### MASTER SPECIFICATIONS: DIVISION 27 – COMMUNICATIONS

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SECTION 27 0500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. It is intended this project pursue a LEED “Gold” rating. LEED criteria will be followed for the installation of building systems. This Contractor shall be responsible for the following items to ensure the Facility achieves LEED certification:

1. SS credit 8 – Light Pollution Reduction.
2. EA prerequisite 2 – Minimum Energy Performance.
4. MR credit 2 – Construction Waste Management.
5. IEQ credit 4.1 – Low Emitting Materials: Adhesives and Sealants
7. IEQ credit 6.1 – Controllability of Systems: Lighting.

B. Section Includes:

1. This Section contains the Common communications installation requirements that shall be required of Contractors bidding and executing any part of these documents.

1.2 SUBMITTALS

A. N/A.

PART 2 - PRODUCTS

2.1 N/A.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

A. Comply with most current edition of the Northwestern University Design Standards.

B. *(Select based on project location)* [Comply with City of Chicago Codes and Standards.]
   [Comply with City of Evanston Codes and Standards.]

C. Comply with NECA, NFPA, and OSHA requirements.

D. All work shall be installed in a neat, workmanlike manner in accordance with ANSI/NECA 1 – 2015.
E. All materials and equipment provided under this contract shall be new (except where otherwise noted) and shall be listed, labeled or certified by Underwriters Laboratories, Inc.

F. All equipment of the same type and capacity shall be by the same manufacturer.

G. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

H. During construction the contractor shall at all times maintain electrical utilities of the building without interruption. Should it be necessary to interrupt any electrical service or utility, the contractor shall secure permission in writing from the University for such interruption at least seven days in advance. Any interruption shall be made with minimum amount of inconvenience to the University and any shut-down time shall have to be on a premium time basis and such time to be included in the contractor's bid. Arrange to provide and pay for temporary power source if required by project conditions.

I. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounted items.

J. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

K. Working clearance around equipment shall not be less than that specified in the N.E.C. for all voltages specified.

L. The locations of switches, receptacles, lights, motors, etc. outlets shown are approximate. The contractor shall use good judgment in placing the preceding items to eliminate all interference with ducts, piping, etc. The contractor shall check all door swings so that light switches are not located behind doors. Relocate switches as required, with approval from the Design Professional. The University may direct relocation of outlets before installation, up to five (5) feet from the position indicated on the Drawings, without additional cost.

M. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity. Normal maintenance shall not require the removal of protective guards from adjacent equipment. Install equipment as close as practical to the locations shown on the Drawings.

1. Where the University determines that the Contractor has installed equipment not conveniently accessible for operations and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the University.

2. "Conveniently Accessible" is defined as being capable of being reached without use of ladders, or without climbing or crawling over or under obstacles such as motors, pumps, belt guards, transformers, racks, piping, ductwork, raceways or similar.

N. Right of Way: Give to piping systems installed at a required slope.

O. Firestopping shall be applied to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of the assembly according to Division 07 and 09 Sections and the University’s Commissioning Agent.
P. Owner furnished equipment: Equipment furnished by the University shall be received, stored, uncrated, protected, and installed by the Contractor with all appurtenances required to place the equipment in operation, ready for use. The Contractor shall be responsible for the equipment as if he had purchased the equipment himself.

END OF SECTION 27 0500
SECTION 27 0526 - TECHNOLOGY GROUNDING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENT

A. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

1.2 SUMMARY

A. Section Includes

1. Busbars
2. Lugs
3. Grounding Accessories
4. Labeling Requirements

B. RELATED SECTIONS

1. Section 27 05 00 – Technology Common Work Results
2. Section 27 05 28 - Communications Systems Pathways
3. Section 27 10 00 – Structured Cabling
4. Division 26 - Electrical

