FACILITIES & OPERATIONS
ARCHITECTURE, ENGINEERING AND CONSTRUCTION
UNIVERSITY OF MICHIGAN

DESIGN GUIDELINE 4.10

TELECOMMUNICATIONS CABLING SYSTEM

Scope: UM Telecommunication Cabling System Standards.

Related Sections:

U-M Design Guideline Sections:
5.4 Telecommunication Rooms

U-M Master Specification Sections:
None

U-M Standard Details:
None

Reference Documents:
None

UNIVERSITY OF MICHIGAN
TELECOMMUNICATION CABLING SYSTEM
STANDARDS

rev 11/16/23

SECTION -- TELECOMMUNICATIONS DISTRIBUTION SYSTEM

A. PART 1 GENERAL

1. SUMMARY

a. Section Includes: Equipment, materials, labor, and services to provide telephone and data distribution system including, but not limited to:

1) Raceway, boxes, and cable tray
2) Telephone and data cabling terminations
3) Optical fiber and terminations
4) Telecommunications outlets
5) Terminal blocks/cross-connect systems
6) Equipment racks and cabinets
7) System testing
8) Documentation and submissions
9) Removal of abandoned cable, if required

b. Provide all equipment, materials, labor, and services, not specifically mentioned or shown, which may be necessary to complete or perfect all parts of the installation. Ensure that they are in compliance with requirements of the following:

1) Current edition of the *National Electrical Code*®
2) Current edition of the *National Electrical Safety Code*®
3) ANSI/NECA/BICSI-568-2006 *Standard for Installing Commercial Building Telecommunications Cabling*
4) Current edition of the BICSI *Telecommunications Distribution Methods Manual*
5) Current edition of the BICSI *Cabling Installation Manual*
6) Latest issue of the ANSI/TIA/EIA Standards as published by Global Engineering Documents as ANSI/TIA/EIA *Telecommunications Building Wiring Standards*
7) All local codes and ordinances.
8) Project Plans and Specifications

c. Work not included:

1) The following work will be done by others:

(a) Cable tray, raceway, conduits, junction boxes, etc.

(b) Wall and Floor coring

(c) Providing switches, servers, routers, Wi-Fi equipment, computers, and other active devices.

2) Painting will be done by the University of Michigan

3) Removal of hazardous materials, if required

2. REFERENCES

Unless otherwise specified by Project,

a. Design, manufacture, test, and install telecommunications cabling networks per manufacturer's requirements and in accordance with NFPA-70 (Currently adopted edition of the *National Electrical Code*®), IEEE C2 2007(NESC 2007 or currently adopted), state codes, local codes, requirements of authorities having jurisdiction, and particularly the following standards:

ANSI/NECA/BICSI-568-2006 -- Standard for Installing Commercial Building Telecommunications Cabling-Latest Version

ANSI/TIA/EIA Standards-Latest Version

1. ANSI/TIA/EIA-568-C.0–*Generic Telecommunications* Cabling *for Customer Premises*
2. ANSI/TIA/EIA-568-C.1,-- *Commercial Building Telecommunications Cabling Standard*"
3. ANSI/TIA/EIA-568-C.2 -- *Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components*
4. ANSI/TIA/EIA-568-C.3 -- *Optical Fiber Cabling Components Standard*
5. ANSI/TIA/EIA-569-C -- *Commercial Building Standard for Telecommunications Pathways and Spaces*
6. ANSI/TIA/EIA-606(C) -- *The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*

7. ANSI-J-STD-607(D) -- *Commercial Building Grounding and Bonding Requirements for Telecommunications*
8. TIA-526-7 –OFSTP-7 *Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant*
9. TIA TSB-140 Additional Guidelines for Field Testing Length, Loss and Polarity of Optical Fiber Cabling Systems

b. Install cabling in accordance with the most recent edition of BICSI® publications:

1) BICSI -- *Telecommunications Distribution Methods Manual*

2) BICSI – *Installation Transport Systems Information Manual*

c. Federal, state, and local codes, rules, regulations, and ordinances governing the work, are as fully part of the specifications as if herein repeated or hereto attached. If the contractor should note items in the drawings or the specifications, construction of which would be code violations, promptly call them to the attention of the University of Michigan's representative in writing. Where the requirements of other sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply.

