PART 1 GENERAL

1.01 SECTION INCLUDES
A. Communications system design requirements.
B. Communications pathways.
C. Copper cable and terminations.
D. Fiber optic cable and interconnecting devices.
E. Communications equipment room fittings.
F. Communications outlets.
G. Communications grounding and bonding.
H. Communications identification.

1.03 REFERENCE STANDARDS
A. EIA/ECA-310 - Cabinets, Racks, Panels, and Associated Equipment; Electronic Industries Alliance/Electrical Components Association; Revision E, 2005.
B. ICEA S-83-596 - Indoor Optical Fiber Cables; Insulated Cable Engineers Association; 2011 (ANSI/ICEA S-83-596).
C. ICEA S-90-661 - Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cables (With or Without An Overall Shield) For Use in General Purpose and LAN Communications Wiring Systems Technical Requirements; Insulated Cable Engineers Association; 2012. (ANSI/ICEA S-90-661)
D. NECA/BICSI 568 - Standard for Installing Building Telecommunications Cabling; National Electrical Contractors Association; 2006. (ANSI/NECA/BICSI 568)
E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
G. TIA-492AAAA-B - Detail Specification for 62.5-um Core Diameter/125-um Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers; Telecommunications Industry Association; Rev B, 2009.
I. TIA-492AAC-B - Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers; Telecommunications Industry Association; 2009.
J. TIA-492AAD - Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers; Telecommunications Industry Association; 2009.
P. TIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards; Telecommunications Industry Association; Rev C, 2009 (with Addenda; 2014).
R. TIA-569-C - Telecommunications Pathways and Spaces; Telecommunications Industry Association; Rev C, 2012 (with Addenda; 2013).
T. TIA-598-C - Optical Fiber Cable Color Coding; Telecommunications Industry Association; Rev C, 2005.
W. UL 444 - Communications Cables; Current Edition, Including All Revisions.
Y. UL 1651 - Fiber Optic Cable; Current Edition, Including All Revisions.
Z. UL 1863 - Communications-Circuit Accessories; Current Edition, Including All Revisions.

1.04 SUBMITTALS
A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
B. Sustainable Design Documentation: Submit manufacturer's product data on cable and cable insulation showing compliance with specified lead content requirements.
C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
D. Test Plan: Complete and detailed plan, with list of test equipment, procedures for inspection and testing, and intended test date; submit at least 7 days prior to intended test date.
E. Field Test Reports.
F. Project Record Documents.
   1. Record actual locations of outlet boxes and distribution frames.
   2. Identify distribution frames and equipment rooms by room number on contract drawings.
H. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

1.05 QUALITY ASSURANCE
A. Installer Qualifications: A company having at least 3 years of experience in the installation and testing of the type of system specified, unless otherwise approved by Michigan Tech Telecommunications.
B. Products: Listed, classified, and labeled as suitable for the purpose intended.
C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
1.07 DELIVERY, STORAGE, AND HANDLING
   A. Store products in manufacturer's unopened packaging until ready for installation.
   B. Keep stored products clean and dry.

1.08 WARRANTY
   A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
   B. Correct defective Work within a 2 year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Cabling and Equipment:
      2. Panduit; http://www.panduit.com
      3. Legrand; http://www.legrand.us

2.02 SYSTEM DESIGN
   A. Provide a complete permanent system of cabling and pathways for voice and data
      communications, including cables, conduits and wireways, pull wires, support structures,
      enclosures and cabinets, and outlets.
      1. Comply with TIA-568 (cabling) and TIA-569 (pathways), latest editions (commercial
         standards).
      2. Comply with Communications Service Provider requirements.
      3. Provide fixed cables and pathways that comply with NFPA 70 and TIA-607 and are UL
         listed or third party independent testing laboratory certified.
      4. In this project, the term plenum is defined as return air spaces above ceilings, inside
         ducts, under raised floors, and other air-handling spaces.
   B. System Description:
      1. Provide a one-to-one jack replacement unless otherwise specified.
      2. Install 4-cables and 4 jacks per jack location outlet unless otherwise specified.
      3. Provide additional outlets where indicated on drawings.

