

**NEMA Standards Publication VE 2-2006**

*Cable Tray Installation Guidelines*

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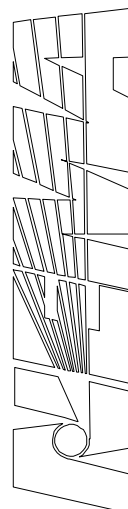
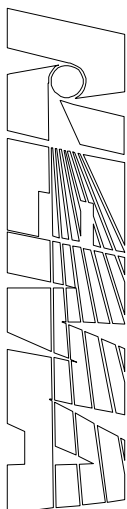
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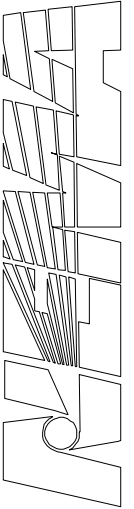
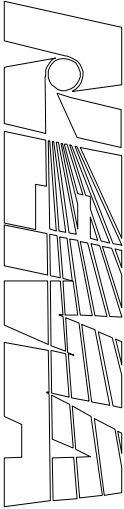
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## Foreword

**For Cable Tray Installers**—This publication is intended as a practical guide for the proper installation of cable tray systems. Cable tray systems design shall comply with NEC Article 392, NEMA VE 1, and NEMA FG 1 and follow safe work practices as described in NFPA 70E.

These guidelines and information do not intend to cover all details or variations in cable tray systems nor provide for every possible installation contingency.

**Construction Experience**—It is recommended that the work described be performed by qualified persons familiar with standard electrical construction practices, electrical equipment, and safety of electrical wiring systems.

These guidelines will be useful to engineers, contractors, and maintenance personnel. This publication will be reviewed periodically with the purpose of updating it to reflect advancing technology and construction techniques. Please address any comments or questions to:



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This is the third edition of this publication.

This standards publication was developed by the NEMA Metal Cable Tray and Nonmetallic Cable Tray Sections. Section approval of the standard does not necessarily imply that all section members voted for its approval or participated in its development. At the time it was approved, the Metal Cable Tray and Nonmetallic Cable Tray Sections were composed of the following members:



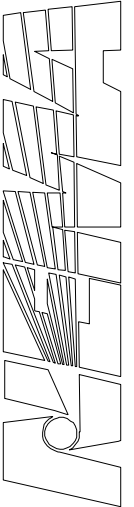
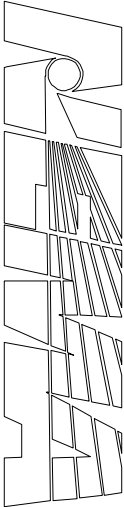
Allied Tube & Conduit/Cope—Harvey, IL  
Cablofil Inc—Mascoutah, IL  
Champion Fiberglass—Spring, TX  
Chalfant Manufacturing Company—Brunswick, OH  
Cooper B-Line—Highland, IL  
GS Metals Corporation—Pinckneyville, IL  
MP Husky Corporation—Greenville, SC  
P-W Industries, Inc.—Pico Rivera, CA  
Thomas & Betts Corporation—Memphis, TN  
The Wiremold/Legrand—West Hartford, CT

## SCOPE

This publication addresses shipping, handling, storing, and installing cable tray systems. Information on maintenance and system modification is also provided.

Abbreviations used in this standard are as follows:

- “in.” denotes inch;
- “ft” denotes foot;
- “lb” denotes pound;
- “mm” denotes millimeter;
- “kg” denotes kilogram;
- “m” denotes meter;
- “N” denotes newtons;
- “°F” denotes degree Fahrenheit;
- “°C” denotes degree Celsius.



## Section 1 GENERAL

**WARNING!—Do not use a cable tray as a walkway, ladder, or support for people;** cable tray is a mechanical support system for cables and raceways. Using cable trays as walkways can cause personal injury and also damage cable tray and installed cables.

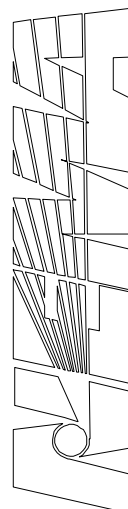
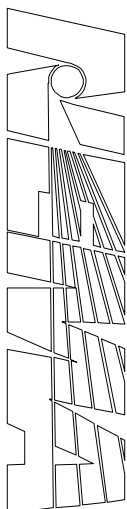
Hazardous voltages in electrical equipment can cause severe personal injury or death. Safety related work practices, as described in NFPA 70E, Part 11, should be followed at all times.

The performance of a cable tray wiring system is dependent on its proper installation, including supports and cables. Neglecting installation and maintenance guidelines may lead to personal injury as well as damage to property.

Installation and maintenance of cable tray wiring systems shall be conducted only by qualified personnel. For the purposes of this guideline, a qualified person is one who is familiar with electrical construction. In addition, the person is:

Trained and authorized to test, energize, clear, ground, tag, and lock out circuits in accordance with established safety practices.

Trained in the proper care and use of protective equipment such as insulated rubber gloves, hard hat, safety glasses or face shields, dust mask, and flash resistant clothing in accordance with established safety practices.



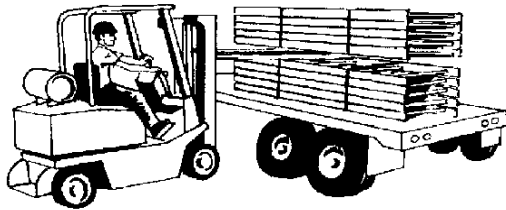
## Section 2 RECEIVING AND UNLOADING

Cable tray is generally bundled and shipped via motor freight, except for export shipments that could be crated or loaded in containers. Accessories and small components are boxed and often skidded.

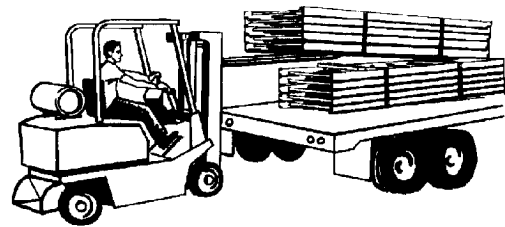
Cable tray can be shipped via enclosed van, trailer, or flat bed trailer. Van trailers are normally used for less than truckload (LTL) shipments. This method of shipment is most common and cost effective and offers maximum protection from the weather during shipment. LTL shipments should be hand unloaded unless provisions have been made with the cable tray manufacturer for forklift unloading.

Flat bed trailers are often used for full truckload shipments and when customers want side forklift unloading or sling unloading by crane. (Special care must be exercised using slings so cable tray is not crushed from the improper location and lifting by sling.)

