

Electrical Level 2



Pull and Junction Boxes 26205-14



Objectives

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

1. Describe the different types of nonmetallic and metallic pull and junction boxes.
2. Properly select, install, and support pull and junction boxes and their associated fittings.
3. Describe the *National Electrical Code*[®] (*NEC*[®]) regulations governing pull and junction boxes.
4. Size pull and junction boxes for various applications.
5. Understand the NEMA and IP classifications for pull and junction boxes.
6. Describe the purpose of conduit bodies and Type FS boxes.



Performance Tasks

1. Identify various NEMA boxes.
2. Properly select, install, and support pull and junction boxes over 100 cubic inches in size.
3. Identify various conduit bodies and fittings.



Introduction



26205-14_F01.EPS

- Pull and junction boxes can be used to provide pull points or to make conductor connections.
- **NEC Article 314** covers pull and junction box requirements.
- Boxes for damp and wet locations must be nonconductive and protected against the entry of moisture.

1.0.0 – 1.2.0

IP Classification System

First Number Degree of Protection against Solid Objects	Second Number Degree of Protection against Water
0 Not protected.	0 Not protected.
1 Protected against a solid object greater than 50 mm, such as a hand.	1 Protected against water dripping vertically such as condensation.
2 Protected against a solid object greater than 12 mm, such as a finger.	2 Protected against dripping water when tilted up to a 15°.
3 Protected against a solid object greater than 2.5 mm, such as a wire or tool.	3 Protected against water when spraying at an angle of up to 60°.
4 Protected against a solid object greater than 1.0 mm, such as wire or thin strips of metal.	4 Protected against water splashing from any direction.
5 Dust-protected. Prevents ingress of dust sufficient to cause harm.	5 Protected against jets of water from any direction.
6 Dust-tight. No dust ingress.	6 Protected against heavy seas or powerful jets of water. Prevents ingress sufficient to cause harm.
	7 Protected against harmful ingress of water when immersed between a depth of 150 mm to 1 m.
	8 Protected against submersion. Suitable for continuous immersion in water.

The ingress protection (IP) classification system uses a two-digit number to represent the enclosure's degree of protection against solid objects and water.



1.0.0 – 1.2.0

NEMA and IP Enclosures

- A cross-reference between NEMA and IP enclosure classifications is shown here.
- Common NEMA Types include Type 1, for general-purpose indoor applications, and Type 3, which is commonly used in outdoor applications such as construction work.

NEMA Enclosure Type	IP Classification
1	IP20
2	IP21
3	IP54
3R	IP24
3S	IP54
4,4X	IP56
5	IP52
6,6P	IP67
12,12K	IP52
13	IP54

