Berry Bros. General Contractors, Inc.

Standard Operating Procedures for Cable Tray Installation

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INSTALLATION PRACTICES OF LADDER TRAY

SECTION A: INTRODUCTION

To ensure that the complete ladder tray wiring system performs as designed, it is important that it is properly installed. Personal injury as well as property damage will result if proper installation and maintenance procedures are not adhered to. Qualified field personnel working to a pre-determined layout plan will save considerable installation time. Per the National Electrical Code (NEC) a qualified person is one who is familiar with the construction of the apparatus and the hazards involved.
The system designer (engineer) who has access to the local building codes, the building design, equipment specification and location, and the clearances required by other subtrades is the person best suited in designing the layout and supporting structures. It is the designer who has the technical information critical in designing and routing a satisfactory support structure. Due to the ease in field altering today's ladder tray product, there is a tendency to leave the routing up to the electricians on site. On a project of considerable scope there are large quantities of strut, threaded rod, clips, connectors, ladder tray, fittings as well as hardware, all intended for specific functions and locations. Field personnel must be free to do their disciplines of electrical constructions, testing, energizing, grounding and locking out of circuitry. All this must be done in accordance with the National Electrical Code (NEC) as well as local and customer building regulations.

SECTION B: RECEIVING AND UNLOADING

Due to the increasing complexity and inherent technical nature of today's electrical products, care should be taken in packing, delivering and receiving the product. Reference to detailed documentation will save considerable hours searching for components as the job progresses.
To limit damage, straight lengths should be bundled and shipped on a flat deck trailer. Straight lengths are shipped without exterior crating. Fittings and ancillary products are often boxed or palletized and shipped either on a flat deck or if a separate order via an enclosed truck.
Due to the ratio of ladder tray's bulk to its weight, the freight costs for tray are higher than other metallic products. If scheduling permits, freight costs for ladder tray can be greatly reduced if shipped with other project items (e.g. strut).
When offloading tray from a flat deck trailer using an overhead crane, care should be exercised in the placement and length of the slings to prevent crushing the product.
During forklift offloading on uneven ground, one must exercise extreme caution to prevent load shifting. Only offload single bundles per lift.
When shipping straight sections by truck, all loading and offloading should be done by hand. Exceptions can be made if straight sections are palletized. In no case should the tray be used as an attachment point for forklift forks, chains or slings to withdraw the product from within the truck

.

Immediately after unloading, use the manufacturer's packing list to note shipping damage or shortages in order to file a freight claim. Regardless of the freight terms of payment, the manufacturer should be notified.

SECTION C: STORAGE

All tray items whether stored outside or indoors, should be placed on sufficient support, to enable future mechanical lifting. Trays and fittings should be stacked by their physical dimensions (width) and type. Cable tray should be stored away from well travelled corridors. Stack loosely on adequate support to prevent contact with moisture and the ground. For straight lengths; supports should be placed no closer than 1/4 of the tray from its ends if using 20 foot tray that would be approximately 5 foot from either end. If not covered, the tray should be stacked slightly higher at one end to allow for the drainage of accumulated moisture.

SECTION D: INSTALLATION

Installation should only be attempted by site personnel well versed in State and Federal electrical construction practices and the NEC as it relates to electrical equipment and wiring.

D.1: COMMON TOOLS FOR INSTALLATION

a. Tape measures
b. Ratchet and socket set (3/8" drive)
c. Four (4) foot level
d. Open/closed end box wrenches
e. 3/8" drive portable drill with bits
f. Assorted screwdrivers
g. Metal file (medium)
h. Scribe or other metal marking unit.
i. Reciprocating Saw

LADDER TRAY IS A MECHANICAL SUPPORT SYSTEM FOR CABLES AND IS NOT TO BE USED AS A WALKWAY, LIFTING APPARATUS OR LADDER.

This SOP is intended only as a practical guide for installers and its intent is not to cover all the possible contingencies encountered on site.

D.2: INSTALLATION OF SUPPORT STRUCTURE

D.2.1: TRAY SUPPORTS

Despite the system designer's attempts to provide the field personnel with a definitive layout, job conditions sometimes dictate a rerouting of the tray system. The field supervisor must be familiar with the total loads the support structure will be subjected to. He must also be aware of the placement of these supports in relation to the location of the tray connectors to prevent joining the trays in a simple beam configuration. There are numerous methods of supporting the ladder tray system. This article will cover the common ones.

D.2.1.1: TRAPEZE (SWING) TYPE (REFER TO DIAGRAMS D.1.A THROUGH D.1.E)

The Trapeze or swing support is the most common type.

To Install:

1. Thread hex nut 1" to 2" above location of the tray bottom.
2. Slide on square washers. The cross member comes next followed by a second set of square washers. All vertical hangers will project through the cross member. Therefore, sufficient size holes will have to be punched or drilled through the cross member. These holes should be 1/16" to 1/8" larger than the diameter of the all-thread to prevent thread damage and easy adjustment of the

cross member. The length of the cross member should be sufficient to allow for the attachment of the tray clips plus some horizontal adjustment of the tray.

3. Thread second set of hex nuts onto all-thread moving the top of the cross member up to the underside of the ladder tray.
4. Ensure cross member is level (with bottom set of hex nuts), then move top set of nuts down until the cross member is snug and level.
5. Cross check the length of cross member to ensure tray clips and required horizontal adjustment can be accomplished.

DIAGRAM D.1.A 1/2" SPRING NUTS

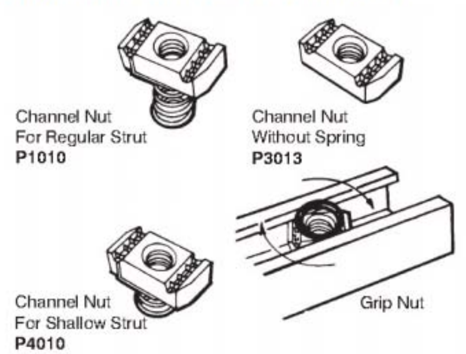


DIAGRAM D.1.B ANGLE IRON

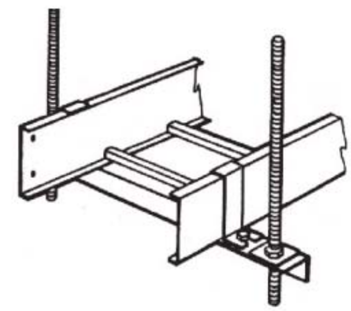


DIAGRAM D.1.C STRUT

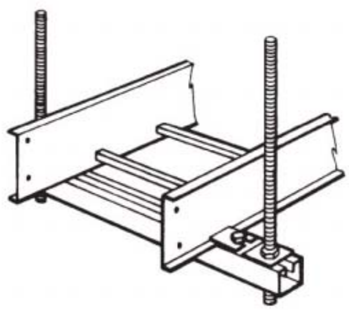


DIAGRAM D.1.D
TYPICAL STRUT INSTALLATION

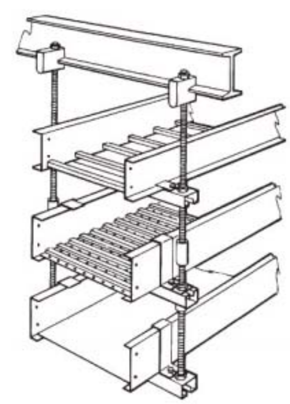


DIAGRAM D.1.E STRUT-EXPLODED VIEW 1/2" ROD

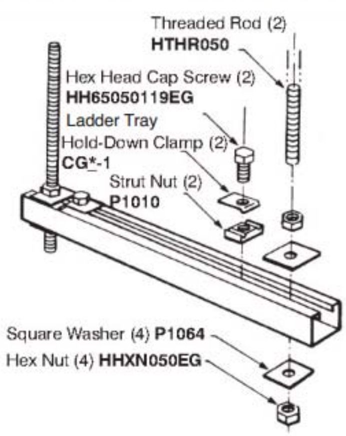
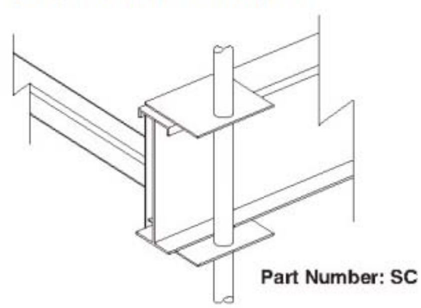


