

Electrical Level 2



Cable Tray 26207-14



Objectives

When trainees have completed this lesson, they should be able to do the following:

1. Describe the components that make up a cable tray assembly.
2. Explain the methods used to hang and secure cable tray.
3. Describe how cable enters and exits cable tray.
4. Select the proper cable tray fitting for the situation.
5. Explain the *National Electrical Code*[®] (*NEC*[®]) requirements for cable tray installations.
6. Select the required fittings to ensure equipment grounding continuity in cable tray systems.
7. Interpret electrical working drawings showing cable tray fittings.
8. Size cable tray for the number and type of conductors contained in the system.



Performance Tasks

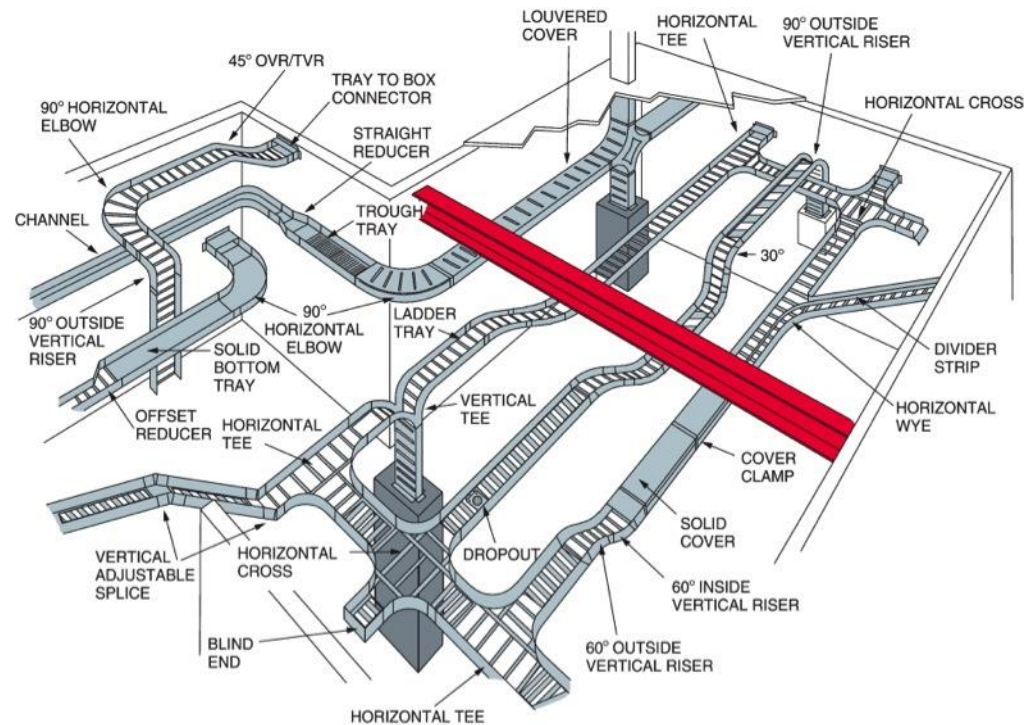
1. Generate a list of materials for a cable tray layout. List all the components required, including the fasteners required to complete the system.
2. Join two straight, ladder-type cable tray sections together.



1.0.0

Introduction

- Cable trays are used to support wiring systems in industrial applications.
- **NEC Article 392** covers the requirements for cable tray.



