PART 1 GENERAL

1.00 SECTION INCLUDES

A. Raceways

B. Cable Trays

1. Provide cable tray at the locations shown on the drawings. Except where otherwise indicated, cable tray shall be installed above ceilings to prevent easy installation and rearrangement of telephone, computer, intercom, closed circuit TV, television distribution, access control cables, temperature control system cables and other low voltage system cables.

2. Examine drawings and existing conditions above ceiling spaces and include bends and offsets to avoid ducts, pipes, conduits and other obstacles in the bid price.

C. Conduit

1. Metal conduit.
2. Flexible metal conduit.
3. Liquid tight flexible metal conduit.
4. Electrical metallic tubing.
5. Rigid plastic conduit.
6. Fittings and conduit bodies.
7. Surface Metallic Raceway (Wiremold).

a. Multi-outlet assemblies.
b. Wireways.
c. Wall duct.

1.01 RELATED DOCUMENTS


C. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 RELATED SECTIONS
A. Refer to the following sections for additional requirements for the Communications Distribution System (CDS):

1. Standards Section 078413 (07841) – Through-Penetration Fire Stop System
2. Standards Section 101000 (10019) – Space Identification-Standard
3. Standards Section 260000 (16111) – Raceway System
4. Standards Section 260000 (16130) – Boxes (Sizes, Styles and Types)
5. Standards Section 260000 (16650) – Electrical System-CDS
6. Standards Section 132100 (16652) – Requirements for Communication Rooms
7. Standards Section 271000 (16651) – Communications Distribution System
8. Standards Section 271000 (16651) – APPENDIX-A CDS Approved Products
9. Standards Section 271000 (16651) – APPENDIX-B CDS Glossary of Terms
10. Standards Section 271000 (16651) – APPENDIX-C CDS Building Acronyms
11. Standards Section 271000 (16651) – APPENDIX-D CDS Station Cable Record
12. Standards Section 271000 (16651) – APPENDIX-E CDS Typical Rack Layout For Equipment
13. Standards Section 271000 (16651) – APPENDIX-F CDS Typical Rack Layout For Data Patch Panels
14. Standards Section 273226 (16630) – Rescue Assistance Telephone System
15. Standards Section 275316 (16680) – Clock System
16. Standards Section 275319 – Distributed Antenna System
17. Standards Section 274100 (16710) – Audio-Video (Multi-Media) Systems
18. Standards Section 281300 – Electronic Access Control and Intrusion Detection System
19. Standards Section 282300 (16710) – Video Surveillance System

1.03 REFERENCES

A. ANSI C80.1 – Rigid Steel Conduit, Zinc Coated.
B. ANSI C80.3 – Electrical Metallic Tubing, Zinc Coated.
C. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
E. ASTM A 123 – Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip.
F. National Electrical Code Article 318 – Cable Tray.
H. National Electrical Contractors Association (NECA) Standard of Installation.
I. NEMA RN 1 – Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
J. NEMA TC 3 – PVC Fittings for Use with Rigid PVC conduit and Tubing.

K. Underwriters Laboratories

1. UL 1 – Flexible Metal Conduit.
2. UL 5 – Surface Metal Raceways and Fittings.
3. UL 6 – Rigid Metal Conduit.
4. UL 360 – Liquid-tight Flexible Steel Conduit.
5. UL 514B – Fittings for Conduit and Outlet Boxes.
6. UL 651 Schedule 40 and 80 Rigid PVC Conduit.
7. UL 651A – Type EB and A Rigid PVC Conduit and HDPE Conduit.
8. UL 797 – Electrical Metallic Tubing

1.04 DESIGN REQUIREMENTS

A. All raceways shall be UL listed and labeled.

B. Conduit Size: ANSI/NFPA 70

1.04 SUBMITTALS

A. Product Data:

1. Provide data for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, nonmetallic conduit, flexible nonmetallic conduit, wiremold, nonmetallic tubing, fittings, conduit bodies and fire sealants.

2. Provide dimensions, knockout sizes and locations, materials, fabrication details, finishes and accessories.

3. Cable Tray

   a. Product Data: Provide data for fittings and accessories.
   b. Shop Drawings: Indicate tray type, dimensions, support points and finishes.

1.05 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and shown.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with a minimum 5 years documented experience.

1.07 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Section 01770.

B. Accurately record actual routing of conduits larger than 1 inch.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle Products to site under the provisions of Section 16000.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering

D. Protect PVC conduit from sunlight.

1.09 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Contract Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing is shown on Contract Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

1.10 FIELD MEASUREMENTS AND COORDINATION

A. Verify that field measurements are as indicated on the shop drawings.

B. Examine the Contract Drawings and existing conditions below ceiling spaces and include bends and offsets to avoid ducts, pipes, conduits and other obstacles in the bid price.

