

# TELECOMMUNICATIONS SYSTEMS

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## PART 1 – GENERAL

### 1.01 REFERENCE REQUIREMENTS

The provisions of the General Conditions, Special Conditions, Program Requirements and Division 1, General Requirements, apply to the work of this Section.

### 1.02 SECTION INCLUDES

- A. Telecommunications service entrance.
- B. Premises wiring system.
- C. CCTV video system.

### 1.03 RELATED SECTIONS

- A. Shop Drawings, Product Data and Samples
- B. Product Record Documents
- C. Cast-In-Place Concrete
- D. Painting
- E. Wiring Materials and Methods
- F. Outside Power Transmission and Distribution

### 1.04 REFERENCES

#### ***Codes & Standards***

- A. Insulated Cable Engineers Association (ICEA)

ANSI/ICEA S-80-576-2002, Category 1 & 2 Individually Unshielded Twisted-Pair Indoor Cables for Use in Communications Wiring Systems

ANSI/ICEA S-84-608-2002, Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor

ANSI/ICEA S-90-661-2002, Category 3, 5, & 5e Individually Unshielded Twisted-Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems

ICEA S-102-700-2004, ICEA Standard for Category 6 Individually Unshielded Twisted-Pair Indoor Cables for Use in LAN Communication Wiring Systems Technical Requirements, 2004

- B. National Fire Protection Association (NFPA)

NFPA 70, National Electrical Code® (NEC®)

NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces,

NFPA 72, National Fire Alarm Code®

NFPA 75, Standard for the Protection of Electronic Computer/Data Processing Equipment

NFPA 76, Recommended Practice for the Fire Protection of Telecommunications Facilities

NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems

NFPA 101, Life Safety Code®

NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials

NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces

NFPA 780, Standard for the Installation of Lightning Protection Systems

NFPA 5000™, Building Construction and Safety Code

### ***Reference Standards***

A. Telecommunications Industry Association (TIA)

B. ANSI/NECA/BICSI 568-2006, Standard for Installing Telecommunications Systems

ANSI X3T9.5, Requirements for UTP at 100 Mbps

ANSI/TIA-526.7-A, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

ANSI/TIA-568.0-D, Generic Telecommunications Cabling for Customer Premises

ANSI/TIA-568.1-D, Commercial Building Telecommunications Cabling Standard

ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard

ANSI/TIA-568.3-D, Optical Fiber Cabling and Components Standard

ANSI/TIA-568-C.4, Broadband Coaxial Cabling and Components Standard

ANSI/TIA-569-D, Telecommunications Pathways and Spaces

ANSI/TIA-606-C, Administration Standard for Telecommunications Infrastructures

ANSI/TIA-862-B, Structured Cabling Infrastructure Standard for Intelligent Building Systems

ANSI/TIA-942-B, Telecommunications Infrastructure Standard for Data Centers

J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

T-526-14-C, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

TIA-598-D, Optical Fiber Cable Color Coding

TIA-604.3-B, FOCIS 3—Fiber Optic Connector Intermateability Standard, Type SC

TIA-604.10-B, FOCIS 10—Fiber Optic Connector Intermateability Standard, Type LC

TIA TSB-125, Guidelines for Maintaining Optical Fiber Polarity Through Reverse-Pair Positioning

TIA-758-B, Customer-owned Outside Plant Telecommunications Infrastructure Standard

TSB-155-A, Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T

***Other Reference Materials***

ANSI/NECA/BICSI-568-2006, Standard, Installing Commercial Building Telecommunications Cabling BICSI Outside Plant Design Reference Manual (COOSP), current edition.

BICSI Electronic Safety and Security Reference Manual (ESSDRM), current edition

BICSI Information Transport Systems Installation Methods Manual (ITSIM), current edition

BICSI Network Design Reference Manual (NDRM), current edition

BICSI Telecommunications Distribution Methods Manual (TDMM), current edition

BICSI Wireless Design Reference Manual (WDRM), current edition

Institute of Electrical and Electronic Engineers (IEEE)

National Electrical Manufacturers Association (NEMA)

Underwriters Laboratories (UL) Cable Certification and Follow Up Program

CommScope SYSTIMAX GigaSPEED X10D U/UTP Channel Performance Specification

CommScope SYSTIMAX SCS Generic Specifications: Fiber Optic Outside Plant Cable

SYSTIMAX 360 GigaSPEED X10D Solution; Design & Installation Guidelines

**1.05 QUALITY ASSURANCE**

- A. Contractor shall install work in accordance with the BICSI Telecommunications Distributions Methods Manual.
- B. Contractor shall install work in accordance with the SYSTIMAX® SCS Guidelines.
- C. Contractor shall test work in accordance with the SYSTIMAX® SCS Testing and Certification Guidelines. All fiber testing should be done following the SYSTIMAX Structured Connectivity Solutions Field Testing Guidelines for Fiber Optic Cabling Systems dated May 2016.

**1.06 SUBMITTALS**

- A. Before the installation of any wire or equipment, Contractor shall submit shop drawings and product data under provisions of, "Shop Drawings, Product Data and Samples" for University approval.
- B. Contractor shall indicate installation details, cable routing, system configuration, and outlet numbering on all shop drawings.
- C. Contractor shall submit all appropriate product data for each component.
- D. Contractor shall submit manufacturer's installation instructions.

## **1.07 PROJECT RECORD DOCUMENTS**

- A. Contractor shall submit record documents.
- B. Contractor shall accurately record location of service entrance conduit, termination backboards, outlet boxes, messenger cable raceways and cable trays, pull boxes, and equipment boxes on **compact disc (CD)** or using the latest version of AutoCAD.
- C. Contractor shall document the cable plant and associated equipment installation in accordance with parts 3.18, 3.19, and 3.20 in this Section.

## **1.08 QUALIFICATIONS**

- A. Installation of all wire, equipment, terminations and associated services shall be performed by a company that is currently a Authorized SYSTIMAX® SCS Business Partner (BP) in good standing with SYSTIMAX Solutions™; and has a minimum of (5) years of experience on similar SYSTIMAX® SCS systems. Prior to the final selection of the telecommunications sub-contractor, the main contractor shall submit its choice for telecommunications sub-contractor for the University's approval.
- B. The company specializing in supplying the products specified in this Section shall have a minimum of three (3) years' experience distributing such supplies, and shall be duly authorized by the product manufacturer.