**CORRECT**



**NOT CORRECT**



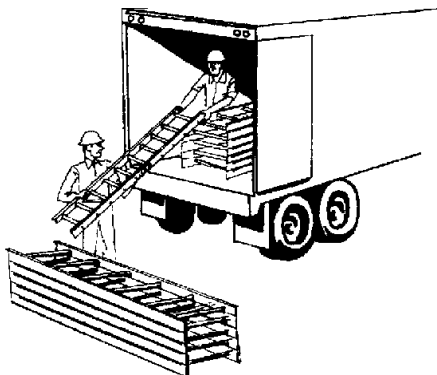
\*Except when utilizing extended forks for skidded bundles

Small to medium size orders less than 600m (2000 ft.) are generally shipped via common carrier - LTL in enclosed vans.

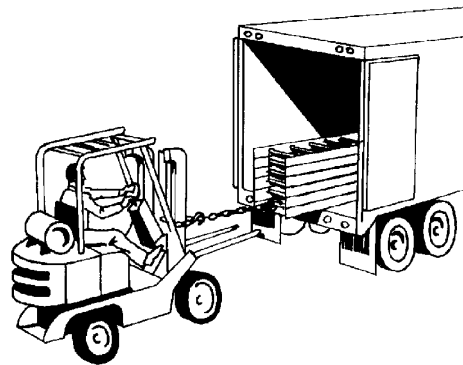
If hand unloaded, workers should wear gloves.

To prevent damage to cable tray, never pull cable tray from truck trailer by chaining to bottom rung and dragging out of trailer.

**CORRECT**



**NOT CORRECT**



Inventory all items immediately after unloading, using the manufacturer's packing list. Note on the bill of lading any shortage or shipping damage for filing freight claim.



### Section 3 STORAGE

Hot dipped galvanized after fabrication (H.D.G.A.F.) (see ASTM A 123) steel, aluminum, and stainless steel cable tray and fiberglass or other non-metallic cable tray can be stored outside without cover, but should be loosely stacked, elevated off the ground, and ventilated to prevent storage stain. If appearance is important, cable tray should be stored indoors to prevent water or other foreign materials from staining or adhering to cable tray.

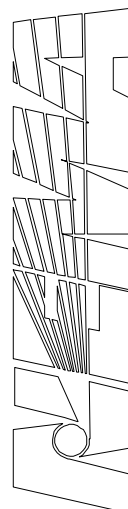
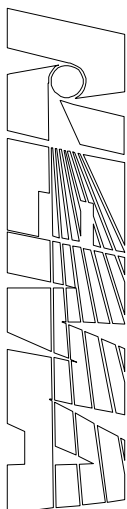
Mill galvanized (see ASTM A 653) or electro-galvanized (see ASTM B 633) cable tray must be protected or stored in a well ventilated, dry location.

Bare steel cable tray should receive a protective coating as soon as possible to prevent surface rust.

PVC or painted cable tray should be protected and stored indoors if possible. Cable tray must be protected from scratching and marring of finish.

Small accessories should be stored to prevent loss.

Cable tray should be stored away from high traffic areas. Cable tray should be stacked by width and type.



## Section 4 INSTALLATION

**For Cable Tray Installers**—This publication is intended as a practical guide for the proper installation of cable tray systems. Cable tray system design shall comply with NEC Article 392, NEMA VE 1, and NEMA FG 1, and shall follow safe work practices as described in NFPA 70E.

These instructions and information do not intend to cover all details or variations in cable tray systems nor provide for every possible installation contingency.

**Construction Experience**—It is recommended that the work described be performed by qualified persons familiar with standard electrical construction practices, electrical equipment, and safety of electrical wiring systems.

### Cable Tray Installation Locations

**Where not allowed** - Article 392 states that cable tray systems shall not be installed in hoist ways or where subject to sever physical damage. Metal cable tray systems may support conductor types allowed in certain areas to include environmental air and classified locations. The restrictions apply to the conductors being installed not the cable trays. Local codes apply.

**Provide access** - Cable tray systems are to be installed so they are accessible. If possible 300mm (12 inches) minimum should be left above or between installed systems to allow for cable installation and maintenance.

**In possible fire areas** - Cable tray installations should avoid possible fire areas. Should that not be possible and there are critical circuits involved, stainless steel cable tray and fire resistant cables should be considered. Wrapping the cable tray in a flame resistant blanket may create a cable-heating problem without a fire. Installing a physical fire shield beneath the cable tray system may provide only limited improvement and create other issues.

### 4.1 COMMON TOOLS FOR INSTALLATION

The following tools are commonly used for installation of cable tray:

- Metal cutting saw
- Touch-up material
- Screwdriver
- Drill with bits
- File
- Open end wrench
- Nylon cord or laser
- Sealant for cut edges (Fiberglass)
- Cutting Saw (Fiberglass) Carbide or Diamond Tipped
- Leveling device
- Tape measure
- Square
- C-clamp
- Torque wrench
- Ratchet wrench
- Offset Bolt cutters (Wire mesh)
- Dust Mask (Fiberglass)
- Appropriate safety equipment

### 4.2 SUPPORT INSTALLATION

**Caution!** Do not cut or drill structural building members (e.g. I-beams) without approval by the general contractor.

In order to install the cable tray supports, first find the required elevation from the floor to the bottom of the cable tray and establish a level line with a laser or a nylon string. A string works well because it can be used to align the threaded rods on one side of a trapeze and find the tops of the supports.

In order to speed the process of installing the trapeze hangers, some nuts may be pre-threaded onto the threaded rod to the approximate location where the nut will be needed. One method for pre-threading the nuts is to put the nuts onto the end of a piece of threaded rod, attach a drill to the threaded rod, and run the nuts up the rod holding onto them with an open-end wrench.

NOTE—Nonmetallic supports and hardware may require special load bearing considerations due to material composition and application temperature. Consult the cable tray manufacturer for recommended practices.

#### 4.2.1 Cable Tray Supports

**Caution!** Supports for cable trays should provide strength and working load capabilities sufficient to meet the load requirement of the cable tray wiring system. Consideration should be given to the loads associated with future cable additions (see section 6.3) or any other additional loads applied to the cable tray system or the cable trays support system.

NOTE—Nonmetallic supports and hardware may require special load bearing considerations due to material composition and application temperature.

NOTE—Special consideration may be required for center-supported systems considering eccentric loading.

