SECTION 16720

TELECOMMUNICATIONS BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Conduit

B. Conduit Supports

C. Hangers and Cable Ties

D. Raceways

E. Ladder Racking

F. Innerduct

G. Cable Tray

H. Flex Tray

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O. Copper Cable Termination Blocks

P. Equipment Racks

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R. Wire Managers

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1.2 RELATED SECTIONS

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D. Section 16715 - Telecommunications Acceptance Testing

E. Section 16725 - Telecommunications Cable

F. Section 16730 - Underground Structures - Telecommunications

G. Section 16760 - Telecommunications Grounding and Bonding

1.3 APPLICABLE PUBLICATIONS

A. As defined in Section 16710 - Telecommunications General Requirements.

1.4 SUBMITTALS

The owner's representative shall receive the following Contractor materials prior to the start of work:

A. Product data for:

1. Innerduct
2. Cable trays
3. Splice cases
4. Racks and wire managers
5. Fiber optic patch/termination panels, frames, enclosures, and hardware
6. Copper terminals and hardware
7. Cable and splice case identification tags
8. Station hardware (outlets and jacks)
9. Protector Panels and Protector Modules
10. Conduit plugs

PART 2 - PRODUCTS

2.1 Materials and equipment shall be installed by certified installers under the Corning Lanscape® Solutions and Systimax® Structured Cabling Systems. The various sections of this specification pertain to specific products and/or installation requirements that must conform to the warranty requirements of the structured cabling systems manufacturer.

2.2 CONDUIT

A. Conduit – General

1. All communication conduits two inches in diameter and larger shall be equipped with a terminating bushing or collar to protect cables during placement.

2. All station conduits shall be no smaller than one and one-quarter inch (1¼") in diameter unless otherwise noted.

B. Rigid Steel Conduit

1. Rigid steel conduit shall comply with Underwriter's Laboratories UL-6 Specification, ANSI C80.1 and Federal specification WW-C-581E or latest revisions. Conduit shall be hot dip galvanized on the exterior, with zinc or enamel on the interior.

2. Couplings, locknuts, and all other fittings shall be galvanized or sheardized, waterproof and threaded type only. Rigid conduit shall terminate with two locknuts - one outside and one inside enclosures and specified bushings. No running threads or chase nipples shall be issued without approval. Manufacturer: Appleton, Crouse-Hinds or equal.

3. Bushings shall be non-metallic for 1 inch and smaller and insulated metallic for conduits larger than 1 inch.

C. Electrical Metallic Tubing (EMT)

1. EMT conduit shall comply with Underwriter's Laboratories UL 797, ANSI C80.3 and Federal Specification WW-C-563 or latest revision. EMT shall be galvanized or sheardized.

2. Couplings and connectors for EMT shall be galvanized or cadmium plated and shall be of the compression type requiring the tightening of a nut on a gland ring. No die cast type shall be allowed. All connections shall have permanent insulated throats. Manufacturer: Appleton, Crouse-Hinds or approved equal.

D. Polyvinylchoride (PVC)

1. SCHEDULE 40 conduit shall be in 20 foot lengths with a bell end and a smooth end. Conduit shall meet UL listing 651, conform to NEMA TC 2 and gray in color. Schedule 40 may be used as a direct buried application.

2. TYPE C conduit shall be 20 foot in length with a bell end and a sooth end. Conduit shall meet PTS-77, and GTS 8342 and gray in color. TYPE C can only be used when duct bank is encased with 2500 PSI slurry mix. (see construction drawings for duct configurations)

2.3 CONDUIT SUPPORTS

A. Pipe hangers for individual conduits shall be factory made, consisting of a pipe ring and threaded suspension rod. The pipe ring shall be malleable iron, split and hinged, or shall be interlocked with the suspension rod socket.

B. Pipe racks for a group of parallel conduits shall be galvanized structural steel preformed channels of length as required, suspended on threaded rods and secured thereto with nuts above and below the cross bar. All offsets shall be in the same plane and shall be parallel.

C. Factory made pipe straps shall be one-hole malleable iron or two-hole galvanized clamps.

D. Manufacturer: Kindorf, Unistrut, T&B or approved equal.

2.4 HANGERS AND CABLE TIES

A. Materials: All hangers and cable ties shall be designed to support communications cable (including the fiber) without kinking or damage to the cables. Hangers may be used to support station cables in spaces above dropped ceilings from the outlet conduits to the cable tray system or to the BDF room.

1. Hangers shall be metal construction and shall provide a J-hook designed to support multiple communications cables.

2. No more than twelve (12) station cables may be supported by a standard size J-hook.

3. Larger types of wire hangers (larger J-hooks or Tri-hooks) are acceptable for locations requiring more than twelve cables. Copper and fiber cables must be properly installed per the manufacturer's specifications to insure maximum cable performance.