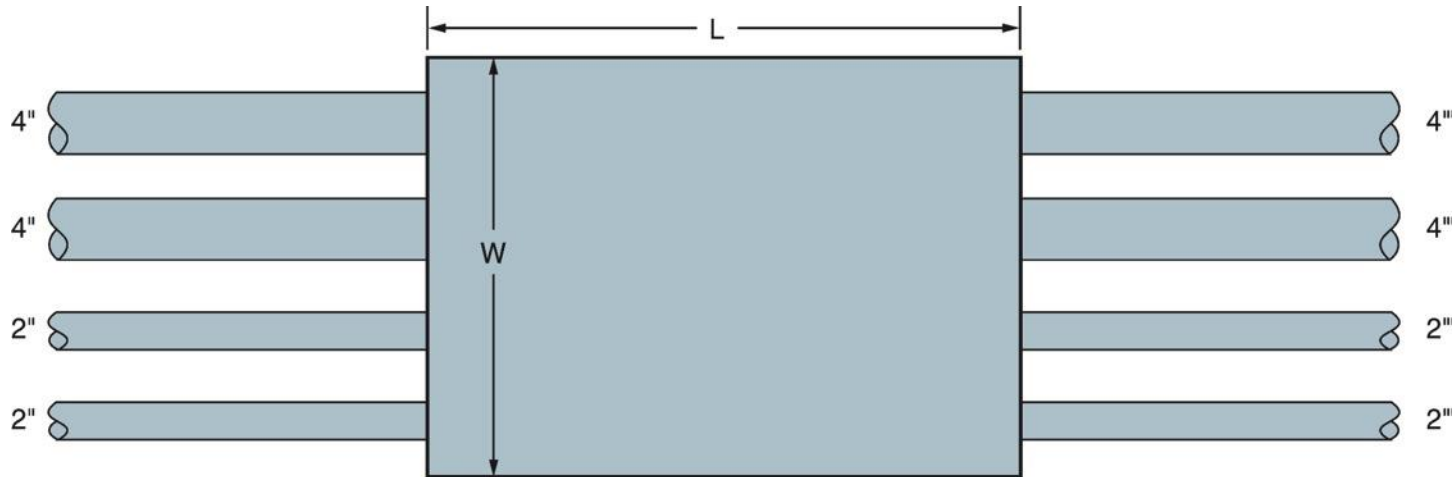
Performance Task

This session will conclude with trainees identifying various NEMA boxes.



2.0.0 – 2.2.0

Sizing Pull and Junction Boxes

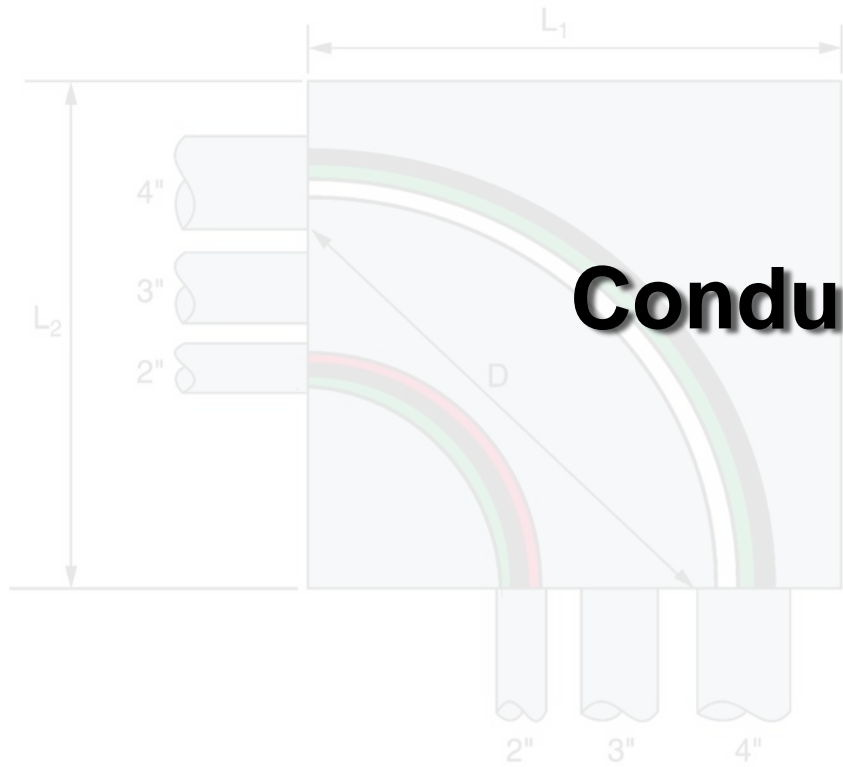


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- Pull and junction boxes eliminate bends and provide strain relief during longer pulls.
- Pull and junction boxes must provide sufficient free space for the conductors. For straight pulls, the minimum length of the box is eight times the trade size of the largest conduit.

2.0.0 – 2.2.0

Next Session... Pull Box With Conduit Runs Entering at Right Angles

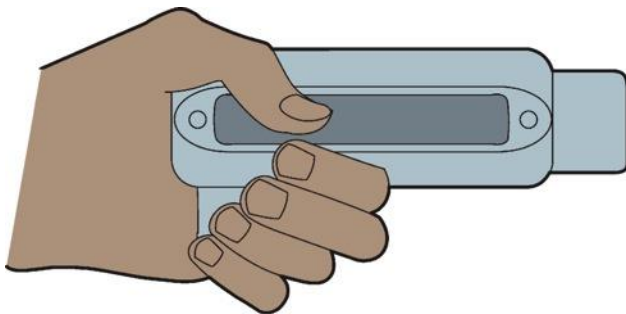


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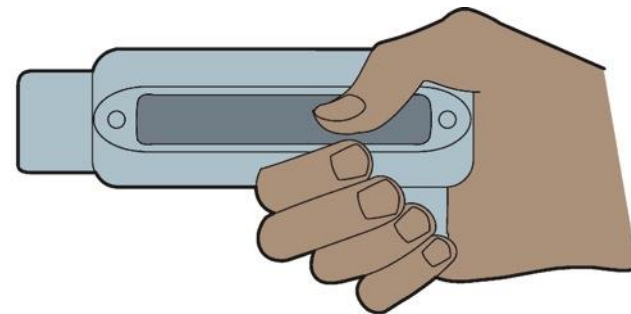
- For pull and junction boxes in which the conductors are pulled at an angle, the minimum length of the box is six times the trade size of the largest conduit, plus the sum of all other conduit diameters entering the box.
- The installation of boxes in systems over 1,000V must meet the requirements of *NEC Article 314, Part IV.*