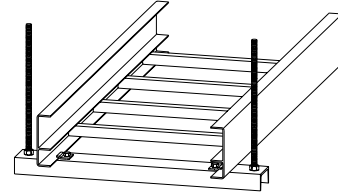
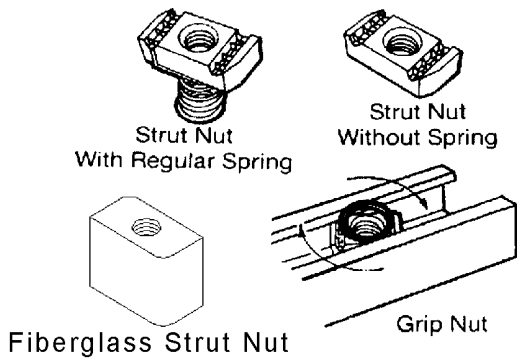
NOTE—Installations requiring seismic considerations affects the cable tray systems supports. The supports should be braced according to the affecting seismic zone. Contact the manufacturer for approved bracing information.

##### 4.2.1.1 Trapeze Type (See Figures 4.1A through 4.1G.)

To install:

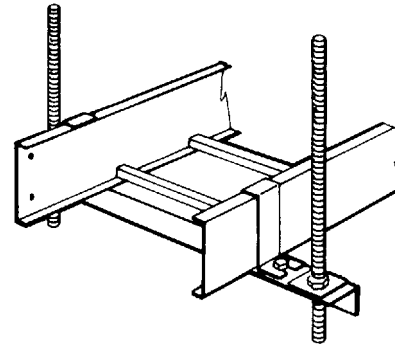
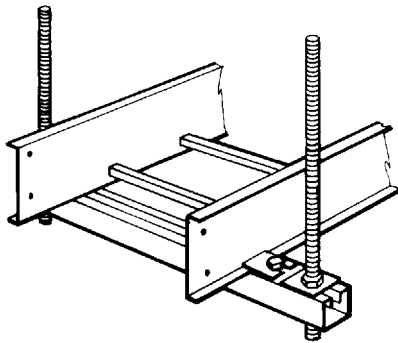
- a. Thread nuts onto threaded rod approximately 50 mm (2 in.) above desired location for bottom of cable tray.
- b. Slide on square washers followed by cross member and second set of square washers.
- c. Thread second set of nuts onto threaded rod.
- d. Move cross member so the top surface is located where bottom of cable tray run will be located.
- e. Move second set of nuts up threaded rod until cross member is reached and held in place.
- f. Make sure cross member is level, then move first set of nuts down threaded rod until cross member is secured in place.

In most cases, hold-down guide clamps may be mounted on either the inside or outside of the cable tray side rail. When installed on the inside of the cable tray, the clamp and/or attaching hardware should not extend above the rung.



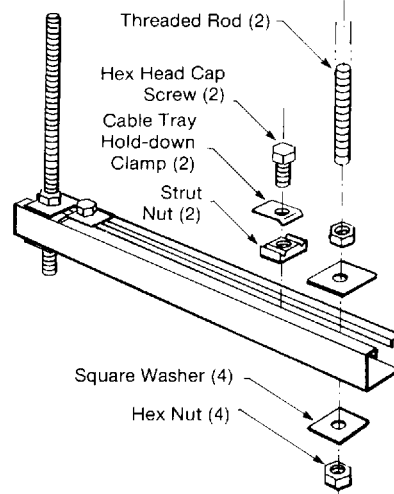
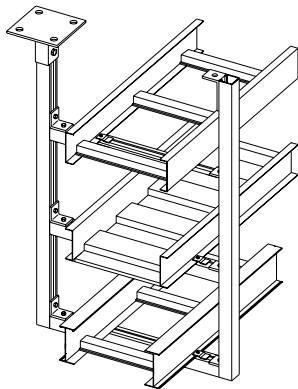
**Figure 4.1A  
STRUT NUT**

**Figure 4.1B  
C-CHANNEL SUPPORT**



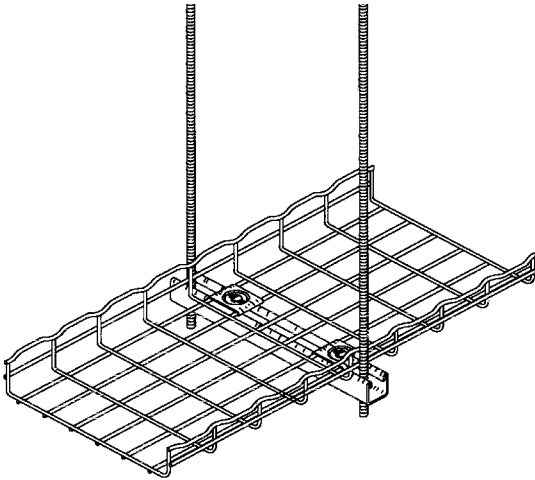
**Figure 4.1C  
STRUT SUPPORT**

**Figure 4.1D  
ANGLE IRON SUPPORT**



**Figure 4.1E  
TYPICAL STRUT SUPPORT INSTALLATION**

**Figure 4.1F  
STRUT-EXPLODED VIEW**

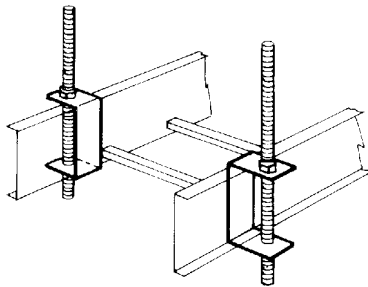


**Figure 4.1G**  
**HOLD DOWNS**

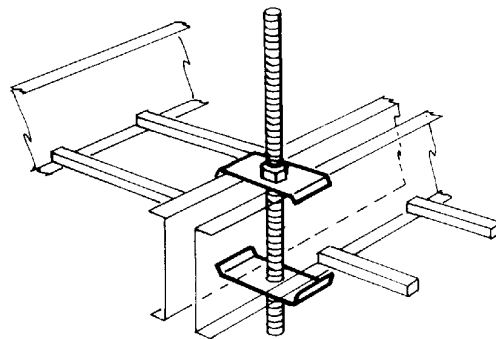
**4.2.1.2 Hanger Rod Clamp** (See Figures 4.2A through 4.2E.)

