabling Standard
- D. ANSI/TIA/EIA 569 – Commercial Building Standard for Telecommunications Pathways and Spaces
- E. ANSI/TIA/EIA 606-A – Administration Standard for the Telecommunications Infrastructure of Commercial Building; TR-42.6 - Labeling

- F. ANSI/TIA/EIA 607A – Commercial Building Grounding and Bonding Requirements for Telecommunications
- G. ANSI/TIA – TSB 95 – Testing Standards
- H. ANSI/TIA-568-B.2-ad10 – Augmented Category 6
- I. ANSI/TIA 942 – Data Center Cabling Standard
- J. BICSI TDMM – Telecommunications Distribution Methods Manual
- K. Belcore - Telcordia
- L. Northwestern University Design Information Technology Building Infrastructure Requirements for Communications Systems
- M. Comply with most current edition of the Northwestern University Design Standards.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Include data sheets for the following additional items:
  - 1. Twisted Pair Cable
  - 2. High Pair Count Twisted Pair Cable
  - 3. Fiber Optic Cable
  - 4. Patch Panels (Copper and Fiber optic)
  - 5. Jacks
  - 6. Faceplates
  - 7. Racks
  - 8. Wire Management
- C. Shop Drawings
  - 1. A detailed riser diagram demonstrating the Contractor's understanding of the backbone cabling.
  - 2. Drawings of any through floor fittings with details of their contents.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports
- B. The Contractor shall include the riser diagram for all backbone cabling and testing data from this system within a unique section of the Operation and Maintenance Manual.
- C. The Operations and Maintenance Manual section for this Section shall include a copy of all test results in native format. Test results shall be sent via email to: doug-dickerson@northwestern.edu.

1.6 QUALITY ASSURANCE

A. Qualifications

1. The Contractor shall be fully qualified to perform installations as described on the Contract Drawings and within these Specifications.
2. The Contractor shall have completed a minimum of three projects of like scope and complexity within the last three (3) years.
3. The Contractor shall have been active in bidding, being awarded, and performing work consistent with that which is indicated on the Contract Documents for a period not less than five (5) years.
4. The Contractor shall maintain an installation staff whose sole function is the installation of Structured Cabling and associated equipment and shall not utilize additional personnel obtained by means of a temporary placement or staffing agency.
5. The Contractor shall have a dedicated Project Manager, who shall be the sole point of contact for the Engineer or Owner. The Project Manager shall be assigned to the project for the duration of the project.

B. Certifications

1. The Contractor shall possess current certifications by BICSI for the installation and maintenance of all Structured Cabling and associated equipment being provided under the Structured Cabling Contract.
2. The Contractor shall possess current certification for the installation of all required fire stopping to be installed under the scope of the Structured Cable Plant.

C. Samples

1. Northwestern University reserves the right to request samples of components required by these specifications.

D. Mock Ups

1. The Contractor shall provide equipment assemblies for review at the request of Northwestern University.

E. Meetings

1. The Contractor shall be attend all Pre-Construction, Pre-Installation or Progress Meetings that may be called by Northwestern University

1.7 DELIVERY STORAGE AND HANDLING

- A. The Contractor shall responsible for the storage and handling of all Materials required by the Structured Cabling portion of this Contract.

B. Storage and Protection

1. Any Materials that show signs of mishandling or have been stored in a fashion so as to reduce the value of the Materials shall be replaced with new Materials at no additional cost to the Owner.

C. Waste Management and Disposal

1. All excess Materials shall be discarded in an appropriate manner.
2. Any/all hazardous materials shall be handled appropriately and shall be disposed of in a manner consistent with same, and compliant with all applicable codes and regulations.

1.8 PROJECT/SITE CONDITIONS

- A. The Contractor shall become and remain familiar with all project/site conditions that may have impact on the timing, quality and/or quantity of Materials for the project. The Contractor shall coordinate their efforts with changes in the Project/Site conditions so as to optimize the installation for the Owner.
- B. Any additional efforts by the Contractor due to a lack of awareness of project/site conditions shall not require additional compensation from the Owner. .