1.3 QUALITY ASSURANCE

A. Codes, regulations and standards referenced in the Section are:

1. NFPA 70 – The National Electrical Code, including but not limited to, Article 250 Grounding and Bonding
2. IEEE 1100 – Recommended Practice for Powering and Grounding Electronic Equipment.
3. ANSI/TIA 607-B – Commercial Building Grounding and Bonding Requirements for Telecommunications.
4. ANII /TIA-606B – Administration Standard for Telecommunications Infrastructure.
5. BICSI TDMM – Telecommunications Distribution Methods Manual
6. Northwestern University Design Information Technology Building Infrastructure Requirements for Communications Systems
7. 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 product data sheets for the following additional items:

1. Busbars
2. Busbar accessories
3. Conductors
4. Lugs
5. Labels
6. Tools

C. Shop Drawings

1. The Contractor shall submit the following shop drawings:
   
a. A detailed riser diagram demonstrating the contractor’s understanding of the grounding system.

1.5 DELIVERY STORAGE AND HANDLING

A. The Contractor shall be 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.

1.6 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 MATERIALS

A. Conductors

1. Conductors shall be as specified within the materials and methods of Division 26, but shall be compliant with any additional requirements listed in this Section.
2. Conductors shall be insulated as appropriate for the environment for which they are installed. Where non-insulated conductors are used, they shall be insulated from contact with other bonded devices or building steel.
2.2 COMPONENTS

A. Busbars

1. All busbars shall be ¼” solid electro-tin plated copper.
2. All busbars shall be ASTM B187-C11000 compliant.
3. All busbars shall be UL and cUL listed to UL 467.
4. TMGB
   a. The TMGB shall:
      1) be a minimum of 20” long x 4” high,
      2) have a minimum of 24 pairs of 5/16” holes, and
      3) have a minimum of 3 pairs of 7/16” holes.
   b. The TGB shall:
      1) be a minimum of 20” long x 2” high (or 12” long x 4” high),
      2) have a minimum of 12 pairs of 5/16” holes, and
      3) have a minimum of 3 pairs of 7/16” holes.
   c. Acceptable busbars shall be:
      1) Panduit TMGB – GB4B0624TPI-1
      2) TGB – GB2B0312TPI-1
      3) Equal by Erico or Harger

5. Insulators
   a. All insulators shall be manufactured from an environmentally friendly, halogen free nylon material, reinforced with fiberglass.
   b. All insulators shall be 2” tall.
   c. All insulators shall meet UL 94 VO for self extinguishing.
   d. All insulators shall be provided in kit form with the busbar from the manufacturer of the busbar.

6. Brackets and Fasteners
   a. All brackets and fasteners shall be type 304 stainless steel.
   b. All brackets shall be 1/8” thick.
   c. All brackets and fasteners shall be provided in kit form with the busbar from the manufacturer of the busbar.

B. Lugs

1. All lugs shall be UL listed for use up to 35kV, temperature rated to 90 degrees C.
2. All lugs shall be two hole and shall have a long barrel construction with sufficient length to allow for two discreet crimps.
3. All lugs shall be tin plated to inhibit galvanic corrosion.
4. All lugs shall be constructed with an inspection window to visually assure full conductor insertion.
5. All lugs shall be tested by Telcordia, and be NEBS level 3 compliant.
6. All lugs shall be compliant with ANSI J-STD-607-B.
7. Acceptable lugs shall be:
C. HTAPs

1. All HTAPs shall be UL listed and CSA certified to 600V.
2. All HTAPs shall be contained in a crimp location for the main cable run and a minimum of one tap.
3. All HTAPs shall be designed for use with continuous cabling runs.
4. All HTAPs shall be tinned to inhibit galvanic corrosion.
5. All HTAPs shall come with a clear cover having a UL 94 V-0 flame rating and an oxygen index of 28 providing self-extinguishing, flame retardant properties.
6. Acceptable HTAPs shall be:
   a. Panduit Code/Flex Conductor HTAPs
   b. Equal by Burndy
   c. Equal by T&B or 3M

2.3 ACCESSORIES

A. Ground Straps

1. Straps shall be constructed of flexible tinned copper flat braid.
2. Straps shall utilize all compression flat lugs.
3. Strap kit shall come with a toothed lock washer for each bolt location
4. Acceptable Manufacturer and Kit shall be:
   a. Homaco GS8, or equal

B. Paint Piercing Ground Washers (PPGW)

1. PPGW shall not require paint scraping.
2. PPGW shall have a 3/8" stud
3. PPGW shall have machine cut spurs to provide the piercing action through any of the coating processes potentially encountered.
4. PPGW kits shall contain antioxidant treatment.
5. Acceptable PPGW shall be:
   a. Panduit RGW series.