PART 2 - PRODUCTS

2.01 RACEWAYS

A. Non-metallic raceway shall not be used above grade.

B. Non-metallic raceway installed below grade shall be Schedule 40 PVC, with concrete encasement at all times.

2.02 CABLE TRAYS

A. General

1. Conform with NEMA VE-1. Cable tray shall be flange-in, galvanized steel or Aluminum with 3 3/8” high (minimum) side rails. Cable tray width shall be as indicated on the drawings.

2. Acceptable Manufacturer’s include:
a. Chalfant.
b. P-W.
c. Husky.
d. Cope.
e. Square-D.
f. T & B

g. B-Line
h. Or approved equivalent.

3. Finish shall be manufacturer’s standard finish. Steel trays shall be galvanized.
4. Structure of trays shall be suitable to support a continuous loading of cables weighing 75 lbs. per linear foot, when supported on 12’ – 0” centers, without any deflection exceeding 1/100 part of the span, with a safety factor of 1.50. Actual support spacing shall be as indicated in Part 3 EXECUTION of this Section.
5. Interior surfaces shall be smooth and free of sharp edges, projections or misalignment. Assembly bolts for end to end connections shall have a pattern which does not cause any damage to cable sheaths or jackets. Add edges shall be smooth and de-burred.
6. Manufacturer’s factory fabricated accessories and special transitions shall be provided for all changes in direction and offsets. Use manufacturer’s standard fittings including bolting assemblies for all end to end connections.
7. No on-site fabricated transitions shall be accepted.
8. There shall be NO Cable Tray installed in any Telecommunications Room. Cable support in these rooms shall be CPI Cable Runway.

B. Ladder-Type Cable Tray

1. Description: NEMA VE 1, Class 12A ladder type tray.
2. Material: Flange-in Steel or Aluminum.
4. Inside Width: As indicated on the Contract Drawings.
5. Inside Depth: 3⅛” high (minimum) side rails.
6. Straight Section Rung Spacing: 9 inches on center.
8. Provide manufacturer’s standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors and grounding straps.
9. Covers: None.

C. Solid-Bottom-Type Cable Tray shall not be accepted.

D. Warning Signs

1. Engraved Nameplates: ½-inch black letters on yellow laminated plastic nameplate, engraved with the following wording:

   WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER OR SUPPORT. USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND PLASTIC TUBING.

E. Supports
1. Wall brackets shall be used in main corridors, classrooms and other public areas. The Contractor shall attach the cable tray to the support bracket.
2. In mechanical rooms, telecommunications closets and other non-public spaces, channel supports may be used. Single channel supports shall be formed, steel type with finish as specified by the Engineer.
3. Where so indicated, center-hung cable tray supports shall be used.

F. Fire stop Pillows

1. Fire stop pillows for penetrations through building fire separations shall be non-toxic, intumescent type. Pillows shall be U.L. listed with a fire rating of 3 hours.
2. Acceptable manufacturers:
   b. Approved equivalent.

2.03 RIGID METAL CONDUIT (RMC) AND FITTINGS

A. UL 6, hot-dip galvanized inside and out. Factory cut threads shall be galvanized after cutting. Rigid metal conduit shall meet the provisions of ANSI C80.1.
B. Acceptable Manufacturers: Allied Tube and Conduit, LTV, Triangle PWC, Western Tube and Conduit or approved equal.
C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; Threaded galvanized or cadmium plated steel fittings. Bushings shall have nylon insulated throats.
D. Utilize “Erickson” type fittings where necessary. Pinch-bolt type split couplings and threadless couplings are not acceptable.

2.04 PVC COATED METAL CONDUIT

A. Acceptable Manufacturers: Allied Tube and conduit, LTV, Triangle PWC, Western Tube and Conduit or approved equal.
B. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil thick.
C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; Threaded galvanized or cadmium plated steel fittings. Bushings shall have nylon insulated throats. All steel fittings shall have an external PVC coating to match conduit.

2.05 FLEXIBLE METAL CONDUIT

A. Acceptable Manufacturers: AFC, Anamet, Triangle PWC or approved equal.
B. Description: Interlocked, galvanized steel construction with PVC jacket.
C. Ferrous Metal: UL 360, galvanized.
D. Fittings:
2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Acceptable Manufacturers: AFC, Anamet, Electriflex, Alflex or approved equal.