## **1.09 MAINTENANCE SERVICE**

Contractor shall furnish warranty of SYSTIMAX® SCS products, applications, and workmanship for no less than 20 years from the date of acceptance by the University. All other non-SYSTIMAX products and workmanship shall carry warranties equal to or greater than the SYSTIMAX warranty from date of acceptance by the University

## **1.10 DEFINITION—STRUCTURED CABLING SYSTEM**

Structured Cabling Systems, Henceforth referred to as "SCS," wiring is defined as all required equipment and cabling including hardware, termination blocks, cross connect wiring, patch panels, telecommunications outlets, UTP and fiber light guide cable installed and configured to provide computer data and voice connectivity from each data or voice device to the network file server or voice network/ switch designated as the service point of the local area network.

## **PART 2 – PRODUCTS**

### **2.01 TELEPHONE TERMINATION BACKBOARDS**

- A. The Contractor shall install 3/4-inch fire resistant plywood with Class A surface in all communications rooms (BDF and ER/TR). Equipment Room (ER) and Telecommunications Room (TR)
- B. Termination backboards shall cover entirely, to a height of 8 feet, on one wall minimum within a communications room, to be determined by closet design and equipment installation.
- C. Minimum backboard size shall be 4' X 8' unless otherwise approved by the University

### **2.02 STATION COPPER CABLE**

A. All UTP station copper cable supporting voice and data communications requirements shall be SYSTIMAX® XX91B (where XX is either 10 or 20 depending on insulation type) with a BLUE jacket color, and shall meet the following technical specifications:

**Specifications:**

The SYSTIMAX® GigaSPEED® X10D Guaranteed Performance Specifications for 4-Connection GigaSPEED X10D Channels (1):

Guaranteed Performance Specifications for 4-Connection GigaSPEED® X10D U/UTP Channels		
Electrical Parameter	Current Claims	New Claims
Insertion Loss	3 %	3 %
NEXT	1 dB	3 dB
PSNEXT	2.5 dB	5 dB
ACR-N	3 dB	5 dB
PSACR-N	4 dB	6.5 dB
ACR-F	6 dB	6 dB
PSACR-F	8 dB	8 dB
Return Loss	>0 dB	1 dB
PSANEXT	>0 dB	2 dB
PSAACR-F	>0 dB	2 dB
Average PSANEXT	>0 dB	2 dB
Average PSAACR-F	>0 dB	2 dB

(1) Insertion Loss margin is calculated based on 2m of 95 series cordage and 88m of 91 series cable plus connections. If the total cord length in a 100m channel has to be greater than 2m, please refer to GigaSPEED X10D Design and Installation Guidelines for the instruction on how to scale cable and cord length properly.

Guaranteed Channel Performance Specifications for 4-Connection GigaSPEED X10D U/UTP Systems														
Freq (MHZ)	Insertion Loss (dB)	PS ANEXT (dB)	Ave. PS ANEXT (dB)	PS AACR-F (dB)	Ave. PS AACR-F (dB)	NEXT (dB)	ACR-N (dB)	PS NEXT (dB)	PS ACR-N (dB)	ACR-F (dB)	PS ACR-F (dB)	Return Loss (dB)	Delay (ns)	Delay Skew (ns)
1	2.2	80.0	82.25	77.0	81.0	73.7	71.5	72.3	70.1	69.3	68.3	19.0	580	40
4	4.0	74.0	76.23	65.0	69.0	64.0	60.0	62.5	58.5	57.2	56.2	19.0	562	40
8	5.6	71.0	73.22	58.9	62.9	59.2	53.5	57.6	52.0	51.2	50.2	19.0	557	40
10	6.3	70.0	72.25	57.0	61.0	57.6	51.3	56.0	49.7	49.3	48.3	19.0	555	40
16	7.9	68.0	70.21	52.9	56.9	54.2	46.3	52.6	44.7	45.2	44.2	18.0	553	40
20	8.9	67.0	69.24	51.0	55.0	52.6	43.8	51.0	42.1	43.2	42.2	17.5	552	40
25	9.9	66.0	68.27	49.0	53.0	51.0	41.1	49.3	39.4	41.3	40.3	17.0	551	40
31.3	11.1	65.0	67.29	47.1	51.1	49.4	38.3	47.7	36.6	39.3	38.3	16.5	550	40
62.5	15.9	62.0	64.29	41.1	45.1	44.4	28.5	42.6	26.7	33.3	32.3	14.0	549	40
100	20.3	60.0	62.25	37.0	41.0	40.9	20.7	39.1	18.8	29.3	28.3	12.0	548	40
200	29.2	55.5	57.73	31.0	35.0	35.8	6.6	33.9	4.7	23.2	22.2	9.0	547	40
250	32.9	54.0	56.28	29.0	33.0	34.1	1.2	32.2	-0.7	21.3	20.3	8.0	546	40
300	36.2	52.8	55.09	27.5	31.5	32.7	-3.5	30.8	-5.5	19.7	18.7	7.2	546	40
400	42.3	51.0	53.22	25.0	29.0	30.6	-11.8	28.6	-13.8	17.2	16.2	6.0	546	40
500	47.8	49.5	51.77	23.0	27.0	28.9	-18.9	26.8	-21.0	15.3	14.3	6.0	546	40

Guaranteed Channel Performance Margin for registered SYSTIMAX installations performed by a SYSTIMAX Business Partner in accordance with the GigaSPEED X10D Design and Installation guidelines.

Note: The table provides reference values only. All parameters comply with the governing equations given above over the entire frequency range. All values and equations apply to worst-case channels utilizing four-pair 91 series cables with full cross-connects, consolidation points and work area outlets (4 connections in a channel) for the length up to 100 meters.

- B. All copper cable and jumpers shall conform to the REA color guide meet NEC article 125-38, 3 (B) 1, 2 and 3.

### 2.03 RISER COPPER CABLE

All UTP riser copper cable supporting voice communications requirements shall be standard 24 gauge, paired dual, semi-rigid PVC skin over foamed PE, Superior Essex Cable - 50 pairs, and shall meet the following technical specifications:

COPPER VERTICAL RISER CABLES (NOTE: SYSTIMAX WILL EXTEND IT'S WARRANTY AND APPLICATION ASSURANCE TO COVER THE USE OF SUPERIOR ESSEX AEMM CABLE AS PART OF A TOTAL SYSTIMAX SCS)

The 24 AWG multi-pair copper cables shall be used as the vertical riser cables. The cable shall support analog voice service applications. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation and the multi-pair copper cables shall be in nonplenum form and placed in conduit as required.

The SUPERIOR ESSEX ARMM cables are a nonplenum cable and shall consist of solid copper conductors insulated with expanded polyethylene covered by a PVC skin, be conformance tested to meet EIA/TIA 568B for Category 3 cables, be UL and c(UL) listed as CMR. The core shall be overlaid with a corrugated aluminum sheath, which is adhesively bonded to an outer jacket of PVC plastic to form an ALVYN sheath.