C. Electrostatic Discharge (ESD) Port Kit

1. ESD Port kit shall contain one 3M 4mm plug socket that shall accept a standard 3M ESD wrist strap.
2. ESD Port kit shall contain antioxidant treatment
3. ESD port kit shall contain a thread forming screw designed to clear any paint that may exist within the screw thread.
4. ESD Port kit shall include one 3M ESD wrist strap.
5. Acceptable ESD Port kit shall be:
   a. Panduit RGESD-1.
6. Acceptable ESD wrist strap shall be as manufactured by:
   a. Panduit
   b. Or Equal, approved by NUIT.

D. Tools
   1. The crimp tools shall be capable of utilizing multiple heads, either rotating or replaceable
dies, which contain a die number able to be embossed into the lug.
   2. The crimp tools shall contain a physical means by which to notify the user that sufficient
pressure has been applied to the lug, and will not allow the tools to generate additional
pressure thereby damaging or destroying the cable retention.
   3. Acceptable Tools shall be:
      a. Panduit Contour Crimped Controlled Cycle Tools; Die Type, Manual Hydraulic, 14
         Ton, Crimping Tool; or, Die Type, Battery Powered Hydraulic, 12 Ton, Crimping
         Tool;
      b. Equal by Burndy
      c. Engineer Approved Equal.

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. General
      1. Technology System grounding and bonding shall be in accordance with the NEC and
NFPA. Horizontal Cables and equipment shall be grounded in compliance with
ANSI/NFPA 70 and local requirements and practices. Horizontal equipment includes
cross connect frames, patch panels and racks, active telecommunications equipment and
test apparatus and equipment. Provide a minimum of a # 6 AWG bonding conductor to
provide direct bonding between equipment located in a given area and the associated
TGB. Note that the Technology Grounding System shall be an independent system from
the Building Grounding Electrode System with the exception of the bond to the Building
Grounding Electrode System.
      2. The Technology Contractor shall bond all non-current carrying equipment provided by the
Technology Contractor including, but not limited to, cable trays, racks, wall fields,
protection devices, etc., to the local TGB.
3. The Electrical Contractor shall bond all non-current carrying equipment provided by the Electrical Contractor including, but not limited to, cable trays, conduit, back boxes, etc., to the local TGB.

B. Busbars
   1. All busbars shall be located as indicated on the Drawings, and installed in accordance with manufacturer’s suggested installation practices.
   2. All Busbars shall labeled as indicated on the Drawings and as enumerated elsewhere in these specifications.

C. Conductors
   1. All conduits routed through metallic conduit for greater the 12” shall be bonded to the conduit at both the point of entry and exit. A #6 AWG wire shall be used to bond the conduit.
   2. The Contractor shall keep all cabling continuous throughout the length of the run.
   3. All conductors shall be routed by means of a smooth radius turn consisting of a radius that is a minimum of 10 times the conductor diameter.
   4. Conductors 1/0 and greater shall make any required turns by means of a smooth bend with a radius of at least 48”.
   5. Conductors shall remain insulated from structure throughout the length of the runs other than that which is indicated on the Drawings. Should the conductor be required to route in open architecture through a plenum rated space, and have an outer jacket that is not plenum rated, the Contractor shall utilize a bare conductor cable encased in a plenum rated innerduct.
   6. Ground conductors routed below grade shall not be permitted to be run in a direct burial fashion. Ground conductors routed below grade shall be routed in a PVC conduit that is sized based on a 28% fill ratio.
   7. Any devices or equipment that requires bonding conductors to assure a continuous ground path shall utilize a ground strap as specified herein, or an accessory provided by the manufacturer of the device or equipment, designed specifically for the purposes of providing a continuous ground.