3. SYSTEM DESCRIPTION *(highlighted text to be edited by University of Michigan Facilities Engineer per Project Requirements)*

A telecommunications cabling system generally consists of one telecommunications outlet in each workstation, wall telephones in common and mechanical areas, Local Distribution Frames (LDF's) on each floor, and the Building Distribution Frame (BDF), typically located in the basement, ground level, or first floor.

a. The typical work area consists of a dual-gang box/single gang plate with one standards compliant work area outlet.

b. One work area outlet consists of two (2) four-pair data, installed from the work area outlet to the TR. Terminate data cables on wall /rack mounted modular patch panels located in the appropriate LDF/BDF cables

c. **New Construction or Additions shall utilize Category 6A cable only for Data Network Applications and Wi-Fi Applications. Category 6 is not allowed.**

d. Category 5e cabling may be used in repairs or renovations, as well as other specified applications (such as Telephone) at the discretion of the ITS Facilities Engineer. Bandwidth requirements, longevity of repairs/renovations, as well as other factors, will determine the ITS Facilities Engineer's guidelines for renovations, repairs, and other specific applications)

e. Alternately, the work area outlet may consist of a single pair, single mode fiber cable exclusively, or in conjunction with copper cables as described in Sec.3,b. Terminate fiber cables on wall / rack mounted modular patch panels located in the appropriate LDF/BDF, or other point of connectivity as directed by the ITS Facilities Engineer.

f. Vertical/horizontal copper backbone cabling consists of multiple pair unshielded twisted-pair installed from the main cross-connect (MC) in the BDF to the horizontal cross-connect (HC) located in the LDF(s).

e. Vertical/horizontal backbone cabling consists of single-mode optical fiber cable installed from the BDF to the LDF(s) and shall be utilized for data transmission.

4. SUBMITTALS

a. Submit to the University of Michigan Facilities Engineer or AEC shop drawings, product data (including cut sheets and catalog information), and samples required by the contract documents. Submit shop drawings, product data, and samples with such promptness and in such sequence as to cause no delay in the work or in the activities of separate contractors. The University of Michigan Facilities Engineer or AEC will indicate approval of shop drawings, product data, and samples submitted to the engineer by stamping such submittals "APPROVED" with a stamp. Submitted shop drawings shall be initialed or signed by the contractor, showing the date and the contractor's legitimate firm name.

1) By submitting shop drawings, product data, and samples, the contractor represents that he or she has carefully reviewed and verified materials, quantities, field measurements, and field construction criteria related thereto. It also represents that the contractor has checked, coordinated, and verified that information contained within shop drawings, product data, and samples conform to the requirements of the work and of the contract documents. The University of Michigan Facilities Engineer remains responsible for the design concept expressed in the contract documents as defined herein.

2) The University of Michigan Facilities Engineer's approval of shop drawings, product data, and samples submitted by the contractor shall not relieve the contractor of responsibility for deviations from requirements of the contract documents, unless the contractor has specifically informed the University of Michigan Facilities Engineer in writing of such deviation at time of submittal, and the University of Michigan Facilities Engineer has given written approval of the specific deviation. The contractor shall continue to be responsible for deviations from requirements of the contract documents not specifically noted by the contractor in writing, and specifically approved by the University of Michigan Facilities Engineer in writing.

3) The University of Michigan Facilities Engineer's approval of shop drawings, product data, and samples shall not relieve the contractor of responsibility for errors or omissions in such shop drawings, product data, and samples.

4) The University of Michigan Facilities Engineer's review and approval, or other appropriate action upon shop drawings, product data, and samples, is for the limited purpose of checking for conformance with information given and design concept expressed in the contract documents. The University of Michigan Facilities Engineer's review of such submittals is not conducted for the purpose of determining accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the contractor as required by the contract documents. The review shall not constitute approval of safety precautions or of construction means, methods, techniques, sequences, or procedures. The University of Michigan Facilities Engineer's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

b. Perform no portion of the work requiring submittal and review of shop drawings, product data, or samples, until the University of Michigan Facilities Engineer has approved the respective submittal. Such work shall be in accordance with approved submittals.

c. Submit shop drawings, product data, and samples as a complete set within ten (10)) days of award of contract.

1) For initial submission and for resubmission required for approval, submit two (2) copies of each item. The University of Michigan Facilities Engineer will only return one (1) copy. Make reproductions as required for your use and distribution to subcontractors

2) Illegible submittals will not be checked by the engineer

d. General: Submit the following:

1) Bill of materials, noting long lead time items

2) Project schedule including all major work components that materially affect any other work on the project

e. Product Data -- Provide catalog cut sheets and information for the following:

1) Wire, cable, and optical fiber

2) Outlets, jacks, faceplates, and connectors

3) Terminal blocks and patch panels

4) Enclosures, racks, and equipment housings

f. Project record documents:

1) Submit project record documents at conclusion of the project and include:

(a) Approved shop drawings

(b) Plan drawings indicating locations and identification of work area outlets

(c) Labeling and administration documentation.