4. J-hooks or wire hangers shall be installed at a distance of no more than five feet apart.

5. Cable ties used within a rated ceiling plenum space shall be rated low smoke and shall be certified for use in a plenum environment.

B. Manufacturers: CPI Chatsworth, B-Line, Caddy, or approved equal.

2.5 SURFACE RACEWAYS

A. Materials

1. Surface mounted raceways may only be used where specified in the construction documents. They are not to be used to simplify the installation. The Contractor must obtain approval from the owner's representative prior to installation of any surface mounted raceway that is not shown on the construction documents.

2. The raceway shall be non-metallic with a minimum opening of 1.51 " wide by .94 " high if limited to serving only a single station with no more than 8 cables. Pan-way Type LD10 Surface Raceway or equivalent.

3. If more than eight cables and less than 38 cables are being served to multiple data outlets, the raceway shall be non-metallic with a minimum opening of 4.04 " wide x 1.77 " high. Pan-way T-70 Surface Raceway or equivalent.

4. The raceway shall be equipped with all accessories such as elbows, tees, junction boxes, and covers necessary to provide a complete and high quality installation.

5. The raceway material shall meet or exceed UL-5A standards and shall be equipped with a single piece cover or a snap-in-place cover designed to fasten securely.

6. The raceway must be attached to the walls with mechanical fasteners every six feet in addition to any mastic provided as part of the product.

B. Manufacturer: Panduit LD10 and T-70 Surface Raceways or equivalent

2.6 LADDER RACKING

A. Materials

1. Cable support ladder racks shall be installed as defined in the Contract Documents and in any location where additional pathways are required to support large numbers of station cables that are otherwise not supported.

2. The racks shall be twelve inches wide unless otherwise noted.

3. In some locations the ladder rack shall be equipped with a four-to-six inch fence on both sides to support bundles of patch or jumper cables. This fence shall mechanically attach to the side or bottom of the ladder, not the surface over which the cable will be placed.

4. The racks shall be classified by Underwriters Laboratories (UL) as suitable for equipment grounding.

5. The racks shall be earthquake braced; the zone shall be zone 4.

6. The Contractor shall provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, cable runway radius drops and grounding straps.

7. BDF's shall have steel tubular style ladder racking, factory painted telco gray.

B. Manufacturer: CPI Chatsworth, B-Line, PW industries

2.7 INNERDUCT – PLENUM AND RISER

A. Materials

1. Indoor innerduct for both plenum and riser applications shall be non-metallic corrugated flexible conduit.

2. Innerduct shall be 1"dia. in size with pre-installed pull tape.

3. Innerduct shall meet the requirements of Underwriters Laboratory (UL) Specifications 2024 of UL 910,NFPA 90A,NFPA 262 NEC 300-21,300-22.

4. All innerduct for risers shall be orange in color.

B. Manufacturer: Carlon (Part # CF4X1C-2500), Vickmatic Plenum Duct, or approved equal.

2.8 INNERDUCT – OUTSIDE PLANT

A. Materials

1. Outdoor innerduct shall be a non-metallic raceway with a ribbed inner diameter and a smooth outer diameter. Innerduct shall meet ASTM D3035, ASTM D2447 and NEMA TC 7.

2. Innerduct shall 1" dia. in size with pre-installed pull tape.

3. All outdoor innerduct shall be orange in color.

B. Manufacturer: Carlon (Part # AF2B1E-7000), Vikimatic Inner Duct, or approved equal.

2.9 WIRE BASKET SUPPORT TRAY

A. Materials

1. The cable trays shall be welded, steel wire mesh with an electroplated zinc galvanized finish.

2. The trays shall be twelve inches (12”) wide by a minimum of 2” deep unless otherwise noted.

3. The trays shall be equipped with elbows and tees at all intersections and other accessories as required tocomplete the installation following manufacturer’s guidelines.

4. The trays shall be supported no less than every six feet. Support attachments shall be made only to the building structure.

5. Each end of the tray shall be equipped with a finished lip and drop off to reduce damage to cables.

6. The cable tray shall comply to NEMA VE-1, proposed IEC 61537. Trays shall qualify under NEC section 318-7 (b) as equipment grounding conductor.

B. Manufacturer: GS Flextray®, Copper B-Line or approved equal.

2.10 SPLICE CASES - INDOOR COPPER

A. Materials

1. All indoor splices shall be contained within an approved splice case designed for multiple closures and rated for indoor use.

2. All end plates shall be designed for the number and size of cables served by the splice case and rated for indoor use.