B. Description: Interlocked, ferrous metal galvanized construction with PVC weatherproof cover: UL 360.

C. Fittings:
   1. ANSI/NEMA FB 1. Specifically designed for the purpose.
   2. UL 514B galvanized steel.

2.07 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

A. Acceptable Manufacturers: Allied Tube and Conduit, LTV, Triangle PWC or approved equal.

B. Ferrous Metal: UL 797, galvanized.

C. Fittings: UL 514B, galvanized steel, compression ring type. Set screw and drive on top are not acceptable.

D. Description: ANSI C80.3; galvanized tubing.

E. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel, rain tight compression type with nylon insulated throats on connectors.

2.08 RIGID NONMETALLIC CONDUIT (PVC)

A. Acceptable Manufacturers: Carlon, PW Pipe, Triangle PWC or approved equal.

B. Schedule 80, rigid PVC type for buried underground applications without ductback.

C. Schedule 40, rigid PVC type for buried underground applications with ductbank.

D. Description: NEMA TC 2; Schedule 40 PVC.

E. PVC elbows or formed bends less than (10) feet in radius are not permitted. Use rigid steel elbows and bends where radius will be less than (10) feet.

F. Fittings and Conduit Bodies: NEMA TC3.

G. PVC stub-ups are not permitted. Use rigid steel stub-ups.

H. Where entering manhole, handholes, or cable trenches, install PVC end bells on each conduit.
2.09 SURFACE METAL RACEWAY

A. Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway. Formed steel type. Shop primed for field painting. Provide field painting in accordance with Specification Section 09910.

B. Size: Type and size as shown on the Contract Drawings.

C. Fittings, Boxes and Extension Rings: Furnish manufacturer’s standard accessories.

D. Acceptable Manufacturer:
   1. Wiremold or approved equal.

2.10 MULTI OUTLET ASSEMBLY

A. Multi Outlet Assembly: Sheet metal channel with fitted cover, with pre-wired receptacles, suitable for use as multi outlet assembly.

B. Size: Type and size as shown on the Contract Drawings.

C. Receptacles: NEMA WD 6, Type 5-15R, single receptacle, unless indicated otherwise.

D. Receptacle Spacing: As indicated on the Contract Drawings.

E. Channel Finish: As selected by Owner.

F. Fittings: Furnish manufacturer’s standard couplings, elbows, outlet and device boxes and connectors.

G. Acceptable Manufacturers:
   1. Wiremold.
   2. Post Glover/Halsey.
   3. Approved Equal.

2.11 WIREWAY AND AUXILIARY GUTTER

A. Description: NEMA 1, UL 870; General purpose, Lay-in type, 16 gauge steel minimum, with full length removable screws, hinged cover and end caps with full gasketing as required.

B. Size: Cross-sectional dimensions shall be 8 times diameter of the largest conduit entering from side, with a minimum dimension of 4” x 4”, unless otherwise indicated. Length shall be as required.

C. Knockouts: Manufacturer’s standard.

D. Finish: Rust-inhibiting primer coat with manufacturer’s standard enamel finish.
E. Acceptable Manufacturers:

2. Approved equal.

2.12 WALL DUCT

A. Description: Steel, sheet metal wall duct suitable for specified cable installation with covers and accessories as indicated. Provide necessary fittings for transition to Underfloor or Trench Duct.

B. Size: As indicated on the Contract Drawings. Length as required.

C. Acceptable Manufacturers:

1. Square D Company, Model RWT
2. Approved equal.

2.13 EXPANSION FITTINGS

A. Malleable iron hot dip galvanized allowing 4” (± 2”) conduit movement. O-Z/Gedney type AX series or approved equal; Install where indicated or described on the drawings.

2.14 SEALING FITTINGS

A. Function: Sealing fittings will function to prevent the flow of water into the protected space either within the conduit or between the conduit and surrounding concrete wall or floor. In hazardous areas the seals will serve to minimize the passage of gases and vapors and prevent the passage of flames from one portion of electrical installation to another through the conduit.

B. Wall sealing fittings shall be O-Z/Gedney FSK series for new construction and CSM series for existing construction. AT each wall sealing fitting provide an O-Z/Gedney or Crouse Hinds EYS series conduit seal fitting. Raceway stubups and stubouts shall have O-Z/Gedney CSB series conduit seals together with the wall sealing fittings.

C. Through-Wall and Floor Seals for Sealing conduit Passing Through a Wall or Floor: OZ Gedney, Type FSK.

D. Conduit Sealing Bushings for Sealing Conductors within Conduit: OZ

2.15 CONDUIT FITTINGS

B. Install insulating bushings on all metal conduits terminating in panels or cabinets. Bushings shall be insulated type, with body of malleable iron or steel, with malleable iron or steel threads and conduit stop, and with phenolic insulation molded in an irregular shape at the top to provide smooth insulating surface at the top inner edge of that part of the bushing above conduit stop. Material in these bushings must not melt or support combustion.