(d) Warranty documents for equipment.

(e) Horizontal Cabling/Copper certification test results

(f) Optical fiber power meter/light source test results.

(g) OTDR test results.

5. QUALITY ASSURANCE

a. The following manufacturer's cabling systems are approved for the work of this section:

1) Belden

2) Hubbell

3) Corning

4) Superior Essex

b. **The contractor shall be an authorized Belden / Hubbell and/or Corning cabling system installer for each system respectively.**

c. The contractor shall have worked satisfactorily for a minimum of five (5) years on systems of this type and size.

d. Upon request by the University of Michigan Facilities Engineer, furnish a list of references with specific information regarding type of project and involvement in providing of equipment and systems.

e. Equipment and materials of the type for which there are independent standard testing requirements, listings, and labels, shall be listed and labeled by the independent testing laboratory.

f. Where equipment and materials have industry certification, labels, or standards (i.e., NEMA - National Electrical Manufacturers Association), this equipment shall be labeled as certified or complying with standards. Modifications to ANY rated components shall not be allowed.

g. Material and equipment shall be new, and conform to grade, quality, and standards specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout.

h. Subcontractors shall assume all rights and obligations toward the contractor that the contractor assumes toward the University of Michigan and University of Michigan Facilities Engineer.

6. WARRANTY

a. Unless otherwise specified, unconditionally guarantee in writing the materials, equipment, and workmanship for a period of not less than one (1) year from date of acceptance/final payment by the University of Michigan. The University of Michigan shall deem acceptance as beneficial use. Guarantee MUST include manufacturer’s warranties.

b. Transfer manufacturer's warranties to the University of Michigan in addition to the General System Guarantee. Submit these warranties on each item in list form with shop drawings. Detail specific parts within equipment that are subject to separate conditional warranty. Warranty proprietary equipment and systems involved in this contract during the guarantee period. Final payment shall not relieve you of these obligations.

c. Effect replacement or substitutions of equipment within 24 hours of first notification. Complete repairs to equipment within 72 hours. If repairs cannot be completed during this time period, or if ordering of parts is required, forward to the University of Michigan every 72 hours, documentation of progress of repairs. This repair capability is mandatory.

7. DELIVERY, STORAGE, AND HANDLING

Protect equipment during transit, storage, and handling to prevent damage, theft, soiling, and misalignment. Do not store equipment where conditions fall outside manufacturer's recommendations for environmental conditions. Do not install damaged equipment; remove from site and replace damaged equipment with new equipment.

8. SEQUENCE AND SCHEDULING

Submit schedule for installation of equipment and cabling. Indicate delivery, installation, and testing for conformance to specific job completion dates. As a minimum, dates are to be provided for bid award, installation start date, completion of station cabling, completion of riser cabling, completion of testing and labeling, cutover, completion of the final punch list, start of demolition, University of Michigan acceptance, and demolition completion.

9. USE OF THE SITE

a. Use of the site shall be at the University of Michigan's direction in matters in which the University of Michigan deems it necessary to place restrictions if applicable.

b. Access to building wherein the work is performed shall be as directed by the University of Michigan if applicable

c. The University of Michigan may occupy the premises during the entire period of construction for conducting his or her normal business operations. Cooperate with the University of Michigan to minimize conflict and to facilitate the University of Michigan's operations if applicable.

d. Schedule necessary shutdowns of plant services with the University of Michigan, and obtain written permission from the University of Michigan if applicable. Proceed with the work without interfering with ordinary use of streets, aisles, passages, exits, and operations of the University of Michigan if applicable

10. CONTINUITY OF SERVICES

a. Take no action that will interfere with, or interrupt, existing building services unless previous arrangements have been made with the University of Michigan's representative if applicable. Arrange the work to minimize shutdown time.

b. University of Michigan's personnel will perform shutdown of operating systems. The contractor shall give advance notice for systems shutdown if applicable.

c. Should services be inadvertently interrupted, immediately furnish labor, including overtime, material, and equipment necessary for prompt restoration of interrupted service if applicable. Contractor shall assume liability for losses.

d. University of Michigan Network Operations Center (NOC) shall be notified IMMEDIATELY if any loss or interruption of service should occur due to actions of Contractor…..734-764-HELP (764-4357)

B. PART 2 - PRODUCTS

1. MANUFACTURERS

a. Provide products of manufacturers as named in Specifications.

b. Where no manufacturer is specified, provide products of manufacturers in compliance with Specifications.

2. FABRICATION

Fabricate custom-made equipment with careful consideration given to aesthetic, technical, and functional aspects of equipment and its installation.

