

11) Where conduits cross building expansion joints, use suitable sliding or offsetting expansion fittings. Unless specifically approved for bonding, use a suitable bonding jumper.

12) Support conduits:

- a) Provide anchors, hangers, supports, clamps, etc. to support conduits from the structures in or on which they are installed. Do not space supports farther apart than five feet.
- b) Provide sufficient clearance to allow conduit to be added to racks, hangers, etc. in the future.
- c) Support conduit within three (3) feet of each outlet box, junction box, gutter, panel, fitting, etc.

13) Ream conduits to eliminate sharp edges and terminate with metallic insulated grounded throat bushings. Seal each conduit after installation (until cable is installed) with a removable mechanical-type seal to keep conduits clean, dry and prevent foreign matter from entering conduits.

14) Install a pull string in each conduit.

15) For conduits entering through the floor of a telecommunications room, terminate conduits 6" above the finished floor.

16) Do not install communications conduits in wet, hazardous or corrosive locations.

17) Where conduit is shown embedded in masonry, embed conduit in the hollow core of the masonry. Horizontal runs in the joint between masonry units are not permitted.

18) Where conduit is shown embedded in concrete, embed conduit a minimum of two inches from the exterior of the concrete. Do not place conduit in concrete less than 4 inches thick.

- a) One inch trade size conduit shall be used. Conduits sized smaller than one inch trade size conduit are not permitted embedded in concrete without approval from the Owner.
- b) Run conduit parallel to main reinforcement.

- c) Conduit crossovers in concrete are not permitted
- 19) Where conduit exits from grade or concrete, provide a rigid steel elbow and adapter.
 - 20) Where conduit enters a space through the floor and terminates in that space, terminate the conduit at 6" above the finished floor.
 - 21) Where conduits terminate at a cable tray, the conduits shall be consistently terminated no more than 8" from the cable tray, and have a visually uniform appearance.
 - 22) Where several circuits follow a common route, stagger pullboxes or fittings.
 - 23) Where several circuits are shown grouped in one box, individually fireproof each conduit.
 - 24) Bend and offset metal conduit with standard factory sweeps or conduit fittings. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
 - a) Conduit Sweeps:
 - 1) Sweeps shall exceed 90 degrees
 - 2) Do not exceed 180 degrees for the sum total of conduit sweeps for a section of conduit (between conduit termination points).
 - 3) Sweep radius shall be at least 10 times the internal diameter of the conduit.
 - 4) 90-degree condulets (LB's) and electrical elbows are not acceptable.
 - b) Factory-manufactured sweeps are required for bends in conduit larger than 1-1/4" trade size.
 - c) For bends in 1 1/4" trade size conduit and larger, field-manufactured bends (using a hydraulic bender with a 1 1/4" boot) are permitted only when factory-manufactured sweeps are not suitable for the conditions. In all other cases, factory-manufactured sweeps are required. "Hickey-bender" use is prohibited.

25) Connect conduit to enclosures, cabinets and boxes with double locknuts and with insulating type bushings. Use grounding type bushings where connecting to concentric or eccentric knockouts. Make conduit connections to enclosures at the nearest practicable point of entry to the enclosure area where the devices are located to which the circuits contained in the conduit will connect.

26) Penetrations for raceways:

- a) Do not bore holes in floor and ceiling joists outside center third of member depth or within two feet of bearing points. Holes shall be 1- $\frac{1}{4}$ " diameter maximum.
- b) Penetrate finished walls and finished surfaces with a PVC or sheet metal sleeve with an interior diameter (ID) at least $\frac{1}{4}$ " greater than the outer diameter (OD) of the conduit, set flush with walls, pack with fiberglass, seal with silicone sealant.
- c) Penetrate poured-in-place walls and free slabs with a cast iron sleeve (or Schedule 40 PVC black pipe sleeve for above-grade only) with retaining ring or washer. Set sleeves flush with forms or edges of slab. Pack around conduit with fiberglass and seal with silicone sealant.

27) Raceway terminations and connections:

- a) Join conduits with fittings designed and approved for the purpose and make joints tight. Do not use set indent-type or screw-type couplings.
- b) Make threaded connections waterproof and rustproof by applying a watertight, conductive thread compound. Clean threads of cutting oil before applying thread compound.
- c) Make conduit terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
- d) Cut ends of conduit square using a hand saw, power saw or pipe cutter. Ream cut ends to remove burrs and sharp ends. Where conduit threads are cut in the field, cut threads to have same effective length, same thread dimensions and same taper as specified for factory-cut threads.