3. All cases shall be equipped to provide a continuous bond of cable shields through all splices.

B. Manufacturer: Preformed, 3M or approved equal.

2.11 SPLICE CASES – OUTDOOR COPPER

A. Materials

1. All outdoor splices shall be re-enterable units full dressed and enclosed to fit the number and type of cables terminated.

2. The cases must be leak proof to restrict the movement of fill compound from the outdoor cable.

3. All splices shall utilize 710 or 3M splice modules. Cable shields shall be bonded through all splices.

B. Manufacturer: Preformed, 3M, or approved equal.

2.12 FIBER OPTIC TERMINAL PANELS

A. Materials

1. The fiber optic terminals/patch panels shall utilize Corning Cable Systems Closet Connector Housings. (CCH)

2. The CCH shall provide cross-connect, inter-connect, and splicing capabilities and contain the proper troughs for supporting and routing the fiber cables/jumpers.

3. The CCH shall consist of a modular enclosure with retainer rings in the slack storage section to limit the bending radius of fibers.

4. The CCH shall have a "window" section to insert connector panels for mounting of connectorized fibers (LC style couplers and connectors).

5. The CCH shall provide terminating capability of couplers, in the quantity noted on the contract drawings, in panels of 6 or 12 respectively.

6. The Contractor shall install Corning Cable Systems Unicam LC connectors for 50 um multimode fiber with ceramic ferrule and Unicam LC with ceramic ferrule for singlemode fibers. The connectors shall have composite couplers in all patch bays that meet or exceed the following specifications.

7. Connector specifications shall be as follows:

Interconnect Compatibility:	Compatibility with FOICS 10 for LC junior version
Operating Temperature:	≤ 0.3db change -40º to 140ºF (-40º to 60ºC) in 21 cycles
Insertion Loss:	
Multimode	0.4dB average, 0.77 dB max.
Singlemode	0.4dB average, 0.77 dB max.
Durability	500 remateings, 0.75 dB max. loss
Tensile Strength	0.5dB, 0.75 dB max. loss Single-mode
Reflectance:	≤ -50dB (+18° to +-26°C)
Nominal fiber OD:	125 uM
Housing:	
Single-mode:	Ceramic ferrule blue housing 50 uM
Multimode:	Ceramic ferrule black housing

8. A common panel shall be used to terminate singlemode and multimode optical fibers.

B. Manufacturer: Corning LANscape Solutions.

2.13 CABLE TAGS AND SPLICE CASE LABELS

A. Materials:

1. Metal or heavy plastic identification tags with cable type and number, copper pair or optic number assignments, and destination shall be provided on both ends of all cables (except station cables) and all splice cases.

2. All cables shall be clearly labeled with cable number, cable counts, cable type, and cable size at each end of the cable, when it enters or leaves a conduit and at 30-foot intervals when run in accessible areas such as tunnels, manholes, ceilings, etc. Cable tags shall indicate the cable information as shown on the interbuilding and riser drawings for copper and fiber cables.

B. Manufacturer: 3-M, Panduit, Tech Products, Inc.

2.14 OUTLET LABELS

A. Materials:

1. All labels shall be made using a label maker that produces clear adhesive labels with black typeset characters. The labels must have a strong adhesive that will not come off unless it is forced off. The label size will be 3/16 inch wide with a typeset font no smaller than 10 point. The Contractor shall utilize the label maker and labels that are recommended for the selected Structured Cabling System.

2. The Contractor must submit a sample outlet faceplate with proposed labels to the University for approval prior to labeling the new outlets.

3. The labels on each faceplate shall contain the following information:

   a. Room number (with alpha as needed) located in the top left corner of the faceplate. Do not cover the screw.

   b. Voice/ Data Outlet:

      Port 1 (Gray Jack): V1 (For voice cable)
      Port 2 (Orange Jack): D1 (For first data cable)
      Port 3 (Orange Jack): D2 (For second data cable)

   c. Voice/ Data/Fiber Outlet:

      Port 1 (Gray Jack): V1 (For voice cable)
      Port 2 (Orange Jack): D1 (For first data cable)
      Port 6 in a single-gang faceplate or Port 8 in a dual-gang faceplate (LC Connector): FOMM1 (For first multimode, fiber optic cable)

   d. Data Only Outlets (1 to 8 cables)

      Port 1 (Orange Jack): D1 (For first data cable)
      Port 2 (Orange Jack): D2 (For second data cable)
      Etc.

   e. For two or more outlets in one room.

      (See above for labeling for first outlet.)
      Second Outlet:
      Port 1 (gray Jack): V2 (For second voice cable in same room)
      Port 2 (Orange Jack): D3 (For third data cable in same room)
      (The numbering for voice cables will be consecutive and sequential in each room. e.g. V1, V2, etc.)
      (The numbering for data cables will be consecutive and sequential in each room. e.g. D1, D2, etc.)