### 2.04 UNDERGROUND COPPER CABLE

The installation of copper cables to buildings for analog services will no longer be required. In lieu of copper, UMD College Park will now do analog services using analog gateways. This equipment will be purchased at the same time, as the gear necessary for VoIP and Network services in each closet. In the event OSP copper cabling is ever required, the following information will apply:

The underground copper cable supporting analog communications requirements shall be 24 gauge, paired, dual-insulated with foam skin and plastic, flooded by FLEXGEL filling compound, Superior Essex ANMW, and shall meet the following technical specifications:

#### OUTSIDE PLANT COPPER CABLES

All voice grade wire and cable placed in the outside environment shall be solid, twisted pair, and multi-conductor. The copper twisted pairs shall have a mutual capacitance at 1kHz of 15.7 nF/1,000 ft. The cable shall be resistant to mechanical damage, lightning or damage from wildlife.

The buried or underground cable shall have an aluminum steel polyethylene (ASP) sheath and a core of solid-copper conductors, dual insulated with foam skin and plastic, surrounded by FLEXGEL III® filling compound.

### 2.05 CABLE PROTECTORS FOR COPPER CABLE

- A. For all pairs, Contractor shall install three-element gas protector modules, SYSTIMAX® 4R1AN-180, containing silicon avalanche on both ends.
- B. Contractor shall supply and install CommScope 110-Style Enterprise Grade BEPs, multi-pair protector panels in BDF and MDF.

### 2.06 FIBER OPTIC CABLE

- A. For single mode fiber, Commscope® TeraSPEED™ Central and Stranded Loose Tube Fiber (4 -288 strands) cable.
- B. For multi-mode fiber, Commscope™ LazrSPEED 500 OM4 Central and Stranded Loose Tube Fiber (4 -288 strands) cable.
- C. For riser fiber between BDF and all IDF's, is to be a 24sm/24mm (50 micron OM4) hybrid cable.

## **2.07 OPTICAL FIBER TERMINATIONS**

- A. All OSP and fiber riser for single mode fiber is to be terminated in a cartridge that holds 10 sm LC connectors and 2 sm APC/LC connectors per twelve strands. In the case of 24 strand or higher, strands 1-10 and 13-22 are LC. Strands 11, 12, 23 and 24 are APC.
- B. Multimode fiber (OM4) riser is to be terminated in a cartridge that holds 12 LC connectors.

## **2.08 OPTICAL FIBER PATCH CORDS**

The University will provide optical fiber patch cords as it relates to the University's voice and data systems.

## **2.09 CONNECTING BLOCKS AND FIBER SHELVES**

- A. All UTP riser copper cable shall be terminated on high-density, modular 110AW2-XXX, where XXX indicates pair capacity, connecting blocks.
- B. All UTP station copper cable shall be terminated on SYSTIMAX 360™ GigaSPEED X10D® 1100GS6 Evolve Category 6A U/UTP Patch Panel, 48 port 760152595 | 360-IPR-1100-E-GS6-2U-48. A SYSTIMAX equivalent patch panel may be substituted with approval by the Division of Information Technology.
- C. All optical fiber cable in Building Distribution Frame (BDF) rooms and Intermediate Distribution Frame (IDF) rooms shall be terminated in a CommScope Standard Density 1U Sliding Panel "SD-1U"
- D. All OSP optical fiber shall be terminated in the (Building Distribution Frame (BDF) in a SYSTIMAX® 1U Adapter Panel Sliding Fiber Shelf.
- E. CommScope TeraSPEED Cassette, 12 LC, No Pigtails. PNL-CS-12LCW
- F. CommScope TeraSPEED Cassette, 24 LC, No Pigtails. PNL-CS-24LCW
- G. CommScope TeraSPEED LC-APC Duplex Low Profile Adapter. AFA-LC02-GR/LP
- H. CommScope Qwik-II Connector, LC-APC Singlemode. SFC-LCF-09-8A-25
- I. CommScope Qwik-II Connector, LC-UPC Singlemode. SFC-LCF-09-8X-25
- J. CommScope LazrSPEED Cassette, 12 LC, No Pigtails. PNL-CS-12LCX
- K. CommScope LazrSPEED Cassette, 24 LC, No Pigtails. PNL-CS-24LCX
- L. CommScope Qwik-II Connector, LC, OM3/4/5. MFC-LCF-09-5X-25



## 2.10 EQUIPMENT RACKS

All equipment racks will be Ortronics "Mighty Mo 6" racks with the following accessories:

<u>Item</u>	<u>Ortronics Part #</u>
10.5" channel X 7' high rack	OR-MM6710
Vertical cable mgmt 10" x 13" x 7'	OR-MM6VMD710
Vertical cable mgmt 6" x 8" x 7'	OR-MM6VMD706
10.5 channel dust cover	OR-MM6BDC10

## 2.11 CCTV INTERBUILDING SYSTEM

All CCTV locations will consist of two (2) standard, eight (8) position, eight (8) wire modular RJ45 outlets.

### HEAD END EQUIPMENT

ZBT0080148, Z-Light 16TX, 16mW Fiber Transmitter w/AGC & Automatic Channel Load Control.

### BDF/MDF EQUIPMENT

T010070010 Fiber Coupler – 8, 1 x 8 Fiber Coupler

### IDF/TR EQUIPMENT

(Depending on number of TV's per closet)

- Z-Band, ZBT0100055, Z-Distribution ZHC 24F, 24 port 1U Video Hub 54-860MHz, w/AGC & Fiber RX Option Diagnostic Ready.
- Z-Band, ZBT0100054, Z-Distribution ZHC 16F, 16 port 1U Video Hub 54-860MHz, w/AGC & Fiber RX Option Diagnostic Ready.
- Z-Band, ZBT0100053, Z-Distribution ZHC 8F, 8 port 1U Video Hub 54-860MHz, w/AGC & Fiber RX Option Diagnostic Ready.

### TV/MEDIA DEVICE

ZBT0010021, Z-Balun QAM, Free Hanging Shielded Balun

## 2.12 OUTLET BOXES

A. All outlet boxes supporting voice/data communications requirements shall be double-gang, four (4) inch square, by two and one half (2.5) inch deep minimum galvanized steel boxes.

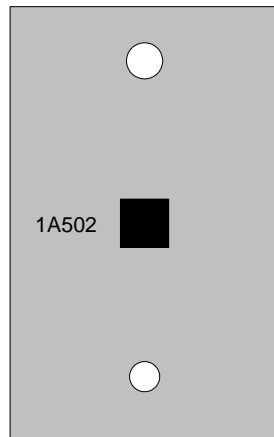
B. All outlet boxes supporting video communications requirements shall be single gang; two and one half (2.5) inch deep minimum galvanized steel boxes.