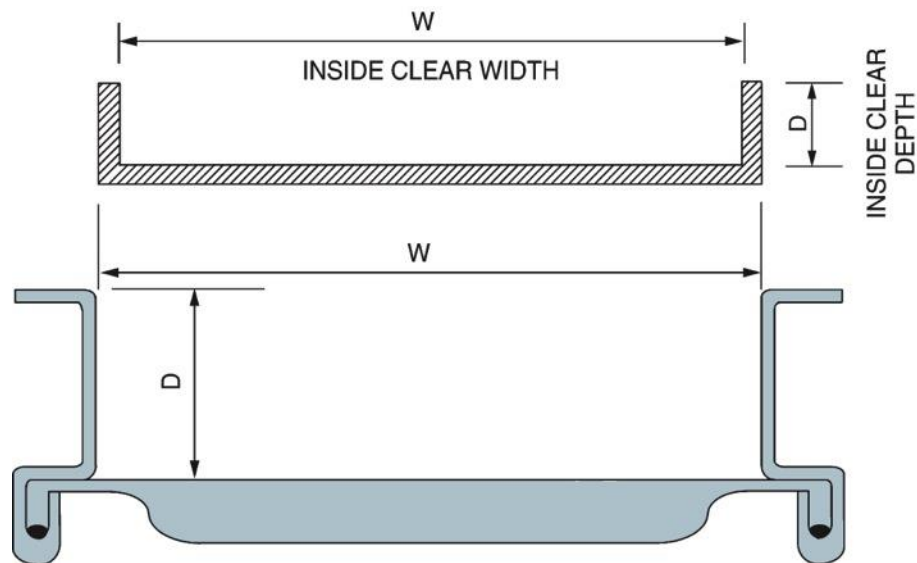
26207-14_F01.EPS



1.0.0

Cross Section of Cable Tray Comparing Usable Dimensions to Overall Dimensions

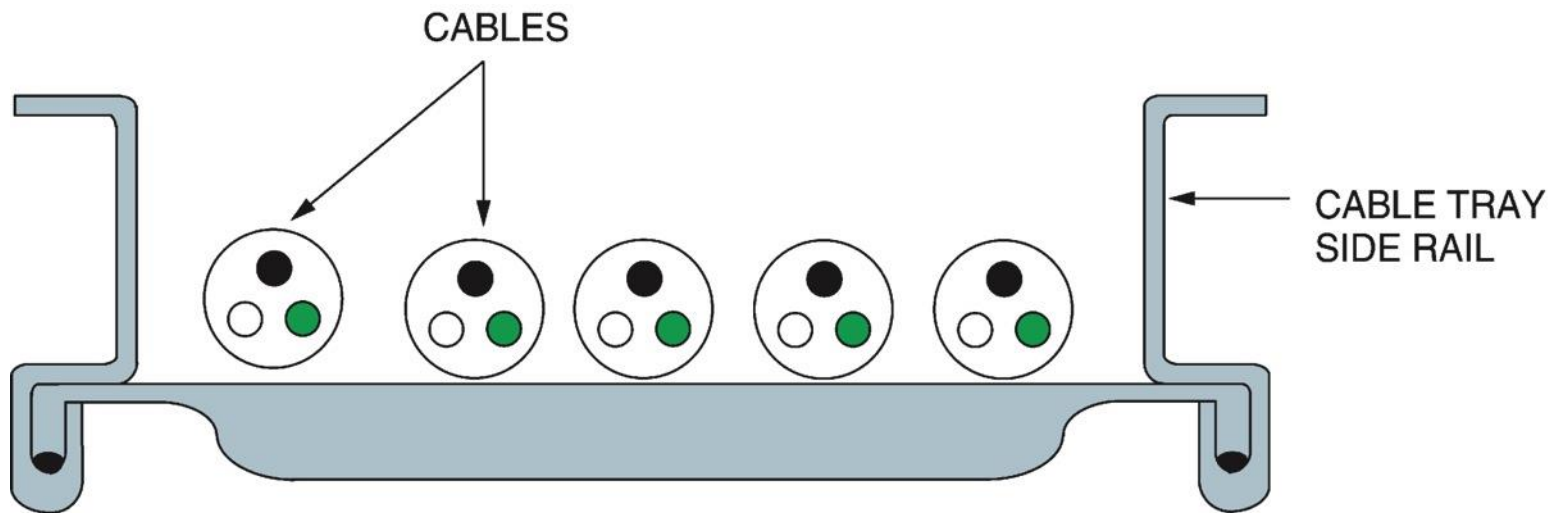
- Cable tray dimensions vary according to the tray design.
- Cable tray has specific fill requirements in the same way as boxes and conduit.



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1.0.0

Cables Rest on the Bottom of the Tray and are Held in Place by the Longitudinal Side Rails

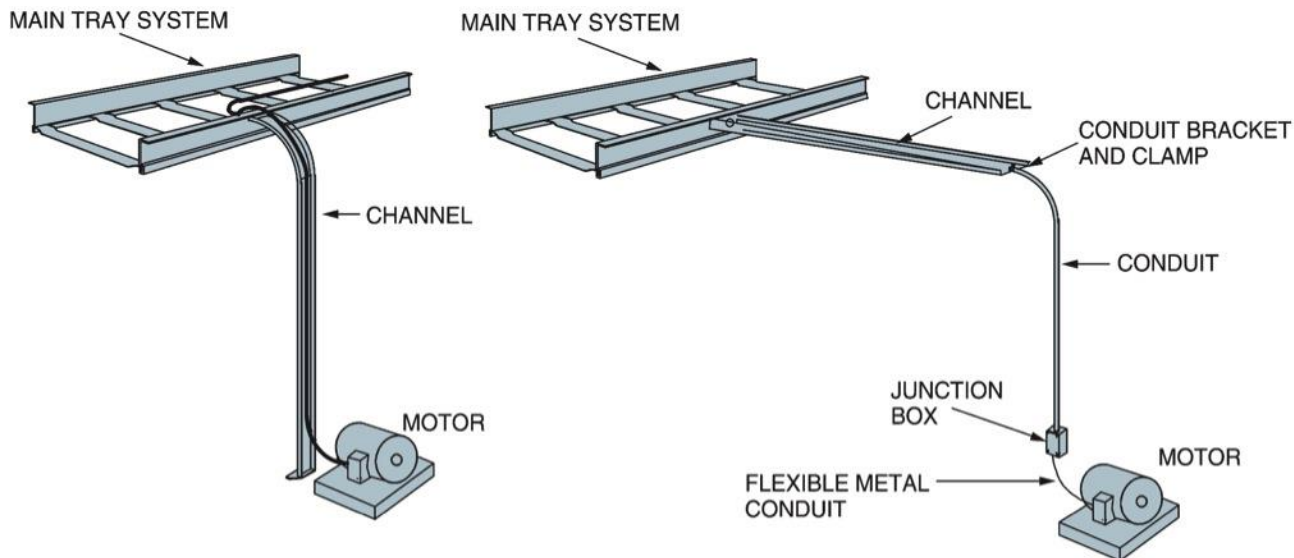


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1.0.0

Two Applications of Cable Tray Channel

- Channels are used to carry cable from the tray to the point of use or termination.
- *NEC*[®] and National Electrical Manufacturers Association (NEMA) standards must be followed when designing and installing cable tray systems.

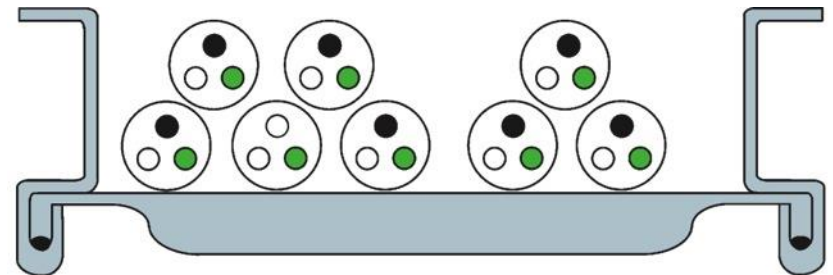


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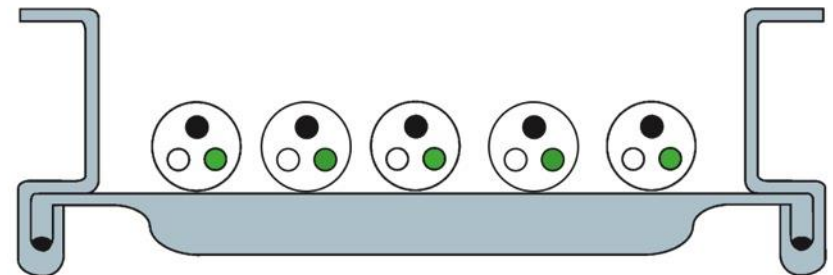


Cable Tray Loading

- The load capacity of cable tray depends on many factors including the shape and thickness of the side rails and bottom members, rung spacing, support method, and type of material. Refer to the cable tray manufacturer's capacity information.
- Cables must be packed loosely in tray to avoid overloading and loss of efficiency.



