

NORTH ORANGE COUNTY COMMUNITY COLLEGE DISTRICT
SECTION 27 05 28 – PATHWAYS FOR COMMUNICATION SYSTEMS
SAMPLE SPECIFICATION

RELATED SECTIONS:

Section 27 00 00 General Requirements
Section 27 02 00 General Communication Requirements
Section 27 05 26 Grounding and Bonding for Communications
Section 27 05 37 Fire-Stopping for Communication Systems
Section 27 10 00 Structured Cabling Testing
Section 27 11 00 Communication Equipment Room Fittings
Section 27 12 00 Communication Requirements for (RF) CATV System
Section 27 13 00 Communications Backbone Cabling
Section 27 13 23 ABF Fiber Optic Cabling
Section 27 15 00 Communications Horizontal Cabling
Section 27 16 00 Communications Connection Cords

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Install empty raceway system, including under floor and overhead distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves, caps, cable troughs, service poles, miscellaneous and positioning material to constitute complete system, as indicated for distribution of Telecommunications wiring which includes cables for Data, Voice, Video, Audio, Security and future signal requirements.
- B. The location at which all new telecommunications wiring will terminate is called a Telecom Outlet (TO). There are several styles of outlets:
 - 1. New construction
 - 2. Existing construction typical
 - 3. Existing construction variations
 - 4. Telephone (Voice) only
 - 5. Data only
- C. Furnish and install split channel raceway and outlet boxes as specified in the Drawings and as specified herein.
- D. Furnish and install conduit stubs in walls and floors for cable routes.

1.2 REFERENCES

ASI/NFPA 70/250 - National Electric Code – Ground and Bonding
ANSI/NFPA 70/318 – National Electric Code – Cable Trays
CANSI/NFPA 70/645 – National Electric Code – Information Technology Equipment
ANSI/NFPA 70/770 – National Electric Code – Optical Fiber Cables and Raceways
ASTM A 510 - Specifications for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
ASTM B 633 - Specifications for Electrodepositing Coatings of Zinc on Iron and Steel, Sections SC2 and SC3

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ASTM A653 - Specifications for Steel Sheet, Zinc-Coated (Galvanized) by Hot Dip Process
ASTM A123 - Specifications for Zinc (Hot Galvanized) Coatings on Iron and Steel
ANSI/TIA - 568-C series Commercial Building Telecommunications Cabling Standard.
ANSI/TIA - 569-C Commercial Building Standard for Telecommunications Pathways and Spaces
ASTM – A276-06 Standard Specification for Stainless Steel Bars and Shapes
ASTM A580/A580M-06 Standard Specification for Stainless Steel Wire
NEMA VE 2-2006 Cable Tray Installation Guidelines
NEMA VE-1/CSA C22.2 No 126 1-02 Metal Cable Tray Systems
UL and cUL E209183
ANSI C80.1 Rigid Steel Conduit - Zinc Coated
ANSI C80.4 Fittings for Rigid Metal Conduit
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

1.3 QUALITY ASSURANCE:

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- B. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- C. Assure that the "as installed" system is correctly and completely documented including engineering drawings, manuals, and operational procedures in such a manner as to support maintenance and future expansion of the system.
- D. Material and work specified herein shall comply with the applicable requirements of the current revision of the following:
ANSI/TIA – 568 Commercial Building Telecommunications Cabling Standard
TIA – 569 Commercial Building Standard for Telecommunications Pathways and Spaces
ANSI/TIA – 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
ANSI-J-STD – 607 Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
NFPA 70 – National Electric Code
BICSI – Telecommunications Distribution Methods Manual

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NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to cable tray systems.

1.4 SUBMITTALS

- A. Product Data: For features, ratings, and performance of each component specified.
- B. Submit manufacturer's instructions for storage, handling, protection, examination, preparation, operation, and installation of products. Include application conditions or limitations of use stipulated by any product testing agency. Submit for the following:
 - 1. Wall Boxes
 - 2. Raceway
 - 3. Conduit
 - 4. Conduit Bushings
- C. Shop Drawings:
 - 1. Component List: List manufacturer, part number, and quantity of each component.
 - 2. Include dimensioned plan and elevation views of equipment rooms, labeling each individual component. Show raceway assemblies, method of field assembly, workspace requirements, and access for cable connections.

1.5 DELIVERY STORAGE AND HANDLING:

- A. Delivery: Deliver materials to site in manufacturer's original un-opened containers and packaging, with labels clearly indicating manufacturer and material.
- B. Storage: Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions.
- C. Handling: Protect materials and finishes during handling and installation to prevent damage.

PART 2 - PRODUCTS

2.1 TELECOM OUTLETS (TO)

- A. New construction TO consists of one (1) 4-11/16" square by 2-1/8" deep flush mounted box. Each outlet box shall have a EMT conduit stubbed above the drop ceiling or extended into the hallway cable tray. Conduits size is as follows:
 - 1. For Outlets with 3 or less cables, use a 1" EMT conduit
 - 2. For Outlets with 3-6 cables, use a 1.25" EMT conduit
 - 3. For all other sizes, calculate fill ratio at 40% for proper sized conduit
- B. Existing surface-mounted construction TO typically consists of surface-mounted raceway including base, cover, end fitting, entrance end fitting, and (2) 1" EMT conduits stubbed out top of entrance end fitting to above ceiling or out to nearest hallway distribution system. Size of the raceway is site dependent based on number of conductors to be installed.
- C. The intent of the installation of the TOs which consist of the raceway is as follows:
 - 1. Where ceilings are accessible, the raceway and entrance end fitting shall extend above the ceiling and the conduits installed above the ceiling in the room to the nearest hallway distribution system.
 - 2. Where ceilings are partially accessible, or if the Drawings and/or Specifications indicate installation of access panels, the raceway shall extend above the ceiling and the

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conduits installed above the ceiling in the room to the nearest hallway distribution system.