DIAGRAM D.2.A
SINGLE LADDER HANGER



D.2.1.2: SINGLE ROD HANGER SUPPORT (REFER TO DIAGRAMS D.2.A AND D.2.B)

Center hung tray supports allow for quicker and easier cable installation by allowing cables to be deposited into tray systems from each side. There is a maximum load capacity per hanger of 3g 700lbs to 750lbs with the maximum support spacing of 1/8". Up to 750lbs loading capability this system reduces the cost of the support system substantially. There is an overall reduction in hardware, all-thread, and field labor required in the fabrication of supports and installation. Caution must be exercised in loading the cable. Each side must be symmetrically loaded with equal cable weight on either side of the center support. This system is limited to tray width of 24".

To Install:

1. Thread rod onto all-thread up to 8" above bottom elevation of tray.
2. Slide the washer and followed by 1⁄2" x 6" tube and then another washer onto all-thread.
3. The tray must be lifted up so that the all-thread passes through its center.
4. Slide horizontal support onto all-thread to the underside of the tray (held at approximate elevation).
5. Place another washer on the all-thread.
6. Thread a second nut up the all-thread until it reaches the cross member. Continue threading second nut until desired elevation is reached.

vii. Thread first nut down until cross support is held in place.

The tray can be affixed to the cross support in the majority of cases either to the inside or outside of tray. The placement of the vertical hanger is critical. They must be as close to the center grid line of the tray run as possible.

DIAGRAM D.2.A CENTER HANGER SUPPORT

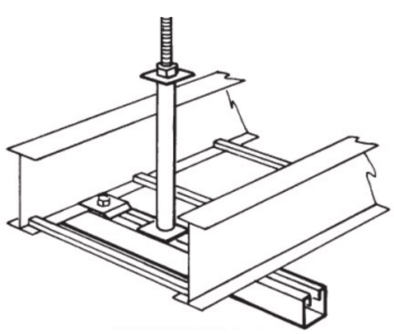
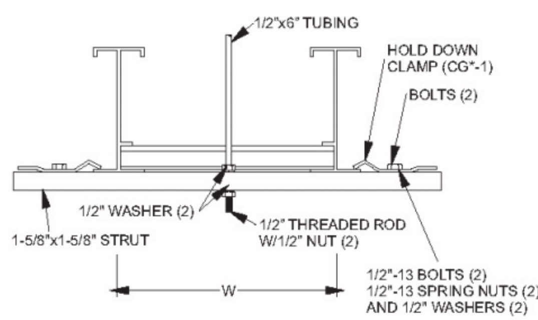


DIAGRAM D.2.B CENTER HANGER SUPPORT



NOTE: All items are supplied except for 1/2" threaded rod.

D.2.2: WALL AND CANTILEVER SUPPORTS (SEE DIAGRAMS D.3.A THROUGH D.3.D)

These supports may be attached to the following structural materials: poured-in-place concrete, precast concrete, brick or concrete and structural steel. For concrete and concrete related structures use masonry expansion bolts. A minimum of two (2) bolts must be used. Please consult the manufacturer's data for both pullout and shear loads for masonry bolts. For attachment to structural steel use beam clamps, bolting or welding. Avoid drilling or welding to light structural members as it may impair the capacity of the member. When welding is the only option; it must be done by a certified structural welder after receiving explicit approval from the OSR.

Position trays on brackets as close to the attachment point as possible to minimize the bending moment. The lengths of the bracket shown in diagram D.3.A is limited to 24" and therefore, tray width should not exceed 18". In Diagram D.3.B the maximum length of the bracket is 22" and maximum tray width is 12". In diagram D.3.C and D.3.D maximum bracket length 36" and maximum tray width is 30"

DIAGRAM D.3.A SINGLE STRUT CANTILEVER BRACKET

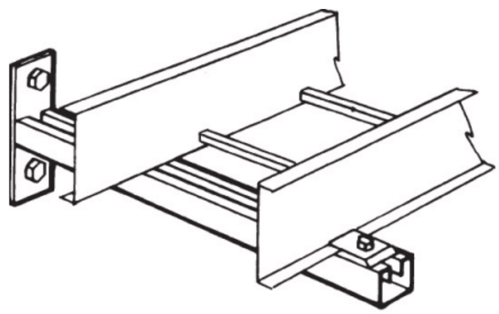


DIAGRAM D.3.B WALL SUPPORT CANTILEVER BRACKET

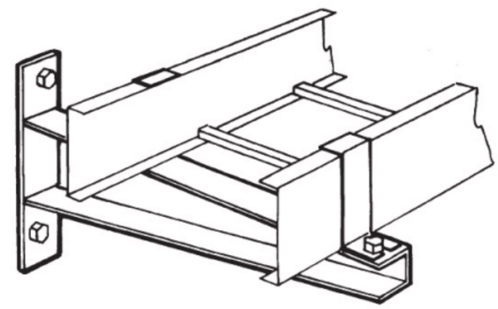


DIAGRAM D.3.A SINGLE STRUT CANTILEVER BRACKET

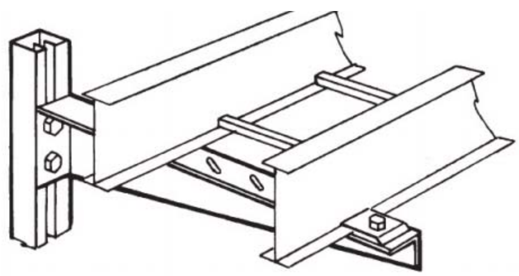
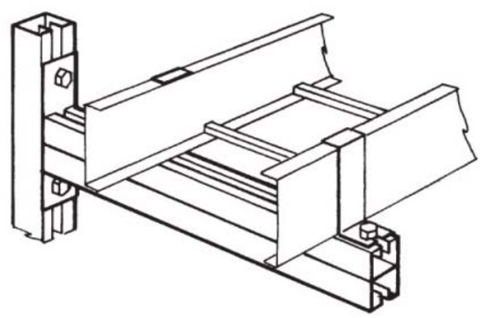


DIAGRAM D.3.B WALL SUPPORT CANTILEVER BRACKET



D.2.4: VERTICAL SUPPORT INSTALLATIONS (DIAGRAMS D.4.A THROUGH D.4.C)

The installations of supports for these applications are covered in the preceding documentation. However, due to the inherent complexity of this install, the issue of safety cannot be overemphasized. This is not an application left to the inexperienced electrician.

The securing of cable to the tray run must be accomplished through the use of "P" clamps. Plastic tie wraps are not permissible.

Pre-planning at this stage may address the installation of temporary bracing (if required) during the installation of the cable. This bracing will prevent unbalanced loading from exceeding design-bending moments. These temporary braces might also serve as pickup/fastening points for the placement of cable rollers and pulleys.