To install:

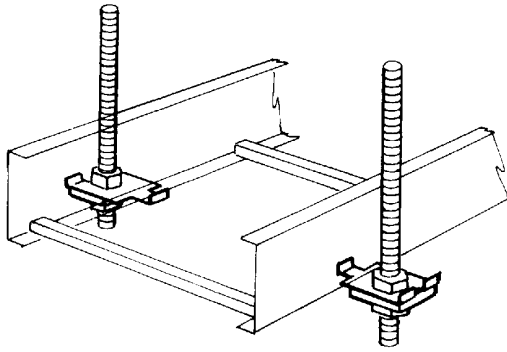
- a. Thread nuts onto threaded rod approximately 225mm (9 in.) above desired location for bottom of cable tray.
- b. Place clamp around side rail of cable tray.
- c. Lift entire cable tray section onto threaded rod running threaded rod through holes in clamps.
- d. Thread a second set of nuts onto threaded rod moving them up until bottom of cable tray reaches desired location.
- e. Move first set of nuts down threaded rod and secure clamps in place.



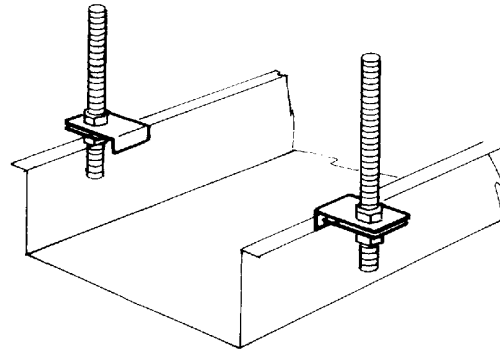
**Figure 4.2A**  
**SINGLE CABLE TRAY HANGER**



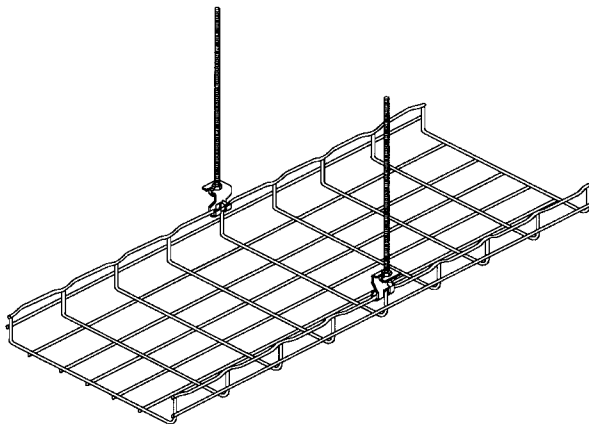
**Figure 4.2B**  
**DOUBLE CABLE TRAY HANGER**



**Figure 4.2C**  
**SINGLE CABLE TRAY HANGER**



**Figure 4.2D**  
**SINGLE CABLE TRAY HANGER**



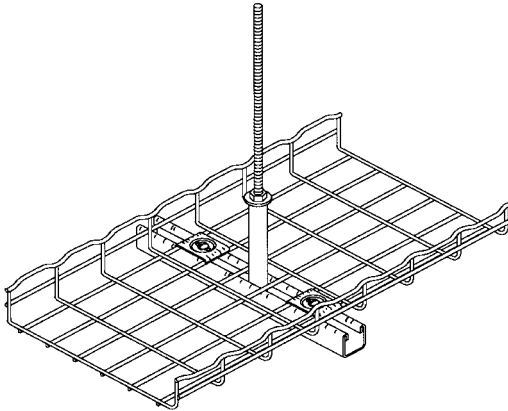
**Figure 4.2E**  
**SINGLE CABLE TRAY HANGER**

#### 4.2.1.3 Center Hung Support (See Figures 4.3A and 4.3B)

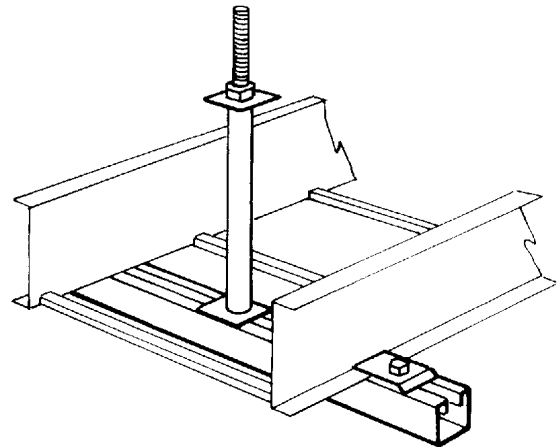
To install:

- a. Thread nut onto threaded rod approximately 225mm (9 in.) above desired location for bottom of cable tray.
- b. Slide washer and support onto threaded rod with upright tube going through center of cable tray section needing support.
- c. Place a square washer on threaded rod and thread on second nut.
- d. Move cross member so its top surface is located at the place where bottom of cable tray run will be located.
- e. Move second nut up threaded rod until it reaches cross member and holds it in place.
- f. Move first nut down threaded rod until it secures cross member in place.

In most cases, hold-down/guide clamps may be mounted on either the inside or outside of the cable tray. When installed on the inside of the cable tray, the clamp and/or attaching hardware should not extend into the cable pathway.



**Figure 4.3A**  
**CENTER HANGER SUPPORT**

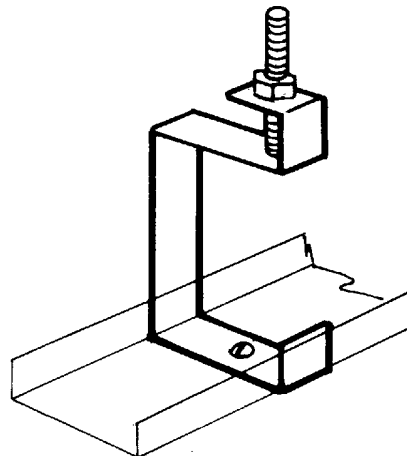


**Figure 4.3B**  
**CENTER HANGER SUPPORT**

#### 4.2.1.4 Single Channel Cable Tray Hanger (See Figure 4.4)

To install:

- a. Thread nut onto threaded rod to height required.
- b. Place hanger on threaded rod and follow with one nut.
- c. Run nut up threaded rod until bottom of hanger is at desired height.
- d. Run top nut down to tighten.
- e. Place channel on hanger and secure in place as necessary.

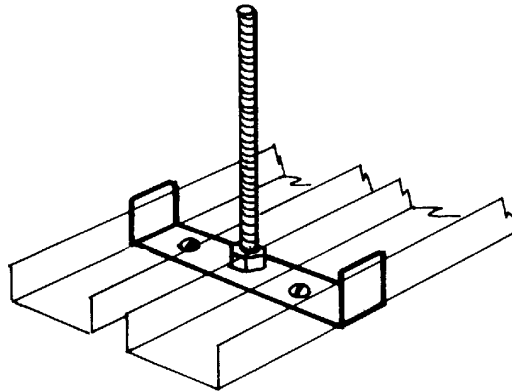


**Figure 4.4**  
**SINGLE CHANNEL HANGER**

#### 4.2.1.5 Double Channel Cable Tray Hanger (See Figure 4.5.)

To install:

- a. Thread nut onto threaded rod to height required.
- b. Place hanger on threaded rod and follow with one nut.
- c. Run nut up threaded rod until bottom of hanger is at desired height.
- d. Run top nut down to tighten.
- e. Place channels on hanger and secure in place as necessary.