3. Where ceilings are inaccessible or no ceilings exist, the raceway shall extend up as close to the ceiling as practical to allow installation of conduits as high as possible to the nearest hallway distribution system.

2.2 HORIZONTAL DISTRIBUTION SYSTEMS

A. Conduit System (Renovations only, where conduit exists)

1. Provide conduits secured to wall above corridor ceilings as shown on the Drawings or as specified herein for installation of telecommunications cables. Any exposed conduit
2. Corridor conduits shall be 4" EMT, furnished in 10 foot lengths wherever possible, with no sharp edges, reamed as necessary, evenly supported at two locations per 10 foot section spacing. Conduits shall be sized and quantified to account for handling cables in all TO conduits at 40% fill back to the TR and/or ER rooms. Verify size prior to installation. Bushings and/or connectors on ends of EMT are required.
3. All conduits shall be installed stacked and attached to walls unless conditions exist which prohibit this type of installation. When this condition exists, mount conduits side-by-side supported with 3/8" rod attached to building structure utilizing unistrut channel to form a trapeze. Double nut the top and bottom at the unistrut. Utilize conduit clamp to secure conduits to unistrut.
4. Provide measured pull line in each conduit rated at 1200 lbs. minimum. Increments must be in 12" steps.
5. Grounding of conduits is not required per NEC 250-33, Exception No. 2. shall be painted except conduit above suspended ceilings or in mechanical, electrical or telecommunication rooms. Color to match that of surface installed upon or as directed by Owner's Representative. Coordinate with other trades prior to painting.
6. Provide restorable fire stops inside and around conduits as recommended by UL1479 or ASTM E814 for all conduits penetrating fire-rated construction. Fire rated construction to be verified with AHJ. See Section 27 05 37 for more firestopping information.

B. Corridor Cable Tray System

1. Complete wall mounted or suspended aluminum cable tray system and necessary accessories shall be provided as shown on plans. Install entire cable tray system in accordance with manufacturer's minimum installation practices and all local governing codes.
2. Coordinate installation of cable tray with other trades to allow a minimum of 12" above, 12" in front, and 12" below of clearance from piping, conduits, ductwork, etc. Allowance must be provided for access to the tray with reasonable room to work. Obstructions to the tray must be minimized and cannot block more than 6 feet of the tray at any point in the run.
3. Submittal drawings, in the form of 8 1/2"x 11" catalog cut sheets, shall be provided for the following items: cable tray, fittings, accessories and load data.
4. Cable tray shall not be loaded beyond 60% of manufacturer's recommended load capacity.

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5. Install wall mounted cable tray on both sides of hallway as shown on drawings and where applicable.
 6. Where a new cable tray distribution system encounters a wall, install sufficient 4" EMT sleeves through the wall so cabling does not exceed 20% fill.
 7. Where cable tray is exposed below ceiling, install the appropriate solid bottom inserts to conceal cables.
 8. Install cable tray dropouts where large quantities of cables exit the distribution system.
 9. Cable tray must be sized to facilitate sufficient growth capacity for migration cable plant to coexist in same tray as existing cable plant, wherever possible.
 10. Manufacturer of cable tray in corridors and telecom rooms shall be and approved industry leader per submittal requirements in contract SOW.
- C. Telecommunication Room Cable Tray System
1. TR cable tray shall completely wrap all walls within the room. Cable tray shall extend over all equipment frames.
 2. Cable tray shall be a minimum width of 2" high x 12" wide. Cable tray may be sized upwards if fill ratio requirements need to be met based on cable quantities.
 3. Manufacturer of tubular ladder type cable tray in telecommunication rooms shall be CommScope.
 4. Cable tray shall be 12 inch cable runway.
 5. Rectangular steel tubing cross members welded at 12-inch intervals. Finish in black enamel. CommScope, Part Number CR-SLR-10L12W or equivalent.
 - a. 12-inch Wall Angle Assembly Kit – CommScope Part Number CR6-12WRSK or equivalent.
 - b. 3-inch Channel Rack-To-Runway Mounting Plate - CommScope Part Number CRR2RRMK or equivalent.
 - c. End Closing Tube - CommScope Part Number CRPECK or equivalent.
 - d. Corner Clamp - CommScope Part Number CRTJSK or equivalent (2 required per End Closing Tube to complete assembly).
- D. All open pathway/trays shall be installed a minimum of six (6) inches away from any light fixture or other source of EMI (Electromagnetic Interference).
- E. All pathways shall be grounded per NEC Article 250.
- F. Provide external grounding strap at expansion joints, sleeves and crossover and at other locations where pathway/tray continuity is interrupted.
- G. Support all pathways from building construction. Do not support pathways from ductwork, piping, or equipment hangers.
- H. Install cable tray level and straight unless noted on the construction drawings.

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2.3 STATION CONDUITS

Station conduit is defined as conduit that originates at the TO and rises within the walls or is exposed from a raceway and extends up into the drop ceiling or over to the hallway distribution system.