AVOID PACKING CABLES
CLOSE TOGETHER



PACK CABLES LOOSELY

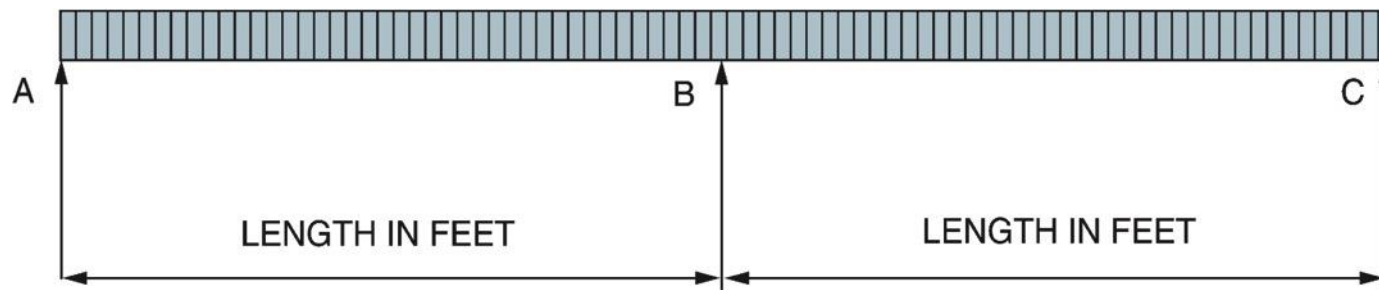
26207-14_F05.EPS

2.0.0 – 2.13.1

Determining the Load on Supports

- Each support must be able to withstand 1.25 times the full weight of the cable and the tray.
- Excess loading will result in deflection of the side rails and tray bottom, and potential failure of the cable tray system.

$$\text{UNIFORM LOAD OF TRAY AND CABLE} = \frac{\text{FULL WEIGHT OF TRAY AND CABLE}}{\text{TOTAL LINEAR FEET}}$$



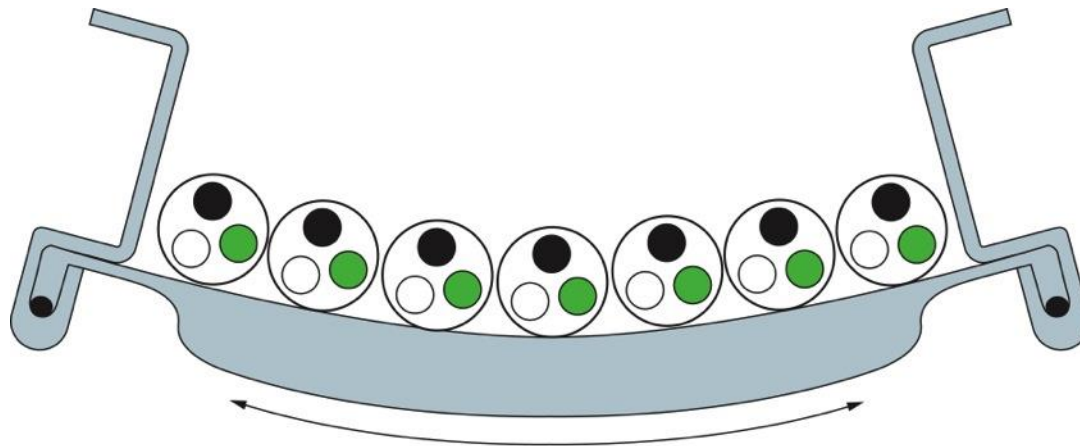
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Cable Tray 26207-14



Bending of Loaded Tray

- The two types of cable tray failure are longitudinal (side rail) and transverse (rung) failures.
- Longitudinal failures occur as bending failures and buckling failures. Bending is more likely with shorter spans, while buckling typically occurs only on longer spans.

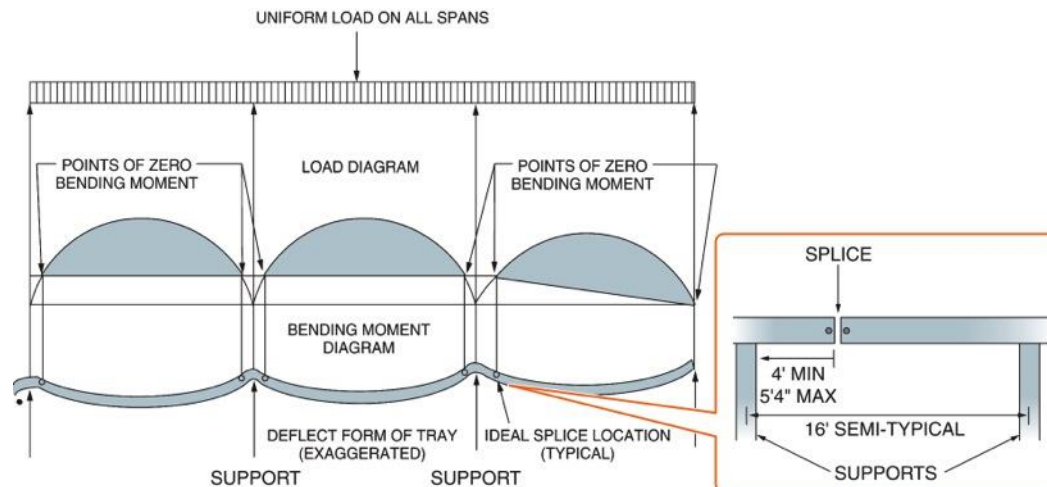


TENSION IN LOWER PORTION OF RUNG

2.0.0 – 2.13.1

Load of Cable Creates Bending Moments Along the Span

- The stress in the side rails is directly proportional to the bending moments at all points along the tray.
- Splices are points of weakness in a cable tray system and should be located within $\frac{1}{4}$ of the span's distance from the nearest support whenever possible.