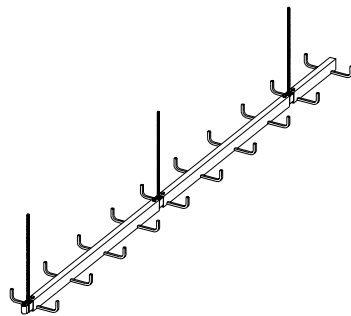


**Figure 4.5**  
**DOUBLE CHANNEL HANGER**

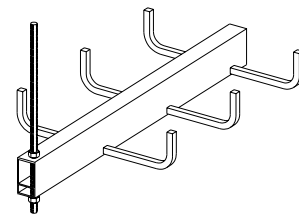
#### 4.2.1.6 Single Rail Cable Tray Hangers (See Figures 4.6A through 4.6C)

To install:

- a. Thread nut onto threaded rod to height required.
- b. Place hanger or cable tray on threaded rod and follow with one nut.
- c. Run nut up threaded rod until bottom of hanger or cable tray is at desired height.
- d. Run top nut down to tighten.
- e. Place cable tray in hanger and secure in place as necessary.

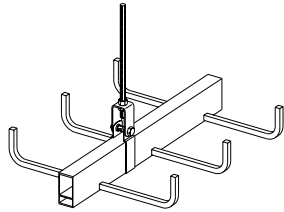


**Figure 4.6A**  
**MULTIPLE SPLICE SUPPORT**



**Figure 4.6B**  
**ROD THROUGH SPINE HANGER**

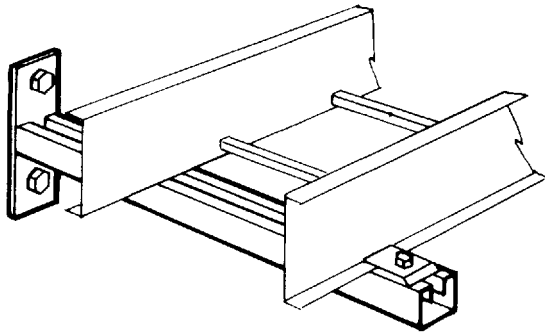




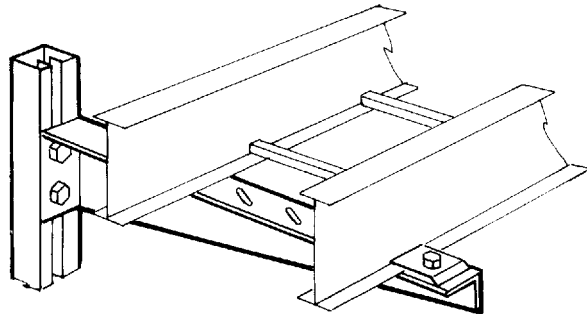
**Figure 4.6C**  
**CLEVIS HANGER**

**4.2.2 Wall and Cantilever Brackets (See Figures 4.7A through 4.7E.)**

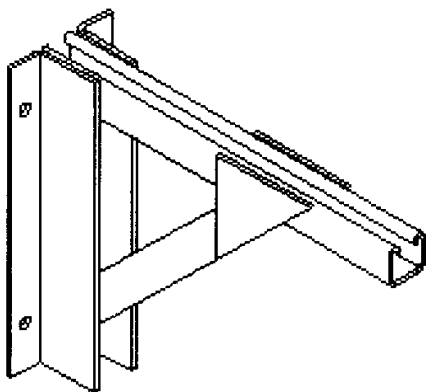
Secure the brackets to the structure making sure they are level and aligned with each other.



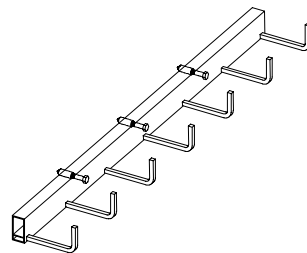
**Figure 4.7A**  
**SINGLE STRUT CANTILEVER BRACKET**



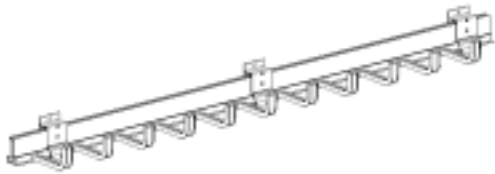
**Figure 4.7B**  
**GUSSET CANTILEVER BRACKET**



**Figure 4.7C**  
**FIBERGLASS CANTILEVER BRACKET**



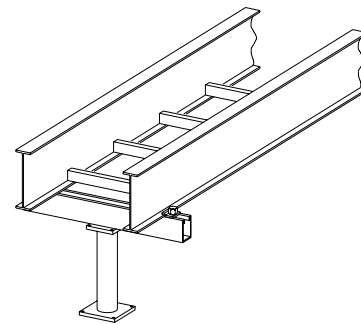
**Figure 4.7D**  
**SINGLE RAIL DIRECT WALL MOUNT**



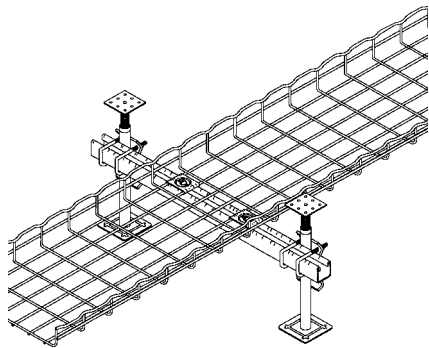
**Figure 4.7E**  
**SINGLE RAIL CLAMP WALL MOUNT**

**4.2.3 Floor and Roof Installations**  
(See Figures 4.8A through 4.8C.)

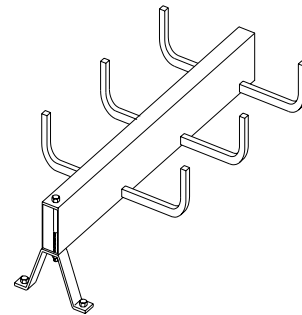
Cable tray should not be laid directly on the floor or roof. It should be mounted far enough off the floor or roof to allow the cables to exit through the bottom of the cable tray. If strut is used for this purpose, mount the strut directly to the floor or roof and attach the cable tray to the strut using hold-down clamps and/or guide clamps.