DIAGRAM D4.A VERTICAL THREADED ROD SUPPORT

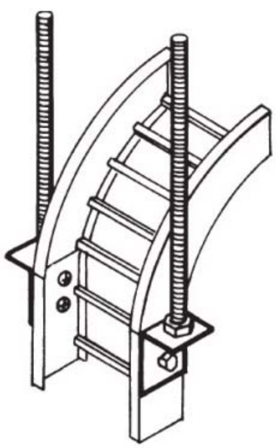


DIAGRAM D.4.B VERTICAL GUSSET CANTILEVER SUPPORT

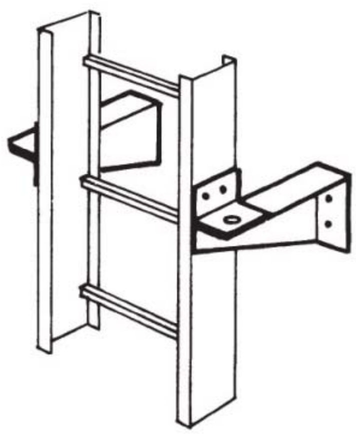
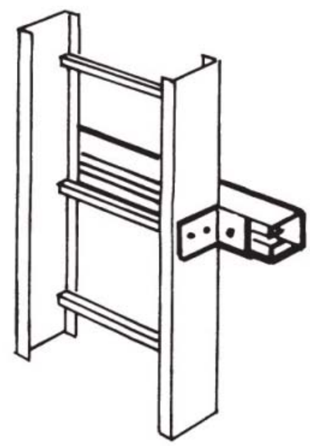


DIAGRAM D.4.C VERTICAL STRUT SUPPORT

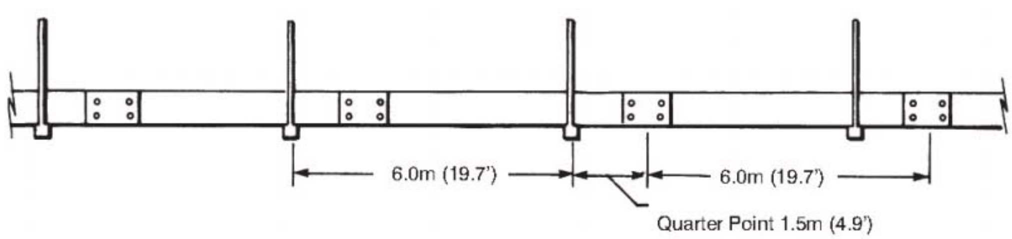


D.3: STRAIGHT LENGTH INSTALLATION

D.3.1: PLACEMENT OF STRAIGHT LENGTHS (DIAGRAMS D.5.A THROUGH D.5.C)

Whenever it is feasible, designers should pre-specify the location of the connectors. This will avoid the creation of simple beam configurations, minimizing the structural repercussions of improperly located connecting points.

DIAGRAM D.5.A LADDER TRAY SUPPORT LOCATIONS



Once the supports are in place, installation of the ladder tray may begin at any location that is convenient. To maximize the rigidity of the ladder tray, the section should be laid out so that the splice locations are between the quarter point of the tray 5’ for a 20’ section and the location of the support (Diagram D.5.A). This pre-layout is especially important if the support spacing is not equal. On the other hand, if installing 6 meter tray lengths on support spacing of 6 meters, the connector plates will be in the same position (Diagram D.5.A) throughout the tray run. If the span between the tray supports is less than the length of the straight section (Diagram D.5.B), place the tray across both supports so that the ends are cantilevered. If the support span is the same as the length of tray, fasten two sections together (Diagram D.5.C). The support span should not exceed the length of one section of tray! There should not be more than one splice connection between two (2) supports. Do not locate tray connectors over supports or at the midpoint. Position the next straight length across the next support and connect it to the previous one. The connecting plates and bolt ends (nuts) must be on the outside of the tray. (Diagram D.8) Tighten the rib-shanked bolts to draw bolt head flush with the inside of the siderail (20-27 ft/lbs).

DIAGRAM D.5.B LADDER TRAY INSTALLATION

DIAGRAM D.5.C LADDER TRAY INSTALLATION

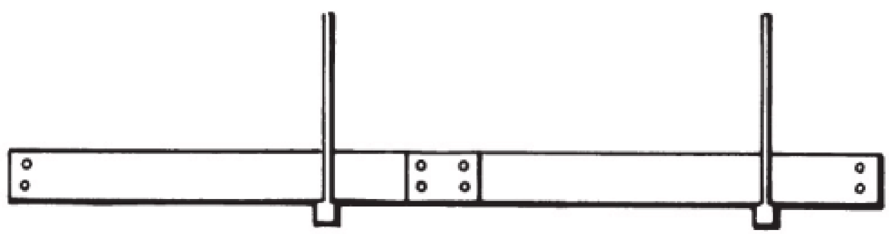
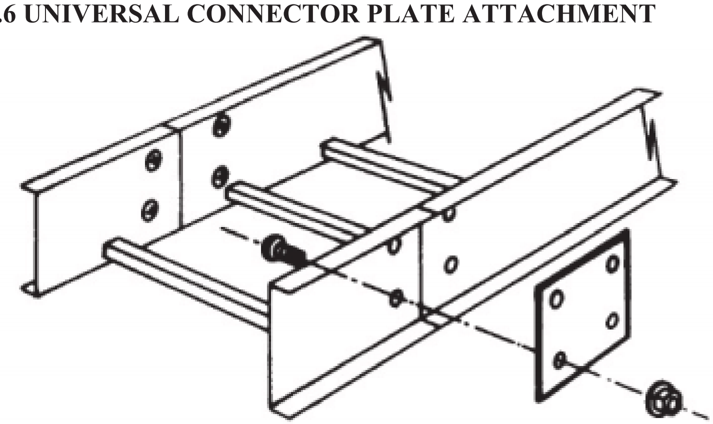


DIAGRAM D.6 UNIVERSAL CONNECTOR PLATE ATTACHMENT



D.3.2: EXPANSION CONNECTORS

When installing ladder tray it is important to consider the amount of thermal movement of the system. This expansion and contraction is quite pronounced when installed outdoors especially in northern climates. Steel and aluminum have different coefficients of linear expansion. The number of expansion connectors (EC) is determined by: 1. temperature differential and 2. the length of the straight run of ladder tray (Diagram D.7).

DIAGRAM D.7

MAXIMUM SPACING BETWEEN EXPANSION JOINTS THAT PROVIDE FOR 25mm OF MOVEMENT					
Temperature Differential		**Steel**		**Aluminum**	
Celsius	**Fahrenheit**	**Meter**	**(FT)**	**Meter**	**(FT)**
-45	(23)	156	(512)	79	(260)
10	(50)	78	(256)	40	(131)
25	(77)	52	(171)	27	(89)
40	(104)	39	(128)	20	(66)
50	(122)	31	(102)	16	(52)
65	(150)	26	(85)	13	(43)
80	(176)	22	(72)	11	(36)

At the midpoint between two expansion joints the tray should b
At all other support locations, the tray is secured to the support
part number CG*-1 (Diagrams D.8.A and D.8.B).