## 2.13 VOICE/DATA/CCTV OUTLETS AND COVER PLATES

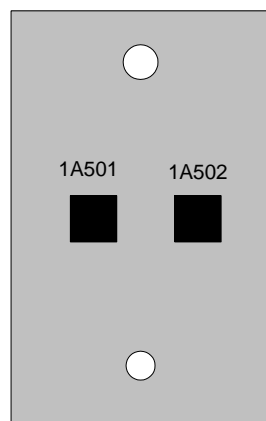
- A. All outlet plates shall be (SYSTIMAX® M12L-246 (108168477) faceplates for voice/data applications, and if required M20AP-246 modular covers filling unused portals.



- B, The outlet assembly to support voice, data or CCTV only communications requirements shall be one (1) eight (8) wire GigaSPEED X10D® MGS600 Series Information Outlet, **(760092361)** (BLACK) modular RJ45 outlet, wired per the 568B wiring standard The faceplate will be SYSTIMAX® M10L-246 **(108258419)** flush mounted faceplate.



- C. The outlet assembly supporting voice/data communications requirements herein referred to as a "standard" outlet shall be two (2) eight (8) position, eight (8) wire modular RJ45 outlets, **wired per the 568B wiring standard**. The SYSTIMAX® M12L-246 (108168477) flush mounted faceplate. shall consist of two (2) RJ45 outlets. The standard outlet is to be mounted in a vertical position with two (2) SYSTIMAX® MGS600-003 (760092361) (BLACK) modular RJ45 outlets.



- D. The "pin-out" wiring assignment for the 4-pair UTP copper cable for both voice and data shall be consistent with the TIA/EIA T568B Commercial Building Telecommunications Wiring Standard.

## **2.14 HORIZONTAL DISTRIBUTION CABLE MANAGEMENT SYSTEM**

### **A. Cable Tray Pathways**

1. Cable tray is required in all areas where horizontal cabling bundle quantity (copper, optical fiber and coax) exceeds 40 wires.
2. Cable tray shall be installed to the specifications of the manufacturer.

### **B. J-Hook Pathways**

1. J-hooks shall be utilized in all areas where bundle quantity is between 10 and 40 cables
2. All j-hook pathways shall be provided with a center hung, triple tiered, six-hook cable support system with a maximum spacing specified as not greater than four (4) feet. Contractor shall submit samples and cut sheets on proposed solutions.

## **2.15 DUCTBANK INNERLINERS**

Ductbank Innerliners are required for outside plant cable/fiber installation, Contractor shall furnish and install MaxCell inner duct. In one 4" conduit, the contractor should install two, 3 cell, inch and a half, MaxCell inner ducts.

## **2.16 CABLE LUBRICANT**

Cable pulling lubricant, Ideal Yellow 77 or a University approved equal, shall be utilized when required for pulling high-pair count riser and backbone cable.

## **2.17 COPPER CASES AND SPLICES**

- A. In the event of OSP copper installation, all outside plant (OSP) Cable Splice Cases shall be Preformed Line Products Stainless Steel with Filling Flange and must be filled with a University Approved re-enterable encapsulant.
- B. All entrance cases in the Patuxent Building; Building 010 shall be SYSTIMAX® Cable Rearrangement Facilities.

## **2.18 FIRESTOPPING**

- A. Contractor shall provide firestopping protection that shall meet NFPA Life Safety Code #101, 6-2.3.6, "Penetrations and Miscellaneous Openings and Fire Barriers" and the NEC 300.21 "Fire Stopping" regulations and standards.
- B. All vertical penetrations consisting of conduit, sleeves, or chases shall be firestopped at the bottom of the penetration.
- C. All horizontal penetrations consisting of conduit, sleeves of chases shall be firestopped on both sides of the penetration.

- D. Individual cable penetrations in plenum air return areas not enclosed in conduit shall be firestopped.
- E. Openings made in concrete floors shall be firestopped using a tested system. Thickness or depth of firestop materials shall be as recommended by the material manufacturer and backed by formal ASTM E-814 tests.
- F. Plenum air return ceiling penetrations for conduit and cables shall be sealed with a system appropriate for the substrate and level of protection required.
- G. All metal conduits designed for communications with or without wire/cable inside shall be firestopped to restrict transfer of smoke.
- H. On all areas where there is to be 4" sleeves/conduits through floors, or wall penetrations, contractor shall install a pre-manufactured fire rated pathway for future use.

**2.19 ELEVATOR PHONE**

In the event of a new elevator installation that does not come equipped with a phone or during a retrofit, the following equipment will be installed:

<u>Manufacturer</u>	<u>Description</u>	<u>Stock No.</u>
Talk-A-Phone Co. 5013 North Kedzie Ave. Chicago, IL 60625 312-539-1100	Hands-free Phone programmed to use campus circuit assurance equipment	EPT-100E

**2.20 OUTDOOR EMERGENCY PHONE**

The Contractor shall coordinate with the General Contractor to install the following campus approved Emergency Phone:

<u>Manufacturer</u>	<u>Description</u>	<u>Stock No.</u>
Talk-A-Phone Company 5013 North Kedzie Ave. Chicago, Ill. 60625 (773) 539-1100	Vandal resistant security unit with speakerphone, keypad, blue light, strobe, and camera arm.	ETP MTR OPT4 UMCP with ETP-400K Phone
	****Wall Mount for Garages and other locations as specified by the University.	ETP WM UMCP with ETP-400K Phone

All outdoor emergency phones will be wired with the following:

- A. 6 pair OSP cable terminated in the building on a protector in the nearest BDF/TR. The University will terminate the OSP at the phone unless contractor is otherwise instructed.
- B. 6 strand OSP sm fiber to be terminated in a rack mounted LIU, in the nearest BDF/TR to the point of entry into the building, from the emergency phone. At the phone end, fiber will be terminated in a Commscope enclosure WBE-EMT-BK-1P-PNL (760172288), including any necessary cartridges, panels, etc.
- C. Contractor will install a sm fiber riser between the closet with the emergency phone fiber and the designated Security Closet.
- D. Contractor will install one (1) 20 amp double duplex outlet at the base of each phone. All components of the phone assembly will be plugged into this power. **(Do not hardwire any electrical components)**