- e) Provide double locknuts and insulating bushings at conduit connections to boxes and cabinets. Align raceways to enter squarely and install locknuts with dished part against the box. Use grounding type bushings where connecting to concentric or eccentric knockouts.
 - f) Where conduits are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- 28) Install conduit sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed conduits, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
- a) Where conduits pass from warm to cold locations, such as the boundaries of air conditioned or refrigerated spaces and where conduits enter or exit buildings from outdoor areas, including underground ducts or conduit runs.
 - b) Where otherwise required by the NEC.
- 29) Conduits shall be clean and dry.

C. Sleeves:

- 1) Provide sleeves where required, sized as noted on the Contract Documents. Where not noted, sleeve sizing shall be determined by the type and quantity of cable to be routed through the sleeve per TIA/EIA 569A cable capacity standards, plus an additional 20% for future expansion.
- 2) Provide core drilling where required for installation.
- 3) Seal between sleeve and wall or floor in which the sleeve is installed. Firestop all penetrations to restore wall or floor to pre-penetration fire-rating.

D. Surface Raceway:

- 1) Provide surface raceway for all surface mounted telecommunications outlet boxes and as shown on the Contract Documents.
- 2) Surface raceway shall be routed parallel to and perpendicular to surfaces or exposed structural members, and follow surface contours.
- 3) Surface raceway color shall match as closely as possible the existing wall finish. Do not paint Surface Raceway.
- 4) Surface raceway systems shall be completely installed, including insulating bushings and inserts as required by manufacturer's installation requirements. Unused openings in the surface raceway shall be closed using manufactured fittings.
- 5) Surface raceway shall have a minimum two inch radius control at all bend points.
- 6) Surface raceway shall be securely supported by screws or other anchor-type devices at intervals not exceeding 10 feet and with no less than two supports per straight raceway section. Surface raceway shall be securely supported in accordance with the manufacturer's requirements. Tape and glue are not acceptable support methods.
- 7) Mechanically and electrically continuous surface raceway shall be bonded and grounded to the Telecommunications Grounding system.

E. Outlet Boxes:

- 1) Provide outlet boxes and covers as shown on the Contract Documents and as needed. Verify that the appropriate cover type and depth is provided for each type of wall and finish. Provide extension rings as needed.
- 2) Coordinate box locations with building surfaces and finishes to avoid bridging wainscots, joints, finish changes, etc.
- 3) Install boxes in dry locations (not wet, corrosive, or hazardous).
- 4) Attach boxes securely to building structure with a minimum of two fasteners. Provide attachments to withstand a force of one hundred pounds minimum, applied vertically or horizontally.

- 5) Install boxes at the following heights to the bottom of the box, except where noted otherwise:
 - a) Wall mounted telephones: 48" above finished floor.
 - b) Workstation outlets: 18" above finished floor.
 - c) Place boxes for outlets on cabinets, countertops, shelves, and similar boxes located above countertops two inches above the finished surface or two inches above the back splash. Coordinate and verify size, style, and location with the supplier or installer of these items prior to outlet box installation.
- 6) Recessed mounted outlet boxes:
 - a) Recess boxes in the wall, floor, and ceiling surfaces in finished areas. Set boxes plumb, level, square and flush with finished building surfaces within one-sixteenth inch for each condition. Set boxes so that box openings in building surfaces are within one-eighth inch of edge of material cut-out and fill tight to box with building materials. Single gang opening shall extend at least to the finished wall surface and extend not more than 1/8 inch beyond the finished wall surface. Provide backing for boxes using structural material to prevent rotation on studs or joists.
 - b) Install floor boxes level and adjust to finished floor surface.
- 7) Surface-mounted outlet boxes:
 - a) For boxes surface-mounted on finished walls, provide Wiremold outlet box or equivalent. Cut box as necessary to accept conduit.
 - b) For boxes surface-mounted on unfinished walls (i.e. electrical rooms, mechanical rooms), provide 4"x4" (minimum) outlet box with single gang cover.

F. Floor Boxes:

- 1) Provide floor boxes as shown on the Contract Documents.
- 2) Set device boxes plumb, level, square and flush with floor, within 1/16" tolerance for each condition.

- 3) For floor boxes with combined power and telecommunications circuits, provide metal dividers to separate power from telecommunications circuits.