D. Lugs
   1. All lugs shall be affixed by applying two discreet crimps. The first crimp shall be made at the point closest to the screw holes, with the second crimp being made closer to the cable entry.
   2. Each crimp shall be made by means of a tool specifically designed for the purpose of crimping lugs, and having the capability of embossing the die number into the lug as the lug is crimped.
   3. The Contractor shall utilize the appropriate embossing die. The die shall be positioned on the crimp as recommended by the manufacturer, and so the embossed die number is easily visible.

E. Labeling
   1. Conductors/Cabling
      a. All cabling shall be labeled as to the source and destination room and busbar, as well as cable ID. Cable labeling shall be protected with a clear shrink tube covering as illustrated on the Drawings.
2. Busbars
   a. Each Busbar shall be labeled with the following information.
      1) Busbar name
      2) Source of ground
      3) Room being serviced
      4) Standard warning
   b. The label shall be screwed to the wall as indicated on the drawings utilizing the
      appropriate wall anchors for the type of surface to which the label is being applied.
   c. The label shall be located so as to be easily readable by a person of standard
      height standing in front of the busbar.
   d. The standard warning shall be: "WARNING – The device is an integral part of the
      Technology Grounding System. Do not disconnect. Should any portion of this
      system require servicing, contact NUIT."

3. Terminations
   a. All terminations shall be by means of irreversible crimp. Contractor shall utilize a
      crimp tool that provides an imprint of the dye used. Use the appropriate dye as
      recommended by the manufacturer for the gauge and crimp selected.

F. Terminations and Intersections of Equipment
   a. All points where a ground strap or ground conductor is attached to a device or
      piece of equipment, the Contractor shall utilize a paint piercing ground washer as
      specified herein.
   b. At intersections of equipment, such as perpendicular intersections of cable runway,
      the Contractor shall utilize paint piercing ground washer as specified herein.
   c. All racks shall be assembled utilizing paint piercing ground washers at each major
      intersections to assure complete continuity of ground.

3.3 FIELD QUALITY CONTROL

A. Site Test and Inspections
   1. All grounding shall be tested to assure a ground impedance of less than or equal to 1
      ohms.

B. Record Drawings
   1. Actual installation results shall be documented and submitted with the entire Record
      Drawing set as outlined herein.

C. System And Service Shutdown
   1. Should the Contractor need to shut down any system to perform any bonding, etc., the
      Contractor shall provide warning to the Owner as outlined elsewhere in these
      Documents.

END OF SECTION 27 0526
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. This section includes the following:

1. Telecommunications Backboard
2. Cable Tray
3. Cable Runway
4. Conduits
5. Boxes

B. Related Sections

1. Division 26 – Electrical.
2. Division 27 – Technology and Communications Systems
3. Division 28 – Electronic Safety and Security

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


I. Northwestern University Design Information Technology Building Infrastructure Requirements for Communications Systems
J. 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. Cable Tray
   2. Cable Runway
C. Samples
   1. The Engineer reserves the right to request, and have submitted, additional samples, or samples not explicitly requested within these Documents.

1.5 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.

1.6 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 MATERIALS
A. Telecommunications Backboards
1. Telecommunications Backboards shall be provided on three wall of each TR (Telecommunications Room). The Backboards and shall be 4' wide x 8' high x ¾" thick fire retardant plywood, painted with white paint.