DIAGRAM D.8.A HOLD DOWN CLAMP/EXPANSION GUIDE

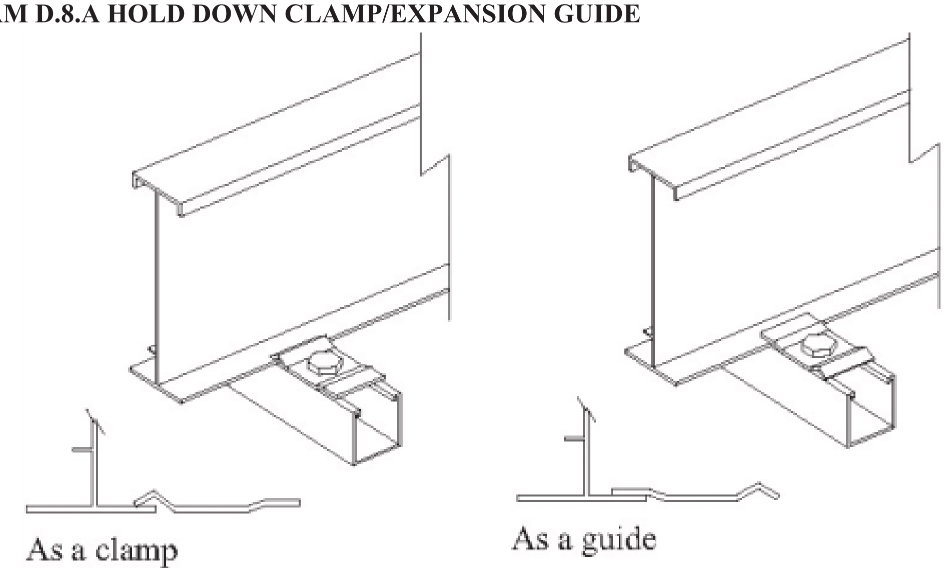


DIAGRAM D.8.B

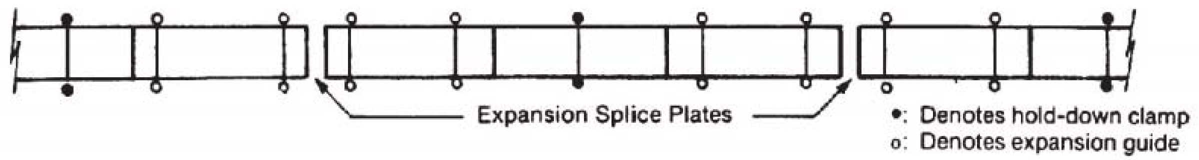
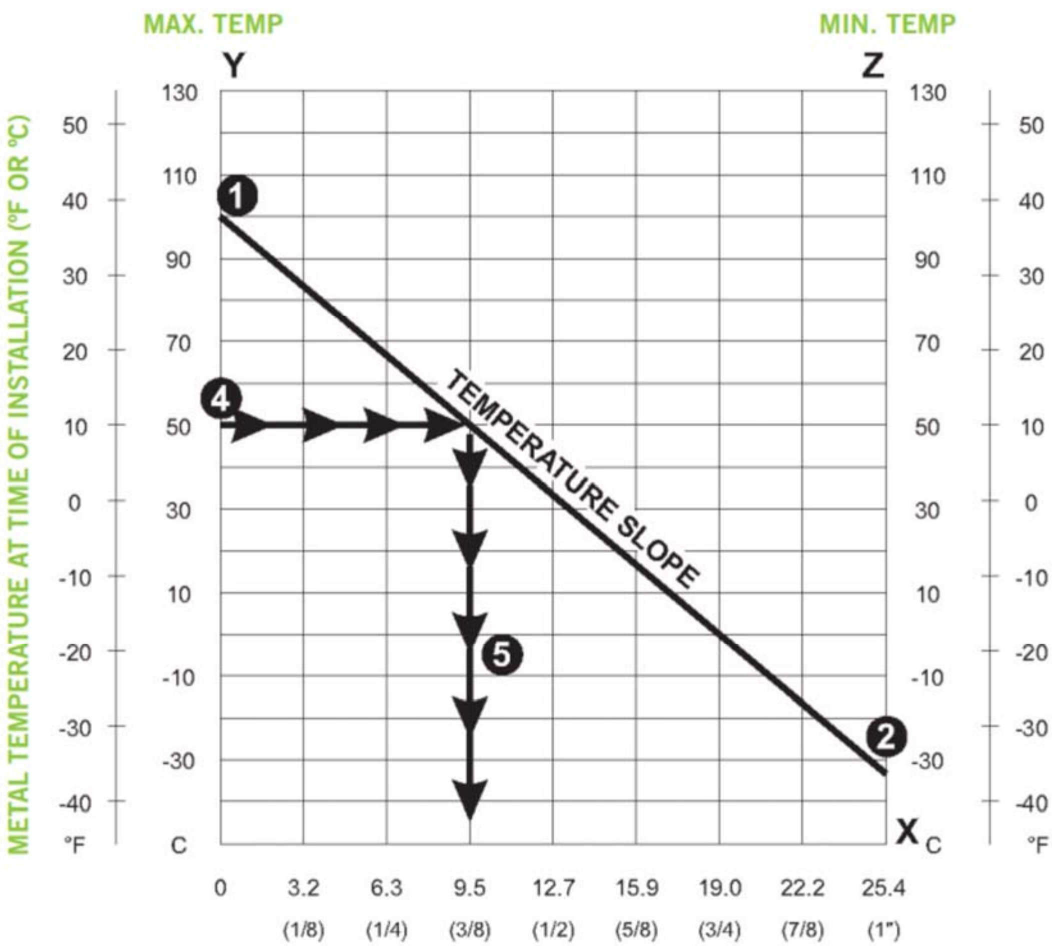


DIAGRAM D.8.C



GAP SETTING mm (inches)

GAP SETTING OF EXPANSION CONNECTOR PLATES 25.4mm (1") GAP MAXIMUM

In order for the expansion connector to function properly, it is necessary to set the expansion gap accurately. Please refer to Diagram D.8.C.

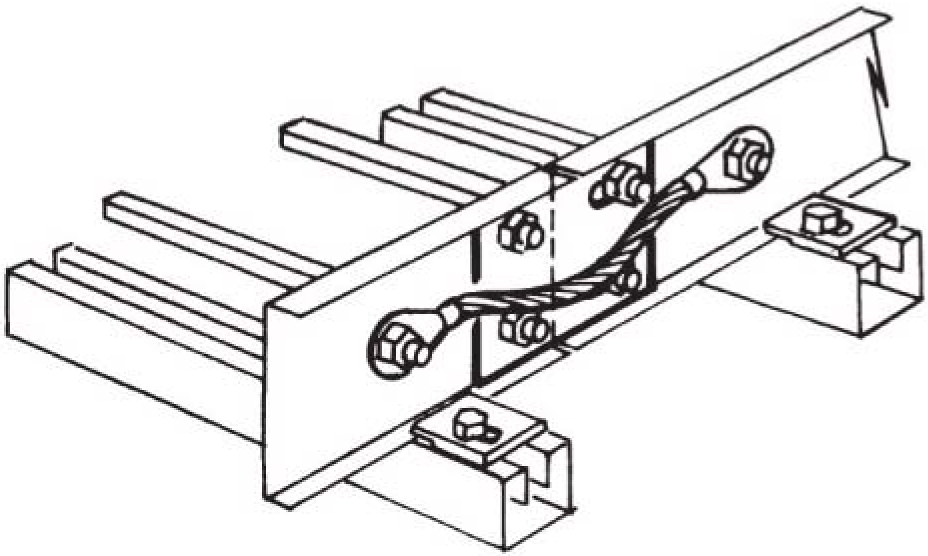
PROCEDURE

Step 1. On the Y-axis mark the highest expected metal temperature 1.
Step 2. On the Z-axis mark the lowest expected metal temperature 2.
Step 3. Draw a straight line connecting 1 to 2.
Step 4. On the Y-axis find the temperature at time of install. Draw a horizontal line from that point connecting line 1 to 2.
Step 5. From the intersection point draw a straight line down to the bottom axis X.
Step 6. That point will give you the required gap setting at the time of installation.

When installing the hardware on the expansion connector, tighten the bolt (20-27ft/lbs). The underside

of the bolt head must be flush with the inside of the siderail. Then back off the nut 1/2 turn.
To maintain electrical continuity all expansion connectors require a bonding jumper. The ends of the jumper must be a minimum distance of 50mm (2") from the edge of the connector plate. It must have sufficient length to allow for anticipated maximum expansion. (Diagram D.8.D).

DIAGRAM D.8.D EXPANSION CONNECTION



There must be a support located no more than 24" from each side of the expansion connector.

D.3.3: VERTICAL CONNECTORS (SEE DIAGRAMS D.9.A AND D.9.B)

For vertical directional changes that are minor and do not require a radius fitting, use vertical connectors (VC). Position supports within 610mm (24") of each end of connectors.
i. Position connector halves to adjust for material thickness and fasten using 3/8" nut and bolt.
ii. Attach to existing ladder tray sections which will establish required angle.
iii. Field drill 3/8" hole (Diagram D.9.A).
iv. Insert and tighten all hardware.