PART 2 - PRODUCTS

2.1 FIBER BACKBONE COMPONENTS

A. Connectors

1. The connector shall be a duplex type LC connector on a single mode fiber optic pigtail.
2. The average insertion loss shall be 0.2dB with a maximum of 0.75dB for a mated pair.
3. Acceptable Manufacturer and Model

- a. Corning # 000201R4Z31001M

B. Fiber Connector Panels

1. The cabinets shall be capable of being mounted in a standard 19" rack utilizing four units of standard height (1.75 inch EIA hole spacing).
2. The cabinets shall utilize a modular connector plate (Connector Panel) with LC connectors.
3. Connectors shall be duplex 'LC' unless otherwise noted on Drawings.
4. Acceptable Manufacturer and Model:

- a. Corning # CCH-04U
- b. Corning # CCH-CP24-A9

NOTE: The Contractor shall provide all adapter panels required to terminate 100% of the fibers indicated on the Drawings. The Contractor shall provide blank fillers for all unutilized openings in the housing. All components must be by Corning.

C. Fiber Cabinets

1. The cabinets shall be capable of being mounted in a standard 19" rack utilizing one, two three or four units of standard height (1.75 inch EIA hole spacing).
2. The cabinets shall utilize a modular connector plate to allow for versatile connector configuration, with panels for LC connectors.
3. The unit shall be capable of flush or partially flush mounting with a front protector that shall be capable of readily mounting any required labeling.
4. The unit shall be compliant with both ANSI/TIA/EIA-568C and ANSI/TIA/EIA-606.

5. The unit shall utilize a slide out drawer assembly.
6. The unit shall be capable of accepting a field installable lock mechanism.
7. Connectors shall be duplex 'LC' unless otherwise noted on Drawings.
8. Acceptable Manufacturer and Model

- a. Corning # CCH-04P Enclosure with # CCH-CP24-A9 Connector Panels.

NOTE: The Contractor shall provide all connector panels required to terminate 100% of the fibers indicated on the Drawings unless noted otherwise. The Contractor shall provide blank fillers for all unutilized openings in the housing. The blank fillers shall be as manufactured by the same manufacture as the housing, and shall be designed specifically for the housing utilized.

D. Fiber Cabling

1. Fiber

a. Outdoor Single Mode Fiber

- 1) Singlemode (OS2) fiber type shall be 8.3/125 micron fiber.
- 2) Interbuiding Singlemode fiber will be 48 strand with a "green" stranded 12AWG routed alongside the fiber for the entire length of the cable.
- 3) Acceptable Manufacturer and Model

- a) Corning "ALTOS" (dryblock).

- 4) NUIT-Telecom & Network Services will consult with the Contractor's Project Manager to determine the actual required fiber optic count based on the intended use and square footage of the building.

b. Indoor Single Mode Fiber

- 1) The cable shall be listed by the NEC for OFNR compliance and CSA for FT-6 compliance.
- 2) The cable shall be compliant with plenum, riser and general building applications, as appropriate. The cable shall be an all dielectric construction requiring no electrical connection to ground.
- 3) The fiber type shall be 8.3/125 micron fiber.
- 4) Acceptable Manufacturer and Model

- a) Corning MIC riser cable # 024E81-33131-A1.

c. Indoor Single Mode Fiber

- 1) The cable shall be listed by the NEC for OFNP compliance.
- 2) The cable shall be rated for use in plenums, risers and general building applications, as appropriate.
- 3) The fiber type shall be a single mode fiber with:

- a) a maximum attenuation of 1.0dB/km @ 1310 nm and 1.0 dB/km @ 1383 nm, and 0.75 dB/km @ 1550 nm

- 4) Acceptable Manufacturer and Model

- a) Corning MIC plenum cable # 024E88-33131-29.