G. Junction Boxes:

- 1) Provide junction boxes as shown in the Contract Documents and as required.

- a) Where sizing is not shown in the Contract Documents, size junction box length and depth according to the size of the feeder conduit in the following table:

Feeder Size	Box Length	Box Depth
1"	12"	4"
1 – ¼ "	12"	4"
1 – ½ "	12"	4"
2"	24"	4"
2 – ½ "	24"	6"
3"	36"	6"
3 – ½ "	48"	6"
4"	60"	6"

- b) Where sizing is not shown on the Contract Documents, size junction box with the following formula:

- 1) From the table below, select the width associated with the largest conduit on the distribution side of the box. For each additional distribution conduit, add the "Increase Width" value associated with the size of that distribution conduit to the box width for the largest distribution conduit.

- a) For example, if the distribution side of the junction box has one 1-¼" distribution conduit

and three 1" distribution conduits, the total distribution-side width would be $6" + 2" + 2" + 2" = 10"$.

2) Repeat the above process for the feeder side of the junction box. Junction boxes are typically fed by a single conduit, therefore unless the box has more than one feeder conduit, the "Increase Width" part of the formula is unnecessary.

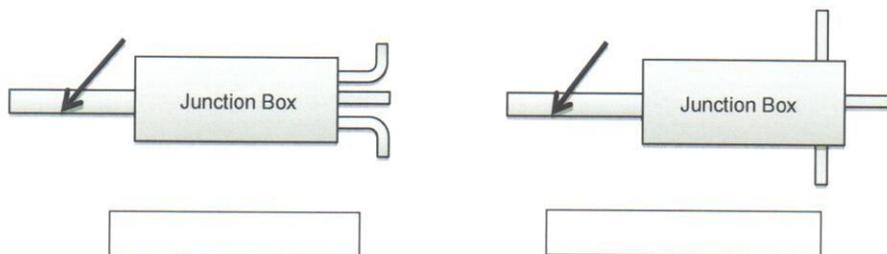
a) For example, if the feeder side of the junction box has two 2" feeder conduits the total feeder-side width would be $8" + 5" = 13"$.

3) The larger of the two width calculations (distribution side vs. feeder side) shall be the width of the junction box to be provided.

a) For example, if the distribution-side width were 10" and the feeder-side width were 13", provide a 13" wide junction box.

Conduit Size	Box Width	For each additional conduit increase width
1"	4"	2"
1 - ¼ "	6"	3"
1 - ½ "	8"	4"
2"	8"	5"
2 - ½ "	10"	6"
3"	12"	6"
3 - ½ "	12"	6"
4"	15"	8"

- 2) A junction box may not be substituted for a 90-degree bend. 90 degree condulets (LB's) are not acceptable.
- 3) Install junction boxes in a location readily accessible both at time of construction and after building occupation. Do not install junction boxes in inaccessible interstitial building spaces.
- 4) Where junction boxes are to be mounted on ceiling structure above ceiling grid, do not mount higher than 4' above grid.
- 5) Install hinged-cover enclosures and cabinets plumb, and supported at each corner.
- 6) Install junction boxes so that the access door opens from the side where the cable installer will normally work – typically from the bottom (floor side) of the box.
 - a) Where a junction box is installed in a ceiling space, coordinate with other trades to provide full access to the junction box door and adequate working room for both the installation personnel and for proper looping of cable during installation.
 - b) Provide a lockable access cover (or junction box door if junction box is exposed) in hard lid ceilings.
- 7) Install junction boxes such that conduits enter and exit at opposite ends of the box as follows:



H. Pull Boxes:

- 1) Provide pull boxes as shown on the Contract Documents and as required.

- a) Where sizing is not shown on the Contract Documents, size pull boxes as follows:

Size of Largest Conduit	Box Width	Box Length	Box Depth
1"	4"	12"	4"
1 – ¼"	6"	12"	4"
1 – ½"	8"	12"	4"
2"	8"	24"	4"
2 – ½"	10"	24"	6"
3"	12"	36"	6"
3 – ½"	12"	48"	6"
4"	15"	60"	6"