2.16 BUSHINGS

A. Insulated grounding bushings for all raceway ends, except 120 volt branch circuits require only insulated bushings.

2.17 OUTLET AND JUNCTION BOXES

A. The outlet and junction boxes shall be installed in accordance with the NEC, including the provisions for accessibility and grounding. The boxes shall be supported independently of the conduit, except for cast boxes that are connected to two rigid metal conduits both supported within 12 inches of the box.

B. The mounting heights and locations of the outlets mounted above walkways shall be coordinated. The wall-mounted outlet boxes for switches, thermostats and similar devices shall be aligned.

C. Spare holes and cutouts in junction boxes shall be sealed. In NEMA Type 12 indoor boxes, round spare holes shall be sealed with Type KО snap-in seals and oblong spare cutouts shall be sealed with plate of a minimum thickness the same as the original box and shall completely cover the cutout. All such plates shall be secured with round head bolts with bolt heads on the interior of the box. In NEMA Type 3R and 4 boxes, the spare holes and cutouts shall be sealed with an interior and an exterior plate of a minimum thickness the same as the original box with a neoprene gasket and centered bolts.

2.18 IDENTIFICATION

A. Conduit terminating at floors or in boxes, cabinets or cubicles shall be identified by stamped brass or stamped aluminum metal tags bearing the conduit number. The tags shall be securely attached to the conduit directly under the terminating bushing.

B. Conduit terminating in walls shall be identified by a metal tag fastened to the wall directly under the conduit or fastened to the conduit.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Primary service and secondary service entrance conduit types shall be any combination of the following:
1. Rigid metal conduit for exposed or concealed runs.
2. Rigid nonmetallic conduit with a separate ground wire for underground or under slab on grade runs.

B. Raceway Schedule

1. Feeder conduit types shall be as follows:

a. Rigid Metal Conduit (RMC)
   1) Hazardous areas and exposed locations with watertight connections.
   2) Do not substitute IMC.
   3) Stubups, terminations and elbows in underground PVC conduit runs.
   4) Panel, MCC, transformer and busway feeders.
   5) Use where exposed raceway runs, 2 inches or larger is required.
   6) Wet interior locations with watertight connections.
   7) Exposed interior locations subject to damage. Conduit runs below 4 feet above floor, minimum.
   8) May be used as a substitute for EMT.

b. Electrical Metallic Tubing (EMT)
   1) Use with separate ground wire in non-masonry/concrete walls or above ceilings, except for runs in hazardous locations.
   2) For communications wiring only.
   3) Dry interior locations.

c. Rigid Nonmetallic Conduit
   1) Use with separate ground wire for underground or under slab on grade runs.
   2) Use underground where encased in concrete.

d. Flexible Steel Conduit
   1) For connecting motors, transformers and other equipment subject to vibration.
      a) Install with 90 degree loop, minimum.

e. Liquid-tight Flexible Steel Conduit
   1) For pump motors and equipment subject to vibration in damp or wet locations or areas subject to being washed down or machinery where cutting oil is used.
      a) Install with 90 degree loop, minimum.

C. Sizes

1. Minimum raceway sizes unless otherwise noted shall be follows:
   a. Communications Raceways 1 inch
   b. Branch Circuits ¾ inch
   c. Home Runs (over seven conductors) 1 inch
d. Runs terminating at a switch or at a ¾ inch receptacle back box

D. Branch circuit conduit types shall be as follows:

1. Rigid metal conduit for exposed runs up to 4’-6” above the finished floor in sheltered spaces, for all exposed runs subject to weather, and for runs in hazardous locations.

2. Electrical metallic tubing in non-masonry/concrete walls or above ceilings, and for exposed runs more than 4’-6” above the finished floor in sheltered spaces, except runs in hazardous locations.

3. Liquidtight flexible steel conduit for connections to transformers, motors and other vibrating equipment in damp and wet areas or where exposed to the weather.

4. Flexible steel conduit for connections to transformers, motors and other vibrating equipment in dry, sheltered areas.

5. Rigid nonmetallic conduit with a separate ground wire for underground or under slab on grade runs.

E. Conduits shall be sized in accordance with the applicable codes except where larger conduits are called for on drawings. Sizes shown on the drawings are based on the use of rigid metal conduit and copper conductors with THW insulation unless noted otherwise.