**Figure 4.8A**  
**ELEVATED STRUT TYPE SUPPORT**

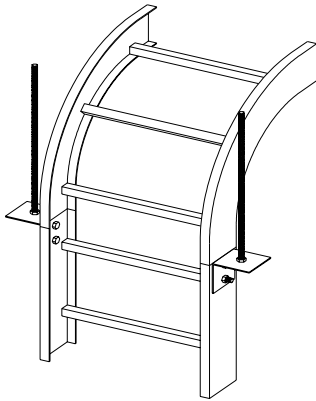


**Figure 4.8B**  
**UNDERFLOOR SUPPORT ATTACHED TO FLOOR PEDESTALS**

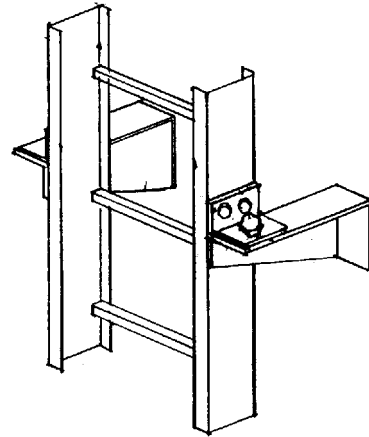


**Figure 4.8C**  
**SINGLE RAIL FLOOR SUPPORT**

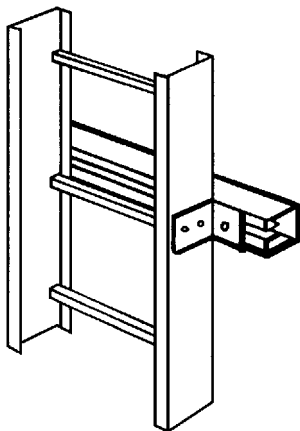
**4.2.4 Vertical Applications (See Figures 4.9A through 4.9D.)**



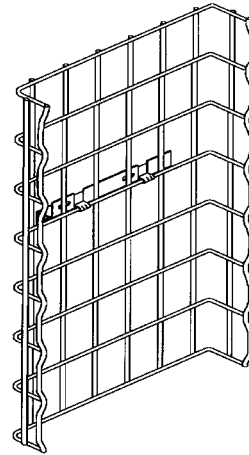
**Figure 4.9A  
VERTICAL THREADED ROD SUPPORT**



**Figure 4.9B  
VERTICAL GUSSET CANTILEVER SUPPORT**



**Figure 4.9C  
VERTICAL STRUT SUPPORT**



**Figure 4.9D  
VERTICAL WALL MOUNT**

**4.3 STRAIGHT SECTION INSTALLATION**

Use the torque data below for fasteners. Follow manufacturer's recommendations for nonmetallic or nonferrous fasteners. Torque values do not apply for hollow sections such as tubes. Consult the manufacturer for recommendations.

**Table 4-1  
FASTENER TORQUE**

Inch: GRD. 2 UNC		Metric: Class 5.8	
Size	Ft-Lbs	Size	N-m
1/4 – 20	4-6	M8 x 1.25	14-16
3/8 – 16	17-23	M10 x 1.5	26-33
1/2 – 13	42-56	M12 x 1.78	45-58

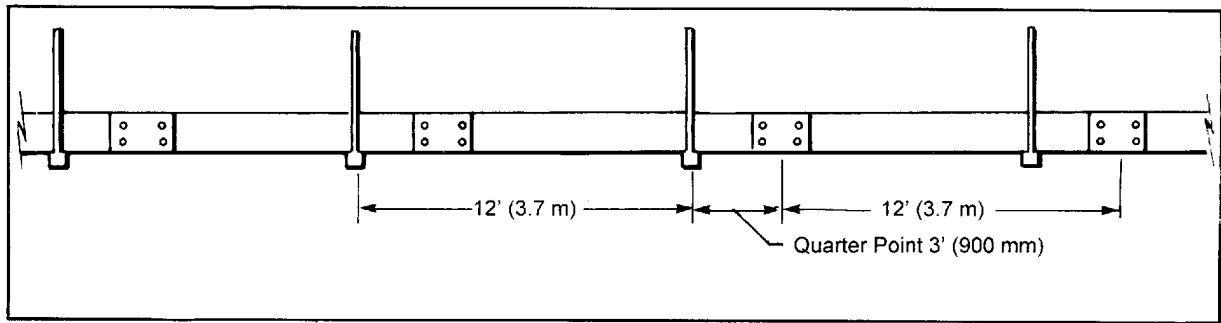
**NOTES**

- 1 Threads are not lubricated.
- 2 Fastener Finishes: zinc plated, cadmium plated, and stainless steel.

**4.3.1 Straight Section Position**

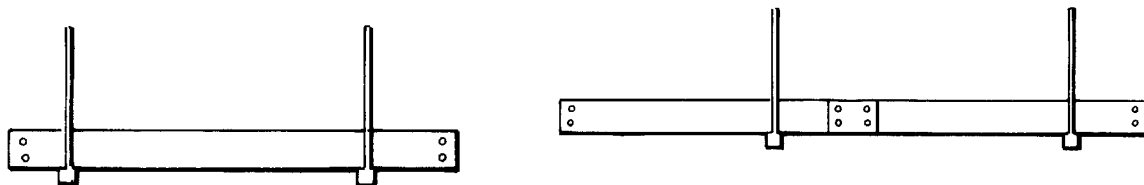
After the supports are in place, the installation of the cable tray can begin at any place that is convenient. It is not necessary to start at one end of the run. It is ideal to lay out the system so that splice joints fall between the support and the quarter point (Figure 4.10A). This maximizes the rigidity of the cable tray. For example, when installing a 12-foot long section, a support spacing of 3.7m (12 ft.) will cause the splice joints to fall at the same position every time.

For single rail cable tray see Figures 4.6A, 4.7D, and 4.7E.



**Figure 4.10A  
CABLE TRAY SUPPORT LOCATIONS**

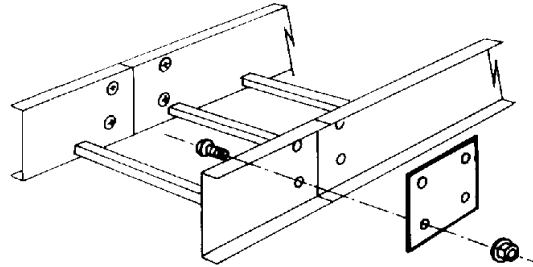
To begin, place a straight section across two supports so that the ends of the section are not directly on the support (Figure 4.10B). If the support span is equal to the length of the straight sections, bolt two pieces together for this step (Figure 4.10C). **The support span should not be greater than the straight section length or as recommended by the manufacturer, to ensure no more than one splice is located between supports.** As a general practice, avoid placing splice plates over supports or at mid-span. However, certain cable tray systems (see Figure 4.6A) and certain splice designs allow for random splice location. See manufacturer for details.