- b) Where a pull box is required with conduits 1" or smaller, an outlet box may be used as a pull box. Where outlet boxes are used as pull boxes, the outlet boxes shall be dedicated for use as a pull box and shall not host cable termination hardware.
- 2) A pull box may not be substituted for a 90-degree bend. 90 degree condulets (LB's) are not acceptable.
 - 3) Install pull boxes in an accessible location, readily accessible both at time of construction and after building occupation. Do not install pull boxes in inaccessible interstitial building space.
 - 4) Where pull boxes are to be mounted on ceiling structure above ceiling grid, do not mount higher than 4' above grid (mount on wall instead).
 - 5) Install hinged-cover enclosures and cabinets plumb, and supported at each corner.
 - 6) Install pull boxes so that the access door opens from the side where the cable installer will normally work (typically from the bottom, or floor side, of the box).
 - a) Where a pull box is installed in a ceiling space, provide full access to the junction box door and adequate working room for both the installation personnel and for proper looping of cable during installation.
 - b) Provide a lockable access cover (or pull box door if pull box is exposed) in hard lid ceilings.

- 7) Install pull boxes such that conduits enter and exit at opposite ends of the box as follows:

I. Firestopping:

- 1) Only employees trained/certified by the firestopping manufacturer shall apply firestopping materials.
- 2) Maintain fire rating of penetrated fire-rated walls. Firestop and seal each penetration made during construction.
 - a) Provide firestopping material for through and membrane penetrations of fire-rated barriers.
 - b) Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
 - c) Install firestops in accordance with fire test reports, fire resistant requirements, acceptable sample installations, manufacturer's recommendations, local fire and building authorities and applicable codes and standards referenced in **PART 1-1.2 REFERENCES**. Apply all sealing material in a manner acceptable to the local fire and building authorities.

- J. Grounding/Bonding: Grounding and Bonding work shall comply with Uniform Fire Code, National Electric Code

SECTION 270536 Cable Trays for Communications Systems

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide all materials and labor for the installation of a cable tray system to be utilized for communications infrastructure. This section includes requirements for providing a cable tray system for communications circuits.

1.2 REFERENCES

- A. The pertinent portions of the following specifications, standards, regulations and codes shall be incorporated by reference into these specifications.

1) General

- a) National Electrical Code (NEC)
- b) National Electrical Safety Code (NESC)
- c) Occupational Safety and Health Act (OSHA)
- d) **ASTM A123** – *Specification for Zinc (Hot Galvanized) Coatings on products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.*
- e) **ASTM A653** – *Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process, Structural (Physical) Quality.*
- f) **ASTM A1011** – *Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with improved Formability.*
- g) **ASTM A1008** – *Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy Formability.*
- h) **ASTM B633** – *Specification for Electrodeposited Coatings of Zinc on Iron and Steel.*
- i) **NEMA VE 1** – *Metallic Cable Tray Systems*
- j) **NEMA VE 2** – *Cable Tray Installation Guidelines*

2) Communications

- a) **TIA/EIA – 568**: *Commercial Building Telecommunications Cabling Standard.*
- b) **TIA/EIA – 569**: *Commercial Building Standard for Telecommunication Pathways and Spaces.*
- c) **TIA/EIA – 606**: *The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.*

- d) **TIA/EIA – 607:** *Commercial Building Grounding and Bonding Requirements for Telecommunications.*
- e) **ISO/IEC IS 11801:** *Generic Cabling for Customer Premises.*
- f) **BICSI TCIM:** *BICSI Telecommunications Cabling Installation Manual.*
- g) **BICSI TDMM:** *BICSI Telecommunications Distribution Methods Manual.*

1.3 DEFINITIONS

- A. **“EMT”** shall mean Electrical Metallic Tubing.
- B. **“RMC”** shall mean Rigid Metal Conduit.
- C. **“Raceway”** shall mean any enclosed channel for routing wire, cable or busbars.
- D. **“TMGB”** shall mean Telecommunications Main Grounding Busbar. There is typically one (1) TMGB per building, located in the main telecommunications room. This busbar is directly bonded to the electrical service ground.
- E. **“TGB”** shall mean Telecommunications Grounding Busbar. There is typically one (1) TGB per Telecommunications Room (TR). The TGB is connected both to the TMGB and to the building structural steel or other permanent metallic systems.
- F. **“TBB”** shall mean Telecommunications Bonding Backbone. The TBB is a conductor used to connect TMGBs to TGBs.
- G. **“Pullbox”** shall mean a metallic box with a removable cover, used to assist pulling cable through conduit runs longer than 100’ or in which there are more than 180 degrees of bends. Pullboxes shall have no more than one (1) conduit entering and one (1) conduit exiting the box.
- H. **“Junction Box”** shall mean a pullbox wherein a conduit run transitions from a feeder conduit to multiple distribution conduits.