## 2.2 HIGH PAIR COUNT

### A. High Pair Count Twisted Pair Cables

1. 24 AWG multi-pair copper cables shall be used as the interbuilding backbone cables. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation..
2. The cable shall consist of 24 AWG solid copper conductors insulated with color coded PVC. Cable shall be 100 pair PE-89 type cable.
3. Approved manufacturers:
  - a. Superior/Essex
  - b. General Cable
  - c. Equal - must accepted by NUIT

## 2.3 HORIZONTAL COMPONENTS

### A. Connectors

1. Data/Voice (Copper) – All jacks shall be blue in color.
  - a. Panduit Mini-Com Category 5e – shall be used only with Belden Category 5e cable.
  - b. Panduit Mini-Com Category 6a – shall be used only with Panduit or Belden Category 6a cable.
  - c. Belden Category KeyConnect 6a #AX102288 – shall be used only with Panduit or Belden Category 6a cable.

### B. Faceplates

1. All Faceplates shall be available in single, duplex, triplex, quadplex, or sixplex arrangements in a single gang configuration.
2. Faceplates shall be available in eightplex arrangements in a two gang configuration.
3. Surface mount boxes shall be available in single, dual, quad, and sixplex configuration.
4. All faceplates shall be as manufactured by the manufacturer of the associated connectors, unless otherwise noted in the Drawings.
5. The preferred faceplates shall be 2 position stainless steel. Where the use of stainless steel is not possible, faceplates shall match the color of the associated electrical faceplates. Coordinate the faceplate color with the electrical contractor and drawings prior to installation.
6. Acceptable Manufacturers and Series
  - a. Panduit – Mini-com faceplates # CFP\*SY (2 to 6 port as appropriate).
  - b. Belden – AX1020\*\* (1 to 6 port as appropriate).

### C. Patch Panels

1. Copper

- a. The termination jacks shall support the appropriate Category 5e or Category 6a applications, both current and future, designed for the associated connectivity solution.
- b. Patch panels shall be angled "Quick-connect" type mounting frame, capable of accepting the appropriate RJ-45 jack.
- c. All patch panels jacks shall be wired to EIA/TIA 568B.
- d. The patch panels shall be Underwriter's Laboratories (UL) listed..
- e. All patch panels shall be 48 port 2U configurations.
- f. Approved manufacturers and part numbers
  - 1) Panduit 48 port angled all metal patch panel frame – Mini-Com Angled Patch Panel # CPA48BLY.
  - 2) Belden 48 port angled all metal patch panel frame – KeyConnect Angled Patch Panel # A104601.

#### D. Cabling

##### 1. Copper

- a. Category 5e Unshielded Twisted Pair (UTP), 4 Pair
  - 1) Category 5e UTP, 4 Pair Horizontal Distribution Cables shall extend between the station location and the associated HC, shall consist of 4 pair, 24 gauge, UTP, and shall terminate all conductors onto an 8 pin modular jack provided at each outlet. Cable jacket shall comply with Article 800 of the NEC for use as a plenum or non-plenum cable as required by these Specifications and by the local authority having jurisdiction. The 4 pair UTP cable shall be UL Listed Type CMP (plenum) or CM (non-plenum).
  - 2) The Category 5e UTP cable shall be a round cable design with fluting to maintain the appropriate pair spacing relationship. The cable shall support all current future applications designed to run on Category 5e cabling.
  - 3) The Category 5e cable shall be specified to a minimum of 100 MHz.
  - 4) Approved manufacturers and part numbers
    - a) Belden # 1701A (Plenum)
    - b) Belden # 1700A (Non-Plenum)
- b. Category 6a Unshielded Twisted Pair (UTP), 4 Pair
  - 1) Category 6a UTP, 4 Pair Horizontal Distribution Cables shall extend between the station location and the associated HC, shall consist of 4 pair, 24 gauge, UTP, and shall terminate all conductors onto an 8 pin modular jack provided at each outlet. Cable jacket shall comply with Article 800 of the NEC for use as a plenum or non-plenum cable as required by these Specifications and by the local authority having jurisdiction. The 4 pair UTP cable shall be UL Listed Type CMP (plenum) or CM (non-plenum).
  - 2) The Category 6a UTP cable shall be a round cable design with fluting to maintain the appropriate pair spacing relationship. The cable shall support all current future applications designed to run on Category 6 cabling.
  - 3) The Category 6a UTP cable shall be designed to have improved balance of 10dB as compared to current Category 5e cable, which shall result in higher immunity to EMI.
  - 4) The Category 6a cable shall be specified to a minimum of 500 MHz.
  - 5) Approved manufacturers and part numbers