**Figure 4.10B  
CABLE TRAY INSTALLATION**

Place the next straight section across the next support, and attach it to the previous section with a pair of splice plates and hardware. Splice plates should be placed on the *outside* of the cable tray, unless otherwise specified by the manufacturer, with the bolt heads on the *inside* of the cable tray (Figure 4.11).

**Figure 4.10C  
CABLE TRAY INSTALLATION**

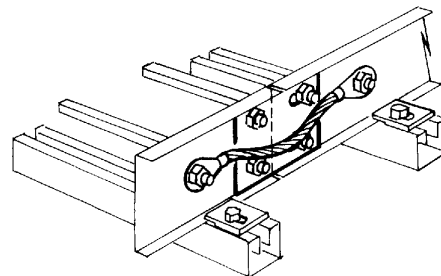


**Figure 4.11  
SPLICE PLATE ATTACHMENT**

#### 4.3.2 Expansion Splice Plates

It is important that thermal contraction and expansion be considered when installing cable tray systems. The length of the straight cable tray run and the temperature differential govern the number of expansion splice plates required (see Figure 4.12 and Table 4-2).

**Figure 4.12  
EXPANSION SPLICE PLATE ATTACHMENT**



\*Bonding jumper not required for fiberglass cable tray systems

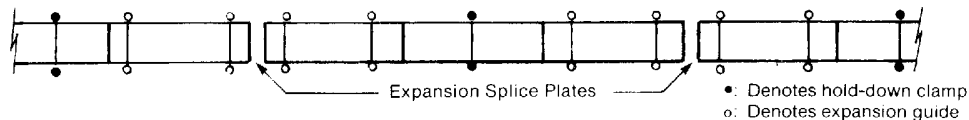
**Table 4-2  
MAXIMUM SPACING BETWEEN EXPANSION JOINTS  
THAT PROVIDE FOR 250mm (ONE INCH) MOVEMENT\*\***

Temperature Differential		Steel		Aluminum		Fiberglass	
°C	(°F)	m	(feet)	m	(feet)	m	(feet)
14	(25)	156	(512)	79	(260)	203	(667)
28	(50)	78	(256)	40	(130)	102	(333)
42	(75)	52	(171)	27	(87)	68	(222)
56	(100)	39	(128)	20	(65)	51	(167)
70	(125)	31	(102)	16	(52)	41	(133)
83	(150)	26	(85)	13	(43)	34	(111)
97	(175)	22	(73)	11	(37)	29	(95)

\* The temperature differential is the difference in the temperature between the hottest and coldest days of the year.

\*\* For designs that provide for 16 mm (5/8 in.) movement (typically non-metallic), multiply maximum spacing between expansion joints by 0.625.

The cable tray should be anchored at the support nearest to its midpoint between the expansion splice plates and secured by expansion guides at all other support locations (see Figure 4.13A). The cable tray should be permitted longitudinal movement in both directions from that fixed point.



**Figure 4.13A  
HOLD DOWN AND GUIDE CLAMP LOCATIONS**

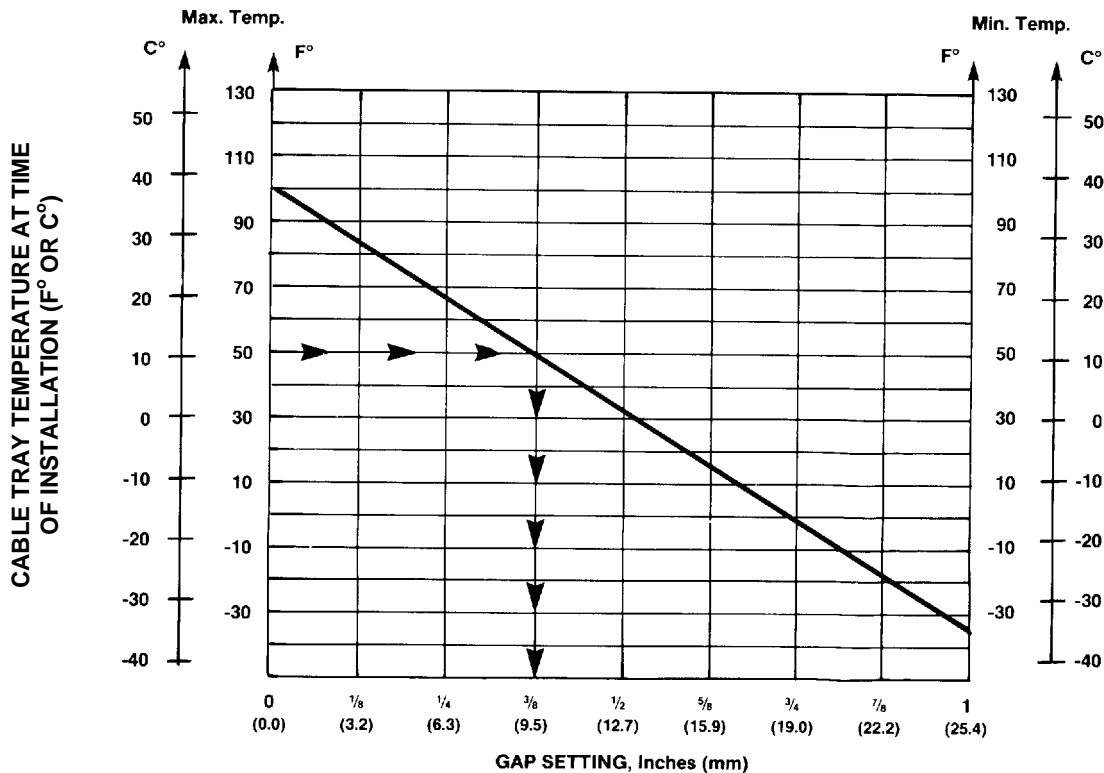
Accurate gap setting at the time of installation is necessary for the proper operation of the expansion splice plates. The following procedure should assist the installer in determining the correct gap (see Figure 4.13B):

- Plot the highest expected temperature on the maximum temperature line.  
Example Value = 38°C (100°F)
- Plot the lowest expected temperature on the minimum temperature line.  
Example Value = (-33°C (-28°F))
- Draw a line between the maximum and minimum points.
- Plot the temperature at the time of installation to determine the gap setting.  
Example Value = 9.5 mm (3/8 in.), 10°C (50°F).