1.4 SYSTEM DESCRIPTION

- A. Furnish, install, and place into adequate and successful operation all materials, devices, and necessary appurtenances to provide a complete, permanent Cable Tray Infrastructure for Telecommunications Circuits as specified in the Contract Documents. The Cable Tray System shall support an ANSI/TIA/EIA and ISO/IEC compliant telecommunications Structured Cabling System (SCS).
- B. The work shall include materials, equipment and apparatus not explicitly mentioned herein or noted in the Contract Document but which are essential to make a complete working ANSI/TIA/EIA and ISO/IEC compliant Cable Tray System.

1.5 SUBMITTAL INFORMATION

- A. Product Data Submittals: Provide submittal information for evaluation before materials are delivered to the site. Provide product data submittals for all products at the same time.
 - 1) Submit a letter stating that materials will be provided as indicated, and specifically list any items that will not be provided as indicated. The letter shall also state that the Contractor has reviewed the indicated items and has come to an understanding that they are applicable to the project in all aspects.
 - 2) For those items noted as "Or Equal" and which are not being provided as specifically named, submit standard cut sheets or other descriptive information, along with a separate written description detailing the reason(s) for the substitution.
 - 3) Provide standard manufacturer's cut sheets and Operating and Maintenance (O&M) instructions at the time of submittal review for each device in the system. These instructions shall detail how to install and service the equipment and shall include information necessary for rough-in and preparation of the building facilities to receive said materials.
- B. Closeout Submittals:
 - 1) O&M Manual- At the completion of the project, the contractor shall submit and O&M to the DC-Net project Manager, reflecting any changes that occurred during the process of construction.

- 2) Records- Maintain at the project site a minimum of one set of Drawings, Specifications, and Addenda. Drawings shall consist of redline markups, specifications and spreadsheets.
 - a) Document changes to the system from that initially shown from the Contract Documents, and clearly identify component labels and identifiers on Drawings.
 - b) Keep Drawings at the job site and make available to DC-Net and or Designer at all times.
 - c) Keep Drawings current throughout the progress of construction. ("Current" is defined as not more than one (1) week behind actual construction).
 - d) Show identifiers for major infrastructure components on Drawings.

PART 2- PRODUCTS

2.1 GENERAL

- A. Materials shall consist of tray sections, tray fittings, connectors, supports, expansion joints, barrier strips, radius drops, bonding conductors and other incidentals and accessories as required for a complete, permanent Cable Tray Infrastructure. Provide all incidental and or miscellaneous hardware not explicitly shown in the Contract Documents but that is required for a fully operational system.
- B. Physically verify existing site conditions prior to purchase and delivery of materials.
- C. Cable Tray components must be manufactured by a single manufacturer. Components shall not be intermixed between different manufacturers.
- D. For a given manufacturer, all components shall be part of a single cable tray product line- components shall not be intermixed between a manufacturer's cable tray product line.

2.2 MATERIALS AND FINISH

- A. Welded wire: Cable Tray shall be constructed of a welded wire mesh (high strength steel wires) with a continuous safety edge wire lip. Cable tray shall be complete with all tray supports, materials, and supplementary and miscellaneous hardware required for a complete cable tray system.
 - 1) Finish: Carbon steel with electro-plated zinc galvanized finish.
 - 2) Width: Width shall be as shown on the Contract Documents. Where cable tray width is not shown in the Contract Documents, it shall be sized according to the amount of cable to be placed in the trays (as shown in the Contract Documents) plus an additional 20% for future expansion.
 - 3) Depth: minimum of two (2) inches.
 - 4) Mesh: 2 x 4 inches.
 - 5) Fittings: Fittings shall be field fabricated from straight sections using manufacturer-approved tools and in accordance with the manufacturer's instructions.
- B. Grounding/Bonding: In accordance with ANSI/NFPA 70 Section 318-7, cable tray shall be complete with bolted splicing hardware for grounding/bonding throughout the entire cable tray system.

2.3 FIRESTOPPING MATERIALS

- A. Firestopping material: Conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL1479 fire test in a configuration that is representative of the actual field conditions.

2.4 LABELING AND ADMINISTRATION

- A. Labels: As recommended in ANSI/TIA/EIA 606. Permanent (i.e. not subject to fading or erasure), permanently affixed and created by hand carried label maker or a computer/software-based label making system. Handwritten labels will not be acceptable.