- a) Belden # 10GX33 D151000 (Plenum)
- b) Belden # 10GX32 0061000 (Non-Plenum)
- c) Panduit # PUP6AM04BU-UG (Plenum)
- d) Panduit # PUP6AM0BU-UG (Non-Plenum)

## 2.4 EQUIPMENT RACKS

- A. Each MC/ER/HC shall be equipped with a 19" Aluminum Rack System to house Owner provided equipment and Contractor provided termination bays for the multiple cable types.
- B. 19" Aluminum Rack System
  - 1. The rack shall be able to support and organize electronic equipment, cross connection and/or termination hardware for fiber optic cabling, horizontal distribution cabling, riser cabling, or building entrance cabling as may be required by the design. The rack face shall have a conventional equipment mounting width of 19". The rack shall be designed for cable and jumper management and shall have hardware to organize and support cabling and patch cords in the vertical and horizontal planes. The rack system shall be equipped for electrical grounding to meet EIA/TIA 606 Standards, and the designed grounding system. The fastening system for the equipment shall facilitate installation with roll-formed threads in the screw holes for greater strength and durability and the mounting screws shall have pilot points. All rack components shall be charcoal black in color and made of lightweight 6061-T6 extruded aluminum. The rack shall be shipped with all necessary hardware to assemble the frame. It shall be packed in cartons with suitable shipping inserts such that no damage occurs to the rack finish. The finish shall not be scratched, chipped, or marred.
  - 2. Self-Supported Rack Framework
    - a. The self-supporting equipment rack shall be 7' tall with 3" wide channels at each side and with extruded aluminum top angles and base angles providing support. Standard grade frames shall be capable of supporting 700 lbs., with uniform distribution of weight.
    - b. Standard frames shall provide a .19" thick channel flange and .13" web thickness.
    - c. Standard base angles shall be .3125" thick, and top angles shall be .1815" thick.
    - d. Racks shall be able to be mounted side by side and be secured to adjacent racks in a line-up with vertical wire management between each rack.
    - e. The self-supporting rack shall maintain a UL listing for a telecommunications accessory.
    - f. Approved Manufacturers and Products shall be:
      - 1) Panduit – 7' UL Standard Rack
      - 2) All accessories and related hardware associated with a rack shall be provided by the manufacturer of the rack, unless otherwise noted in these Documents.
    - g. Horizontal Wire Management
      - 1) Units shall fit in a standard 19" rack.
      - 2) Units shall be 2U construction.
      - 3) Approved Manufacturers and Models shall be:
        - a) Panduit #CMPHF2



h. Vertical Wire Management

1) Approved Manufacturers and Models

a) Panduit #WMPVHCF45E

2.5 ACCESSORIES

A. Patch Cords

1. Copper patch cords shall be provided by NUIT.
2. Fiber Patch Cords shall be provided by NUIT.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Materials shall be examined for damage on receiving the materials. Reject any materials that are damaged.
- B. Examine all materials before installation. Reject and materials that are damaged.
- C. Examine elements and surfaces to which materials will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Cable Routing

1. Provide service loops as determined by the following chart:

	TR	Stub-up	Manhole
Category 5e	0'	10'	NA
Category 6a	0'	10'	NA
Fiber Optic – ISP	10'	10	NA
Fiber Optic – OSP	10'	NA	20'

2. Non-continuous pathways shall keep hallway crossover to a minimum. Furthermore, non-continuous pathways shall be routed so as to follow logical paths parallel and perpendicular to the building structure. Diagonal pathways are unacceptable, unless agreed to by NUIT.
3. In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Contractor shall bundle, in bundles of 50 or less, horizontal distribution wiring with cable ties snug, but not deforming the cable geometry. Where cable bundles are to be supported by J-hooks, the J-hooks shall be attached to the building structure and framework per local codes and regulations at a maximum of five (5) foot intervals.
4. Cables shall be bundled by means of either Velcro or Milli-Ties. Zip-ties are unacceptable.