DIAGRAM D.9.A TWO BOLT VERTICAL CONNECTORS

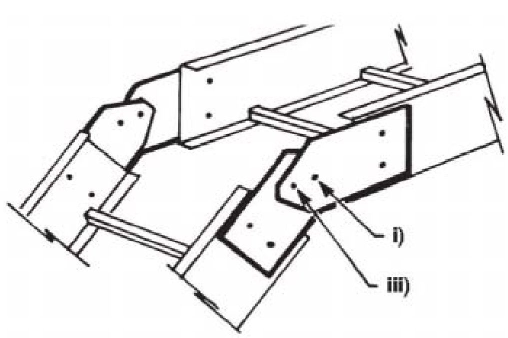
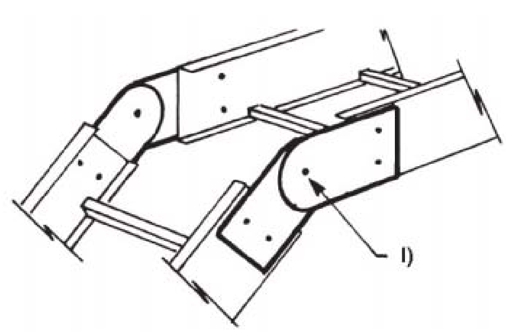


DIAGRAM D.9.B SINGLE BOLT VERTICAL CONNECTOR



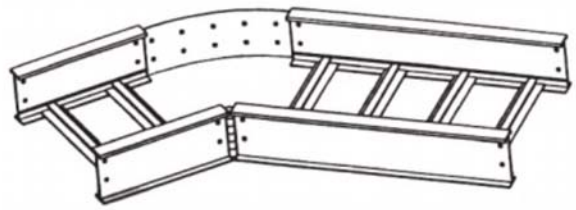
As with expansion connections, bonding jumpers must be used to maintain electrical continuity.

D.3.4: HORIZONTAL ADJUSTABLE ELBOW (DIAGRAM D.10)

For horizontal directional changes that are minor and do not require a radius fitting, use a horizontal adjustable elbow. Supports should be positioned within 24" of each end of the fitting.

i. Connect inside section (with hinge) and position existing tray sections to establish angle.
ii. Position outside connector locating plate at the midpoint.
iii. Trim excess material (if required) from the ends of the outside connecting plate. Install and tighten all hardware. As with expansion and vertical connectors, bonding jumpers may be required to maintain electrical continuity.

DIAGRAM D.10 HORIZONTAL ADJUSTABLE ELBOW

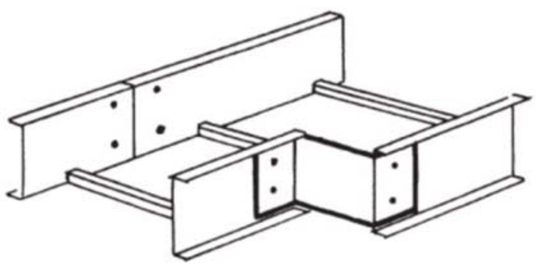


D.3.5: REDUCING CONNECTORS (DIAGRAM D.11)

When there is an immediate change in tray width use reducing connectors (RC).

i. To form an offset reduction, use a reducing connector with a standard universal connector.
ii. To form a straight reduction, use a pair (2) of reducing connectors.

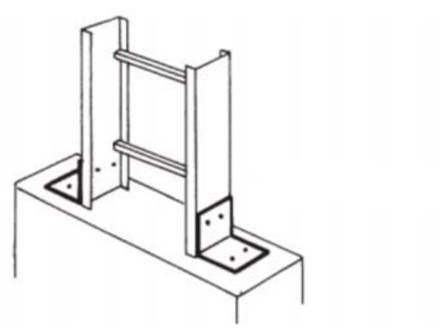
DIAGRAM D.11 OFFSET REDUCING CONNECTORS



D.3.6: BOX-TO-TRAY CONNECTORS (DIAGRAM D.12)

Box-to-tray connectors (BC) are used to terminate (attach) the end of a tray system to a distribution box, control center or to a structural element.

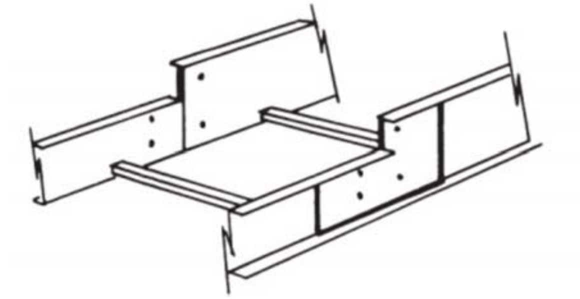
DIAGRAM D.12 TRAY-TO-BOX/FLOOR SPLICE PLATES



D.3.7: ADAPTER CONNECTORS (DIAGRAM D.13)

When connecting ladder trays of different siderail heights or brands, use Adapter Connectors.

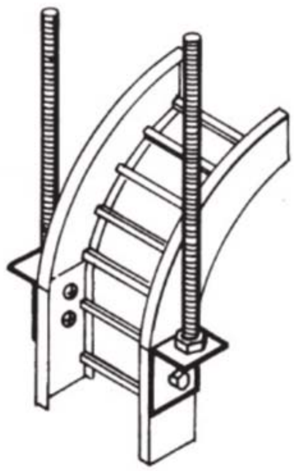
DIAGRAM D.13 ADAPTER CONNECTORS



D.3.8: VERTICAL SUPPORT CONNECTORS (DIAGRAM D.14)

For the support of extended vertical tray runs, use Vertical Support Connectors.

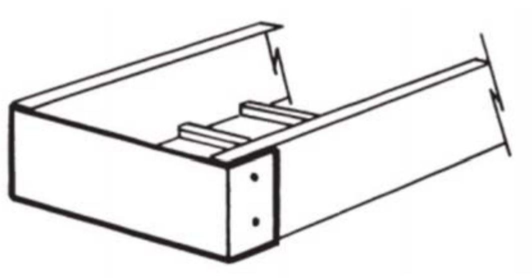
DIAGRAM D.14 VERTICAL SUPPORT CONNECTORS



D.3.9: BLIND END CONNECTORS (DIAGRAM D.15)

The ends of ladder tray shall be closed by the use of blind end closures.

DIAGRAM D.15 BLIND END CONNECTOR



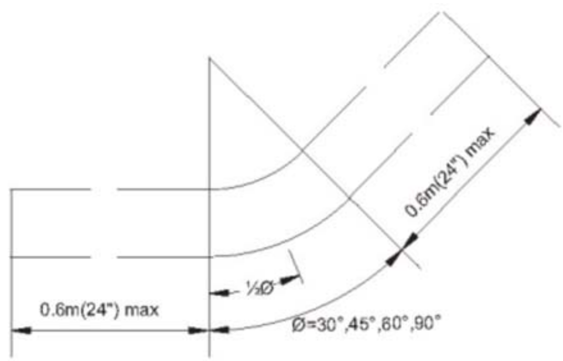
D.4: INSTALLATION OF TRAY FITTINGS

D.4.1: SUPPORT LOCATIONS FOR FITTINGS (DIAGRAM D.16 HORIZONTAL FITTINGS SUPPORT)

Ladder tray comes under its greatest stress at all fitting locations during cable pulling. It is critical that the structural integrity of the system is not compromised during cable pulling. We recommend that the following support locations are used for the appropriate fitting types. Supports for horizontal fittings should be located at a distance, no greater than 24” from each end of the fitting as well as the following locations:

1. At the midpoint (45 degrees) of the arc for a 90 degree elbow.
2. At the midpoint (30 degrees) of the arc for a 60 degree elbow.
3. At the midpoint (22-1/2 degrees) of the arc for a 45 degree elbow, excluded are 12” radius fittings.
4. At the midpoint (15 degrees) of the arc for a 30 degree elbow, excluded are 12” radius fittings.