3. SUITABILITY

Provide products that are suitable for intended use, including, but not limited to environmental, regulatory, and electrical.

4. VOICE/DATA TELECOMMUNICATIONS SERVICE BACKBONE CABLE
(Facilities Engineer to edit highlighted text as required by Project)

a. Solid copper, 24 AWG, 100 Ω balanced twisted-pair (UTP) backbone cable, in sizes as indicated on the drawings, with mechanical and transmission performance specifications that meet or exceed ANSI/TIA/EIA-568-C.2

Note: Listed Type CMR, CMP, (as *outlined in the NEC 2005)*.

b. Single-mode inside plant optical fiber, with fiber counts as indicated on drawings, with mechanical and transmission performance specifications that meet or exceed ANSI/TIA/EIA-568-C.3

Note: Listed type OFNP, OFNR, OFCR, and/or OFCP (as *outlined in the NEC 2005*).

5. VOICE TELECOMMUNICATIONS STATION CABLE

a. Solid copper, 24 AWG, 100 Ω balanced twisted-pair (UTP) **Category 5e** cables with four individually twisted-pairs, which meet or exceed the mechanical and transmission performance specifications in ANSI/TIA/EIA-568-B.2 up to 100 MHz.

Note: Listed Type, CMP ONLY, (as *outlined in the NEC 2005)*.

6. DATA STATION CABLE (Copper)

a. Solid copper, **23 AWG,100 Ω balanced twisted-pair Category 6A** cables with four individually twisted-pairs, which meet or exceed the mechanical and transmission performance specifications in ANSI/TIA/EIA-568-C

Note: Listed Type CMP ONLY, (as *outlined in the NEC 2005,)*.

7. WI-FI ACCESS POINT CABLE (Copper)

a. Two (2) Solid copper, 23AWG, 100 Ω balanced twisted-pair **-Category 6A *ONLY*** cables with four individually twisted-pairs, which meet or exceed the mechanical and transmission performance specifications in ANSI/TIA/EIA-568-C

Note: Listed Type CMP ONLY, (as *outlined in the NEC 2005,)*.

8. DATA STATION CABLE FIBER OPTIC CABLE

One (1) pr. (2 Strand) Single Mode Fiber Optic cable as specified on drawings, compliant with the following:

TIA-526-7 –OFSTP-7 *Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant*

TIA TSB-140 Additional Guidelines for Field Testing Length, Loss and Polarity of Optical Fiber Cabling Systems

Note: Listed type OFNP, or OFCP ONLY (as *outlined in the NEC 2005*).

9. VOICE/DATA – COPPER & OPTICAL -FIBER WORK AREA OUTLETS

Single-gang mounting plate with four (4) openings containing the following devices:

a. Voice Outlet - 8-pin 8Cmodular, **Category 5e**, unkeyed, project-specified color, pinned to T568 B standards.

b. Data Outlet - 8-pin modular, **Category 6A,** unkeyed, project-specified color, pinned to T568 B standards.

c. Optical Fiber Connectors – simplex/duplex 568SC adapter.

Note: Alternate duplex connector designs (i.e. SFF) may be used providing they meet the requirements of ANSI/TIA/EIA-568-C and approved by University of Michigan Facilities Engineer

1) Provide two optical fiber adapters for each faceplate

10. VOICE/DATA WORK AREA OUTLETS –COPPER ONLY

Single-gang mounting plate with two (2) openings containing the following devices:

a. Voice Outlet - 8-pin modular, **Category 5e,** unkeyed, project-specified color, pinned to T568 B standards.

b. Data Outlet - 8-pin modular, **Category 6A,** unkeyed, project-specified color, pinned to T568 B standards.

11. WALL VOICE OUTLETS

Single-gang stainless steel faceplate with an 8-pin modular, **Category 5e** conductor jack and wall telephone mounting lugs

12. DATA ONLY WORK AREA OUTLETS

Single-gang faceplate with 8-pin modular**, Category 6A**, unkeyed, project-specified color, pinned to T568 B standards.

13. VOICE ONLY WORK AREA OUTLETS

Single-gang faceplate with 8-pin modular, 8-pin modular, **Category 5e** unkeyed, project-specified color, pinned to T568 B standards.

14. WI-FI ACCESS POINT OUTLETS

Two (2) **Category 6A** ONLY installed in conduit at WI-FI Access Point to gang box location (conduit and gangbox installed by others) as specified on prints. 18” tails on each cable shall extend from the gang box to allow for connection to the WI-FI- Access Point. No faceplate shall be installed- the 18” tails shall be coiled and neatly tucked inside the gangbox. Tails shall be terminated in a 8-pin modular **Category 6A**, unkeyed, project-specified color modular jack, pinned to T568 B standards.