5. All horizontal cables shall not exceed 90m (295 ft) from the Telecommunications Outlets in the Work Area to the Horizontal Cross Connect. Suspected long cables shall be coordinated with NUIT as soon as they are discovered.
6. The combined length of jumpers, or patch cords and equipment cables in the telecommunications room/closet and the Work Area shall not exceed 10m (33 ft) unless used in conjunction with a multi-user Telecommunications Outlet.
7. A minimum of three horizontal cables shall be routed to each Work Area, unless otherwise noted on the Drawings.
8. Horizontal pathways shall be installed such that the minimum bending radius of horizontal cables is kept within manufacturer specifications both during and after installation.
9. Telecommunications pathways, spaces and metallic raceways, which run parallel with electric power or lighting cables or conduits, which is less than or equal to 480 Vrms, shall be installed with a minimum clearance of 50 mm (2 inches).
10. The installation of telecommunications cabling shall maintain a minimum clearance of 3 m (10 ft) from power cables or conduits in excess of 480 Vrms.
11. No telecommunications cross connects shall be physically located within 20 ft (6 m) of electrical distribution panels, or step down transformers, which carry voltages in excess of 480 Vrms.
12. Each run of UTP/ScTP cable between the horizontal portion of the cross connect in the telecommunication closet and the information outlet shall not contain splices.
13. The Contractor shall provide all devices for routing the cabling as indicated on the Drawings, and as required by the manufacturer of the Structured Cabling System, so as to maintain the long term health and operability of the Structured Cabling System.
14. In a false ceiling environment, a minimum of 3 inches (75mm) shall be observed between the cable supports and the false ceiling.
15. Continuous conduit runs installed by the Electrical Contractor shall not exceed 30.5 m (100 ft) or contain more than two (2) 90 degree bends without utilizing appropriately sized pull boxes, unless otherwise indicated in these Specifications or on the Drawings. The Technology Contractor shall verify the proper installation technique and sizing of the raceway system with the Electrical Contractor prior to installation of the cabling.
16. All horizontal pathways shall be designed, installed and grounded to meet applicable local and national codes.
17. The number of horizontal cables placed in a cable support or pathway shall be limited to a number of cables that will not affect the geometric shape of the cables.
18. Maximum conduit pathway capacity shall not exceed a 40% fill with the exception of perimeter and furniture fill, which is limited to 60% fill for moves, adds and changes, unless otherwise noted on Drawings.
19. Horizontal distribution cables shall not be exposed in the Work Area or other locations with public access.
20. Cables routed in a suspended ceiling shall not be draped across the ceiling tiles. Cable supports shall be mounted a minimum of 75 mm (3 inches) above the ceiling grid supporting the tiles.
21. Cabling shall not be attached to any mechanical, electrical or technology system other than those specifically noted in the Contract Documents.
22. Cabling shall maintain clearance from Line Voltage cabling and devices at all times, and shall be spaced from these devices so as to comply with the TDMM, the NEC, and any other local codes or regulations.
23. Cables shall be bundled by means of either Velcro strap or Milli-Ties. Zip-ties are unacceptable.

B. Racks

1. All racks shall be anchored to the floor, structure below or wall as directed by the manufacturer. And shall comply with any seismic requirements as directed by any local, state or federal regulations.
2. All racks shall be assembled as directed by the manufacturer with the addition of any supplemental grounding requirements listed elsewhere in these Documents.
3. All racks shall be assembled with a vertical wire management located at each side of each row of racks, and on vertical wire management between each two adjacent racks, unless directed otherwise within these Documents.
4. All racks with active electronics mounted within, or indicated as having active electronics installed by others, or in the future shall have a vertical power distribution unit mounted on the rear.