- A. Provide station conduits from TOs to above the drop ceiling or extend over to the hallway distribution systems consisting of 1" EMT minimum or appropriate size as shown on the Drawings or as specified herein for installation of telecommunications cables.
- B. Provide an insulating press fit bushing on all telecommunications conduits including interconnecting nipples and stub to distribution system. To prevent conflicts with other cables or conduits to cable tray, the conduit shall be stubbed not less than 6" above or below conduit/cable tray center line. Where space permits, every effort shall be made to bend station conduits down such that the flow of installed cables promotes the minimum length back to the TR and the least amount of bends in the cables. Bushings must be rated to be used in an environmental air handling space (Plenum).
- C. Manufacturer of insulating bushing on all telecommunication conduits shall be Arlington or approved alternate equal.
- D. Provide measured pull line in 12" increments in each empty conduit to hallway distribution system.
- E. Indelibly mark station conduit at hallway distribution end with Room # that conduit serves.
- F. The use of 90 degree electrical pulling elbows is prohibited.
- G. Do not include more than two 90 degree sweeps between pulling points when installing station conduit runs. If the path of the station conduits requires more than 180 degrees of total bends, installation of an appropriate sized junction box is required. See section 2.4 for junction box requirements.
- H. Place an appropriate sized junction box in each individual station conduit run that exceeds 100 feet in length.
- I. The use of a third bend in a conduit is only acceptable if:
 - 1. The total conduit run is reduced by 15%.
 - 2. The conduit size is increased to the next trade size.
 - 3. One of the bends is located within 12" of the cable feed end.

2.4 JUNCTION BOX REQUIREMENTS FOR STATION CONDUITS

- A. If the station conduit route exceeds the 180 degree of total bends limitation, an appropriate sized junction box is required within a straight section of the conduit run.
- B. Each station conduit run requires a separate junction box. The sharing of a junction box by multiple conduits is prohibited.
- C. A junction box shall not be used in place of a bend. All junction boxes in station conduit paths shall be installed within a straight section of the conduit run.

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2.5 SERVICE ENTRANCE CONDUITS

- A. Minimum of (4) 4" IMC conduits shall be installed from the nearest utility tunnel on outside of the building as shown on the Drawings. Terminate entrance conduits entering ER rooms from below grade to extend 4" above finished floor. Location of entrance conduits shall be within 12" of room corners.
- B. Terminate entrance conduits entering ER rooms from above ceiling height to extend 4" below finished ceiling or 12" above cable tray.
- C. Terminate entrance conduits entering an ER rooms from below ceiling height to extend 4" into the room.
- D. Entrance conduits shall be continuous into the building and to the ER. Securely fasten all entrance conduits to the building to withstand any cable placing operation. Do not include more than two 90 degree bends between pulling points when installing entrance conduits.
- E. On exterior wall penetrations, seal both sides of the wall around outside of conduit with hydraulic cement to prevent water from entering the building. Seal the inside of the conduit on both sides with conduit plugs, water plugs, or duct sealer to prevent water, vapors, or gases from entering the building.

2.6 PATHWAY REQUIRMENTS FOR ENTRANCE CONDUITS

- A. If the entrance conduits exceeds the 180 degree of total bends limitation, an appropriate sized junction box, manhole, or hand hole is required.
- B. As-built drawings of entrance conduit path required to be submitted to Owner's Representative before covered with soil.

2.7 RISER CONDUITS

Riser conduits shall only be used when noted on the Construction Documents for special applications only. Riser conduits are not required as a general rule for the riser system. However, when required:

- A. Minimum of (2) 4" conduits shall be installed between the ER room and each TR room as shown on the Drawings.
- B. Conduits entering ER and TR rooms shall be reamed or bushed and terminated not more than 4" from entrance wall and within 12" of room corners.
- C. Conduits entering ER and TR rooms from below floor shall be terminated not more than 4" above finished floor.
- D. Conduits for riser cables shall be continuous and separate from all other conduit or enclosed raceway systems. Do not include more than two 90 degree bends between pulling points when installing riser conduits. Where junction boxes are required, locate in accessible areas, such as above suspended ceilings in hallways.
- E. Conduits shall not be less than 4" trade size and be equipped with a measured pull line at 12" increments rated at a minimum 1200 pound test.

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- F. Provide restorable fire stops inside and around conduits as recommended by UL1479 or ASTM E814 for all conduits penetrating fire-rated construction. Fire-rated construction to be verified with AHJ. See Section 27 05 37 for more firestopping information.
- G. Provide an insulating press fit bushing on all telecommunications riser conduits. Bushings must be rated to be used in an environmental air handling space (Plenum).
 - 1. Manufacturer of insulating bushing on all telecommunication conduits shall be Arlington or equal.
- H. Riser conduits shall not be used for the distribution of horizontal cables.

2.8 FIRESTOPPING

- A. In all buildings, floor/ceiling assemblies, stairs, and elevator penetrations must be sealed with a 2-hour fire stop assembly at a minimum, unless otherwise noted.
- B. Walls must be sealed with a 2-hour fire stop assembly at a minimum.
- C. Communication pathways requiring fire stopping shall utilize EZ Path fire stopping Pathways for ease of Moves, Adds, and Changes.
- D. All fire stopping penetrations shall conform to the recommended practices listed in UL1479 or ASTM.
- E. See **Section 27 05 37** – Fire-stopping for Communication Systems

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. The intention of the telecommunications conduits is to provide a route between ER and TR rooms, routes from the TRs throughout building floors to hallways, and routes from hallway distribution systems into rooms to individual TOs for telecommunications cabling.
- B. Installation of new pathways shall not interfere with existing pathways in such a way that installation of new cables within the existing pathway is made more difficult.