15. OPTICAL FIBER WORK AREA OUTLETS

Single-gang faceplate with duplex SC568 adapter.

16. TERMINATION BLOCKS

a. Product(s) as approved by the University of Michigan Facilities Engineer: Wiring blocks are to be in following configurations:

1) List dimensional configurations

2) BDF – List pairs connectorized for PBX portion of BDF/LDF and pairs field terminated for backbone and CO portion of BDF/LDF.

b. Provide wiring troughs between BDF/ LDF frame sections.

17. PATCH PANELS

19 in. rack mountable, 48-port 8-pin modular (alternate-24 port 8-pin modular as required by Project) to insulation displacement connector (IDC) meeting **Category 5e or Category 6A** performance standards, and pinned to T568 B standards.

18. WALL MOUNTED OPTICAL FIBER PATCH PANELS

Wall-mounted optical fiber termination panel with 24-fiber capacity, hinged door, cable strain relief, slack storage, and two 12-port (12 fiber) SC/APC Simplex Cassette or approved alternative connector panels with adapters and cassette tray configuration (Corning PWH-02U)

19. RACK MOUNTED OPTICAL FIBER TERMINATION PANEL

19 in. rack mounted 144-port rack-mounted optical fiber termination panel with cable strain relief, grounding lugs (if applicable), slack storage and up to twelve 12-port (12 fiber) SC/APC Simplex or approved alternative connector panels with adapters and provisions for twelve (12) splice trays. (Corning PCH-04U)

20. SPLICE TRAYS

Sized for single-mode fibers, metallic with metallic cover, 12-fiber fusion-splice capacity, compatible with splice enclosure and splicing method.

21. OPTICAL FIBER CONNECTORS

a. Ceramic tipped field installed 568SC connectors, which meet or exceed the performance specifications in ANSI/TIA/EIA-568-C.3.

b. Various alternative field installed connector designs, which meet or exceed the performance specifications in ANSI/TIA/EIA-568-C.3 (Annex A).

22. OPTICAL FIBER JUMPERS

a. Not required by Vendor under this scope of work.

23. OPEN FRAME EQUIPMENT RACK

Open frame, 19 in. equipment rack, 7 foot 6 in. overall height with flange base, mounting rails drilled front and back and tapped to EIA-310-D standards, and a rear-rack mountable 10 outlet multiple outlet electrical strip. Vertical cable management shall be specified by University of Michigan Facilities Engineer.

24. EQUIPMENT RACKS (non-typical)

a. The 19 in. equipment rack shall have the following minimum requirements:

1) 96 in. (51 rack spaces) of panel space

2) Welded frame construction

3) Locking front and rear doors (OPTIONAL PER OWNER)

4) Adjustable front and back equipment mounting rails drilled and tapped to EIA-310-D standards

5) 10 position electrical outlet strip

6) Removable side panels

7) Top mounted, thermostatically controlled exhaust fan (OPTIONAL PER OWNER)

8) Smoked acrylic front door (OPTIONAL PER OWNER)

9) Both vertical and horizontal wire management. Horizontal wire management shall occupy two rack spaces (2Us) and shall be placed above and below the patch panels in the racks.

10) Racks shall have provisions to maintain Category 6A bend radius.

25. LISTED BUILDING ENTRANCE PROTECTORS

Not required by Vendor under this scope of work.

26. SPLICE HOUSING

Not required by Vendor under this scope of work.

27. AUTHORIZED MATERIALS

Material	Manufacturer	Part Number	Substitutions Allowed
4 Pair Cat. 5E 350MHz Plenum - Yellow	BELDEN	1213-004U1000	NO SUBSTITUTIONS
4 Pair Cat. 5E 350MHz Plenum - White	BELDEN	1213-009U1000	NO SUBSTITUTIONS
4 Pair Cat. 6A 10GXS CMP - White	BELDEN	10GXS13 009A1000	NO SUBSTITUTIONS
4 Pair Cat. 6A 10GXS CMP - Blue	BELDEN	10GXS13 D151000	NO SUBSTITUTIONS
4 Pair Cat. 6A OSP UTP Black - Outdoor Rated	BELDEN	OSP6AU-0101000	NO SUBSTITUTIONS
Plenum RG-6 Coaxial Cable	COMMSCOPE	2227V	NO SUBSTITUTIONS
Copper Backbone Cable-24 AWG, 100 Ω balanced UTP	SUPERIOR ESSEX or BELDEN	VARIES PER COUNT- CMR / CMP RATED AS REQUIRED PER PROJECT	NO SUBSTITUTIONS
Single Mode Fiber-48 Count Riser Rated Cable	CORNING	048EUF-T4101D20	NO SUBSTITUTIONS
Single Mode Fiber- 48 Count indoor rated-gel free plenum	CORNING	048EWP-T4101D20	NO SUBSTITUTIONS