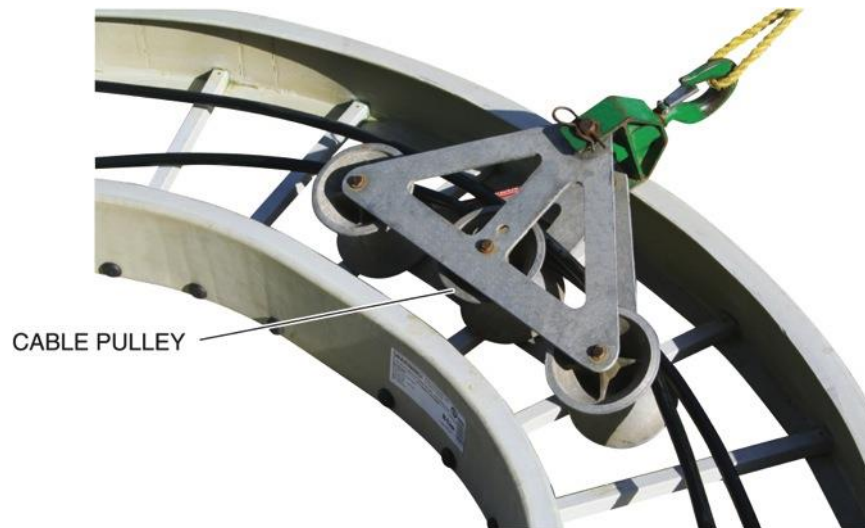


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2.0.0 – 2.13.1

Cable Pulley Used to Facilitate a Cable Pull in a Tray

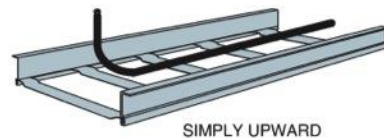
- Cable pulleys can be used to facilitate pulling conductors in the tray.
- Cable tray covers are used to protect objects from falling into the tray and to protect conductors from sunlight.



26207-14_F09.EPS

2.0.0 – 2.13.1

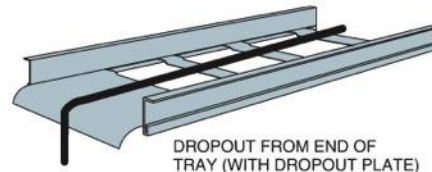
Several Ways in Which Cables may Exit from a Cable Tray



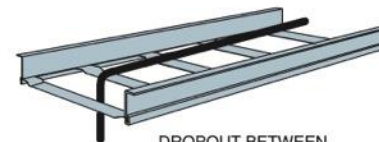
SIMPLY UPWARD



DROPOUT FROM END OF TRAY (NO DROPOUT PLATE)



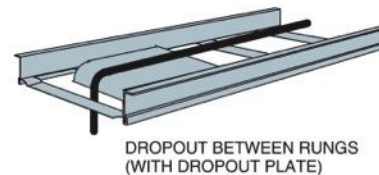
DROPOUT FROM END OF TRAY (WITH DROPOUT PLATE)



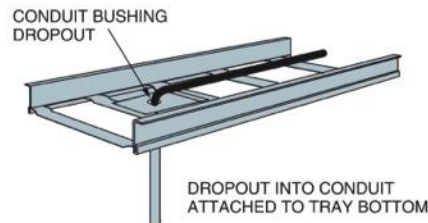
DROPOUT BETWEEN RUNGS (NO PLATE)



OVER THE SIDE RAIL

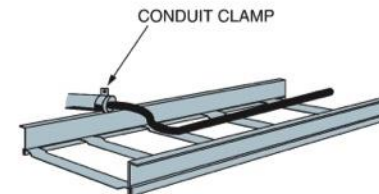


DROPOUT BETWEEN RUNGS (WITH DROPOUT PLATE)



CONDUIT BUSHING DROPOUT

DROPOUT INTO CONDUIT ATTACHED TO TRAY BOTTOM



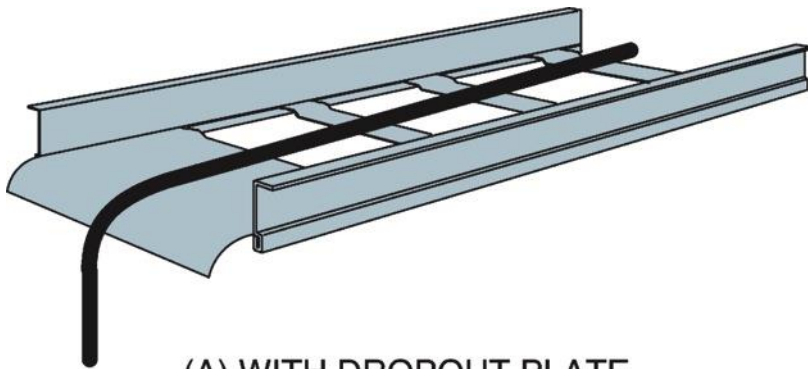
CONDUIT CLAMP

DROPOUT INTO CONDUIT CLAMPED TO THE SIDE RAIL

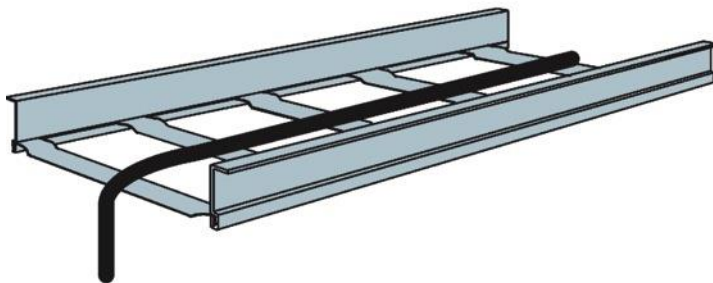
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2.0.0 – 2.13.1

A Dropout Plate Provides a Curved Surface for the Cable to Follow as it Leaves the Tray