PART 3 – EXECUTION

3.1 GENERAL

- A. The Contractor is solely responsible for the safety of the public and workers in accordance with all applicable rules, regulations, building codes and ordinances.

- B. All work shall comply with applicable safety rules and regulations including OSHA. All work shall comply with the requirements of the National Electrical Safety Code (NESC) and the NEC except where local codes and or regulations are more stringent, in which case the local codes and or regulations shall govern.
- C. All work shall comply with the standards, references and codes listed in **PART 1.2 REFERNCES** above. Where questions arise regarding which standards, references, or codes apply, the more stringent shall prevail.
- D. All work shall comply with the requirements and recommendations of the product manufacturers. Where questions arise regarding which requirements and recommendations apply, the more stringent shall prevail.
- E. Replace and or repair to original (or better) condition any existing structures, materials, equipment, etc. inadvertently demolished or damaged by the Contractor during the course of construction at no additional cost to DC-Net.
- F. Install the cable tray system in a manner ensuring that telecommunications circuits, when installed, are able to fully comply with the ANSI/TIA/EIA and other references listed in **PART 1.2 REFERENCES**, above.
- G. Remove all surplus material and debris from job site and dispose of them legally.

3.2 INSTALLATION

- A. Provide cable tray, in the locations and widths shown on the Contract Documents and in accordance with manufacturer's requirements and industry practices (NEMA VE 2). Ensure that the cable tray equipment complies with the requirements of NEC, and applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.
 - 1) Cable tray shall be installed plumb, level and square with finished building surfaces.
 - 2) Provide factory-manufactured connection hardware between each cable tray segment. Cable tray segments shall be mutually aligned. Connection hardware shall be installed according to the manufacturer's requirements.
 - 3) Cable tray elevation changes shall be gradual.

- B. Slots/sleeves: Provide slots/sleeves where required and where shown on the Contract Documents. Provide hammer-drilling, core drilling and saw cutting where required for installation. Seal and firestop (firestop only if fire rated barrier) between slot/sleeve and cable tray.

- C. Cable Tray Routing:
 - 1) Route cable tray as shown on the Contract Documents. Where not shown on the Contract Documents, route cable tray in the most direct route possible, parallel to building lines.

 - 2) Do not route cable tray through areas in which flammable material may be stored or through wet, hazardous or corrosive areas.

- D. Cable Tray Clearance Requirements:
 - 1) Clearance requirements for cable tray accessibility:
 - a) Maintain a clearance of 6" between top of cable tray and ceiling structure or other equipment or raceway.

 - b) Maintain a clearance of 8" between at least one side of cable tray and nearby objects.

 - c) Maintain a clearance of 6" between bottom of cable tray and ceiling grid or other equipment or raceway.

 - 2) Clearance requirements from sources of electromagnetic interference (EMI):
 - a) Maintain a clearance of 5" or more from fluorescent lighting.

 - b) Maintain a clearance of 12" or more from conduit and cables used for electrical power distribution.

 - c) Maintain a clearance of 48" or more from motors or transformers.

 - d) Pathways shall cross perpendicularly to electrical power cables or conduits.

- 3) Maintain a clearance of at least 6 inches from parallel runs of flues and steam or hot- water pipes or other heat sources operating at temperatures above one-hundred degrees Fahrenheit.
- E. Cable Tray Fittings: Provide field-fabricated fittings from straight sections of cable tray using manufacturer-approved tools and in accordance with manufacturer's instructions. Bends shall be long radius. Short radius bends and T-sections shall not be used unless specifically called out on the Contract Documents.
- F. Cable tray supports shall be provided according to the manufacturer's recommendations.
- 1) Supports shall be attached to structural ceiling or walls with hardware or other installation and support aids specifically designed for the cable tray and designed to support the cable tray's weight and required cable weight and volume.
 - 2) Where cable trays abut walls, provide wall-mounted supports.
 - 3) Do not attach cable tray supports to ceiling support system or other mechanical support systems.
 - 4) Trays shall be supported at 5 foot intervals minimum, or more frequently if required by the manufacturer.
- G. Load span criteria: Install tray supports in accordance with the load criteria of L/240, and as shown on the Contract Documents.
- H. Cable tray shall be installed free of burrs, sharp edges, or projections which may damage cable insulation.
- I. Wire-type cable tray shall be cut with a manufacturer-approved cutter with "offset cutting blade" jaws and a minimum 24 inch handle.
- 1) The choice and position of the jaws at the point where the cut is to be made shall allow shearing as close as possible to the intersection of the steel wires.
 - 2) Cuts shall ensure the integrity of the galvanic protective layer.
- J. Expansion Joints: Provide cable tray sliding or offsetting expansion joints/fittings where cable tray crosses building expansion joints in addition to

where shown on the Contract Documents. Provide bonding jumper except where expansion joints are explicitly approved for bonding.