Single Mode Fiber- 2 Count MIC indoor rated plenum	CORNING	002E88-31131-29	NO SUBSTITUTIONS
48 Port C5e UTP Patch Panel (Rack Mount)	HUBBELL	P5E48U	NO SUBSTITUTIONS
24 Port C5e UTP Patch Panel (Rack Mount)	HUBBELL	P5E24U	NO SUBSTITUTIONS
Rear Cable Support Bar	HUBBELL	CMBR	OR OWNER APPROVED SUBSTITUTION
C5e 8-Position Jack Module, Green	HUBBELL	HXJ5EGR	NO SUBSTITUTIONS
C5e 8-Position Jack Module, Red	HUBBELL	HXJ5ER	NO SUBSTITUTIONS
Jack Module Data Cat. 6A Black	HUBBELL	HJ6ABK * Older Style	NO SUBSTITUTIONS
Jack Module Data Cat. 6A Purple	HUBBELL	HJ6AP * Older Style	NO SUBSTITUTIONS
Jack Module Data Cat. 6A Yellow- Cobra Lock	HUBBELL	HJU6AY	NO SUBSTITUTIONS
Jack Module Data Cat. 6A Red - Cobra Lock	HUBBELL	HJU6AR	NO SUBSTITUTIONS
Jack Module Data Cat 6A Shielded	HUBBELL	SJ6A	NO SUBSTITUTIONS

Jack Module Cat. 6A Shielded - Black	HUBBELL	HJS6ABK	NO SUBSTITUTIONS
F Type Compression Connector - Plenum	GILBERT	GF-UR-6-PL	NO SUBSTITUTIONS
Self Terminating F Connector Jack Module	CSC	HUSTF-OW	NO SUBSTITUTIONS
Blank Module	HUBBELL	SFB10	NO SUBSTITUTIONS
(2) RMU Horizontal Cable Manager	CHATSWORTH	30130-719	NO SUBSTITUTIONS
4-Port Single-Gang Faceplate Office white	HUBBELL	IFP14OW	NO SUBSTITUTIONS
Angled 4-Port Single-Gang Faceplate	HUBBELL	AFP14	NO SUBSTITUTIONS
Clear Label Cover (for angled faceplates) 100 per pack	HUBBELL	LBLPK	NO SUBSTITUTIONS
6 Port Double gang Faceplate – Office White	HUBBELL	IFP26OW	NO SUBSTITUTIONS
Relay Rack 19” x 7’ - Black	CHATSWORTH	55053-715	NO SUBSTITUTIONS
19” Rack Insulator Kit	CHATSWORTH	10606	NO SUBSTITUTIONS

19” x 29” x 8’ 4-Post Rack Enclosure- 51 RU	CHATSWORTH	51020-715	NO SUBSTITUTIONS
6” Cable Bracket – Black	CHATSWORTH	SB-580-A-06-FB	OR OWNER APPROVED SUBSTITUTION
Runway, Rack Mounting Bracket Kit, 20-24” Black	CHATSWORTH	12408-724	NO SUBSTITUTIONS
7’ High Single-Sided Wide Vertical Cabling Section	CHATSWORTH	55053-703 Correct # 11374-703	NO SUBSTITUTIONS
24” Wide Cable Runway - Black	CHATSWORTH	SK2233-724	NO SUBSTITUTIONS
24” Runway Wall Angle Support Kit - Black	CHATSWORTH	11421-724	NO SUBSTITUTIONS
Runway Butt-Splice Kit	CHATSWORTH	11301-701	NO SUBSTITUTIONS
Runway Junction-Splice Kit	CHATSWORTH	11302-701	NO SUBSTITUTIONS
2-Hole Ground Terminal Block	CHATSWORTH	40167-001	NO SUBSTITUTIONS
#6 Insulated Solid Ground Wire	VARIES	VARIES	AS APPROVED
Duplex Faceplate (for covering duplex style devices) use with 106 type mounting frames	WIREMOLD	5507	OR OWNER APPROVED SUBSTITUTION