3.2 EXAMINATION

- A. Examine areas to receive cable management system. Notify the Owner's Representative of conditions that would adversely affect the installation or subsequent utilization of the system.
- B. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install in accordance with recognized industry practices, to ensure that the equipment complies with requirements of the NEC, and applicable portions of NFPA 70B and NECA "Standards of Installation" pertaining to general electrical installation practice.
- B. Coordinate installation with other trades.

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- C. Field verification is required before installation.
- D. Install cable management system at locations indicated on the drawings and in accordance with manufacturer's instructions.

Hangers and Supports for Communications Systems

PART 1 – GENERAL

1.1 WORK INCLUDES

The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the system of non-continuous cable supports as described in this specification.

1.2 SCOPE OF WORK

This Section includes the minimum requirements for the support structures for the Communications Systems for the project as outlined in the Bid Document.

- A. Non-continuous cable supports (2.3A)
- B. Adjustable non-continuous cable support sling (2.3B)
- C. Multi-tiered non-continuous cable support assemblies (2.3C)
- D. Non-continuous cable support assemblies from tee bar (2.3D)
- E. Non-continuous cable support assemblies from drop wire/ceiling (2.3E)
- F. Non-continuous cable support assemblies from beam, flange (2.3F)
- G. Non-continuous cable support assemblies from C & Z Purlin (2.3G)
- H. Non-continuous cable support assemblies from wall, concrete, or joist (2.3H)
- I. Non-continuous cable support assemblies from threaded rod (2.3I)
- J. Raised floor non-continuous cable support assemblies (2.3J)
- K. Cantilever-Mounted Option for non-continuous cable supports (2.3K)
- L. Installation accessories for non-continuous cable supports (2.3L)

1.3 SUBMITTALS

- A. Submit product data on non-continuous cable support devices, including attachment methods. Product data to include, but not limited to materials, finishes, approvals, load ratings, and dimensional information.

1.4 QUALITY ASSURANCE

- A. Non-continuous cable supports and cable support assemblies shall be listed by Underwriters Laboratories for both Canadian and US standards (cULus).
- B. Non-continuous cable supports shall have the manufacturers name and part number stamped on the part for identification.
- C. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of five years documented experience in the industry, and certified ISO 9000.

1.5 COORDINATION

Coordinate installation of hangers, supports and cables with other trades.

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PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with these specifications, non-continuous cable supports shall be as manufactured by ERICO, Inc or approved equal.

2.2 REFERENCES

- ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel
ASTM B 695-90 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM A109 Standard Specification for Steel, Strip, Carbon, Cold-Rolled
ASTM A167 Standard Specification for Stainless and heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A480/A480M Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
ASTM A568 Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy Hot-Rolled and Cold-Rolled
A653 G60-Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip process
ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A682 Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled, Spring Quality
ASTM A879 Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
ASTM B117 Standard Method of Salt Spray (Fog) Testing
ASTM D610 Standard test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.
ANSI/ TIA-568 Commercial Building Telecommunications Cabling Standard, current revision level.
ANSI/ TIA-569 Commercial Building Standard for Telecommunications Pathways and Spaces, current revision level.
NFPA 70 National Electrical Code®

2.3 NON-CONTINUOUS CABLE SUPPORT SYSTEMS

- A. Non-continuous cable supports
1. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; cULus Listed.

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2. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
 3. Non-continuous cable supports sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.
 4. Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.
 5. Stainless Steel non-continuous cable supports are intended for indoor and outdoor use in non-corrosive environments or where only mildly corrosive conditions apply.
 6. Non-continuous cable supports shall be ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64, CAT21SS, CAT32SS, CAT64SS; CAT-CMTM Double J-Hook CAT100CM; CAT-CMTM U-hook series CAT200CMLN, CAT300CMLN; and CAT-CMTM retainer CATRT200CM, CATRT300CM or approved equal.
- B. Adjustable non-continuous cable support sling
1. Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair UTP; rated for indoor use in non-corrosive environments. Rated to support Category 5e and higher cable, or optical fiber cable; cULus Listed.
 2. Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.
 3. Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.
 4. If required, assemble to manufacturer recommended specialty fasteners including beam clips, flange clips, C and Z purlin clips.
 5. Acceptable products: ERICO CADDY Cable Cat™CAT425; or approved equal.
- C. Multi-tiered non-continuous cable support assemblies
1. Multi-tiered non-continuous cable support assemblies shall be used where separate cabling compartments are required. Assemblies may be factory assembled or assembled from pre-packaged kits. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; cULus Listed.
 2. If required, the multi-tier support bracket may be assembled to manufacturer recommended specialty fasteners including beam clamps, flange clips, C and Z purlin clips.
 3. The multi-tiered support bracket shall consist of ERICO CADDY CATHBA and CableCat™ J-Hooks with screws; or approved equal.
- D. Non-continuous cable support assemblies from tee bar
1. Tee bar support bracket with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
 2. Acceptable products: ERICO CADDY CAT12TS, CAT21528, CAT32528; or approved equal.
- E. Non-continuous cable support assemblies from drop wire/ceiling
1. Fastener to wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
 2. Acceptable products: ERICO CADDY CAT124Z34, CAT126Z34, CAT214Z34, CAT216Z34, CAT324Z34 or CAT326Z34; or approved equal.
- F. Non-continuous cable support assemblies from beam, flange