2.03 PATHWAYS
   A. Conduit: provide pull cords in all conduit.

2.04 COPPER CABLE AND TERMINATIONS
   A. Provide cables with lead content less than 300 parts per million.
   C. Copper Horizontal Cable:
      1. Description: 100 ohm, balanced twisted pair cable complying with TIA-568 and listed and
         labeled as complying with UL 444.
      2. Cable Type - Voice and Data: TIA-568 Category 6 UTP (unshielded twisted pair); 23
         AWG.
      3. Cable Capacity: 4-pair.
      4. Cable Applications: Use listed NFPA 70 Type CMR riser cable unless otherwise
         indicated.
      5. Cable Jacket Color – Blue for plenum, gray for riser.
      6. Product(s):
            1) Category 6E UTP Cable:
               (a) CommScope Model TE630P-BLRB: Type CMP Plenum Rated Cat 6E UTP
                   cable; 23 AWG.
               (b) CommScope Model TE630R-GYRB: Type CMR Riser Rated Cat 6E UTP
                   cable; 23 AWG.
D. Copper Cable Terminations: Insulation displacement connection (IDC) type using appropriate tool; use screw connections only where specifically indicated.

D. Jacks and Connectors: Modular RJ-45, non-keyed, terminated with 110-style insulation displacement connectors (IDC); high impact thermoplastic housing; suitable for and complying with same standard as specified horizontal cable; UL 1863 listed.
1. Performance: 500 mating cycles.
2. Voice and Data Jacks: 8-position modular jack, color-coded for both T568A and T568B wiring configurations.
3. Product(s):
      1) RJ45 Jacks:
         (a) CommScope Model 2-1375055-3: White SL Cat 6.
         (b) CommScope Model 2-1375055-7: Red SL Cat 6.
         (c) CommScope Model 2-1375055-2: Black SL Cat 6.
         (d) CommScope Model 2-1375055-8: Yellow SL Cat 6.

2.06 COMMUNICATIONS EQUIPMENT ROOM FITTINGS

A. Copper Cross-Connection Equipment:
3. Patch Panels for Copper Cabling: Sized to fit EIA/ECA-310 standard 19 inch (482.6 mm) wide equipment racks; 0.09 inch (2.2 mm) thick aluminum; cabling terminated on Type 110 insulation displacement connectors; printed circuit board interface.
   a. Jacks: Non-keyed RJ-45, suitable for and complying with same standard as cable to be terminated; maximum 48 ports per standard width panel.
   c. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA-606.
   d. Provide incoming cable strain relief and routing guides on back of panel.
4. Product(s):
      1) Patch Panels:
         (a) CommScope Model 1375292-1: 48 port unloaded.
         (b) CommScope Model 1933307-1: 24 port unloaded.

2.07 COMMUNICATIONS OUTLETS

A. Outlet Boxes: Comply with Section 26 0537.
1. Provide depth as required to accommodate cable manufacturer's recommended minimum conductor bend radius.
2. Minimum Size, Unless Otherwise Indicated:
   a. Data or Combination Voice/Data Outlets: 4 inch square by 2-1/8 inch deep (100 by 54 mm) trade size.
3. Surface Mount is allowed with the following configurations:
   a. 1” conduit to 4SQ box
   b. Panduit LD10 to JB1DIW
   c. Legrand V700 to V5748 or V5744-2
B. Wall Plates, Mounting Straps, and Modular Boxes:
1. Comply with system design standards and UL 514C.
2. Accepts modular jacks/inserts.
3. Wall plates should be used unless otherwise noted or approved.
3. Product(s):
      1) Wall Plates:
         (a) CommScope Model 2111009-1: Single Gang 2-port.
         (b) CommScope Model 2111011-1: Single Gang 4-port.
         (c) CommScope Model 83935-1: Double Gang 4-port
      2) Mounting Straps:
(a) CommScope Model 1116618-1: Duplex 2-port.
(b) CommScope Model 1339120-1: Duplex 4-port.
(c) CommScope Model 1479504-1: Decora 4-port.
2) Modular boxes:
   (a) CommScope Model 116698-1: 2-port.