## PART 3 – EXECUTION

### 3.01 SYSTEM DESIGN

- A. The cabling system to support voice, data, and video requirements has been designed in accordance with BICSI, EIA/TIA, NFPA, NEC, SYSTIMAX® SCS Design, Installation and Testing Guidelines, IEEE, and FCC communications.
- B. The proposed cabling system has been designed and shall be installed in a manner that provides mechanical integrity and symmetry for the cabling media and any associated frames and racks and which also furnishes ease of access and suitability for future rearrangements and changes.
- C. The transmission media shall be installed through a network of cable trays, conduit, sleeves, and chases and interconnect the various rooms and floors of the building.
- D. All IDF and/or BDF should have four 208/30 amp power outlets with L6-30R receptacles. The sources of this power should be two from normal building power and two from emergency power. If no emergency power is available, then install four normal power outlets, two, from two different panels. There should also be at least one 20 amp courtesy outlet in each room.
- E. Telecommunications Closet Design Requirements (BDF and IDF)
1. BDF
    - a. BDF shall be located on lowest level of building.
    - b. BDF shall be at least 200 square feet.
    - c. BDF width and depth shall be 12 feet minimum.
    - d. BDF shall have four sources of power; normal building power and UPS power (see 3.01d for UPS power distribution).
    - e. BDF shall have card access through the Department of Public Safety Lenel System.
    - f. BDF shall be cooled through the building HVAC, or stand-alone system (to be determined during design) including dust filtering of all pathways, penetrations, venting and doorways.
  2. IDF (All Telecommunications Closets)
    - a. TR(s) must be placed such that the longest station run is less than 90 meters from outlet termination point to the cross connect.
    - b. TR(s) shall be sized to accommodate, unencumbered, 4' of access on three sides of a two-post rack or multiple racks.
    - c. TR(s) shall be "stacked" one above the other, if possible.
    - d. 4" conduits (or sleeves where appropriate) shall be installed to accommodate current needs plus 100% growth.
    - e. Office grade HVAC, or stand-alone system shall be provided, including dust filtering of all pathways, penetration, venting and doorways.
    - f. TR(s) shall have four sources of power, normal building power and UPS power (see 3.01d for UPS power distribution).
    - g. TR(s) shall have card access through the Department of Public Safety.
- F. Determination of station quantities—quantity and placement of outlets, as well as outlet labeling assignments, shall be shown on the floor plans.

### 3.02 FORBIDDEN WORK

- A. Other than the entrance splice, no cable splices shall be allowed within buildings.
- B. Aerial cable construction shall not be permitted.

**3.03 EXAMINATION**

- A. Contractor shall verify that surfaces are ready to receive work.
- B. Contractor shall verify that field measurements are as shown on the CDT's Construction Drawings approved by the University.

**3.04 INSTALLATION OF BACKBOARDS**

- A. All backboards shall be supported as specified under provisions of "Wiring Materials and Methods."
- B. All backboards shall be marked with the legend "COMM" under the provisions of Section 16915.

**3.05 CABLE PULLING**

Contractor shall utilize cable-pulling lubricant for all pulls in conduit ducts or innerliners. Not less than three (3) gallons per kilometer shall be used.

**3.06 COORDINATE WITH OTHER TRADES**

- A. Cable routing shall be designed and installed so that cabling and associated equipment does not interfere with the operation or maintenance of any other equipment. No wiring shall be hung, tied to, or supported from anything other than telecommunications raceway or the building structure.
- B. All cable in accessible spaces shall be designed and installed for easy access. Cable paths above suspended ceilings, mechanical rooms, closets, etc. shall not be blocked or covered in any way that would impede the addition of cable in the future.

**3.07 CONDUIT INSTALLATION**

- A. To support voice and data communications requirements, Contractor shall install one (1) inch conduit from the outlet box stubbed into the accessible ceiling for a maximum of three Category 6A cables. If additional cabling is required to an outlet, conduit must be sized accordingly to meet product specifications. Contractor shall conform to the Conduit Installation Schedule in Section 16100 for selection of appropriate conduit type. All telecommunications wiring shall be concealed in conduit or in the ceiling.
- B. Conduit sleeves shall be four (4) inch trade size minimum. Sleeves shall be Rigid Galvanized Steel for penetrations of concrete slabs, concrete walls, and CMU walls. Sleeves for penetrations of stud walls shall be EMT. All sleeves shall be rigidly installed using appropriate fittings and all masonry penetrations shall be grouted. Sleeves shall project a minimum of six (6) inches beyond wall or floor surface. All penetrations of fire rated construction shall be firestopped with fire-stopping as specified in Part 2.16 of this Section to equal or exceed fire rating of the penetrated material. Sleeves for penetration of walls and floors shall have one hundred percent (100%) spare capacity, and shall be firestopped as per code. See 2.02H regarding the installation of fire-rated pathway products.
- C. Any section of conduit containing two (2) 90-degree bends, a reverse bend, of having length greater than one hundred (100) feet shall have an accessible pullbox. All conduits with less than a 50% fill ratio shall have a 3/32-inch polyethylene pull cord approximately secured at each end.
- D. No oval or square conduit fittings shall be permitted. No screw type fittings shall be permitted.

- E. All metallic conduit and raceways shall be appropriately grounded as specified in the National Electric Code.
- F. Supports and fasteners shall be used to hold all cables, conduits, and trays firmly in place. Supports and fasteners shall be used such that they provide an adequate safety factor. All conduit/cable trays shall be supported from the building structure and not from any other ductwork, pipes, ceiling tiles, or equipment.
- G. Where cable trays or conduit are not provided (especially between the stubbed out conduit and the nearest cable tray). Kindorf lay-in pipe hangers, or a University approved equal shall be installed. The lay-in pipe hanger shall be attachable to a floor slab through the use of a pre-threaded lead insert, which is suitable for installation of a 3/8-inch "all-thread" rod in a predrilled 1/2-inch hole. The threads of the closure bolt on the pipe hanger shall be covered by 3/8-inch copper or aluminum tubing to protect the cabling sheaths.
- H. Cables placed in hangers in the plenum ceiling area shall be routed high and away from all other electrical and mechanical systems so as to avoid contact with light fixtures, ventilation ducts, sprinkler systems or plumbing piping, motors, or any other electrical devices. The cable shall not be run in parallel with any high voltage electrical wiring. The maximum separation between support points for all cabling shall be eight (8) feet. Lay-in pipe hangers shall be installed so as to accommodate these maximum distance spacing. Hangers shall be installed at directional bend points so as to provide a maximum bend angle of 45 degrees for the supported cabling.
- I. Contractor shall install 3/16-inch polyethylene pulling string in each empty conduit, and appropriately secured at each end.