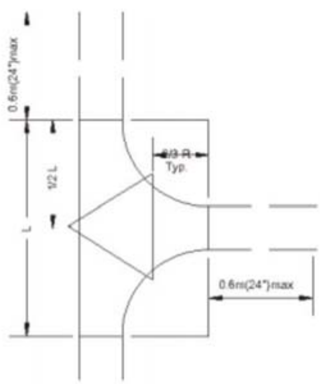
DIAGRAM D.16 HORIZONTAL ELBOW SUPPORT



D.17: HORIZONTAL TEE FITTING SUPPORT

1. For 12” radius Tees, place supports no greater than 24” from each of the three (3) ends.
2. For larger radii, at least one support should be located under each siderail (3) as illustrated.

DIAGRAM D.17 HORIZONTAL TEE SUPPORT

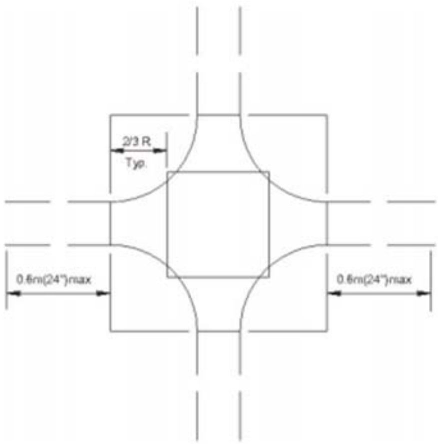


D.18: HORIZONTAL CROSS SUPPORT

i. For 12” radius Tees, place supports no greater than 24” from each of the four (4) ends.

ii. For larger radii, at least one support should be located under each siderail (4) as illustrated.

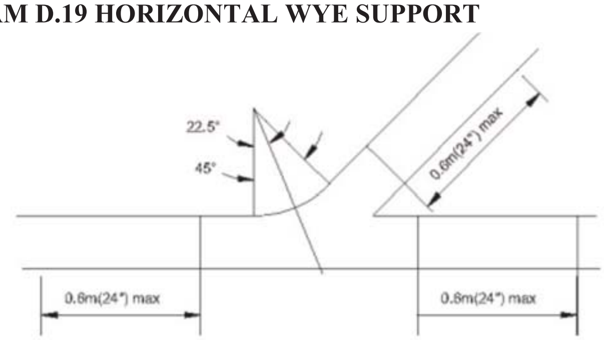
DIAGRAM D.18 HORIZONTAL CROSS SUPPORT



D.19: HORIZONTAL WYE SUPPORT

Place horizontal supports at a distance no greater than 24” from each of the three (3) openings and at the midpoint of the fitting at 22-1/2 degrees.

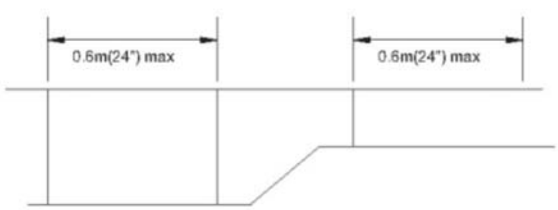
DIAGRAM D.19 HORIZONTAL WYE SUPPORT

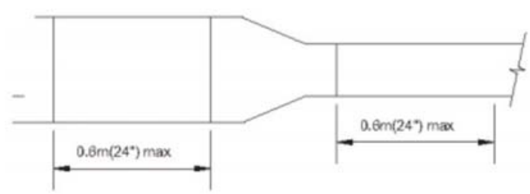


D.20 AND D.21: REDUCER SUPPORT

Place horizontal supports (2) at a distance no greater than 24” from each end.

DIAGRAM D.20 REDUCER SUPPORT DIAGRAM D.21 REDUCER SUPPORT

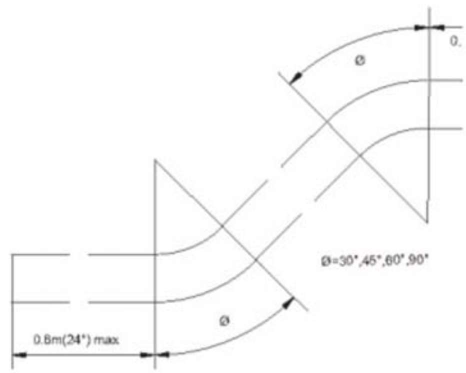




D.22: VERTICAL INSIDE (V/I) AND VERTICAL OUTSIDE (V/O) FITTING SUPPORTS

i. A vertical outside fitting should be supported at a location close to each end, top and bottom.
ii. A vertical inside elbow needs only to be supported at a location close to its top end.
Both inside and outside fittings should be additionally supported at a distance no greater than 24” from each end (2).

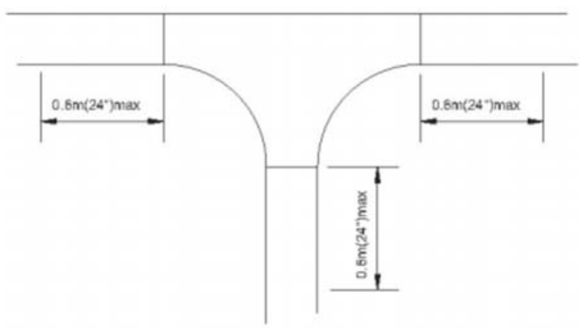
DIAGRAM D.22 VERTICAL CABLE TRAY ELBOWS



D.23: VERTICAL TEE SUPPORTS

Each of the three (3) openings should be supported at a distance no greater than 24” from its end point.

DIAGRAM D.23 VERTICAL CABLE TRAY TEES



D.5: FIELD ALTERATIONS (MODIFICATIONS)

At some point during the project, a standard length (1/8” or ¼”) of tray may have to be cut. If time and economies permit, Tray can fabricate non-standard lengths. If there are many field cuts to be made, a cut list should be made to keep off cuts to a minimum.

D.5.1: MARKING (DIAGRAMS D.24 AND D.25)

Using a 24” square [for tray up to 24” wide] or two squares (for tray wider than 24” overlaid so that Diagram D.24 is duplicated for each siderail, mark the tops of both flanges. Next, position the square as shown in Diagram D.25 and transfer the mark on the top flanges to the webs of the siderails.

DIAGRAM D.24

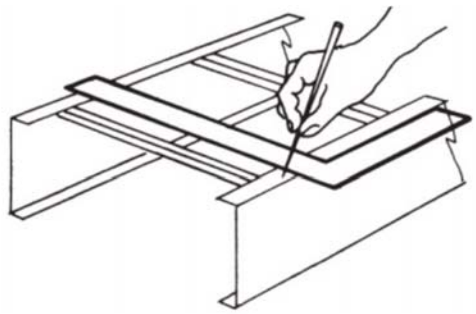
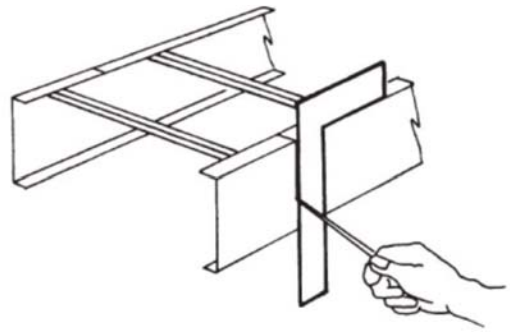


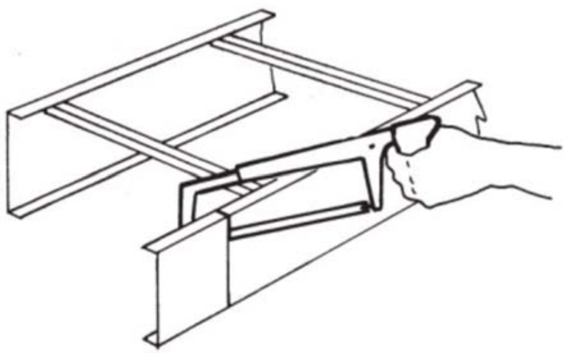
DIAGRAM D.25



D.5.2: CUTTING (DIAGRAM D.28)

These cuts can be made with either a 7 1⁄2” circular saw with a carbide tipped blade, a reciprocating saw or a hand held hacksaw. The use of a suitable cutting lubricant (e.g. pure turpentine for aluminum) will speed up the process as well as preserve the cutting blades. In order to get an adequate splice connection it is important to get a 90 degree (to the longitudinal axis) cut. After cutting, use a file to deburr any rough edges.