(A) WITH DROPOUT PLATE



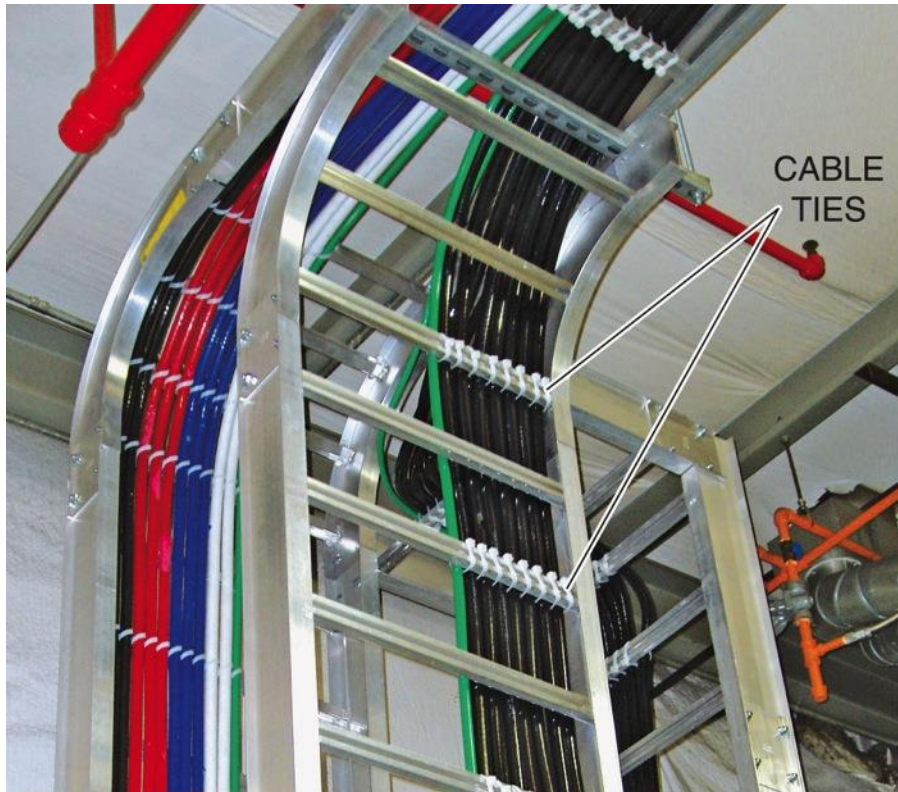
(B) WITHOUT DROPOUT PLATE

26207-14_F11.EPS

- A dropout plate protects conductors from sharp edges and provides a smooth surface for exiting the cable tray.
- Dropout plates also reduce stress on the conductor by increasing the bend radius at the dropout point.

2.0.0 – 2.13.1

Typical Application of Supports in a Vertical Run



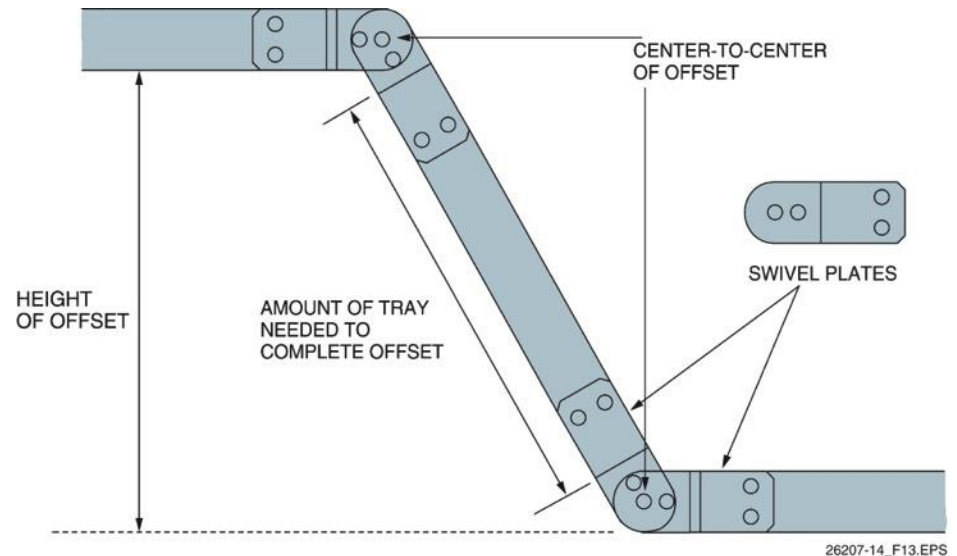
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- A cable hanger elbow is used to suspend cables in long vertical runs.
- The weight of the suspended cable cannot exceed the manufacturer's maximum allowable cable tension.

2.0.0 – 2.13.1

Fabricating a Cable Tray Offset with Swivel Plates

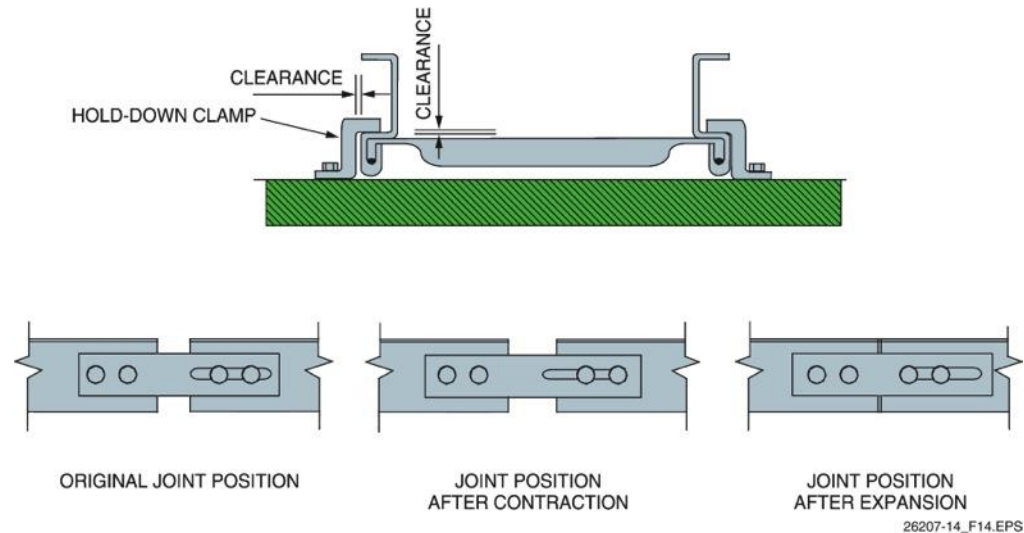
- Types of splice plates include vertical, horizontal, and expansion plates.
- Vertical adjustment splice plates are used to change the elevation in a run of cable tray. They are created using four swivel plates, as shown here.



2.0.0 – 2.13.1

Expansion Joint and Splice Plates

- Expansion joints allow for tray expansion and contraction due to temperature changes.
- Barrier strips can be used to isolate electrical circuits.