2.15 COMMUNICATIONS BACKBOARDS

A. The Contractor shall provide 3/4" A/C void-free plywood as noted on drawings. The backboard shall be sized as noted on the contract drawings and shall be a minimum of 4' by 8'. Plywood shall be extended from 2" A.F.F. to 8'-2" A.F.F. and wall-to-wall unless noted otherwise by the owner's representative.

B. Plywood shall be fire retardant or treated with fire-retardant sealant or covered with a fire-retardant paint. All backboards must be finish sanded, sealed with a primer, and finished with two coats of paint.

C. The Back Boards shall be attached to the wall studs at 16 '' centers with the correct type fasteners. Drywall torque drive type screws shall not be used. Screw fasteners shall be counter sunk to provide a smooth and even surface.

Recommended screw type: # 13 x 3'' self-tapping sheet metal at 16 '' centers.

2.16 STATION OUTLETS

A. Metal Outlet Boxes

1. Metal outlet boxes shall be installed as receptacles for the information outlets in new wall construction, exterior locations, and locations with special vapor proof or explosion proof applications. Outlet boxes shall be galvanized steel. The size of the metal box shall be at least 4 11/6" square by 2 1/8" deep. Boxes installed in any exterior location where exposed to rain or moisture laden atmosphere shall be cast screw hub type with gaskets and weatherproof covers. Boxes for vapor proof or explosion proof applications shall be designed specifically for such use.

2. In new wall construction, each box shall be flush mounted and equipped with a 1 1/4" conduit stubbed into the space above the dropped ceiling. In rooms with exposed ceilings, the conduits from outlets shall be terminated in the space above the dropped ceiling of an adjacent room that is accessible for routing station wire to the BDF room.

3. All floor boxes shall be recessed.

4. All boxes shall be equipped with a dual (two) gang ring in locations with a total of two to eight copper and fiber station cables. All boxes shall be equipped with single (one) gang ring in locations with one voice or one data cable.

5. Manufacturers: Appleton, Raco, or Steel City.

B. Floor-Mounted Power/Communication Outlet Boxes

1. The floor mounted outlet boxes shall be recessed floor boxes, joint power/communication, 4 gang, receptacles with no pedestal appearance. (Hubbell Part No.: HBLCFB301BASE)

2. Each outlet box shall be recessed in the concrete floor equipped with one, 1" diameter conduit for communications station cables stubbed up the wall to the space above the dropped ceiling.

3. Each outlet box shall also be equipped with one conduit for electrical wiring. See electrical plans and specifications for conduit size and wiring details.

4. Floor mounted outlet boxes shall be U.L. listed for carpeted or tile applications.

5. Floor mounted outlet boxes shall be equipped with metallic cover/flange assembly with a cable door to provide ample room for exiting cables. (Hubbell Part No.: HBLTCGNTSW)

6. Manufacturers: Hubbell, Walker, or approved equal.

C. Voice/Data Outlets

1. All terminated category 6 cables shall meet or exceed GigaSPEED XL and Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA 568B.2-1 Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section.

2. The standard voice/data outlet shall consist of three (3) Category 6 four-pair cables unless noted on the plans. Each cable shall be terminated on a separate Category 6 rated, MGS400 Series, 8-position jack following EIA/TIA 568B.2-1 wiring standards. The Systimax® material identification numbers are:

Item	Description	Product	Material ID
a.	Face plate (quad)	M28L-246	108685017
b.	RJ45 voice jack	MGS400-270-GRAY	700206733
c.	RJ45 data jack	MGS400-112-ORANGE	700206683
d.	Dust cover	M20AP-246	107067860

3. Three category 6 cables will terminate in each outlet unless noted on the plans. All pairs will be terminated on GigaSPEED XL jacks, one jack for voice, and two jacks for data. The color of one jack will be gray designated for voice, and the other two jacks will be orange designated for data.

4. The GigaSPEED XL modular jacks must be rated for Category 6 performance in the configuration installed.

5. The faceplate will be clearly labeled with outlet number, and each jack will be labeled with jack number. All labels will be typed or preprinted and shall be securely affixed to the faceplate.