DIAGRAM D.26



D.5.3: DRILLING (DIAGRAMS D.27, D.28, AND D.29)

All holes for connector plates must be drilled. The correct drill size is relative to the hardware being used on the ladder tray. In the case of carriage bolts and a corresponding square or rectangular hole, replace with a round or truss head machine screw of a slightly larger diameter than that of the carriage bolt (e.g. from 1/4” to 5/16” or 3/8”). Factory supplied or field built templates (Diagram D.29) can be used as a locator for the holes. Using a standard connector plate as a template is the most common means of locating the drill holes. Diagrams D.30 and D.31 illustrate when a short piece of siderail with a universal connector already bolted on, is clamped to the field cut section and used as a template. These two rail sections must be flush with one another. Care must be taken while drilling to prevent the distortion of the holes in the template connector. The number of holes to be drilled and the preciseness of the drilling may dictate the use of more than one universal connector as a template.

DIAGRAM D.27

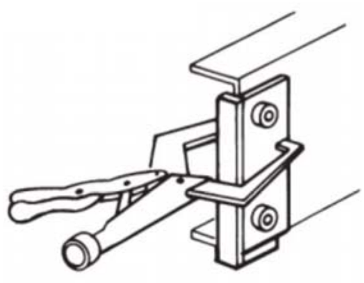


DIAGRAM D.28

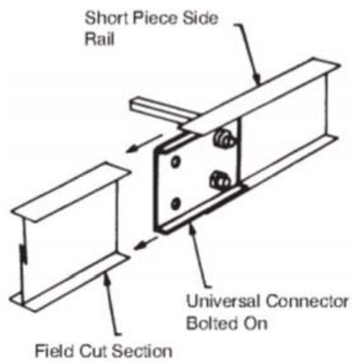
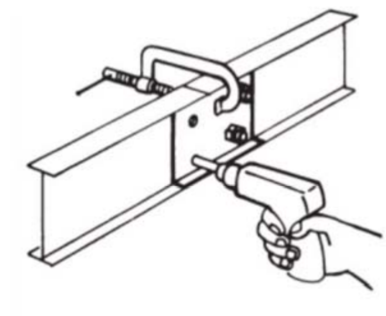


DIAGRAM D.29



D.6: ANCILLARY PRODUCTS/ACCESSORIES (DIAGRAMS D.30 TO D.41)

D.6.1: BARRIER/DIVIDER STRIPS (DIAGRAMS D.30 THROUGH D.41)

Barrier strips are sometimes used to separate cables within a cable tray as required by the National Electrical Code® (NEC®).

Per NEC Code 392.20(B)

(1) The cables operating over 600V are Type MC

(2) The cables operating at over 600 volts are separated from the cables operating at 600 volts or less by a solid fixed barrier of a material compatible with the cable tray.

DIAGRAM D.30
BARRIER STRIP-STRAIGHT SECTION

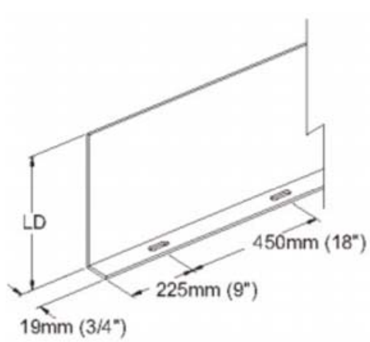


DIAGRAM D.31 BARRIER STRIP-HORIZONTAL FITTING

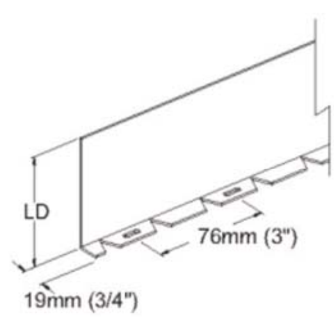
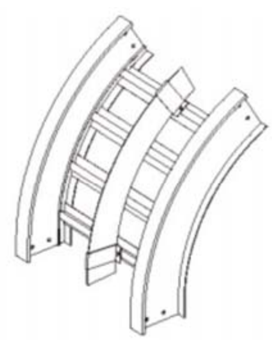


DIAGRAM D.32 BARRIER STRIP-VERTICAL FITTING



Barrier strips are used in ladder trays containing conductors connected to different power or distribution transformers or other different sources of voltage. For straight lengths of tray, the barriers are placed at required locations and then fastened every 36” by either #10 x 1/2” self-drilling and self-tapping screws or clamps (BC). For barriers used on vertical fittings, there should be a minimum of three (3) attachment points. For straight length barriers (SB) straight alignment can be achieved by the use of splice connectors (PSS). The height of the barrier strip must not be greater than the loading depth of the ladder tray

DIAGRAM D.33 BARRIER STRIP APPLICATION

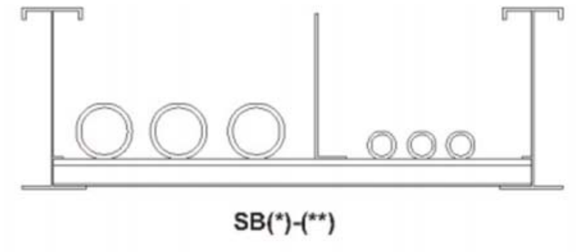


DIAGRAM D.34 BARRIER STRIP ATTACHMENT, SELF DRILLING & SELF TAPPING SCREW

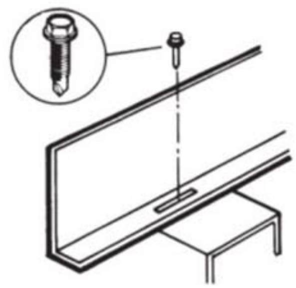


DIAGRAM D.35 BARRIER STRIP ATTACHMENT, BARRIER CLIP (Optional)

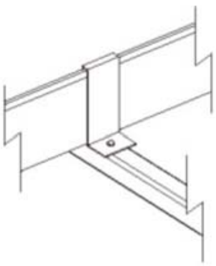


DIAGRAM D.36 BARRIER STRIP SPLICE

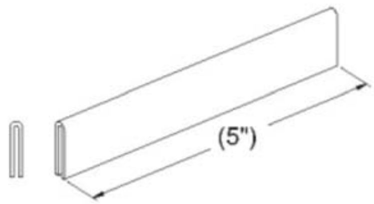
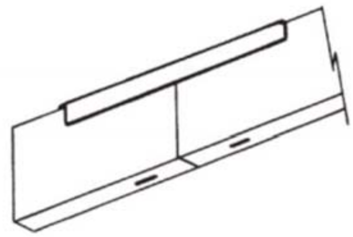


DIAGRAM D.37 BARRIER STRIP SPLICE



D.6.2: CABLE DROP-OUTS (DIAGRAM D.38 AND D.39)

Dropouts are available in 4” radius to provide a means of cable exiting both ladder tray and communication channel. They provide a smooth surface on the radius face to protect the sheathing of the cable. There are two types: snap on or drop in (inserted between rungs). Both types are secured in place with #10 x 1⁄2” self-drilling and self-tapping Tec screws.