### **3.08 COMMUNICATIONS EQUIPMENT ROOMS**

- A. The communications equipment rooms supporting voice, data, and video requirements are identified on the construction documents.
- B. Prior to the installation of any equipment in any of the communications rooms, the Contractor shall provide room layouts, for University approval, for each of the rooms listed above showing the proposed locations of all backboards, termination blocks, distribution panels, security boxes, control boxes, power supplies, etc. required for all communications systems, which is part of this specification.
- C. Cable must be installed such that station wire runs from the outlet to the cross connect do not exceed 90 meters.
- D. Grounding shall be #6 AWG wire provided to each communications equipment room in accordance with ANSI/NFPA 780.
- E. All walls, ceilings and floors must be made non-porous with paint or sealant to minimize dust.
- F. Sleeves or conduits from outlets shall penetrate closet walls at a height above the plywood panels and extend only far enough to install bushings.
- G. Hardware shall be installed plumb and level on the wall backboards. Appropriate wire management shall be installed so that jumper, cross connects, and patch cord wires can be installed in a neat and orderly fashion.
- H. Equipment racks shall be installed level, to manufacturer specifications, and shall be so that jumpers and patch cords can be installed in a neat and orderly fashion. Contractor will install (1) one equipment rack installation of network infrastructure hardware. Contractor will install fiber termination shelves at the top of the rack, unless otherwise instructed. Contractor shall appropriately ground all equipment racks in accordance with the National Electric Code (NEC).

### **3.09 STATION CABLING AND INSTALLATION**

- A. All voice, data, fiber, and video outlets shall be installed in the locations that are conspicuously marked in the building floor plans. If there is a question as to the location of any outlet it shall be brought to the attention of the University prior to installation.
- B. Prior to installing any cabling, drawings indicating all jack numbering shall be submitted by contractor for approval.
- C. All outlets supporting voice and data communications requirements shall be wired with two (2) (SYSTIMAX® XX91) 4 pair UTP copper cables as specified in Part 2.02 of this section.
- D. Data jack for wireless access: All wireless access points will be located above an accessible ceiling in areas designated by the University. If areas designated for wireless access do not have accessible ceilings, jack location is at the discretion of the University.
- E. Fiber jack: The station fiber pairs for singlemode and multimode fiber will be terminated at the outlet in individual outlet boxes separate from other cabling, and in fiber termination shelves mounted at the top of the equipment racks. Where possible, copper and fiber will not share a wall outlet.
- F. The terminations in the BDF and TR's of all UTP riser copper cable shall be on rack mounted 110 termination field.
- G. The terminations in the BDF and TR's of all UTP station copper cable shall be on patch panels.
- H. All wiring supporting voice and data communications shall conform to IEEE 802.3 100Base-T, and 100 Base-T, 1000 BaseT and 10GBaseT wiring standards.
- I. All wiring shall meet Category 6A standards.

### **3.10 RISER CABLING AND INSTALLATION**

- A. In the BDF and all TR's, connecting blocks shall be modular, high-density, 110-type or a University approved equal, with clear protective covers. All telecommunication rooms shall be grounded by means of a #6 AWG insulated copper ground wire connected to the building ground system. The BDF shall also have gas element surge protection with sneak fuses adequate for protecting all circuits entering the building.

Note: All closet layouts shall be approved by the University before installation of any equipment or termination of any wiring.

- B. Contractor shall install 50 pair UTP vertical copper cabling between the BDF and each TR to support analog voice communications requirements.  
  
Each riser cable shall be homerun from the BDF to each TR in the conduit and sleeves provided. In both the BDF and TR, the cable pairs shall be terminated on 110 connecting blocks and appropriately cross-connected to the UTP horizontal copper cabling (in the TR) and the UTP backbone copper cabling (in the BDF), if necessary.
- C. Riser Optical Fiber Cabling: Contractor will install and terminate from the BDF fiber shelves to each of those TR's, 24 strands of singlemode fiber and 24 strands of multimode fiber . All optical fiber riser will be terminated on shelves mounted at the top of the equipment rack.
- D. "Kellums"- type basket hangers, or a University approved equal, shall be installed on all riser cables to provide independent support of cables passing through conduit sleeves installed in floor slabs. Hangers shall have a maximum separation of twelve (12) inches.



**3.11 UNDERGROUND CABLING AND INSTALLATION**

- A. In the event OSP copper cable is installed, the contractor shall install UTP underground copper cabling between the BDF and the **MDF** (Main Distribution Frame located in Patuxent Building, Building 010) to support analog voice and data communications requirements (as specified in Part 2.04 of this Section). The underground cable shall run in the appropriate ductbank and manholes. The contractor shall terminate the underground cable in the cable vault of Building 010 in a University approved Rearrangement Facility (vertical splice case). The pairs shall then be run into the frame room of building 010 and terminated on Contractor provided protector panels, and extend tails to 110 fields, as directed by the University. The Contractor shall make terminations in the BDF, utilizing 110-Style Enterprise Grade multi-pair protector panels and extend tails to 110 fields. The Contractor shall also provide new frame racks to support the protector units. The size of the copper underground cable shall be XXXX pairs. The Contractor shall use the largest size of cable applicable.  
**Note:** In the MDF/BDF the contractor will install a copper tie cable, equal to the number of the OSP copper, and mount it to a rack mounted 110 style connecting block.
- B. Contractor shall install single mode optical fiber backbone cabling between the BDF and the ER to support data communication requirements (as specified in Part 2.06 of this Section). The underground single mode optical fiber shall run in innerliner (as specified in Part 2.17 of this Section) in the appropriate ductbank and manholes. The single mode optical fiber shall be terminated on both ends utilizing a Contractor provided **SYSTIMAX® 360G2-1U-MOD-SD (760193771) Fiber Optic Terminating Unit, with 360DP-12LC-SM (760109389) adapters** *The size of the backbone single mode optical fiber cable shall be 24 strands from two different network hub locations. On all apparatus terminating both ISP and OSP single-mode fiber, the last two strands of fiber in a count should be APC connectors, i.e. for a twenty four strand SM fiber, 1 - 10 are standard SM LC's, 11 -12 are SM LC-APC's, strands 13 – 22 are standard SM LC's and strands 23 – 24 are SM LC-APC's.*
- C. Whenever termination points for single and multi mode fiber are the same, a hybrid cable shall be utilized, when available.

**3.12 OUTLET BOX INSTALLATION**

Unless otherwise noted on the drawings, outlets shall be securely and neatly installed at the height specified in the following table:

Standard Telephone Outlets:	1ft 6 inches above Finished Floor (AFF)
Wall Mounted Telephone Outlets:	4ft 6 inches AFF
Wall Mounted for Head On	
Wheelchair Access:	4ft 0 inches AFF
Service Counter Areas:	0ft 8 inches above counter work surface

**3.13 DUCTBANK DESIGN, CONSTRUCTION, AND UTILIZATION**

- A. In the event copper OSP cable is installed, the contractor shall install XXXX pairs (specified and approved by the University) of multipair, UTP copper cable between the BDF and the Patuxent Building (Building 010). Prior to the termination of this cable in the Patuxent Building, Contractor shall verify its termination location with the University.
- B. Contractor shall install a 24 strand single mode optical fiber cable, from two different locations, between the BDF and the two points determined by the University. (These two points will be from two existing network hubs, or existing manholes, or a combination of both. Prior to termination of this cable in the Patuxent Building, Contractor shall verify its termination location with the University.