6. Dust covers shall be placed in the vacant slots.

7. Manufacturer: Systimax® (Campus Standard)

D. Voice/Data/Fiber Outlets

1. The standard voice/data/fiber wall outlet shall consist of two, 8-wire modular jacks wired as per EIA/TIA 568B.2-1 and two LC style fiber optic connectors in an ivory quad outlet faceplate. One copper cable and gray jack shall be designated for voice and the other copper cable and orange jack shall be designated for data. The outlet shall also contain (1), two optic, 50 micron, multimode fiber cable. Both ends of the fiber station cable shall be terminated on Corning, duplex, Unicam, LC type connectors suitable for 50 micron, multimode fiber cable. The Systimax® and Corning material identification numbers are:

Item	Manufacturer	Description	Product	Material ID
a.	Systimax®	Face plate (quad)	M28AS	(Owner Provided)
b.	Systimax®	RJ45 voice jack	MGS400-270-GRAY	700206733
c.	Systimax®	RJ45 data jack	MGS400-112-ORANGE	700206683
d.	Systimax®	Dust cover	M20AP-246	107067860
e.	Corning	LC Connector	UniCam, 50 µm, laser-optimized multimode fiber	95-050-99-X

2. Two category 6 cables will terminate in each outlet unless noted on the plans. All pairs will be terminated on GigaSPEED XL jacks, one gray jack designated for voice, and one orange jack designated for data.

3. The GigaSPEED XL modular jacks must be rated for category 6 performance in the configuration installed.

4. Both ends of the fiber station cable shall be terminated on Corning, duplex, Unicam, LC type connectors.

5. The fiber optic connector shall extend from the faceplate at an angle in order to provide greater clearance when station cables are connected. University IT staff shall provide Systimax® M28AS faceplates for voice/data/fiber outlets. (M28AS faceplates were discontinued by manufacturer.)

6. The faceplate will be clearly labeled with outlet number, and each jack will be labeled with jack number. All labels will be typed or preprinted and shall be securely affixed to the faceplate.

7. Dust covers shall be placed in the vacant slots.

8. The outlet must provide mechanical protection to the fiber optic connectors so that when a fiber optic drop cable is installed, the connection point does not extend into the room unsupported.

9. One meter of fiber station cable shall be provided as a maintenance loop coiled in the back of the quad outlet. Do not exceed manufacturer's minimum bend radius.

10. Manufacturer: Voice and data Cables: Systimax® (Campus Standard)
Fiber Cable: Corning Cable (Campus Standard)

E. Voice Only Outlets

1. Voice only outlets shall consist of a single four-pair category 6 cable connected to a MGS400-270-GRAY wire modular jack assembly with a metal cover plate suitable for securing a wall mounted telephone. The color of the jack will gray designated for voice.

2. All wall phone outlets shall be placed at 44 inches above the finished floor unless otherwise noted to make the maximum height to the top of the telephone 48 inches above the finished floor.

3. Wall phone outlets shall be equipped with a duplex mud-ring around the standard dual gang outlet box recessed in the wall where possible.

4. Wall phone outlets shall consist of a stainless steel duplex faceplate equipped with a single 630B.

5. Systimax® stainless steel faceplate; Systimax® Product Number: M12SP, Material ID 108615188.

6. Manufacturer: Systimax® (Campus Standard).

F. Data Only Outlets

1. The data only outlets shall consist of one to eight MGS400 8-wire modular jacks wired as per EIA/TIA 568B.2-1 and dust covers in an ivory quad outlet faceplate. The number of terminated cables at each outlet shall be according to floor plan drawings. The Systimax® part numbers are:

Item	Part #	Product	Material ID
a.	Face plate (duplex)	M16L-246	108168592
	Faceplate (quad)	M28L-246	108685017
b.	RJ45 data jack	MGS400-112	700206683
c.	Dust cover	M20AP-246	10706-860

2. One to eight category 6 copper station cables will terminate on GigaSPEED XL orange jacks that must be rated for category 6 performance in the configuration installed.

3. A duplex faceplate shall be installed in outlets with one data cable. A quad faceplate shall be installed in outlets with two to eight cables. The faceplate will be clearly labeled with outlet number, and each jack will be labeled with jack number. All labels will be typed or preprinted and shall be securely affixed to the faceplate.

4. Dust covers shall be placed in the vacant slots.

G. Floor-Mount Voice/Data Outlets

1. The voice/data floor-mount outlet shall consist of three, Category 6, four-pair cables, each terminated on a separate GigaSPEED XL 8-position jack following EIA/TIA 568B.2-1 wiring standards unless otherwise noted on drawings. One jack will be electrical gray for voice, and the other two jacks will be electrical orange for data.

2. The floor mount outlets shall be installed in Floor Mounted Power/Communication Outlet Boxes listed above.

3. The communications portion of the outlet box shall be equipped with two (2) standard Decora® style faceplates and two (2) Systimax®, M108FR3-246 triplex modular mounting frames.

4. The faceplates will be clearly labeled with outlet number, and each jack will be labeled with jack number. All labels will be typed or preprinted and shall be securely affixed to the faceplate.

5. Dust covers shall be placed in the vacant slots.

6. Manufacturer: Systimax® (Campus Standard)

2.17 COPPER CABLE TERMINATION BLOCKS-STATION CABLE

A. Materials

1. All voice copper station cable terminations shall be made on wall mount, Systimax, 110AW2 modular terminals rated for Category 5e.