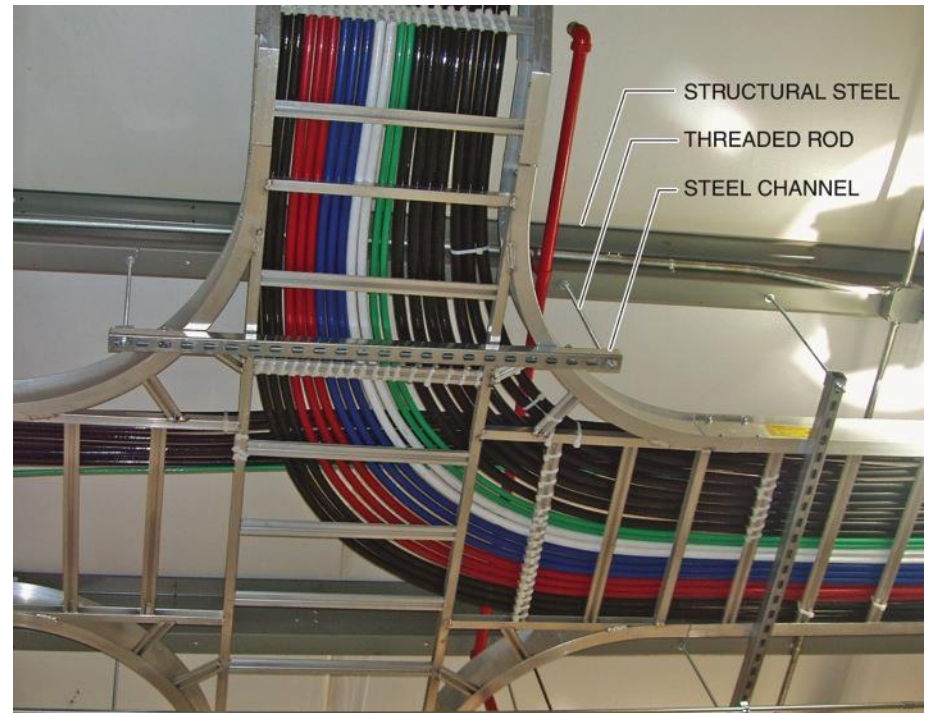
Performance Task

This session will conclude with trainees practicing joining cable tray sections.

3.0.0 – 3.5.0

Cable Tray Support

- Cable tray support systems include trapeze mounting, direct rod suspension, wall mounting, center hung support, and pipe rack mounting.
- Trapeze mounting uses threaded rods to support a steel channel beneath the cable tray.

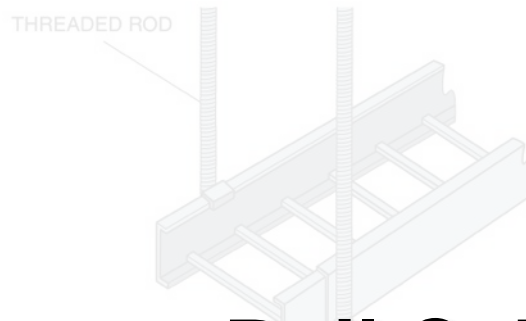


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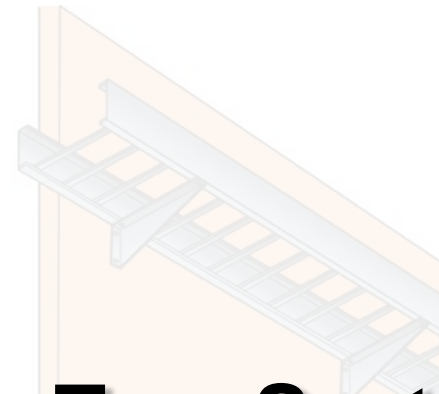
3.0.0 – 3.5.0

Next Session... Ways to Hang Cable Tray

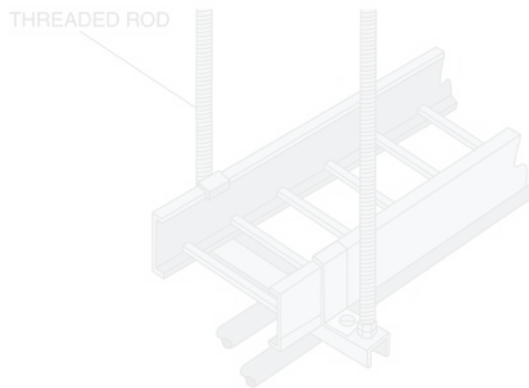
Center Rail Cable Tray Systems



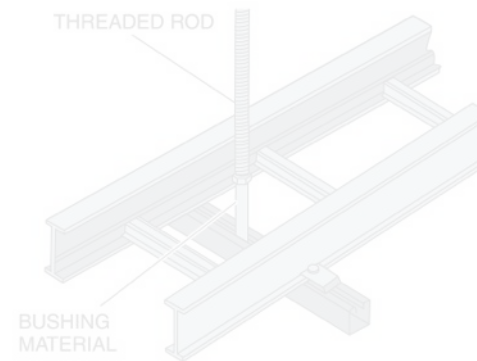
(A) DIRECT ROD SUSPENSION



(B) WALL MOUNTING



(C) TRAPEZE MOUNTING



(D) CENTER HUNG SUPPORT

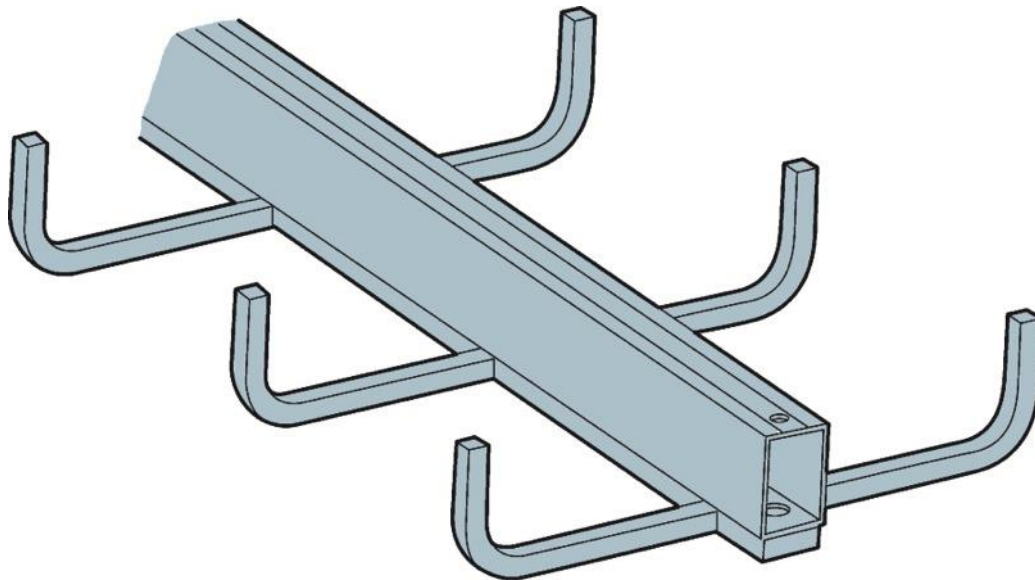
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4.0.0