- C. Contractor shall install new concrete encased ductbank and manholes and/or install new concrete encased ductbank between existing manholes to accommodate the outside plant needs of the facility as directed by the University. The contractor shall submit proposed pathway for University approval.
- D. Any duct supporting optical fiber or copper will require the installation of two, 3-cell Maxcell innerducts. In the event of a larger cable being installed, the remaining duct space will be filled with inner duct. Optical fiber and copper in the specified amounts above shall be run in separate innerducts. Ductbank shall be engineered to accommodate the required twisted pair and fiber optic cable needs plus one hundred percent (100%) spare capacity.
- E. All ductbank shall conform to the provisions of "Outside Power Transmission and Distribution", and shall be arranged in a rectangular fashion. Only four (4) inch PVC "type B" conduit shall be used for communication ducts. No section of ductbank shall have more than a sum of 180 degrees of bends without the installation of a manhole.
- F. Ductbanks shall have a minimum of (30) thirty inches cover over encasement. There shall be twenty-four (24) inch minimum clearance between communications ductbank encasement and any other utilities.

**Note: NO EXCEPTIONS WILL BE MADE WITHOUT PRIOR APPROVAL OF THE UNIVERSITY**

- G. Concrete encased, galvanized intermediate weight rigid steel conduit shall be used instead of PVC or polypropylene wherever ductbanks cross roads, parking lots, or buried steam lines. Steel ducts shall extend ten (10) feet on either side of the crossing. At steam line crossings, encasement shall be covered with an aluminum reflector.
- H. All spare ducts or those with less than twenty-five percent (25%) fill shall have a one-quarter (1/4) inch polypropylene pull wire appropriately secured at each end. All vacant innerducts or those with less than twenty-five percent (25%) fill shall have a 3/16- inch polypropylene pull wire appropriately secured at each end.
- I. All ducts shall be pneumatically rodded using a University approved slug of one-quarter (1/4) inch diameter less than the duct inner diameter.
- J. All ducts, including spares, shall be sealed watertight with expandable urethane foam at both ends.

**3.14 MANHOLES**

- A. Manholes shall have inside dimensions 6 feet Wide x 12 feet 1 inch deep x 7 feet High (6'-0"W x 12'-1"D x 7'0"H) minimum.
- B. Manholes shall conform to the provisions of "Outside Power Transmission and Distribution". All steel equipment shall be hot dipped galvanized. All manholes shall have at least one (1) 7/8-inch diameter steel-pulling eye in the wall opposite each duct entrance. Pulling eyes shall be welded to the reinforcing rods at the time of manhole fabrication. Each manhole shall be equipped with at minimum four (4) cable racks, two (2) per long side, that have adjustable hooks adequately sized to support the hardware. Manhole covers shall have the designation "COMM" cast on the cover.
- C. New ductbank shall be appropriately doweled to existing manholes.

**3.15 CONNECTION TO EXISTING SYSTEM**

- A. Splicing shall only be allowed in manholes or at building entrance locations. No splices shall be allowed in any other location in the new facility or in any ducts or innerliner. Splice cases in manholes shall be securely supported by support hooks on the cable racks not more than two (2) feet away from

the splice case. Before closure, all splices shall be offered for inspection by the University and certification of workmanship by **CommScope**.

- B. Contractor shall make all cross-connections in each TR to connect the first pair of each voice UTP horizontal copper cable to the facility copper riser system.
- C. Contractor shall connect to University video network at the University's direction.

### **3.16 RE-ROUTING OF EXISTING UNDERGROUND CABLES**

- A. Contractor shall re-route any voice, data, and video cables that are currently located in the space where the new facility is to be constructed to new or existing manholes. The re-routing and manhole locations are conspicuously identified on the site plan of the drawings.
- B. Contractor shall notify the University at least two (2) weeks in advance prior to any outage, re-routing any existing voice, data, and video cables; and the outage shall be scheduled at the convenience of the University.
- C. Any cable that is re-routed must be re-terminated and tested according to the termination and testing requirements as described in Part 3.19 of this Section.

### **3.17 CCTV SYSTEM INSTALLATION DESIGN - BUILDING INTERIOR**

**All electronic equipment will be purchased as part of the IT equipment list provided by the Division of Information Technology. The following is for design purposes only. The basic fiber and copper infrastructure are to be provided by others.**

- A. Install a ZBT0080148, Z-Light 16TX, 16mW Fiber Transmitter w/AGC & Automatic Channel Load Control Transmitter in the Head-End located currently in building 147 (Hornbake Library). The University will make the final fiber connection to the transmitter.
- B. Install a T010070010 Fiber Coupler – 8, 1 x 8 Fiber Coupler Receiver in the BDF/MDF of the new building. The University will make the final fiber connection to the receiver.
- C. Depending on number of TV's per IDF/TR closet, install the following 8, 16 or 24 port model:
  - Z-Band, ZBT0100055, Z-Distribution ZHC 24F, 24 port 1U Video Hub 54-860MHz, w/AGC & Fiber RX Option Diagnostic Ready.
  - Z-Band, ZBT0100054, Z-Distribution ZHC 16F, 16 port 1U Video Hub 54-860MHz, w/AGC & Fiber RX Option Diagnostic Ready.
  - Z-Band, ZBT0100053, Z-Distribution ZHC 8F, 8 port 1U Video Hub 54-860MHz, w/AGC & Fiber RX Option Diagnostic Ready.
- D. Depending on the number of TV's or media devices using the CCTV system, install the following for each location:
  - Install a standard two (2) cable, eight (8) position, eight (8) wire modular RJ45 outlet.
  - Install a ZBT0010021, Z-Balun QAM, Free Hanging Shielded Balun.

### **3.18 CABLE PLANT LABELING**

- A. All labeling shall be clear, securely affixed, and consistent on both ends of each installed cable. The University shall approve all labeling in advance.
- B. The labeling of outlets and TR hardware shall be permanently engraved in the field by the Contractor according to the following numbering system:

1. Each outlet identification code shall consist of five (5) characters.
2. The first character shall indicate the floor of the building where the communications room serving the outlet is located. The number 0 (zero) shall be used for the ground floor, 1 (one) for the first floor, etc. The letter B shall be used for basements, S for sub-basements, and M, N, and P for mezzanines.
3. The second character shall be used for the communications room identifier. The letters A through Z (except I and O) shall be used and the University will specify the character to be used for each communications room.
4. The last three (3) characters shall denote the number of the outlet. **All outlet numbering will begin at 001.**

Example: An outlet labeled 1A006 means first floor, TR "A", outlet number 006.