2. All blocks shall be equipped with color coded identification strips following the convention listed below:

a. Green - to dedicated MDF pairs

b. Blue - to voice stations

c. White - to data stations

d. Gray – riser

3. All block assemblies shall include wire retention clips and sufficient 188B2 jumper backboards mounted adjacent for effective use as cross-connect wire holders (minimum one 188B2 for horizontal positions).

4. Each voice 110 terminal shall be equipped with four 88A2 retainers to be used to hold jumper wires.

5. The proper size retaining clips shall be used for all cable terminations (e.g., four-pair for stations and five-pair for riser, interbuilding, and entrance).

6. Voice cables shall be terminated on wall-mounted, 110 terminals unless otherwise noted on the drawings. Cables shall be terminated by room number from lowest to highest and with alpha characters following numeric room numbers. The labeling strips on the 110 terminals shall include the room number and cable number as an example for the first voice cable in room 100 (100 V1) following the University's standard labeling format for faceplates in paragraph 2.14. Only the University's standard labeling scheme shall be accepted.

7. Manufacturer: Systimax® (Campus Standard)

2.18 BDF EQUIPMENT RACK

A. Materials

1. The BDF shall be equipped with a 7' high, 19" wide CPI, Universal, equipment rack for fiber optic terminations and data equipment unless otherwise noted.

2. The frame shall be a bolted aluminum construction and shall meet ANSI/EIA-310D standards for equipment support frames. Seismic brace per manufacturer's recommendations and applicable codes.

3. Floor-mounted frame shall have a self-supporting base that is bolted to the floor and 36 inches of clearance on both sides of the rack.

4. The equipment rack shall be equipped with two CPI vertical wire managers and one horizontal wire manager. (CPI Part Numbers: Single-Sided Wide Vertical Cabling Section 11374; Horizontal wire manager 30130-719)

5. Manufacturers: CPI Chatsworth, Hoffman and Newton

2.19 PROTECTOR PANELS

A. The interbuilding outside plant cable shall be protected with two, 100 pair protector panels. The protector panel shall be UL listed per UL 497, equipped with a 25 foot or less 24 AWG input cable and 110-type connector output block. Protector block shall have a ground connector to accept # 6 GW to building ground. The protector Modules shall be industry standard 5-pin configuration. The protector modules shall have a gas tube rated at 350 volts and equipped with PTC (positive temperature coefficient).

B. Manufacturer: protector panels Circa 1880 B1-100, protector modules Circa C4B1E or equal.

2.20 CONDUIT PLUGS

A. Materials:

1. The conduit plugs shall be of an expandable injection molded chemical resistant gasket type. The plugs shall be corrosion proof, water and air tight, with a sealing capacity of 22

PSI (50ft head of hydrostatic pressure). The plugs shall be solid for vacant conduits and innerducts, simplex (one hole) for conduits with one copper cable or one innerduct, and quadplex (four holes) for conduits with four innerducts. The plugs shall have eyes to allow pull ropes to be attached to the inside of the plugs.

B. Manufacturer: Vikimatic, Jack Moon or equal.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. All installation work shall be performed according to *published* industry guidelines, rules, and regulations. All Structured Cabling System products shall be installed according to Systimax® Structured Cabling System for copper station cables and Corning LANscape® Solutions for fiber optic cables.

B. All pathways shall avoid electromagnetic interference (EMI). Cable that is distributed in partially-enclosed metallic pathways shall be routed with the following minimum clearances:

1. Four (4) feet from motors or transformers.

2. One (1) foot from conduit and cables used for electrical power and distribution.

3. Five (5) inches from fluorescent lighting.

C. Pathways shall cross perpendicular to fluorescent lighting and electrical power cables and conduit.

3.2 CONDUIT

A. All conduit shall be routed parallel and perpendicular to walls.

B. All conduit shall be installed in accordance with NEMA “Standard of Installation” and shall meet applicable local and national building and electrical codes or regulations.

C. New Conduit runs shall not exceed 100 feet or contain more than two 90 degree bends without utilizing appropriately sized pull boxes.

D. No communications outlet boxes shall be “daisy-chained.” Each communications outlet shall be served by a separate 1¼ inch (minimum) conduit.

E. In rooms with a drop or false ceiling, communications outlets shall be served by a one and one-fourth (1¼) inch conduit stubbed six inches above the false ceiling, angled toward the cable tray or open access area, and shall be equipped with a compression fitting and plastic bushing. All stubs shall be marked “Comm.”

F. All conduit shall be equipped with an approved water proofing or barrier seal in building access points.

G. All conduits entering a building from outside shall be plugged with reusable stoppers to eliminate the entrance of water or gases into the entrance room. (Expandable solid, simplex and quadruple gasket plugs)

H. Al conduits leaving the entrance room for other portions of the building will be fire-stopped after the installation of cable.