### 3.3 LABELING

#### A. General Labeling Requirements

1. All cables, faceplates, cabling enclosures, patch panels, termination blocks, racks, equipment enclosures and related hardware shall be labeled in compliance with ANSI/TIA/EI 606.
2. All labels shall be permanently attached, and shall be constructed of materials so as to assure the lifespan of the identification marker to be equal or greater than that of the device being identified.
3. The identification tag or placard shall be self-adhering or attached by means of a permanent adhesive listed for the application, or other permanent mechanical means.
4. All means of identification shall be visible and clearly identifiable by personnel in charge of maintaining the cabling infrastructure.
5. All tape based products shall be manufactured for the purpose of identifying flexible communications cabling, and shall be used only on flexible materials.
6. All labels shall be machine generated onto adhesive labels or tags, or engraved on plastic laminated placards or brass tags.
7. All laminated placards shall have a black field with white letters, unless otherwise noted.

#### B. Work Area Floor Plans

1. Each Horizontal Cross Connect shall contain a lexan covered copy of the floor plan(s) associated with the work area outlets serviced by the Cross Connect.
2. The size of the plans shall be equal to the size of the Contract Drawings, unless Contract Drawings exceed 30" x 42", in which case half size prints are to be utilized.
3. The plans shall be affixed by means of compression between the lexan cover and the backboard to which it is mounted. The Contractor shall make provisions to assure that the plans cannot accidentally fall from behind the lexan.
4. For cross connect locations that are smaller than TIA standard locations, half size plans shall be permitted.
5. The Contractor shall utilize the final set of Record Drawings when providing these plans.

#### C. Backbone Risers

1. Each Main or Intermediate Cross Connect shall contain a lexan covered copy of the riser diagram(s) associated with the backbone cabling serviced by the Cross Connect.
2. The size of the plans shall be equal to the size of the Contract Drawings, unless Contract Drawings exceed 30" x 42", in which case half size prints are to be utilized.
3. The plans shall be affixed by means of compression between the lexan cover and the backboard to which it is mounted. The Contractor shall make provisions to assure that the plans cannot accidentally fall from behind the lexan.

4. For cross connect locations that are smaller than TIA standard locations, half size plans shall be permitted.
5. For locations that are serviced by wall mounted enclosures in shared spaces with other trades, the Contractor shall provide a laminated 8 ½" x 11" plan of only the riser diagram and basic title block information. The laminated copy shall be attached in a semi-permanent fashion to the enclosure.
6. The Contractor shall utilize the final set of Record Drawings when providing these plans.

D. Faceplate Labeling

1. All faceplates shall be labeled with the Horizontal Cross Connect and Faceplate Number.
2. The faceplate number shall be derived based on the room in which the faceplate is located, and a sequential number, e.g. TR01-138-01, where TR01 is the Telecommunications Room, 138 is the room number of the location of the faceplate and 01 indicates that this is the first faceplate in the room.
3. The label shall be permanently affixed to the faceplate in a location specifically engineered by the manufacturer to contain such information, or shall be neatly engraved directly on the faceplate and painted to facilitate easy recognition of the information.
4. The individual jack positions shall be identified with sequential letters, either by means of a pre-manufactured engraving or molding, or by installation of a machine generated label installed in a location specifically designed to hold such a label.

E. Patch Panel Labeling

1. All patch panels shall be labeled as to the identity of the patch panel.
2. The patch panel identification shall be derived based on the rack in which it is mounted and a sequential letter, e.g. TR01A-PP03, where TR01A is the rack ID, and PP03 indicates that this is the third patch panel in the rack.
3. The label shall be installed in the space provided by the manufacturer for this purpose. If no space is provisioned, the Contractor shall provide a laminated placard that shall be engraved with the identification of the patch panel, and shall be mounted in the upper right corner of the patch panel, but shall not block the proper installation of the patch panel.
4. All ports shall be labeled with the ID of the faceplate terminated at that port, and the associated jack letter from the faceplate.