Horizontal Fiber Cable Ports have six positions. Positions 1 and 2 show the Telecom Room Number to which the cable is attached. Position 3, 4 and 5 are sequential numbers between 901 and 999. Position 6 is the letter "F". Fibers are used in pairs and each pair has a jack number. Horizontal fiber cables are in a 6 strand cable. So, each Horizontal fiber drop will have 3 jack numbers. Fiber Cable Example for a single Horizontal drop from TR – 2C901F, 2C902F, 2C903F.

- C. The (5)-five character code for each outlet shall be permanently marked on the outlet, as well as on the corresponding IDF blocks. In addition, each outlet shall be labeled in advance on all telecommunications drawings.
- D. If installed, all coaxial cable shall be labeled with an outlet number consistent with the closest communications outlet.
- E. All UTP copper riser and underground cable termination blocks shall be labeled with white 110 label strips and shall indicate pair count and destination closet. Voice riser shall be labeled separately.
- F. Underground cable protector units shall be labeled with green 110 label strips reflecting cable pair count and cable number. Underground cable in manholes shall be labeled with engraved brass tag showing cable number where entering and exiting manhole.
- G. All optical fiber riser and underground cable termination panels shall be labeled with fiber strand count, destination closet, and "SMOF, or "HYB" to indicate cable type. The underground frame shall be labeled with the fiber strand count, fiber number, and fiber optic hub building number. Underground cable in manholes shall be labeled with engraved stainless steel tag showing cable number where entering and exiting manhole.
- H. All underground coaxial cable shall be labeled on each end with brass tag marked with the building number and designated as a coaxial feed cable.

### 3.19 TESTING AND ACCEPTANCE

- A. Prior to acceptance, all "As-Built" and technical documentation shall be received and approved by the University. As-built documentation shall include the completed **SYSTIMAX® SCS 20 Year Extended Product Warranty and Application Assurance Program certificate**. All intrabuilding and interbuilding wiring and equipment, and all site restoration shall be installed and completed in accordance with University and industry standards. All wiring and equipment provided and/or installed under this Contract shall be tested as described under the terms of this Contract and shall be fully operational. After all work is complete, the Contractor shall also provide the University with SYSTIMAX® SCS Certification for all communications work completed on the project.

- B. All copper cable plant testing shall diagnose, at a minimum, the presence of all open-loop conductors, noisy lines and distortion, low-loop current, high-loop current, ringer failures, grounded, shorted or crossed conductors, dB loss, and split connections. Contractor shall perform a continuity test on all pairs installed in the cable plant, both inside and outside the new facility. The testing shall cover end-to-end, from the outlet to the TR and the BDF to the Patuxent Building (Building 010). In addition, all tests described above shall be performed on a randomly selected pair per twenty-five (25) pair binder group of the copper riser cable. If this random selection is bad, additional testing shall be done to ensure that ninety-nine percent (99%) good pairs exist. The Contractor shall supply complete testing and correction reports to the university for review prior to acceptance of the system. For copper pairs used for any voice/data outlets, the Contractor shall perform such additional testing as required to verify that pairs meet the transmission parameters required for **10base-T and Category 6A (SYSTIMAX® X10D) wiring specifications**. The University shall have final approval on the format used for recording and reporting of test results prior to the start of testing activities.
- C. Optical fiber cable testing shall, at a minimum, quantify the attenuation range, optical loss, bandwidth, and misalignment. The cable completion tests shall be performed after all optical fiber cable has been placed and all splicing completed. All optical fibers shall be tested at both 850nm and 1300nm. For outside plant fiber, testing shall include two-way testing using an Optical Time Domain Reflector (OTDR), and one-way testing using a Multimode Optical Loss Test Set (MOLTS). For optical fiber installation between the BDF and an TR, the contractor shall provide two-way loss testing through the use of MOLTS. Two-way MOLTS testing shall also be performed on station fiber terminated for testing purposes. All fiber testing should be done following the SYSTIMAX Structured Connectivity Solutions Field Testing Guidelines for Fiber Optic Cabling Systems dated May 2016. All traces and results shall be provided to the University for approval. Protective covers shall be in place on all connectors when they are not in use to protect against contamination by dirt or dust. Any fiber found to be defective a result of installation, physical inspection, or operational test shall be replaced at the Contractor's expense.

### 3.20

#### AS-BUILT DOCUMENTATION

- A. The contractor shall provide the following outside plant wiring information, prior to acceptance of the building by the University, for each of the specified media:
1. Cable identification number (Copper, Fiber).
  2. Cable design makeup (Copper, Fiber).
  3. Cable lengths between splice points, (Copper, Fiber,)
  4. Exact routing of cable (Copper, Fiber).
  5. Splice location and identification (Copper, Fiber).
  6. Strand count, mode of installed fiber, loss per splice in dB, and total amount of optical fibers installed (Fiber).
  7. Bonding and grounding (Copper, Fiber).
  8. Location and description of all associated equipment (Copper, Fiber).
  9. Location and description of all associated structures and obstructions. (Copper, Fiber).
- B. The Contractor shall provide the following intrabuilding wiring information for each specified media prior to acceptance of the building by the University:
1. Cable entrance locations and penetration details (Copper, Fiber, Coax).
  2. Location and identification of all distribution closets and of all equipment located inside distribution closets (Copper, Fiber, Coax).
  3. Terminal information, outlet numbering, and pair count information at each distribution frame (Copper).
  4. Schematic drawings of riser (Copper, Fiber, Coax).
  5. Routing of cable and termination information (Copper, Fiber, Coax).

- C. The Contractor shall provide the following MDF wiring information prior to acceptance of the building by the University:
  - 1. Cable pair assignments per connector block.
  - 2. Identification of cable routing to MDF.
  
- D. The Contractor shall provide a complete listing of pair assignment records for copper wiring, optical fiber cabling, and coaxial cabling. Copper cable records shall include the status of each copper pair. Optical fiber cable records shall include strand allocation, test results, and identification of media and protocol used.
  
- E. The Contractor shall provide the University with the operational and maintenance documentation of all telecommunications equipment installed under this contract.
  
- F. As-Built drawings shall include actual locations of installed ductbank and manholes, including elevations, and shall indicate location, elevation and type of service for all utilities crossed by the new ductbank.
  
- G. Contractor shall submit all drawings on compact disc (CD) utilizing AutoCAD latest version.

END OF SECTION