B. Cable Trays

1. Wire Mesh
   a. Cable Trays shall be constructed of continuous, rigid, welded steel wire mesh, which shall permit continuous ventilation of cables and maximum dissipation of heat. Edges shall be constructed with a continuous safety edge T-welded wire lip, and shall be welded at all intersections.
   b. Cable Trays shall have a UL Classification.
   c. Cable Trays shall be constructed of carbon steel wire, ASTM A 510, Grade 1008, wire welded, bent, and surface treated after manufacturing.
   d. The finish for the carbon steel wire shall be applied after welding and bending of mesh, and shall be composed of Electrodeposited Zinc Plating: ASTM B 633, Type III, SC-1.
   e. Nominal Dimensions:
   f. Mesh: 2 x 4 inches (50 x 100mm).
   g. Straight Section Lengths: 118 inches (3,000 mm).
   h. Width: as noted on Drawings.
   i. Depth: 3 inches, unless otherwise noted.
   j. Wire Diameter: 0.177 inch (4.5 mm), minimum.
   k. Fittings shall not be required to be fabricated at the manufacturer. Fittings shall be fabricated in the field from straight sections in accordance with manufacturer's instructions, and shall utilize any and all specialized tools required by the manufacturer for proper installation.
   l. Standard support systems shall consist of wall mounting, trapeze mounting, and under floor mounting hardware – as described on the Drawings.
   m. Connecting hardware, including splice connectors and support components, shall be furnished by the manufacturer. Hardware required to enable the tray to be considered as being continuously grounded for the entire length shall be supplied by the manufacturer, and installed by the Electrical Contractor.
   n. Acceptable Manufacturer shall be:
      1) Cablofil
      2) Equal by Chalfant, B-Line or Flextray

C. Cable Runways

1. Cable runways shall be “ladder” type with 9” rung spacing and a black finish.
2. Straight Sections shall be one piece tubular construction. Side rails shall a box construction. Rungs shall be a box construction with a minimum of 3/4” wide and 1/16” radius edges with a minimum cable bearing surface of 7/8”. Rung shall be tig or mig welded to the web of the side rails. Standard length shall be 10 feet. Width shall be 12” minimum.
3. Material shall be steel.
4. Cable runways shall be built and tested to NEMA VE-1 and shall have a UL classification for cable runways to be used as an equipment grounding conductor.
5. Acceptable Manufacturers and Products shall be:
   a. Homaco Tubular Runway
   b. Equal by B-line or Chatsworth
6. Provide Radius Drops at all points where the cabling is routed down out of the runway or into runway from cable tray. The radius drops shall be as manufactured by the runway manufacturer.

7. Provide manufactured materials from the manufacturer of the cable runway for all connections and splices.

D. Boxes and Conduit

1. All boxes and conduit shall be new and UL listed.
2. All boxes and conduit shall be as specified under the Division 26 specifications.

E. In Floor Service Boxes

1. Floor Service Boxes shall be as specified under the Division 26 specifications.
2. For those locations indicated as being service points on the drawings, provide a box of sufficient size so as to proper bending radius for the quantities of cabling to be routed through this service box.

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. 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).

B. 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.

C. All horizontal pathways shall be designed, installed and grounded to meet applicable local and national codes.

D. Cable Tray and Runway

1. Provide straight sections, hangers, support rods, clamps, related fittings and mounting accessories as recommended by the system supplier. Provide pre-manufactured curved sections for systems created from hard tray materials as fabricated by the manufacturer of the cable tray system. Conflicts shall be brought to the attention of the Architect and Engineer for resolution.
2. For mesh cable tray systems, the Contractor shall, in areas of curvilinear architecture, provide smooth radiused sweeps when routing the tray.

3. The Drawings indicate intended routings. Contractor shall provide horizontal and vertical transitions as required to suit field conditions in order to meet routing requirements. Any deviation from the indicated route, either due to field conditions or coordination issues, causing an increase in the overall cable length by more than 10 feet must be brought to the attention of the Technology Engineer immediately, as these may affect the design of the pathway and the subsequent cable routing. Any unapproved routing of cable tray and runways not brought to the attention of the Engineer, causing such an outcome shall be corrected, and the responsibility for this correction shall be borne by the Contractor responsible for the installation of the cable tray.

4. Provide a minimum of 6” clearance above all cable tray sections from the finished structure of any device or equipment installed or routed above the cable tray.

5. The Contractor shall coordinate these clearances and the routing of the cable tray with all other trades prior to installation, and monitor the installation of the other trades during the progress of the project. The Contractor shall hold all other trades accountable to this coordination. Any deviation by other trades to this coordination effort shall be brought to the immediate attention of the GC or CM for immediate resolution.