4-Port Duplex 106 Outlet Frame – Office White	HUBBELL	Q106O	OR OWNER APPROVED SUBSTITUTION
2-Port Duplex 106 Outlet Frame – Office White	HUBBELL	BR106C	OR OWNER APPROVED SUBSTITUTION
6 Port Single-Gang Faceplate – Office White	HUBBELL	IFP16OW	NO SUBSTITUTIONS
2-Port Single-Gang Faceplate Office white	HUBBELL	IFP12OW	NO SUBSTITUTIONS
Furniture Raceway Applications	HUBBELL	FP4BK	OR OWNER APPROVED SUBSTITUTION
24 Port, Unloaded Jack Panel	HUBBELL	UDX24E	NO SUBSTITUTIONS
Patch Panel 24-Port Cat. 6A Angled Rack Mount	HUBBELL	HP6A24A * Older Style	NO SUBSTITUTIONS
Patch Panel 48-Port Cat. 6A Angled Rack Mount	HUBBELL	HP6A48A * Older Style	NO SUBSTITUTIONS
Patch Panel 48-Port 6A Cobra Lock Terminations	HUBBELL	HPJ6A48	NO SUBSTITUTIONS
Flush Stainless Steel, Wall Phone Plate with 8-position 5e Jack	HUBBELL	P630S1GJ8	OR OWNER APPROVED SUBSTITUTION
Other Raceway, Floor Box and Telco Outlet Adapters	Preferably HUBBELL	VARIES / AS REQUIRED	OR OWNER APPROVED SUBSTITUTION

Biscuit Jack- 2 keystone	HUBBELL	HSB2OW	NO SUBSTITUTIONS

C. PART 3- EXECUTION

1. PRE-INSTALLATION MEETINGS/ SITE SURVEY

   a. During the Developmental Phase, Schematic Phase, and Drawing Phase, meet with University of Michigan Facilities Engineer to review Technical Specifications and drawings. Review areas of potential interference and resolve conflicts before proceeding with the work. Facilitation with the General Contractor will be necessary to plan the crucial scheduled completions of the equipment room and telecommunications closets.

   b. Examine areas and conditions under which the system is to be installed. Do not proceed with the work until satisfactory conditions have been achieved.

2. HANDLING AND PROTECTION OF EQUIPMENT AND MATERIALS

   a. Be responsible for safekeeping of your own and your subcontractors' property, such as equipment and materials, on the job site. The University of Michigan assumes no responsibility for protection of above named property against fire, theft, and environmental conditions.

3. PROTECTION OF UNIVERSITY OF MICHIGAN'S FACILITIES

   a. Effectively protect the University of Michigan's facilities, equipment, and materials from dust, dirt, and damage during construction.

   b. Vapor and/or dust barriers as required

   c. Remove protection at completion of the work.

   d. Housekeeping as required

4. INSTALLATION

a. Receive, check, unload, handle, store, and adequately protect equipment and materials to be installed as part of the contract. Store in areas as directed by the University of Michigan's representative. Include delivery, unloading, setting in place, fastening to walls, floors, ceilings, or other structures where required, interconnecting wiring of system components, equipment alignment and adjustment, and other related work whether or not expressly defined herein.

b. Install materials and equipment in accordance with applicable standards, codes, requirements, and recommendations of national, state, and local authorities having jurisdiction, BICSI, and *National Electrical Code*® (NEC) 2005 in accordance with Project Specifications, and with manufacturer's printed instructions.

c. Adhere to manufacturer's published specifications for pulling tension, minimum bend radii, and sidewall pressure when installing cables.

   1) Where the manufacturer does not provide bending radii information, minimum-bending radius shall be 15 times cable diameter. Arrange and mount equipment and materials in a manner acceptable to the engineer and the University of Michigan.

d. Penetrations shall be fire-stopped after installation and testing, utilizing a firestopping assembly approved for that application.

e. Install station cabling to the nearest LDF/BDF unless otherwise noted.

f. Installation shall conform to the following basic guidelines:

   1) Use of approved wire, cable, and wiring devices

   2) In accordance with accepted Standards and Protocols.

g. Attach cables to permanent structure with suitable attachments at intervals of 48 to 60 inches. Support cables installed above removable ceilings.

h. Install adequate support structures for 10 foot of service slack at each LDF/BDF

i. Support riser cables every three (3) floors and at top of run with cable grips.

   1) Limit number of four-pair data riser cables per grip to fifty (50)

j. Install cables in one continuous piece. Splices shall not be allowed except as indicated on the drawings.

k. Additional specifications regarding ty-wraps, Velcro straps, other approved materials, and additional information shall be specified by the University of Michigan Facilities Engineer on a case- by-case basis.