2.08 GROUNDING AND BONDING COMPONENTS
A. Comply with TIA-607.

2.09 IDENTIFICATION PRODUCTS
A. Comply with TIA-606.

2.10 SOURCE QUALITY CONTROL
A. See Section 01 4000 - Quality Requirements, for additional requirements.
B. Factory test cables according to TIA-568.

PART 3 EXECUTION
3.01 INSTALLATION - GENERAL
A. Comply with latest editions and addenda of TIA-568 (cabling), TIA-569 (pathways), TIA-607 (grounding and bonding), NECA/BICSI 568, NFPA 70, and SYSTEM DESIGN as specified in PART 2.
B. Comply with Communication Service Provider requirements.
C. Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.
D. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

3.02 INSTALLATION OF PATHWAYS
A. Install pathways with the following minimum clearances unless otherwise:
   1. 48 inches (1220 mm) from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
   2. 12 inches (300 mm) from power conduits and cables and panelboards.
   3. 5 inches (125 mm) from fluorescent and high frequency lighting fixtures.
   4. 6 inches (150 mm) from flues, hot water pipes, and steam pipes.
B. Conduit, in Addition to Requirements of Section 26 0534:
   1. Arrange conduit to provide no more than the equivalent of three 90 degree bend(s) between pull points.
   2. Conduit Bends: Inside radius not less than 10 times conduit internal diameter.
   3. Arrange conduit to provide no more than 100 feet (30 m) between pull points.
   4. Do not use conduit bodies unless approved in specific location by Michigan Tech Telecommunications.
   5. Minimum Cover - Underground Service Entrance: Comply with NFPA 70 and Communications Service Provider requirements.
C. Outlet Boxes:
   1. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of telecommunications outlets provided under this section.
      a. Mounting Heights: Unless otherwise indicated, as follows:
         1) Telephone and Data Outlets: 18 inches (450 mm) above finished floor.
         b. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
         c. Provide minimum of 24 inches (600 mm) horizontal separation between flush mounted outlet boxes installed on opposite sides of fire rated walls.
         d. Unless otherwise indicated, provide separate outlet boxes for line voltage and low voltage devices.
         e. Locate outlet boxes so that wall plate does not span different building finishes.
f. Locate outlet boxes so that wall plate does not cross masonry joints.

3.03 INSTALLATION OF EQUIPMENT AND CABLING

A. Cabling:
   1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.
   2. Do not over-cinch or crush cables.
   3. Do not exceed manufacturer's recommended cable pull tension.
   4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.

C. Copper Cabling:
   1. Category 5e and Above: Maintain cable geometry; do not untwist more than 1/2 inch (12 mm) from point of termination.
   2. For 4-pair cables in conduit, do not exceed 25 pounds (110 N) pull tension.
   3. Use T568B wiring configuration.

E. Wall-Mounted Racks and Enclosures:
   1. Install to plywood backboards only, unless otherwise indicated.
   2. Mount so height of topmost panel does not exceed 78 inches (1980 mm) above floor.

H. Identification:
   1. Use wire and cable markers to identify cables at each end.
   2. Use manufacturer-furnished label inserts, identification labels, or engraved wallplate to identify each jack at communications outlets with unique identifier.
   3. Use identification nameplate to identify cross-connection equipment, equipment racks, and cabinets.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Comply with inspection and testing requirements of specified installation standards.

C. Visual Inspection:
   1. Inspect cable jackets for certification markings.
   2. Inspect cable terminations for color coded labels of proper type.
   3. Inspect outlet plates and patch panels for complete labels.
   4. Inspect patch cords for complete labels.

D. Testing - Copper Cabling and Associated Equipment:
   6. Category 5e and Above Backbone: Perform near end cross talk (NEXT) and attenuation tests.
   7. Category 5e and Above Links: Perform tests for wire map, length, attenuation, NEXT, and propagation delay.

F. Final Testing: After all work is complete, including installation of telecommunications outlets, and telephone dial tone service is active, test each voice jack for dial tone.

END OF SECTION