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1. Fastener to beam or flange with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
 2. Acceptable products: ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY beam clamps and CADDY flange clips; or approved equal.
- G. Non-continuous cable support assemblies from C & Z Purlin
1. Fastener to C or Z purlin with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.
 2. Acceptable products: ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY Purlin hangers; or approved equal.
- H. Non-continuous cable support assemblies from wall, concrete, or joist
1. Fastener to wall, concrete, or joist with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.
 2. Acceptable products: ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64, with CADDY angle bracket; or approved equal.
- I. Non-continuous cable support assemblies from threaded rod
1. Fastener to threaded rod with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments, cULus Listed.
 2. The multi-tiered support bracket shall have a static load limit of 300 lbs.
 3. U-hooks and Double J-hook shall attach directly to threaded rod using standard nuts.
 4. Acceptable products: ERICO CableCat™ J-hook, CAT12, CAT21, CAT32, CAT64 with CADDY CATHBA series; CAT-CMTM Double J-hook CAT100CM, CAT-CMTM Direct mount U-hook CAT200CMLN, CAT300CMLN; or AFAB series; or approved equal.
- J. Raised floor non-continuous cable support assemblies
1. Fastener to raised (access) floor pedestal with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments; cULus Listed.
 2. Acceptable products: ERICO CADDY CAT12CD1B, CAT21CD1B or CAT32CD1B; CAT64CD1B; or approved equal.
- K. Cantilever-Mounted cable supports
1. U-hook shall be able to be assembled to a wide variety of wall mount brackets.
 2. Spacing of individual U-hooks as needed, max of 4' to 5' apart.
 3. U-hooks may have the optional attachment of a cable roller for ease in pulling cables.
 4. Acceptable products: ERICO CAT-CMTM U-hooks CAT200CMLN, CAT300CMLN: CAT-CM roller assemblies CATRL200CM, CATRL300CM; CATWMCM bracket; or approved equal.
- L. Installation accessories for non-continuous cable supports
1. Cable Pulley
 - a. Non-continuous cable supports may be used as an installation tool when a removable pulley assembly is included. The pulley shall be made of plastic and be without sharp edges. The pin and bail assembly must be able to be secured to the J-Hook during cable installation. The pulley must remain secured while cables are being pulled.
 - b. The pin and roller assembly must be removed after cables are installed.
 - c. Acceptable products: ERICO CADDY CAT32PLR, CAT64PLR, or approved equal.

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2. Cable Protector
 - a. The protective steel tube shall fit over threaded rod and be at least 4” in length.
 - b. The tube shall prevent damage to cables placed in or pulled through CAT-CMTM U-hooks. The tube shall not inhibit the pulling of cables.
 - c. Acceptable products: ERICO CAT-CMTM CATTBCM, or approved equal.

2.4 FINISHES

- A. ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel
ASTM B 695 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- B. Non-continuous cable supports used where only mildly corrosive conditions apply shall be stainless steel, AISI type 304.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation and configuration shall conform to the requirements of the current revision levels of ANSI/ EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer’s installation instructions.
- B. Do not exceed load ratings specified by manufacturer.
- C. Adjustable non-continuous support sling shall have a static load limit of 100 lbs.
- D. Follow manufacturer’s recommendations for allowable fill capacity for each size non-continuous cable support.
- E. Locate pathways per Telecommunications Drawings.

Conduits and Backboxes for Communications Systems

PART 1 – GENERAL

1.1 OUTLETS

- A. Each data outlet in a wall or floor shall be served by two (2) 27 mm (1 in.) conduits and a double-gang deep device box with a single-gang mud ring.
- B. Wall mounted telephones shall be served by one 21 mm (0.75 in.) conduit and a single-gang deep device box with a single-gang mud ring. The outlet box shall be mounted at a center height of 1220 mm (48 in.) above the finished floor, unless otherwise specified on the drawing, and shall have a clearance of 305 mm (12 in.) of wall surface on all sides.
- C. All outlet conduits shall be stubbed into accessible ceiling space.
- D. All outlet conduits shall have burrs and any other abrasive elements removed and an insulating bushing shall be installed on both ends.
- E. No section of conduit shall be longer than 30 m (100 ft.) between pull points.

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SAMPLE SPECIFICATION

- F. No more than 180 degrees of conduit bends shall be permitted between pull points.
- G. The minimum inside radius for any bend of an outlet conduit shall be six times the inside diameter of that conduit.

1.2 CONDUITS

- A. Electric metallic tubing: Comply with UL 797. Tubing shall have hot dipped galvanized exterior, enamel-coated interior.
- B. Flexible conduit shall not be used in lieu of conduit bends and offsets.
- C. PVC conduit: Comply with UL 651, listed for use with 90 degrees C conductors operating at 90 degrees C.

1.3 STANDARDS COMPLIANCE

- A. General standards: Comply with current revision of TIA 569 as amended

1.4 SUBMITTALS

Provide product data for the following:
Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

1.5 COORDINATION

- A. Coordinate installation of labels with other trades.
- B. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store materials in original cartons and in a clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCTS

- A. Dry location device boxes: Manufacturer shall be Steel City, RACO, or Appleton. Equivalent products by other manufacturers may be used where approved in writing by Owner's Representative.
- B. Wet location boxes: Manufacturer shall be Crouse-Hinds FS or FD, or equal by O-Z Gedney or Appleton. Equivalent products by other manufacturers may be used where approved in writing by Owner's Representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation and configuration shall conform to the requirements of the current revision levels of ANSI/ EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.
- B. Install conduits using techniques, practices, and methods that are consistent with Category 6 or higher requirements and that supports Category 6 or higher performance of completed and linked signal paths, end to end.