F. Do not install conduit in poured concrete or masonry walls or slabs without the Owner’s approval.

G. All conduit penetrations of structural elements or conduits run within masonry walls or slabs shall be approved by the Owner in advance of installation.

H. Conduits run in masonry shall be placed at least one inch from the surface. Care shall be taken to avoid placing conduits where they will be subjected to excessive heat.

I. Conduit ends shall be capped using standard capped bushings or steel “pennies” and bushings to prevent entrance of foreign materials during construction.

J. Rigid conduit shall be reamed after threads are cut. Joints shall be cut square and shall butt solidly into couplings. Running threads will not be permitted. Cut ends of EMT shall also be reamed.

K. Bends in rigid conduit and EMT runs larger than 1¾” shall be of factory-made elbows unless otherwise specifically approved. Bends in 1¼” and 1” runs shall be made in an approved bending machine (or factory made). Hickey bends will not be permitted in conduits larger than ¾”. Bends shall not show flattening.
L. The radius of the inner edge curve of any field bend shall not be less than indicated in the following table:

<table>
<thead>
<tr>
<th>CONDUIT SIZE</th>
<th>INSIDE RADIUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>½”</td>
<td>4”</td>
</tr>
<tr>
<td>¾”</td>
<td>5”</td>
</tr>
<tr>
<td>1”</td>
<td>6”</td>
</tr>
<tr>
<td>1¼”</td>
<td>8”</td>
</tr>
<tr>
<td>1½”</td>
<td>10”</td>
</tr>
<tr>
<td>2”</td>
<td>12”</td>
</tr>
<tr>
<td>2½”</td>
<td>15”</td>
</tr>
<tr>
<td>3”</td>
<td>18”</td>
</tr>
<tr>
<td>3½”</td>
<td>21”</td>
</tr>
<tr>
<td>4”</td>
<td>24”</td>
</tr>
</tbody>
</table>

M. Conduit runs that are/or exceed 100 linear feet and/or exceed 180 degrees of transitional bends and/or kicks, pull/junction boxes shall be provided. Pull box locations shall be indicated on the “As-Built” drawings.

N. Provide a polyethylene pull string rated at 250 pounds (minimum) tensile strength in each installed conduit, end to end.

O. Conduits containing innerducts shall consist of a four inch PVC Schedule 40 outer conduit (underground) or RGS (above ground or indoors), with three each 1¼ inch ribbed orange polyethylene innerducts. All innerducts shall be provided and installed by the Telecommunications Contractor.

P. Ground and bond conduit per the current electrical code.

Q. Identify and label conduit under provisions of Specification Section 16650.

R. Branch circuit runs are shown schematically. Except where exact routing is indicated, branch circuit home runs may be grouped and the actual routing of branch circuit conduits may be determined at the site and properly entered on the “As-Built” drawings.

S. Exposed conduits shall be permitted only in unfinished areas or where approved by the Owner. Exposed runs must be run in groups at the same elevation, properly spaced, and shall be parallel with or at right angles to the walls and floors.

T. Grounding: The Raceway System serves as basic equipment ground. Provide insulated copper equipment grounding conductors in all raceways (See Specification Section 16060). Make all joints tight for minimum impedance.

U. Bends shall be carefully made to avoid injuring or dimpling. Bends 1-¼ inches and larger shall be factory elbows or formed utilizing an approved bending process.

V. Cap raceway during construction, with manufactured seals to prevent the entrance of water or debris. Swab out all raceways before wires and cable are pulled.
W. Install raceway to prevent the trapping of seepage or condensation. Slope exterior raceways away from structures.

X. Provide nylon pull cord in all raceways provided as spare or for other trades. Identify raceway system use.

Y. Stub a minimum of 3 inches above floor (2 inches where clearance is a problem), all raceways terminated beneath free standing enclosure, wall and floor sleeves, etc., to prevent water entry into raceways and tunnels. Flush couplings may be used for transition to other raceway systems.

3.02 PENETRATIONS

A. Seal all openings in walls, tunnel wall penetrations, water control membranes and floors around raceways with an approved product to maintain smoke and fire integrity and watertightness (See specification Section 07840).

B. For raceways that penetrate building exterior, the section of the raceway within the wall shall be sealed inside (UL approved for the application) and around raceway exterior using approved sealant. Where portions of the interior raceway system are exposed to widely different temperatures, circulation of air from a warmer to a colder section through raceway shall be prohibited.

C. Conduits passing through the building construction joints shall have approved expansion fittings, properly bonded.

3.03 SUPPORTS

A. When more than two conduits will use the same routing, group together on formed structural members such as Unistrut. Unistrut shall be large enough to accept the larger of one conduit or 25 percent additional conduits of the same size in the future.