- K. Thermal contraction and expansion: Install cable tray sections with gap settings between cable tray sections that are appropriate for the range of thermal expansion and contraction expected for the space during construction and also during normal occupancy and operation.
- L. Barrier Strips: Provide barrier strips as recommended by manufacturer.
- M. Radius Drops: Provide cable tray radius drops where cable trays cross other telecommunications cable trays or ladder rack in addition to where shown on the Contract Documents.

3.3 GROUNDING AND BONDING

- A. Grounding/Bonding: Grounding and bonding work shall comply with the Uniform Building Code, Uniform Fire Code, National Electrical Code, and UL 467, ANSI/TIA/EIA standards and the references listed in **PART 1.2 – REFERENCES** above, as well as local codes which may specify additional grounding and/or bonding requirements.
- B. Bond metallic raceway (including cable tray) together and to the nearest TGB (as provided under Division 27 Section — “Grounding and Bonding for Communications Systems”). Ensure that bonding breaks through paint to bare metallic surface of painted metallic hardware.
- C. Cable tray bonding splices: Provide cable tray splices according to manufacturer requirements to create a continuous bonding conductor throughout the entire cable tray.
- D. Bonding Conductors:
 - 1) Bond distribution conduits to cable tray.
 - 2) Provide bonding jumpers at expansion joints, sleeves and any other locations where electrical continuity is interrupted.
 - 3) Provide bonding conductor between cable tray and the electrical power distribution system grounding infrastructure.

3.4 FIRESTOPPING

- A. Only employees trained/certified by the firestopping manufacturer shall apply firestopping materials.

- B. Maintain the fire rating of all penetrated fire barriers. Fire stop and seal all penetrations made during construction.
 - 1) Provide firestopping material for through and membrane penetrations of fire-rated barriers.
 - 2) Install firestops in strict accordance with manufacturer's detailed installation procedures.
 - 3) Install firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, manufacturer's recommendations, local fire and building authorities, and applicable codes and standards referenced in **PART 1.2 – REFERENCES**. Apply sealing material in a manner acceptable to the local fire and building authorities.
 - 4) For demolition work, apply firestopping to open penetrations in fire rated barriers where cable is removed. Apply firestopping regardless of whether or not the penetrations are used for new cable or left empty after construction is complete.
 - 5) Firestopping material used to seal open penetrations through which cable passes shall be re-usable/re-enterable.

3.5 CLEANING AND PROTECTION

- A. After completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and in accordance with accepted industry practice, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
 - 1) Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2) Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.6 TESTING

- A. Test cable trays to ensure electrical continuity of bonding and grounding connections. Demonstrate compliance with maximum grounding resistance per NFPA 70B, Chapter 18.

3.7 LABELING AND ADMINISTRATION

- A. Provide the following two labels, alternating one label every 10 feet, along the entire length of the cable tray:
 - 1) Label #1: Label shall read **"TELECOMMUNICATIONS / LOW VOLTAGE CABLING ONLY"**.
 - 2) Label #2: Label shall read **"WARNING! CABLE TRAY SERVES AS A TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT DISCONNECT!"**

SECTION 270543 Underground Ducts and Raceways for Communications Systems

PART 1 – GENERAL

1.1 SCOPE

- A. Provide all services, labor, materials, tools, and equipment necessary for the complete and proper installation of exterior telecommunications pathways as specified in the contract.
- B. This section includes the minimum requirements and installation methods for the following:
 - 1) Cutting and patching of Asphalt and or Concrete.
 - 2) Trenching and Excavation.
 - 3) Underground Conduit systems.
 - 4) Horizontal Drilling (commonly referred to as Directional Boring or Horizontal Boring).

1.2 QUALITY ASSURANCE

- A. Installation for all exterior telecommunications pathways shall be performed in a professional and workmanlike manner. All construction methods that are not specified in the Contract Documents shall be subject to the control of DC-Net.