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SAMPLE SPECIFICATION

- C. Follow manufacturer’s recommendations for allowable fill capacity for each size non-continuous cable support.

Cable Trays for Communications Systems

PART 1 – GENERAL

1.1 SCOPE

- A. Continuous, rigid, welded steel or stainless steel wire mesh cable management system.
- B. Cable tray systems are defined to include, but are not limited to, straight sections, supports and accessories.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 SUMMARY

References:

- IEC 61537 (2006) – Cable Tray Systems and Cable Ladder Systems for Cable Management
- NEMA VE 1-2002/CSA C22.2 No. 126.1-02 – Metal Cable Tray Systems
- ANSI/NFPA 70 – National Electrical Code (NEC)
- TIA 569– Commercial Building Standard for Telecommunications Pathways & Spaces
- ASTM A 510 - Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
- ASTM A 380 – Specification for Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
- ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- ASTM A 123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

1.4 SUBMITTALS

- A. Shop Drawings: Submit shop drawings indicating materials, finish, dimensions, accessories, layout, supports, splices, and installation details.
- B. Design Calculations: Verify loading capacities for supports.
- C. Field verification of all dimensions, routing, etc., is directed.
- D. Factory-certified test reports of specified products, complying with IEC 61537, NEC, and NEMA VE 1/CSA C22.2 No. 126.1.
- E. Submit manufacturer’s certification indicating ISO 9001 quality certified.
- F. Submit training procedure for certifying cable tray installers.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

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- B. Approval and Labeling: Provide cable trays and accessories specified in this Section that are approved and labeled.
The Terms "Classified" pertaining to cable trays (rather than "Listed") and "Labeled": As defined in NFPA 70, Article 100, including painted trays.
Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- C. Comply with NFPA 70, National Electrical Code, Article 392: Cable Trays; provide UL Classification and labels.
- D. Comply with IEC 61537, Cable Tray Systems and Cable Ladder Systems for Cable Management.
- E. Comply with NEMA VE 1/CSA C22.2 No. 126.1, *Metal Cable Tray Systems*, for materials, sizes, and configurations; provide cCSAus Certificate and labels.
- F. Provide documentation of the following certifications:
ISO 9001 quality certification.
American Bureau of Shipping (ABS) Product Design Assessment certification.
Det Norske Veritas (DNV) certification.
E 90 Fire Testing certification.
VDE certification.
- G. Provide ETL test documentation showing cable compression/deformation testing.

1.6 COORDINATION

- A. Coordinate layout and installation of cable tray with other trades.
- B. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.
- C. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

Subject to compliance with requirements, provide industry leading and approved products.

2.2 MATERIALS AND FINISHES:

- A. Cable Tray Materials:
Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture.
- B. Cable Tray Finishes:
Finish for Carbon Steel Wire after welding and bending of mesh;
 - 1. Electrodeposited Zinc Plating: ASTM B 633, Type III, SC-1.
 - 2. Powder-Coated Trays – UL classified Black powder-coated surface treatment over Electrodeposited Zinc Plating (or plain steel) using ASA 61 black polyester coating.

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- C. Cable tray will consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat, with UL Classified splices where tray(including UL Classified painted tray) acts as Equipment Grounding Conductor (EGC). Wire mesh cable tray will have continuous Safe edge T-welded top side wire to protect cable insulation and installers.
- D. Provide splices, supports, and other fittings necessary for a complete, continuously grounded system.
Mesh: Width will be 4, 6, 12 U.O.N.
Straight Section Lengths: Length will be 118 inches (3000mm) U.O.N.
Wire Diameter: Patented design includes varying wire sizes to meet application load requirements; to optimize tray Strength; and to allow tray to remain lightweight.
Safe edge: Patented Safe edge technology on side wire to protect cable insulation and installers' hands.
Fittings: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer's instructions and Item 2.3.
- E. CF Series Cable Tray Size:
1. Depth: Cable tray depth will be 4 inches
 2. Width: Cable tray width will be 6 ,12, 18, or 24 inches as shown on Telecommunications Drawings:
 3. Length: Cable tray section length will be 118 inches (3000mm) unless otherwise shown on drawings.
 4. Fill Ratio: Cable tray may be filled to total fill capacity per NEC. Minimum 20% spare capacity recommended accommodating future cabling changes or additions.
 5. Load Span Criteria: Cable tray will be capable of carrying a uniformly distributed load of 50 pounds per foot on an 8 ft support span, according to load tests of standard shown in Item A above.

2.3 CABLE TRAY SUPPORTS & ACCESSORIES

- A. Fittings/Supports: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer's instructions. Supports shall include a system where possible so that screws, bolts, and additional tools are not required for cable tray mounting; installation time is reduced; and tray path can adapt to installation obstacles without the need for additional parts. Place supports so that support span does not exceed that shown on the drawings.
1. Use system support methods to mount from ceiling and wall structures with 1/4", 3/8" or 1/2" threaded rod, if applicable
 2. Splices, including those approved for electrical continuity (bonding), as recommended by cable tray manufacturer. Select one of the following splicing methods, if applicable: (use following or industry equivalent)
 - a. UL Classified EDRN Fast Splice: No hardware required
 - b. UL Classified SWK Splice Washer Kit: Swaged set for splicing, turns, bends, tees
 - c. UL Classified ED Universal Splice Bar: Cut & bend to fit any configuration