F. LIU Labeling

1. All schedules shall be filled out, including source and/or destination of the fibers terminated within.

G. Rack Labeling

1. All racks shall be labeled as to the identity of the device indicated on the Drawings. The label shall be made of plastic laminate and attached at the center of the front top rail of the rack and shall be visible from eye level.

H. UTP Backbone Cable Labeling

1. All UTP Backbone cabling shall be marked, at both ends, with the exact source and destination information, i.e. Telecommunications Space ID, rack, patch panel and ports, or punch down block ID and ports. Each label shall be approximately 2" from the end of the sheath.

I. Fiber Optic Backbone Cable Labeling

1. All Fiber Optic Backbone cabling shall be marked, at both ends, with the exact source and destination information, i.e. Telecommunications Space ID, rack, patch panel and ports, or punch down block ID and ports. Each label shall be approximately 2" from the end of the sheath. Label for outside cable shall be furnished by NUIT.
2. All Fiber Optic cabling shall have a warning tape, stating, at a minimum, "WARNING: Fiber Optic Cable" at each point of cable pathway that is accessible by the Owner, Owner's personnel, or other Contractor.

3.4 FIELD QUALITY CONTROL

A. Site Test, Inspection

1. NUIT retains the right to be present at any or all cable certification. The Contractor shall provide written notice 48 hours prior to the beginning of the certification process.
2. The Contractor shall provide a copy of the unaltered certification test reports to the Engineer in both hardcopy and electronic format. The Contractor shall also provide a copy of the associated Cable Tester's Database Management Software with unedited soft copy.
3. Independent System Certified testing may be required, at the discretion of the Engineer, provided at the expense of the Contractor, in the event of non-performance of the specified testing procedures, submittals and/or installation procedures.
4. The extent and logistics of the independent testing shall be arranged by the Engineer.
5. Copper Cabling
  - a. Upon completion of the cable installation, the Contractor shall perform complete copper cable certification tests on every cable, included but not limited to:
    - 1) For PE-89 Cabling:
      - a) Length
      - b) Attenuation
      - c) Continuity
    - 2) For Category 5e and 6a Cabling, additional tests shall be:
      - a) Near End Cross Talk (NEXT)
      - b) Equal Level Far End Cross Talk (ELFEXT)
      - c) Propagation Delay and Delay Skew
      - d) Return Loss
      - e) Power Sum Near End Cross Talk (PSNEXT)
      - f) Power Sum Equal Level Far End Cross Talk (PSELFEXT)
      - g) Insertion Loss
  - b. Test shall be performed to published standards, including but not limited to, the latest revisions of EIA/TIA 568, ISO/IEC 11802 and other applicable standards at the time of installation.
  - c. All tests shall be performed with a certified Level III UTP test device.
  - d. All UTP field tester shall be factory calibrated each calendar year by the field test equipment manufacturer as stipulated by the manuals provided with the field test unit. The calibration certificate shall be provided to the Engineer for review prior to the start of testing.

- e. New test leads and/or calibration of testing instruments shall be provided at the beginning of each project.
- f. Autotest settings provided in the field tester for testing the installed cabling shall be set to the default parameters.
- g. Test settings from options provided in the field testers shall be compatible with the installed cable under test.

6. Fiber Optic Cabling

- a. In addition to any specific tests mentioned here, the Contractor shall perform all required testing and documentation to obtain a fully certified installation from the manufacturer.
- b. Fiber optic cabling shall be tested with a Power Meter and OTDR. The results of the tests shall be delivered to NUIT.

3.5 CLEANING

- A. All equipment and Materials furnish, installed or provided shall be cleaned of all debris construction or otherwise prior to Owner final Acceptance.

3.6 DEMONSTRATION

- A. Upon completion of all installation, termination and testing, the Contractor shall review the entire installation with NUIT. At the time of this review, the Contractor shall present the hard copies of all unadulterated test results.

3.7 PROTECTION

- A. The Contractor shall protect all aspects of the cabling system from damage during the time period from the notice to proceed through the point of Owner Acceptance.

**END OF SECTION 27 1000**