B. Conduits 1 inch and smaller may be secured to structure and one hole clamps.

C. All supports for conduit over 1 inch shall be formed structural members such as Unistrut type with a minimum of two anchors to the building structure per hanger and a bolted wraparound type pipe clamp. Pipe clamp may be of the two-piece type which hook into the strut and have a single bolt to clamp the two pieces together over the pipe; or the clamp may be of the one-piece type which uses two bolts into the strut to clamp the pipe. For suspended conduit, trapeze type hangers are preferred; however, single rod and pipe clamp type hangers are acceptable for single conduit runs. All suspended hanger vertical members shall be Unistrut or minimum 3/8-inch galvanized threaded rod. Use only manufactured fittings and hardware on all supports.

D. Provide supports for all raceways in accordance with the NEC. Provide sway bracing in addition to code required supports every 20 feet.

E. Materials Specifications for raceway hangers, supports and fasteners, See Specification Section 16190.
F. Temporarily installed raceways, as noted on the drawings or part of the Contractor’s work plan are exempt from the strictest implementation of these requirements.

3.04 ROUTING

A. Maintain existing head room. Do not block access to junction boxes, valves and mechanical equipment.

B. Provide additional pull boxes as required to avoid excess conductor pulling tension or to comply with the 360° bend code requirement.

C. Locate raceways to not endanger the strength of structural members and 6 inches minimum from parallel runs of the mechanical systems heat piping.

3.05 RACEWAY INSTALLATION – SPECIAL UNDERGROUND REQUIREMENTS

A. Underground conduits installed outside the building perimeter shall be minimum ¾” trade size and shall have minimum cover of 24”. Underground conduits shall be encased in a minimum 3” concrete envelope (all around), See Specification Section 03300.

B. Primary and service entrance conduits shall be buried deeper than 24” if required by the power company.

C. Where PVC conduit is installed beneath concrete slabs on grade, it shall be buried a minimum of 6” below top of sub-surface beneath floor slab. Minimum size of PVC used shall be ¾”.

D. Transitions from underslab/grade rigid nonmetallic conduit to above slab/grade conduits shall be made with rigid metallic sweeps. Rigid nonmetallic conduit shall not be installed above slab/grade. All exposed sections of metallic conduit transitions below grade shall be coated w/coal tar and wrapped as described in Item H below.

E. Rigid steel conduit shall be used at penetrations through basement exterior walls encase conduits in a minimum 3” concrete envelope (all around) for the first 2’-0” on the exterior side of the wall.

F. Make joints liquid and gastight. Ends of all underground conduits shall be sealed after conductors have been installed to prevent breathing and condensation.

G. All conduits stubbed out for future use underground shall be extended 5’-0” clear beyond buildings, foundations, concrete walks, paving, other utilities and the like. Keep such stubouts at least 10’-0” clear of future buildings or other permanent installations. Install a 4” x 4” x 12” (deep) concrete monument with an embedded brass plate at all conduit ends for future location. The brass plate shall indicate the origin of the conduit whose end it marks.

H. All metallic conduits installed underground shall be painted with two coats of asphaltic compound and wrapped with one half-lapped layer of Hunt’s Wrap Process No. 3..
I. Slope underground conduits to handholes or vaults at three inches per 100 feet. Where impractical, provide a duct drain in the low point of the conduit. The finished grade elevation at the top of underground pull boxes shall be lower than the elevation of the finished floor at the point of stub-up within the building.

J. Do not cut, notch or drill foundations, footings, retaining walls or other structural elements without Owner’s advance approval in each case.

K. Flush floor couplings shall consist of a standard galvanized steel coupling with a brass pipe plug installed flush with the floor. The brass plug shall be fitted with a female square or hex depression.

3.06 RACEWAY INSTALLATION – SPECIAL ABOVE-GROUND REQUIREMENTS

A. Conduits shall be concealed in the building construction except in electrical rooms, mechanical rooms and where exposed runs are indicated. Exposed conduits shall be run parallel to walls and ceilings and at the ceiling wherever possible.

B. Conduits, whether exposed or concealed, shall be securely supported and fastened at intervals of nominally every 10'-0” and within 36” of each outlet, ell, fitting, panel, etc. Suspended conduits shall be supported by metal rings or by trapeze hangers of Unistrut or Kindorf channel and threaded steel rods. Multiple runs of conduit on ceilings and walls shall be mounted on Unistrut or Kindorf channel. Perforated plumber’s tape shall not be used. Single runs of exposed conduit shall be supported with steel pipe straps. Conduit shall not be supported from ducts, plumbing or other piping or form other conduits but only from building structural elements. Reference additional conduit support requirements under provisions of Section 16190.

C. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control and expansion joints, or wherever conduit may be affected by dissimilar movements of the supporting structure.

D. Where conduit is exposed to the weather or in wet locations, make joints liquid and gastight. Ends of all such conduits shall be sealed after conductors are installed.

E. Keep conduits at least 6” from hot water or steam pipes and at least 18” from the covering on flues and the like.

F. Do not cut, notch or drill structural framing members for the installations of conduit without the Owner’s advance approval in each case.

G. Rigid steel conduit shall be used at roof penetrations. Where conduits pass through the roof, provide channel supports below the roof spanning the structural elements of the roof and braced to the building structure in at least two directions at right angles to one another. The conduit penetrating the roof shall be secured to the supports at two points below the roof as required to render the portion above the roof rigid.
H. Where flexible metal conduit is used for equipment connections or other special (approved) situations, provide a continuous copper ground conductor sized in accordance with the applicable codes. Liquidtight flexible metal conduit shall be used for all equipment connections in damp and wet areas. Flexible conduit used for connections to vibrating equipment shall be approximately 3'-0” long and contain one 90 degree bend.

I. Install conduits so that there is a minimum of 12 inches of clearance between the bottom of the conduit and the top of the removable ceiling tiles.

J. Surface Raceways

1. Install products in accordance with the manufacturer’s instructions.
2. Use flat-head screws, clips and straps to fasten raceway channel to surfaces. Mount plumb and level.
3. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
4. Wireway Supports: Provide steel channel as specified in Specification Section 16190.
5. Close ends of wireway and unused conduit openings.
6. Ground and bond raceway and wireway under the provisions of Specification Section 16060.

3.07 SLEEVES

A. Provide sleeves of sufficient size to permit ready installation of each conduit which passes through concrete walls or suspended slabs. Sleeves in concrete beams, joists, columns or footing walls may be installed only where permitted by the Owner.

B. For conduit that passes through suspended concrete slabs, place sleeves with the top one inch above finished slab and the bottom flush with the underside of the slab. In all other cases, place sleeves with the ends flush with the concrete surfaces. Space sleeves at least three diameters apart on center or more if required by the Owner.

C. When conduits pass through fire resistive walls, ceilings or floors, sleeves shall be packed with fire resistive compound equal to 3M Fire Barrier.

D. Penetrations through fire rated floors, ceilings and walls shall be sealed using an approved fire barrier sealant. Fire barrier sealants shall be a UL Rated material classified for use in through-penetration fire stop systems, and shall have ICBO, BOCAI, and SBCCI(NRB 243) approved rating per ASTM-814 (UL 1479). The sealant shall be equal to 3M CP-25 caulk, FS 195 strips and CS 195 sheet forms or an approved equal. Acceptable manufacturers are STI, 3M, Pensil, Hilti, Dow, Fyre Putty, Hevi-Duty and Nelson.

1. Where sleeves penetrate existing fire resistive concrete walls or floors, the annular space around the sleeve shall be filled with fire resistive intumescent compound equal to STI “Spec Seal” firestop sealant as manufactured by Specified Technologies, Inc., Somerville, New Jersey. If the annular space exceeds ¼”, it
shall be filled instead with fire resistive grout equal to STI “Spec Seal” firestop mortar.

2. Where sleeves penetrates fire resistive sheetrock walls or ceilings or where they penetrate fire resistive suspended ceilings, the annular space around the sleeve shall be filled with fire resistive intumescent compound equal to STI “Spec Seal” firestop sealant.

3. Where sleeves pass through fire resistive walls, ceilings or floors, sleeves shall be packed with fire resistive intumescent compound equal to STI “Spec Seal” firestop putty.

4. A manufacturer’s supplied installation detail shall be submitted for each type of assembly with the UL approval and limitations indicated.

3.08 CABLE TRAYS

A. General

1. Install metallic cable tray in accordance with NEMA VE 1 and manufacturer’s instructions.

2. Cable tray shall be supported with wall brackets or trapeze type brackets, spaced no more than 4’-0” on center. Additional brackets shall be provided on the ends and two additional brackets at all tees and corners. Securely fasten tray to brackets using clamps, manufactured for the purpose. Only where indicated, shall cable tray be center hung. See electrical Contract Drawings and/or Architectural reflected ceiling plans for typical locations. Attach center hung brackets to structural ceiling using ½” threaded steel rods on a spacing not to exceed 4’-0” centers.

3. Use expansion connectors where required.

4. Mount the bottom of the cable tray at the elevations in the locations as indicated on the Contract Drawings. The finished cable tray shall be located above the ceiling and shall have a minimum clearance of 8” above and to the open side of the cable tray.