Center Rail Cable Tray Systems

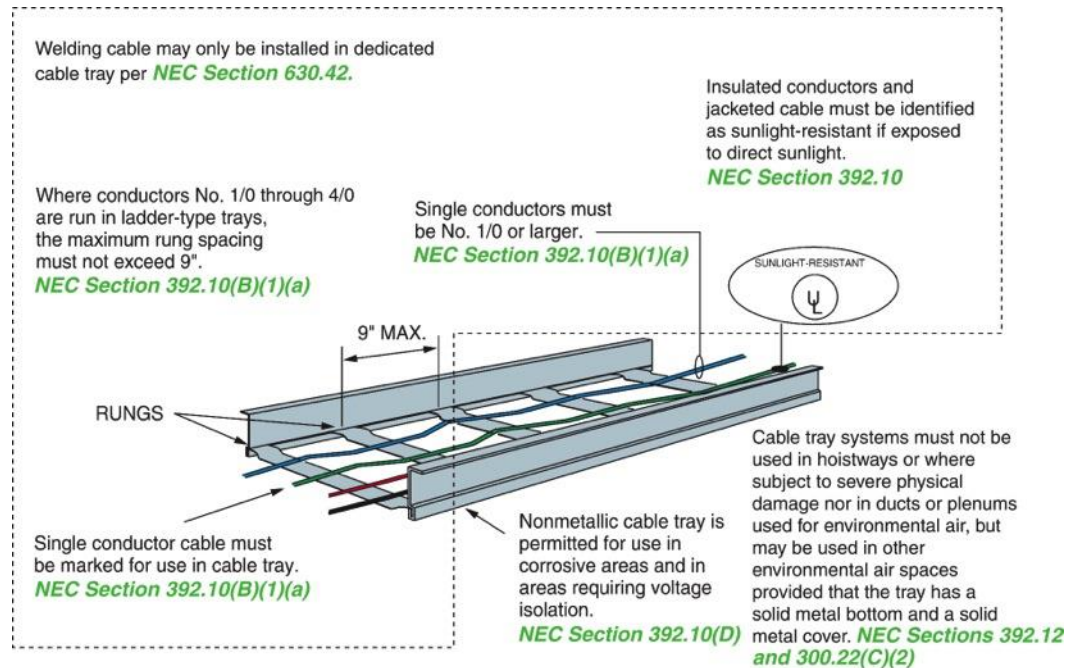
- Center rail cable tray systems have open sides that provide easy access for cable additions or changes.
- This type of cable tray system is typically used in light-duty applications.



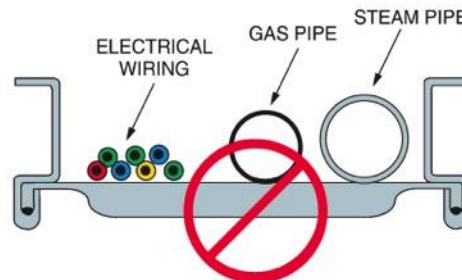
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5.0.0 – 6.3.0

NEC® Requirements; Cable Installation



Electrical conductors must not be installed in the same raceways or cable tray with steam, water, gas, air, or drainage pipes.
NEC Section 300.8



5.0.0 – 6.3.0

NEC® Regulations Governing Cable Tray Construction and Installation

NEC Section 392.100, Construction Specifications

Cable tray must include fittings or other suitable means for changes in direction and elevation of runs.
NEC Section 392.100(E)

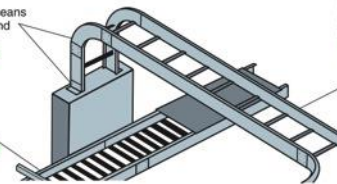
Cable tray must have side rails or equivalent structural members.
NEC Section 392.100(D)

Nonmetallic cable tray must be made of flame-retardant materials.
NEC Section 392.100(F)

NEC Article 392, Part II, Installation

Cable tray must be installed as a complete system, and each run must be completed before installing cable.
NEC Section 392.18(A) and (B)

Sufficient space must be provided and maintained around cable tray to permit adequate access for installing and maintaining the cables.
NEC Section 392.18(F)

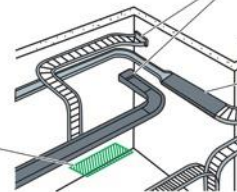


Cable tray must have suitable strength and rigidity to provide adequate support for all contained wiring.
NEC Section 392.100(A)

Tray edges must be smooth, with no sharp edges, burrs, or projections.
NEC Section 392.100(B)

If ferrous metal tray is used, it must be protected against corrosion.
NEC Section 392.100(C)

NEC Section 392.18(D) states that cable tray may be extended through partitions and walls or vertically through platforms and floors if the conditions in *NEC Section 300.21* are met.



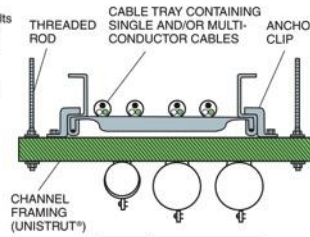
In portions of the cable tray run where additional protection is required, tray covers are normally employed; they must be of a material compatible with the tray system.
NEC Section 392.18(C)

Cable tray may be used as support for raceways under certain conditions.
NEC Section 392.18(G)



Cables 600 volts or less on this side of barrier, cables over 600 volts on opposite side.