Special hardware is supplied with expansion splice plates. The nuts may have a stopping device (plastic stop nut). **Important**—for plastic stop nut designs, tighten hardware, and then loosen 1/2 turn. For other types of hardware, follow manufacturer's instructions.

Metal Cable tray expansion joints require bonding for electrical continuity. Refer to Section 4.7 for bonding jumper installation (see Figure 4.12).

Supports should be located within 600 mm (2 ft.) of each side of expansion splice plates.



**Figure 4.13B**  
**GAP SETTING OF EXPANSION SPLICE PLATE**  
**25.4 mm (1 in.) Gap Maximum\***

\*For designs using 15.9 mm (5/8 in.) maximum gap (typically non-metallic), multiply gap setting by 0.625.

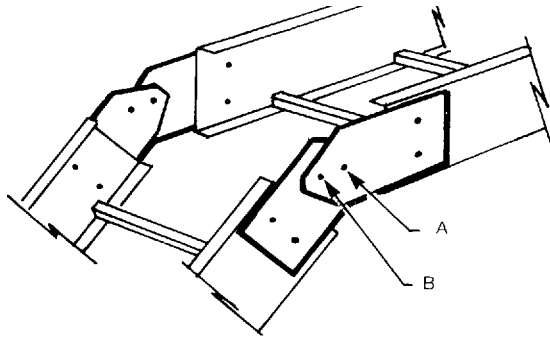
For extended vertical runs see 4.4.2

#### 4.3.3 Vertical Adjustable Splice Plates (See Figures 4.14A and 4.14B.)

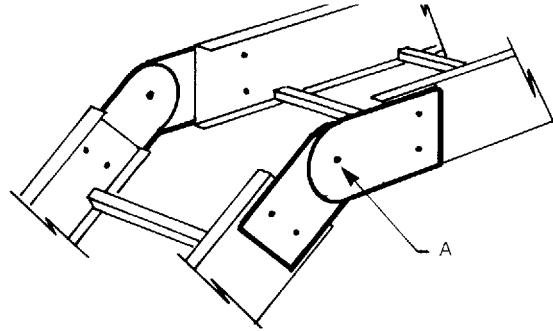
For changes in vertical direction not requiring a radius, vertical adjustable splice plates can be used. Supports should be located within 600 mm (2 ft.) of each side of vertical adjustable splice plates.

- Position splice halves so that offsets adjust for material thickness and fasten with nut and bolt using hole (A).
- Attach to positioned cable tray sections which will set needed angle.
- Drill to complete hole (B). Figure 4.14A only.
- Insert and tighten all hardware.

For metal cable tray, bonding jumpers are required for electrical continuity, unless the splice plates meet the electrical continuity requirements of NEMA Standard VE 1. (Refer to Section 4.7 - Grounding)



**Figure 4.14A**  
**TWO BOLT VERTICAL ADJUSTABLE**  
**SPLICE PLATES**



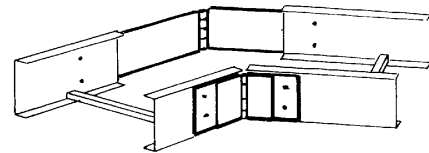
**Figure 4.14B**  
**SINGLE BOLT VERTICAL ADJUSTABLE**  
**SPLICE PLATES**

**4.3.4 Horizontal Adjustable Splice Plates** (See Figure 4.15.)

For changes in horizontal direction not requiring a radius, horizontal adjustable splice plates can be used. Supports should be located within 600 mm (2 ft.) of each side of horizontal adjustable splice plates.

- a. Connect inside connector (short piece) and position cable tray sections to set angle.
- b. Position outside connector locating hinge at mid-point.
- c. Drill required holes and install and tighten all hardware.

For metal cable tray, bonding jumpers are required for electrical continuity unless the splice plates meet the electrical continuity requirements of NEMA Standard VE 1 (Refer to Section 4.7 - Grounding).



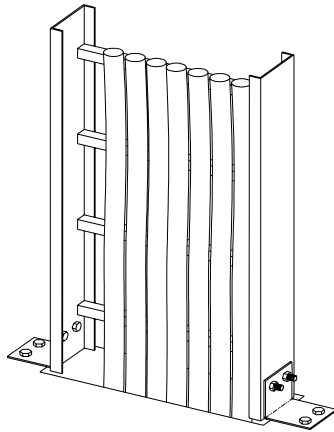
**Figure 4.15**  
**HORIZONTAL ADJUSTABLE**  
**SPLICE PLATES**



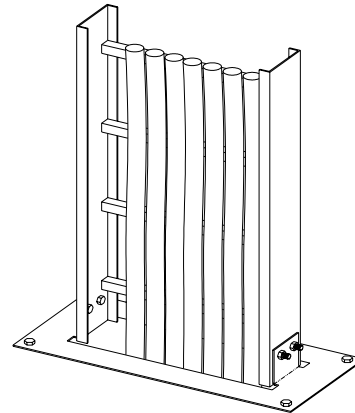
#### 4.3.5 Cable Tray-to-Box or Floor Splice Plates (See Figures 4.16A and 4.16B)

For termination of cable tray system to equipment or structures:

Cable trays and/or cable penetrations through partitions, walls, floors, and ceilings often require special fire rating or environmental concerns and should be handled in accordance with NEC® Articles 392 and 300.



**Figure 4.16A**  
**CABLE TRAY-TO-BOX/FLOOR SPLICE PLATES**

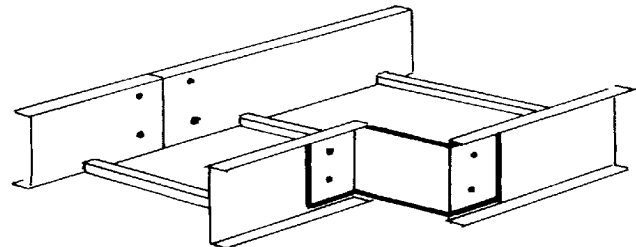


**Figure 4.16B**  
**CABLE TRAY-TO-BOX CONNECTOR**

#### 4.3.6 Offset Reducing Splice Plates (See Figure 4.17.)

For immediate width changes, use offset reducing splice plates. Supports should be located within 600 mm (2 ft.) of each side of offset reducing splice plates.

- a. Use an offset reducing splice plate with a standard splice plate to form an offset reduction.
- b. Use a pair of offset reducing splice plates to form a straight reduction.



**Figure 4.17**  
**OFFSET REDUCING SPLICE PLATE**