6. Installation shall comply with NEC Article 392. Grounding cable trays as required in NEC Article 250. Cable trays and runways used as equipment grounding conductors shall be provided with bonding jumpers sized in accordance with NEC Section 250.102 between sections, raceways, and equipment. Bonding shall be in accordance with NEC Section 250.96.

7. Support of cable trays and runways shall meet NEMA Class 10A, at spans no greater than 6 feet to support 50 pounds/foot (safety factor 1.5).

8. Support all cable tray utilizing a trapeze with strut - using two 3/8” threaded rods with sections directly supported by and clamped to the strut, unless specifically directed otherwise on the Drawings.

9. Any cutting of mesh style trays shall be achieved by use of an offset cutting tool designed specifically for the process of cutting the spokes of a mesh style tray. The Contractor shall verify that all cuts are made in such a fashion, and treated, to assure the inability of the cut materials to damage the cabling routed through the tray with or during normal use.

E. Boxes and Conduit

1. All boxes and conduits shall be grounded, and installed per NEC, as well as any other applicable local, state or federal regulations and codes.

2. All conduit and box materials shall be designed for the environment in which it is to be installed.

3. Boxes
   a. All boxes, unless otherwise specifically indicated, shall be 4-11/16” square by 2-1/8” deep, with a two gang plaster ring, of appropriate depth for the wall material utilized in the application.
   b. Where pullboxes are utilized, conduits shall enter and exit the box on opposite sides of the box. The box shall not be used as the turning point of the cable.

4. Conduit
   a. Conduit shall be provided from the cable tray system to each communication outlet location.
   b. All conduit shall be a minimum of 3/4”.
   c. Conduit routes shall meet the following criteria:
1) No conduit bend shall exceed 90º.
2) Conduit bends must be no less than 6-inch radius.
3) No conduit route shall have more than two bends.
4) Continuous conduit runs shall not exceed 100 ft. nor contain more than two (2) 90º bends without utilizing appropriately sized pull boxes,

5. In Floor Service Boxes shall utilize a minimum of a 1” conduit. In Floor Service box conduits shall be individual home runs, and shall at no cost be daisy chained, i.e. configured so that a box feeds another box, unless explicitly indicated on the Drawings.

3.3 FIELD QUALITY CONTROL

A. Keep areas of work accessible until inspection by authorities having jurisdiction.

B. Where deficiencies are found, repair products so they comply with the Construction Documents.

C. Install work in full accordance with the rules, regulations, and safety requirements of Federal, State, County and City authorities having jurisdiction over premises. Do not construe this as relieving Contractor from compliance with any requirements of the Specifications which are in excess of Code requirements and not in conflict therewith.

D. Correct unacceptable workmanship and, as necessary, provide additional inspection to verify compliance with this Specification at no additional cost to the Owner or the Owner's appointed representative.

3.4 ADJUSTING AND CLEANING

A. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.

B. Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

END OF SECTION 27 0528
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
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) Interbuilding 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


   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
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
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.

\[\text{g. Horizontal Wire Management}\]

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:

<table>
<thead>
<tr>
<th></th>
<th>TR</th>
<th>Stub-up</th>
<th>Manhole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 5e</td>
<td>0'</td>
<td>10'</td>
<td>NA</td>
</tr>
<tr>
<td>Category 6a</td>
<td>0'</td>
<td>10'</td>
<td>NA</td>
</tr>
<tr>
<td>Fiber Optic – ISP</td>
<td>10’</td>
<td>10</td>
<td>NA</td>
</tr>
<tr>
<td>Fiber Optic – OSP</td>
<td>10’</td>
<td>NA</td>
<td>20’</td>
</tr>
</tbody>
</table>

   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. A minimum of three horizontal cables shall be routed to each Work Area, unless otherwise noted on the Drawings.

12. Horizontal pathways shall be installed such that the minimum bending radius of horizontal cables is kept within manufacturer specifications both during and after installation.

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 terminates 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