Where multiconductor cables operating at 600 volts or more are installed in the same cable tray with conductors operating at 600 volts or less, the two types of conductors must be separated by a solid fixed barrier of material compatible with the cable tray unless the cables over 600 volts are Type MC.
NEC Section 392.20(B)(1) and (2)



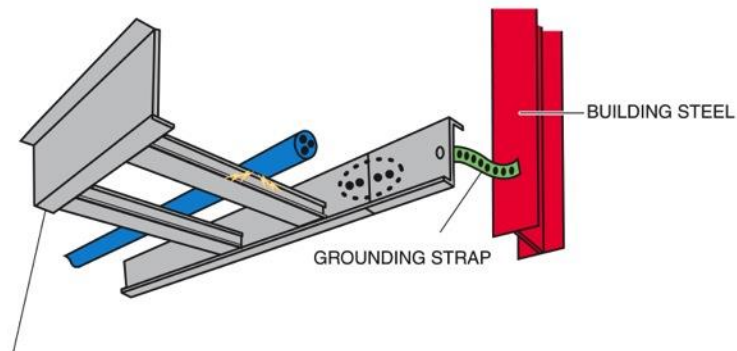
CHANNEL FRAMING (UNISTRUT®)
CONDUIT SECURED TO BOTTOM OF TRAPEZE HANGER

26207-14_F19.EPS



NEC® Regulations Governing Cable Tray Grounding

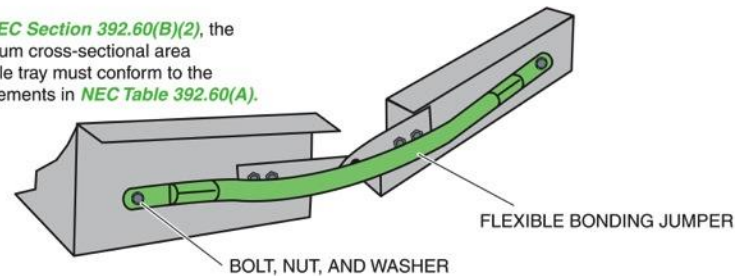
NEC Section 392.60, Grounding and Bonding



Steel or aluminum cable tray systems are permitted to be used as equipment grounding conductors if they meet all of the requirements in [NEC Section 392.60\(B\)](#).

Proper grounding lessens hazards due to ground faults. Therefore, the *NEC*® requires all metallic cable tray to be grounded as required for conductor enclosures in accordance with [NEC Section 250.96](#).

Per [NEC Section 392.60\(B\)\(2\)](#), the minimum cross-sectional area of cable tray must conform to the requirements in [NEC Table 392.60\(A\)](#).



Where supervised by qualified personnel, grounded metallic cable tray may also be used as an equipment grounding conductor. [NEC Section 392.60\(A\)](#).

Cable tray sections and fittings must be bonded in accordance with [NEC Section 250.96](#).

5.0.0 – 6.3.0

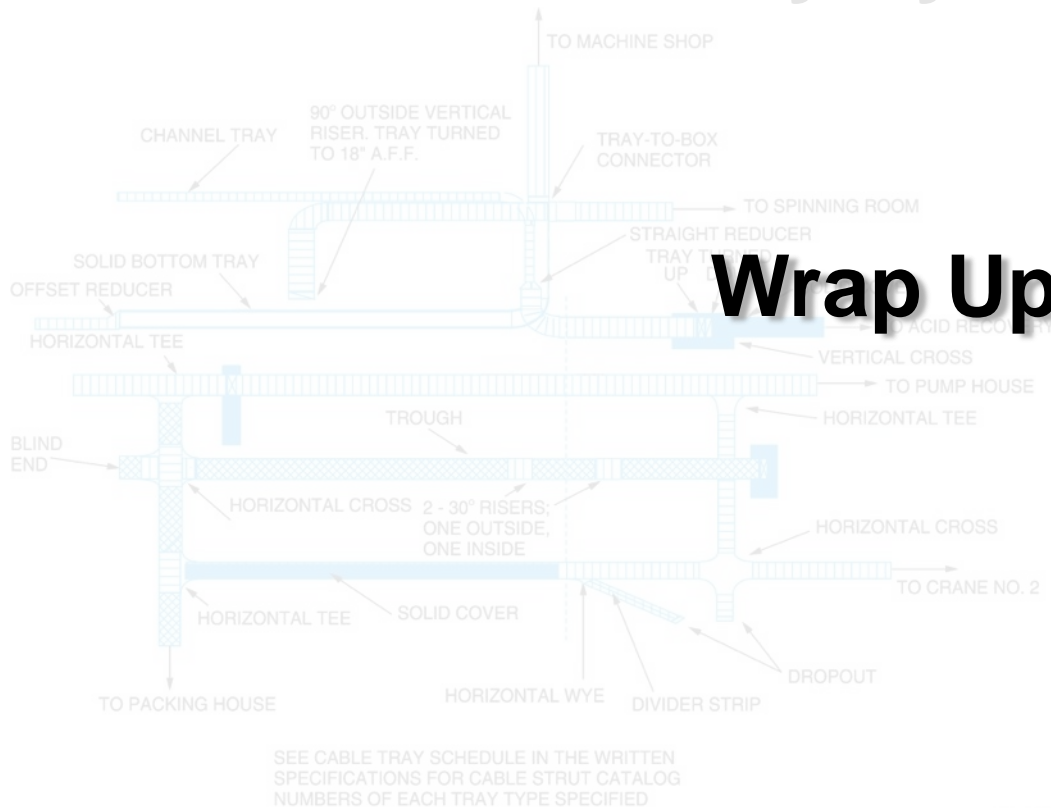
What's wrong with this picture?



26207-14_SA11.EPS

7.0.0 – 9.0.0

Next Session... Tray Drawings; Pulling Cable in Tray Systems; Safety



Wrap Up

Cable tray systems are carefully engineered systems and must be installed per the specifications and working drawings.

Performance Task

This session will conclude with trainees practicing preparing generating a list of materials for a cable tray layout.



Wrap Up

3-2-1

- 3** – Write **3** important things learned during class
- 2** – Write **2** questions you have about the material
- 1** – Write **1** thought you had about the material



Next Session...

MODULE EXAM

Review the complete module to prepare for the module exam. Complete the Module Review as a study aid.