I. All conduits are to be concealed unless installed in exposed ceiling areas as indicated on the drawings. No conduits shall be left exposed in public areas.

J. All 4 inch diameter telecommunications conduits and sleeves shall be labeled with termination locations.

3.3 HANGERS AND CABLE TIES

A. In suspended ceiling and raised floor areas where walker duct, cable trays, or conduit are not available, station wiring shall be bundled with velcro cable ties at appropriate distances.

B. Tie wraps shall not be over tightened to the point of deforming or crimping the cable sheath.

C. Hangers supporting the cable bundling shall be attached to the existing building structure and framework.

D. Hangers must be installed to provide at least 3 inches of clear vertical space between the cable bundling and the ceiling tiles.

E. Hangers shall be spaced to prevent cables from sagging or buckling.

3.4 LADDER RACKING

A. Ladder racking shall be placed so that fully loaded racking shall not obstruct or impede the operation of lighting, air handling systems, and fire extinguishing systems.

B. At a minimum, ladder racking must be installed 7' AFF across the length of the backboards in all locations unless otherwise noted. In addition, a cross section of ladder racking shall be installed linking the backboard ladder rack to the equipment frame rack.

C. Additional ladder racking may be installed from the backboard to the point at which the cable tray or sleeves enter the room.

D. All ladder racking shall be securely anchored to walls, ceilings, or other approved support structures.

E. Ladder rack sections shall be bonded together with a bonding strap for manufacturer's specifications.

3.5 CABLE TRAY

A. Cable trays shall be installed in accordance with NEMA VE 1.

B. The Contractor will be responsible for placement of the cable tray in concert with other trades, allowing sufficient room for the cable installers to gain access to all portions of the tray system. Cable tray location shall be coordinated with open ceiling areas, access panel locations, and feeder conduit positions to provide an accessible cable pathway throughout the facility.

C. All metallic trays must be grounded and may be used as a ground conductor. [Provide #2 AWG bare copper equipment grounding conductor through entire length of tray; bond to each component. Trays used as an equipment grounding conductor must be clearly marked.

D. Trays shall be bonded end-to-end.

E. Trays shall enter distribution rooms six inches into the room, then utilize a drop out to protect station cables from potential damage from the end of the tray.

F. Cable trays shall be placed a minimum of six (6) inches from any overhead light fixture and twelve (12) inches from any electrical ballast. A minimum of eight (8) inches of clearance above the tray shall be maintained at all times. All bends and T-joints in the tray shall be fully accessible from above (within 1 foot). Trays shall be mounted no higher than twelve (12) feet above the finished floor and shall not extend more than eight (8) feet over a fixed ceiling area.

G. A separate conduit sleeve (minimum of two inches) must be provided as a pathway through any wall or over any obstruction (such as a rated hallway) from the cable tray into any room having a communications outlet.

H. The Contractor shall fire stop around the tray and, after installation of the cables, within the tray using removable pillow-style products following manufacturers' guidelines. Sound deadening material shall be provided and installed after installation of cable.

I. In rooms without a drop ceiling (open to the structure), the cable tray shall be mounted as high as possible to provide the greatest clearance above the finished floor, but no higher than twelve (12) feet above finished floor.

3.6 SPLICE CASES – COPPER AND FIBER

A. Any splice case enclosing a filled cable must be rated as a low-smoke (entrance) enclosure and must be designed to eliminate the movement of flow compound.

B. All splices in underground vaults and as noted by engineer shall be encapsulated with a re-enterable type compound.

C. Splice cases or enclosures shall have a hard outer shell (either metal or hard-molded plastic) for mechanical protection to the splice and sealed end plates.

D. The splice case is to utilize a controlled force injection encapsulate system that will force encapsulate into the core of the splice and down the core of the cable. The splice core shall be wrapped with a porous wrap to allow encapsulate to flow out to the walls of the splice and to allow easy re-entry.

E. Encapsulate compound to be used must be re-enterable and meet all requirements for use in confined spaces or OSHA standards for compounds used in confined spaces; which ever is more stringent.

3.7 FIBER OPTIC TERMINAL PANELS

A. Rack-mounted fiber panels shall be mounted at the top of the rack.

B. All cables mounted into fiber optic panels shall be installed and secured as defined by the manufacturer using the tools, materials, and techniques outlined by the manufacturer.

C. Fiber patch panel shall be labeled indicating the LC connectors with cable number and fiber assignments for the outside plant fiber cable as indicated on the interbuilding fiber cable plan. Fiber patch panels shall also be labeled indicating station fiber cable terminations per labeling in Part 2.