5. The cable tray shall be installed parallel and adjacent to the wall and shall have not less than 4” and no more than 6” of space between the cable tray and the wall.

6. The cable tray shall be installed as straight as possible. The cable tray shall not closely parallel high voltage electrical power. Proximity to the fluorescent ballast shall also be avoided.

7. The cable tray shall be installed utilizing the manufacturer’s Factory Fabricated Transitions (intersections, waterfalls, corners, etc.). These transitions shall not be smaller than 90°. Field or job site fabricated transitions shall be considered non-compliant.

8. Corridor cable tray and telecom closet tray shall be connected utilizing the manufacturer’s Factory Fabricated Intersections or transitions. These transitions shall not be smaller than 90°. Field or job site fabricated transitions shall be considered non-compliant.

9. There shall be NO Cable Tray installed in any Communications Room, that type of cable support shall be Cable Runway of the ladder rack type manufactured by Chatsworth Products Inc., and shall be installed by the Communications Distribution System installer.
B. Hanger Brackets

1. Support the cable tray from wall brackets, spaced 4’-0” on center maximum. Provide additional brackets on ends, and two additional brackets at tees and corners. Securely fasten the cable tray to the brackets using clamps manufactured for the purpose.

2. Where so indicated on the Contract Drawings, the cable tray shall be center hung. See electrical Contract Drawings and/or architectural reflected ceiling plans for typical locations. Attach brackets to the structural ceiling using ½” threaded steel rods. Spacing shall not exceed 4’-0” centers.

C. Coordination

1. Coordinate the installation of cable tray with mechanical ductwork and sprinkler system piping such that the cable tray remains accessible (minimum 1 foot clear above the cable tray bottom) after installation. Adequate separation from heat sources shall be maintained as well. Coordinate the exact routing with all trades to avoid interferences.

D. Penetrations of Building Fire Separations

1. Where the cable tray penetrates the building fire separations, seal the penetration with fire retardant pillows for east of removal and replacement by communications technicians when cable moves, additions and/or changes occur.

2. The fire retardant pillows shall be installed in a manner to obtain a 3-hours fire rating. Seal the penetration only after the communication cables and other system distribution cables have been installed.

E. Grounding Conductor

1. Provide #6 AWG bare grounding connector the length of the cable tray. Bond the grounding conductor to the cable tray once on each length or section of cable tray using clamps manufactured for the purpose. Extend and connect the #6 AWG grounding conductor to the building ground using grounding connections in accordance with the requirements of the National Electrical Code.

F. Install warning signs at 50 ft centers along cable tray, located to be visible.

3.08 SEALING OF PENETRATIONS THROUGH BELOW-GRADE EXTERIOR WALLS

A. Openings for conduit penetrations through basement exterior concrete walls shall be core drilled and sealed around the conduit using modular mechanical type of sealing closures.

B. The inside diameter of each wall opening shall be sized as recommended by the manufacturer to allow the proper annular space around the conduit to assure a watertight seal when the sealing closure is installed. Contractor shall determine the required inside diameter of each wall opening before ordering materials or core drilling walls.
C. Install sealing closures in accordance with the manufacturer’s instructions.

3.09 FLASHING OF ROOF CONDUIT PENETRATIONS

A. Electrical conduits passing through the roof shall be flashed using four pound seamless lead flashing assemblies, in accordance with the manufacturer’s instructions for the roof system utilized.

B. The neck of the flashing and the conduit shall be sealed with waterproofing compound as recommended by the manufacturer of the flashing assembly. The protected counterflashing shall be secured to the conduit with vandal-proof set screws. The upper annular space between the conduit and the counterflashing shall also be sealed with the recommended waterproofing compound.

C. Install flashing assemblies in accordance with manufacturer’s instructions.

3.10 LABELING REQUIREMENTS FOR RACEWAYS

A. Raceways

1. All conduit, tray, inner-ducts, poles and sleeves shall be labeled showing the following information based on type, source and destination:

   a. Conduits are defined by a letter “C” for EMT conduits of any size: “RMC” for rigid metallic conduit or pipe of any size. “FC” for Fiber or Orangeburg fiber/tar conduit of any size. “PVC” for Poly Vinyl Chloride conduit of any size.

   b. Trays are defined as to type such as: “ST” for spine tray. “RT” for rung or vented bottom tray. “PT” for Plenum rated tray.

   c. Sleeves are sequentially numbered in each space such as “S1” or “S2”.

   d. Source and Destination are by Building Room Codes, example SNRA1 to SNRA2.

END OF SECTION 26000 (16111)