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- d. Preclick Splice: Bolted connection optional
 - e. UL Classified EDT Splice Plate: Bolted connection
 - f. UL Classified CE 25 & CE 30 Square Splice Washers: Use with EZ BN ¼" Nut & Bolt
 - g. UL Classified CE 40 Square Splice Washer: Use with EZ BN ¼" to splice trays on bends, adjustable tees
 - h. FASLock Splice: For sweeps and bends with tray 12" (300mm) and wider.
 - i. UL Classified EZ T 90 kit: For Tees and 90s
 - j. UL Classified RADT90 kit: For 5-1/2" radius Tees and 90s
- B. Accessories: As required to protect, support, and install a cable tray system. Select from the following accessories, if applicable:
- 1. Cable Routing Accessories:
Cablexit: No additional hardware needed.
- C. Support Accessories: (use following or industry equivalent)
- 1. FS 41: Fastrut connector to mount tray to nistrut without additional hardware.
 - 2. EZJB 5/16: J-Bolt kit to mount tray to 19" or 23" racks with System Profile.
 - 3. Gripple: Wire Cable Hanging Support.
 - 4. HB-2: Wall Termination Bracket
 - 5. Beam Supports:
 - 6. GNDSB: Grounding Clamp to ground cable tray.
 - 7. SZMC Kit: Seismic Bracing Kit; space 30' apart for most seismic conditions. Consult Tray manufacturer for additional information.
- 2.4 EQUIPMENT GROUNDING CONDUCTOR FUNCTION & GROUNDING
- A. UL Classified cable trays (including painted tray) may act as Equipment Grounding Conductors.
 - B. Use UL Classified splicing methods to ensure cable tray is electrically continuous and bonded as recommended by Tray manufacturer.
 - C. Ground cable trays at end of continuous run.
 - D. Test cable tray system per NFPA70B, Chapter 18 to verify grounding less than 1 ohm.
 - E. Ground cable trays against fault current, noise, lightning, and electromagnetic interference by mounting grounding wire to each 10' cable tray section with grounding clamp. Tray manufacturer Model GNDSB.

PART 3 – EXECUTION

- 3.1 EXAMINATION:
- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of cable trays. Do not proceed with installation until unsatisfactory conditions have been corrected.
- 3.2 INSTALLATION
- A. Install cable tray level and plumb according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
 - B. Cutting: Field-fabricate changes in direction & elevation by cutting & bending cable tray.

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1. Cut cable tray wires in accordance with manufacturer's instructions.
 2. Cable tray wires must be cut with side-action bolt cutters with offset head to ensure integrity of protective galvanic layer.
 3. Remove burrs and sharp edges from cable trays.
- C. Certified Installers: Cable tray installers must have successfully completed Tray manufacturer's Certified Installer program.

Underground Ducts and Raceways for Communications Systems

- A. Outdoor telecommunications pathways connect building, pedestals, maintenance holes, handholds, and towers. These pathways consist of underground, direct-buried or aerial. Underground or direct-buried are generally preferred over aerial because of aesthetics and security. Generally, underground duct banks are preferred over direct-buried because of security, ease of future cable installation and maintenance.
- B. Conduit Types
Examples of conduit types include:
- EB-20 – For encasement in concrete;
 - EB-35 – For encasement in concrete;
 - DB-60 – For direct burial or encasement in concrete;
 - DB-100 – For direct burial or encasement in concrete;
 - DB-120 – For direct burial or encasement in concrete;
 - Rigid Nonmetallic Conduit Schedule 40 – For direct burial or encasement in concrete;
 - Rigid Nonmetallic Conduit Schedule 80 – For direct burial or encasement in concrete;
 - Multiple Plastic Duct (MPD) – For direct burial or installation in conduit;
 - Rigid Metallic Conduit – For direct burial or encasement in concrete;
 - Intermediate Metallic Conduit – For direct burial or encasement in concrete;
 - Fiberglass Duct – For direct burial or encasement in concrete;
 - See **Section 27 13 23** for ABF Fiber Optic Tube Cable Requirements.
- C. Installation
1. The length of conduit between pulling points shall not exceed 600 ft (183m).
 2. Manufactured bends should be used whenever possible. No section of conduit shall contain more than two 90-degree bends, or equivalent between pull points.
 3. Conduits should be installed such that a slope exists to allow drainage and prevent the accumulation of water.
 4. When conduits connect maintenance holes, a slope of .125 in per foot (10 mm per meter) should exits from the middle of the span to each maintenance hole.
 5. Conduits must be buried at a minimum depth of **(Provide Depth Here)**.

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SAMPLE SPECIFICATION

Identification for Communications Systems

PART 1 – GENERAL

1.1. WORK INCLUDES

Work covered by this Section shall consist of furnishing labor, equipment and materials necessary for the labeling of the telecommunications infrastructure as described on the Drawings and/or required by these specifications.

1.2. SCOPE OF WORK

This Section includes the minimum requirements for the Identification and labeling of the Communications Systems for the project as outlined in the Bid Document.