3.8 CABLE TAGS AND LABELING

A. The Contractor shall legibly label all voice and data outlets, cable, blocks, frames, and patch panels per Part 2 of these specifications. Outlet faceplates shall be labeled on both sides.

B. Construction labels shall be installed on all cables as they are pulled. These labels shall contain the same information as the finished labels. Typed labels on self-sealing tape shall be

used. Each cable shall have a unique number that shall be related to the appropriate faceplate number and jack letter.

C. A label shall be installed on each conduit attached to a communications wall box and shall be affixed to the end of the conduit near the cable tray. The label shall have a unique number related to the appropriate faceplate number and jack letter.

D. Labels shall be installed on all station cables within two (2) inches of the end of the outer jacket material within the back box and at the blocks/patch panel. Typed labels on self-sealing tape, with a plastic overlay, shall be used. Each cable shall have a unique number that shall be related to the appropriate faceplate number and jack letter.

E. Labels shall be installed on all patch panels, blocks, and both the inside and outside of all faceplates. A uniquely numbered label for each faceplate and a unique letter for each jack shall be supplied and installed. The labels shall be machine printed (not embossed) on vinyl tape using a Brother label maker or equal. The labels shall have protective overlays.

F. Labels shall be numbered according to a scheme developed in consultation with the owner's representative.

G. Ground Bars

1. The master ground bar shall be labeled as such.

2. Each subsidiary ground bar shall be labeled as such and have a unique identifier.

3. All ground bars shall have a warning label that states, *"If this connector or cable is loose or shall be removed, please call the Telecommunications Manager."* All ground bars will be connected to the building ground with continuous 3 ∅ AWG wire.

4. Each ground cable shall be labeled with reference to the termination point of the ground cable.

3.9 COMMUNICATIONS BACKBOARDS

A. Communication backboards shall be configured and installed as defined on the drawings.

B. Backboards shall be mounted vertically, starting 2" above the finished floor.

C. All backboards shall be securely mounted to wall structures or studs using fasteners designed for the surface. All fasteners shall be mounted flush with the backboard and located so as to not interfere with the placement of cable or equipment. Backboards shall be sanded smooth after being secured to the wall.

D. All plywood panels must be mounted in contact with one another, leaving no gaps between sheets.

E. All backboards shall be fire retardant or treated with fire-retardant sealant or covered with 2 coats of a fire-retardant paint.

3.10 STATION OUTLETS

A. Station outlets shall be mounted securely at work area locations.

B. Station outlets shall be located so that the cable required to reach the desktop equipment is no more than 16 feet long.

C. Station outlets should not be “daisy-chained.”

D. Outlets shall be mounted as follows

1. Wall phone: 48 inches above the finished floor.

2. Standard wall mounted voice/data, voice/data/fiber, and data-only outlets: 15 inches above the finished floor.

3. Outlets Above Counter top: 6 inches above the counter top.

E. Modular Furniture Telecommunications Outlets

1. The Contractor shall provide and install all components and labor necessary to completely install, test, and document voice and data telecommunications outlets at each existing modular furniture workstation location.

2. Category 6 station cable shall be placed from the BDF, through the riser sleeves, cable tray system into the conduit, or ceiling and into the furniture to be served.

3.11 FACEPLATES

A. The faceplates shall have their jack positions labeled. Gray jacks will be designated for voice and orange jacks for data.

3.12 COPPER CABLE TERMINATION BLOCKS

A. All 110 terminal blocks in the BDF shall be clearly and neatly labeled with outlet room number and station cable identification indicated on the outlets. All labeling materials and procedures must be approved by the University’s representative prior to installation.

B. All work on terminals shall be accomplished using tools and support hardware designed for the 110 system and following procedures identified by the manufacturer.

3.13 EQUIPMENT RACKS

A. Provide a minimum clearance of 36 inches on both sides of the equipment rack.

3.14 PULL BOXES AND CABINETS

A. Pull boxes shall be installed in easily accessible locations.

B. Pull boxes installed as part of a horizontal cabling pathway shall be installed immediately above suspended ceilings, where possible.

C. Pull boxes shall not be used for splicing cable.

D. Pull boxes shall be placed in conduit runs that exceed 100 feet or which require more than two 90 degree bends. The pull boxes shall be located in straight sections of conduit and must not be used for a right angle bend. Installation shall allow cable to pass through from one conduit to another in a direct line.

E. Pull boxes must have a length at least 12 times the diameter of the largest conduit.

3.15 INNERDUCT

A. Innerducts shall be placed in conduits as noted by the engineer of record. Four innerducts shall be placed in one four-inch conduit even if only one is used for placing fiber optic cable. Construction drawing sheets will designate which conduits are assigned for placement of innerducts. Typically the upper most conduits will be assigned for placing innerducts.

END OF SECTION