5. GROUNDING

a. Grounding shall conform to ANSI-J-STD607(A) - *Commercial Building Grounding and Bonding Requirements for Telecommunications, National Electrical Code*® (2005), ANSI/NECA/BICSI-568-2006 and manufacturer's grounding requirements as minimum.

b. Bond and ground equipment racks, housings, messenger cables, and raceways.

c. Connect cabinets, racks, and frames to single-point ground which is connected to building ground system via #6 AWG green insulated copper grounding conductor.

6. LABELING

Labeling shall conform to ANSI/TIA/EIA-606(A) standards. In addition, provide the following:

a. Label each outlet with permanent self-adhesive label with minimum 3/16 in. high characters.

b. Label each cable with permanent self-adhesive label with minimum, 1/8 in. high characters, in the following locations:

1) Inside receptacle box at the work area.

2) Behind the communication closet patch panel or punch block.

c. Use labels on face of data patch panels. Provide facility assignment records in a protective cover at each telecommunications closet location that is specific to the facilities terminated therein.

d. The letters “D” and “A” may be used to delineate between Data and Audio/Visual patch panels and Horizontal Cabling

e. Use color-coded labels for each termination field that conforms to ANSI/TIA/EIA-606(A) standard color codes for termination blocks.

f. Labels shall be machine-printed. Hand-lettered labels shall not be acceptable. Color of label and specific size of font shall be specified by the University of Michigan Facilities Engineer.

g Label cables, outlets, patch panels, and punch blocks as specified by University of Michigan Facilities Engineer.

h. Mark up floor plans showing outlet locations, type, and cable marking of cables. Turn these drawings over to the University of Michigan within 2 weeks of completion per schedule. If applicable, or required by University of Michigan Facilities Engineer, submit marked up floor plans per "phased" completion

i. An e-set of as-built drawings shall be provided within the same timeframe to the University of Michigan in electronic form and utilizing CAD software that is acceptable to the University of Michigan.

7. TESTING

a. Testing shall conform to ANSI/TIA/EIA-568-C.1 standard.

b. Testing shall be accomplished using Fluke Networks equipment / *Linkware*® analysis software only.

c. Test each pair and shield of each cable for opens, shorts, grounds, and pair reversal. Correct grounded and reversed pairs. If horizontal cable contains bad conductors or shielding, remove and replace cable.

c. Fiber Optic cables shall be Tier II Tested with light source/power meter and OTDR. Initially test optical cable with a light source and power meter utilizing procedures as stated in ANSI/TIA/EIA-526-7 *Measurement of Optical Power Loss of Installed Single-mode Fiber Cable Plant*.

d. Perform bi-directional optical time domain reflectometer (OTDR) testing on each fiber optic conductor.

e. Where any portion of system does not meet the specifications for loss and connectivity, correct deviation and repeat applicable testing at no additional cost to the University of Michigan

f. Test results must be reviewed by Vendor's RCDD and certified as "PASSING" before submittal to University of Michigan.

1) Submit horizontal cabling, light source power meter and OTDR results for each cable tested in E-copy format, either on CD-ROM or placed in a Project Folder created by U of M as a depository for test results

2) Submit electronic media with test results. Electronic media test results must be submitted using the latest version of *Fluke Networks LinkWare*® . Submit 1 copy of electronic media (CD) to University of Michigan Facilities Engineer.

8. FIELD QUALITY CONTROL

a. Employ job superintendent or project manager during the course of the installation to provide coordination of work of this specification and of other trades, and provide technical information when requested by other trades. This person shall maintain current **RCDD®** (Registered Communications Distribution Designer) registration and shall be responsible for quality control during installation, equipment set-up, testing, and Project Closeout. The RCDD shall apply their Stamp to all submitted as built drawings, and include a Written Statement of Certification, to include their Stamp, with all testing documentation binders. The Written Certification shall include:

1) Project Information (Name, Location, Etc.) and Date of Written Statement Submittal

2) Statement of Certification attesting to compliance with Industry Codes and Standards, completeness and thoroughness of work performed, quality control and supervision, and as-built and testing result submittal review.

3) RCDD Signature, Certification Number, Expiration Date, and Stamp

b. Installation personnel shall meet manufacturer's training and education requirements for implementation of extended warranty program. Proof of Certification may be required at any time.

c. Vendor shall be required to attend meetings to provide regular updates, address concerns, and general discussion as to the progress of the Project. University of Michigan Facilities Engineers will perform site visits to ensure quality control, provide input, and support Vendor to ensure successful completion of Project. Any concerns regarding workmanship, installation practices , manpower, adherence to University policy shall be resolved by the Telecommunications Contractor within the specified time frame determined by the University of Michigan Facilities, Engineering, AEC, or both.

END OF SECTION