1.3. SUMMARY

- A. Administration of the telecommunications infrastructure includes documentation of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, Telecommunications Rooms, and other telecommunications spaces. All facilities shall apply and maintain a system for documenting and administering the telecommunications infrastructure.
- B. The owner maintains a campus wide labeling scheme for voice and data outlets and patch panels.
- C. Industry Labeling Standards and Conventions shall be used unless otherwise stated in the bid documents or by the Owner's Representative.
- D. Telecommunications Infrastructure Records must be maintained in a computer spreadsheet, or in a computer database. Paper records are encouraged, but are optional. A cable record is prepared for each backbone cable. The record will show the cable name, and must describe the origin point and destination point of the cable. The cable record will record what services and/or connections are assigned to each cable pair or strand. An equipment record is prepared for services distributed from a certain piece of equipment, such as a router, or a system such as the telephone system PBX.
- E. Installer shall maintain accurate, up-to-date Installation or Construction Drawings. At a minimum, the Installation Drawings shall show pathway locations and routing, configuration of telecommunications spaces including backboard and equipment rack configurations, and wiring details including identifier assignments.
- F. Installer shall provide a complete and accurate set of as-built drawings. The as-built drawings shall record the identifiers for major infrastructure components including; the pathways, spaces, and wiring portions of the infrastructure which may each may have separate drawings if warranted by the complexity of the installation, or the scale of the drawings.

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1.4 QUALITY ASSURANCE

- A. All labels shall be installed in a neat and workmanlike manner. All methods of labeling that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative.
- B. Labels shall be of the quality and manufacture indicated. The labels and labeling equipment specified are based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- C. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data labeling.
- D. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
 - ANSI/TIA/EIA - 606 Administration Standards.
 - ANSI/TIA - 569 Pathway and Spaces
 - ANSI/TIA - 568 Telecommunications Cabling Standard
 - BICSI Telecommunications Distribution Methods Manual
 - UL 969 - UL Standard for Safety for Marking and Labeling Systems

1.5 SUBMITTALS

Provide product data for the following:
Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

1.6 COORDINATION

- A. Coordinate installation of labels with other trades.
- B. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store materials in original cartons and in a clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Panduit
- B. Brady Corporation
- C. Equivalent

2.2 LABELS

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.
- C. Where insert type labels are used provide clear plastic cover over label.
- D. Outside plant labels shall be totally waterproof even when submerged.
- E. Equipment Room Copper, Fiber, and Coax Backbone Cable Labels

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SAMPLE SPECIFICATION

- 1. Panduit Part#LS7-75NL-1 or Brady#WML-1231-292
- F. Equipment Room Copper, Fiber, and Coax Horizontal Cable Labels
 - 1. Panduit Part#LS7-75NL-1 or Brady#WML-317-292
- G. Work Area Copper, Fiber, and Coax Riser Cable Labels
 - 1. Panduit Part#LS7-75NL-1 or Brady #WML-317-292
- H. Patch Panel Labels
 - 1. Panduit Part #LS7-38-1 or Brady #CL-111-619

PART 3 - EXECUTION

3.1 IDENTIFICATION & LABELING

- A. The size, color, and contrast of all labels should be selected to ensure that the identifiers are easily read. Labels should be visible during the installation of and normal maintenance of the infrastructure.
- B. Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light), and should have a design life equal to or greater than that of the labeled component.
- C. All labels shall be printed or generated by a mechanical device.

3.2 TELECOMMUNICATION IDENTIFIERS

- A. Refer to the University of Houston Information Technology Telecommunications Infrastructure Standards Manual for labeling practices.
- B. Outside Plant cabling shall be clearly marked using permanent means. Outside plant shall use the following system of numbering and labeling:
 - 1. Fiber Optic:
 - a. Identify: far-end building name, building number, fiber-type and strand-count
 - b. Label at entrance and exit points of tunnel system and at conduit entry points between 12 inches and 36 inches from the conduit or at closet point that is clearly visible and long cable length in tunnel at 200 foot intervals.
 - c. Label at termination panels at both ends.
 - 2. Copper:
 - a. Identify: far-end building name, building number and strand-count
 - b. Label at entrance and exit points of tunnel system and at conduit entry points between 12 inches and 36 inches from the conduit or at closet point that is clearly visible and long cable length in tunnel at 200 foot intervals.
- C. Riser cabling shall be clearly marked using permanent means. Riser cabling shall use the following system of numbering and labeling:
 - 1. Fiber Optic:
 - a. Identify: far-end EF / ER / TR, fiber-type and strand-count.
 - b. When small facilities are fed from a primary location and treated as an ER, riser shall be labeled similar to Outside Plant Fiber Optic.
 - 2. Copper:
 - a. Identify: far-end EF / ER / TR and pair-count
 - b. Termination points shall be labeled as to actual pair at every fifth (5th) pair-point.

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3.3 LABELING PROCEDURES

- A. To be consistent with ANSI/TIA/EIA standards and industry practices, it is important that both labeling and color coding be applied to all telecommunications infrastructure components. Labeling with the unique identifier will identify a particular component. Proper color coding will quickly identify how that component is used in the overall telecommunications infrastructure of the facility.
- B. Visibility and durability:
1. The size, color, and contrast of all labels should be selected to ensure that the identifiers are easily read. Labels should be visible during the installation of and normal maintenance of the infrastructure.
 2. Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light), and should have a design life equal to or greater than that of the labeled component.
 3. Labels are generally of either the adhesive or insert type. All labels must be legible, resistant to defacement, and maintain adhesion to the application surface.
 4. Outside plant labels shall be totally waterproof, even when submerged.
 5. Labels applied directly to a cable shall have a clear vinyl wrapping applied over the label and around the cable to permanently affix the label.
 6. Other types of labels, such as tie-on labels, may be used. However, the label must be appropriate for the environment in which it is used, and must be used in the manner intended by the manufacturer.
- C. Mechanical generation
1. All labels shall be printed or generated by a mechanical device.
 2. Hand written labels are NOT acceptable.

END of SECTION

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