DIAGRAM D.38 LADDER DROP-OUT

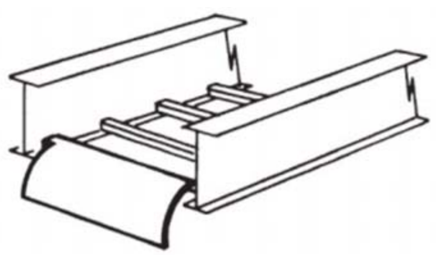
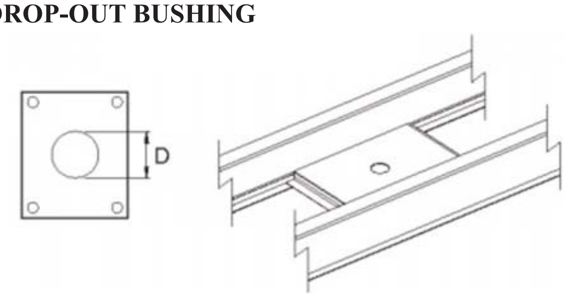


DIAGRAM D.39 CONDUIT DROP-OUT BUSHING



D.6.3: CONDUIT TO TRAY ADAPTER (DIAGRAMS D.40 AND D.41)

This adapter (CT) is used when a conduit run terminates at a ladder tray run. This is a mechanical connection. In order to maintain electrical continuity an equipment grounding connection must be established between the ladder tray and the conduit (Diagram D.43). To fasten this adapter to the top flange field, drill two (2) 3/8” holes, insert bolts from the top, fasten nuts and tighten in place.

DIAGRAM D.40 CONDUIT TO LADDER TRAY ADAPTER

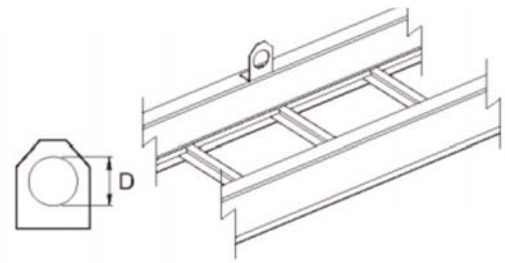
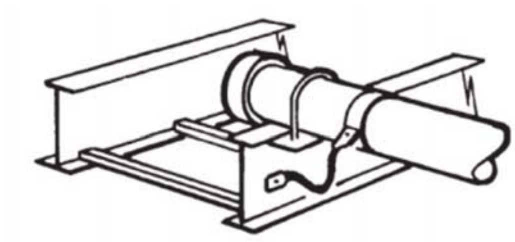


DIAGRAM D.41 INSTALLED CONDUIT TO LADDER TRAY ADAPTER



D.7: GROUNDING OF LADDER TRAY

At standard rigid connections, bonding jumpers do not have to be installed.
When the run of the ladder tray is interrupted (the cross-sectional area of the siderail is compromised), then bonding jumpers should be installed around that break. If a separate conductor is used as a ground throughout the entire length of the tray run, then bonding jumpers are not required. This bonding jumper must be:

1. corrosive resistant material (e.g. copper), and
2. of sufficient size to have an ampacity not less than that required for the corresponding grounding conductor.

If a bonding strap is used for bonding non-current-carrying metal parts, it must have the following dimensions:
STEEL: minimum width 19mm (3/4”), minimum thickness 1.4mm (.055”)
ALUMINUM/COPPER: minimum width 19mm (3/4”), minimum thickness 1.2mm (.047”)
At standard rigid connections, bonding jumpers do not have to be installed. Diagrams D.42 to D.44 illustrate some of the more common applications for bonding jumpers.

DIAGRAM D.42 VERTICAL CONNECTORS

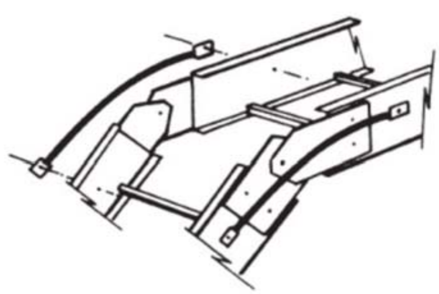


DIAGRAM D.43 EXPANSION CONNECTORS

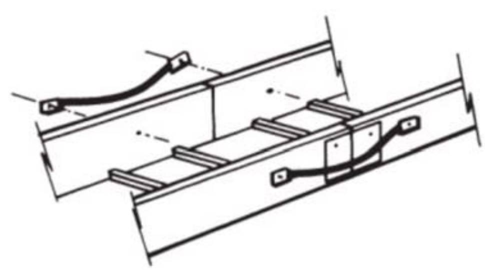
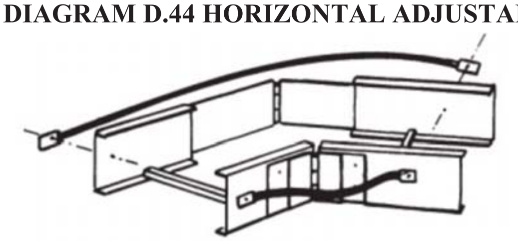


DIAGRAM D.44 HORIZONTAL ADJUSTABLE ELBOW



NEC Reference
392.60 Grounding and Bonding.
(A) Metallic Cable Trays. Metallic cable trays shall be permitted to be used as equipment grounding conductors where continuous maintenance and supervision ensure that qualified persons service the installed cable tray system and the cable tray complies with provisions of this section. <u>Metallic cable trays that support electrical conductors shall be grounded as required for conductor enclosures in accordance with 250.96 and Part IV of Article 250.</u> <u>Metal cable trays containing only non-power conductors shall be electrically continuous through approved connections or the use of a bonding jumper</u>.
Informational Note: Examples of non-power conductors include nonconductive optical fiber cables and Class 2 and Class 3 Remote Control Signaling and Power Limiting Circuits.

It is not necessary to install bonding jumpers at standard rigid aluminum or galvanized steel splice plate connections or offset reducing splice plate connections.
For rigid splice plate connections of materials and finishes other than aluminum or galvanized steel, bond jumpers may be required. For example, stainless steel splice plates require bonding jumpers.
4.7.2 Cable Trays with Separate Equipment Grounding Conductor Installed (See Figure 4.61.)
When a separate EGC cable is installed in or on cable tray, it may be bonded to the cable tray with a grounding clamp. Ground clamp styles include bolted lug types that require drilling the cable tray side rail and clamp-on styles that work like a beam clamp. One grounding clamp should be used on each straight section of cable tray.
At standard rigid connections, bonding jumpers do not have to be installed

GROUNDING AND BONDING
Metal cable trays must be grounded and electrically continuous systems per NEC Article 318. For specific areas requiring bonding for electrical continuity, refer to Figures 4.57 through 4.60.
NOTE—Non-metallic cable trays do not serve as a conductor.
NOTE—It is recommended that wire mesh cable trays not be used as an equipment grounding conductor.

D7.1: PULLING THE CABLE (DIAGRAMS D.50 THROUGH D.54)

Basket grips/pulling eyes may have to be attached to the pulling end for larger metallic cables **(Diagrams D.52 and D.53)**. These can either be installed by the manufacturer, or by experienced field personnel. Basket grips are commonly used for pulling cables with diameters up to 50mm (2”). The tail end of the basket grip is taped to the cable. Pulling eyes/bolts are used for larger cables. This device pulls the conductor as well as its sheathing, braiding or armoring. A basket grip that has the conductor affixed to the eye and its tailing end tapped around the outside of the conductor may also be used.
Make sure all surfaces of the pulling devices that come in contact with the cable and ladder tray are covered by a protective covering of plastic or tape to prevent surface scoring. All axles on pulling devices must turn freely while under load. A device to record accurate pulling tensions should be installed at the pulling end. This will ensure that the manufacture’s tensile limits are not exceeded. Personnel should be placed at either end of the pull. Where hand signals are not possible for communication during a pull, personnel should be radio/cell phone equipped. Caution must be exercised during the pull to prevent the crossing of the cable during de-reeling and from exceeding the cables tension and pulling speed. At the cable reel end (de-reeling) personnel must have a means of braking the reel to prevent slackness of the cable.