Conduit Bodies

- Conduit bodies provide access to the system through a removable cover and are typically used with rigid or intermediate metal conduit.
- Conduit bodies can be identified by holding the body like a pistol and observing where the opening is.



TYPE LR – OPENING ON RIGHT



TYPE LL – OPENING ON LEFT

26205-14_F04.EPS

3.0.0 – 3.8.0

Type C Conduit Body

- A Type C conduit body has a straight body with a cover.
- Type C conduit bodies can be used to provide a pull point in a long run or a run with bends totaling more than 360 degrees.



26205-14_F05.EPS

Pull and Junction Boxes 26205-14



3.0.0 – 3.8.0

Type L Conduit Bodies

- Type L conduit bodies are used to provide a 90-degree change in direction.
- Type L conduit bodies are available with the cover on the back (LB) and either or both sides (LL, LR, or LRL).

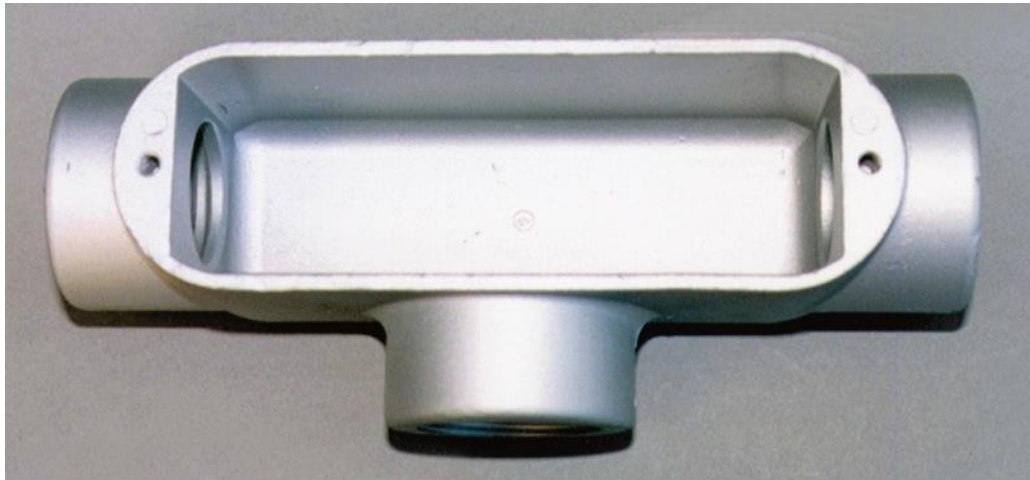


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3.0.0 – 3.8.0

Type T Conduit Body

- Type T conduit bodies are used to provide a junction point for three intersecting conduits and low point drains.
- When installing electrical metallic tubing (EMT), it is more cost effective to use a square box rather than than a Type T conduit body.



26205-14_F07.EPS



3.0.0 – 3.8.0

Type X Conduit Body

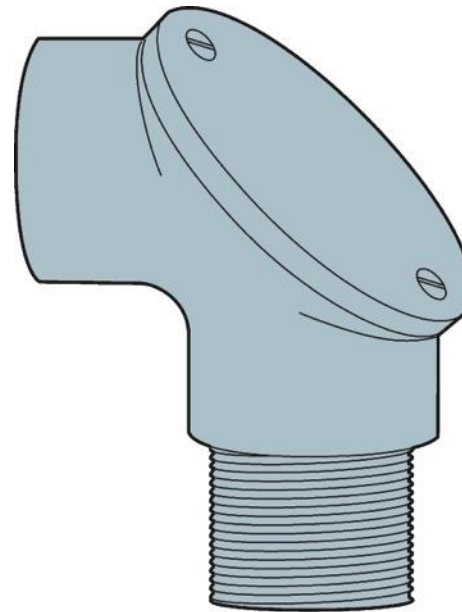
- Type X conduit bodies provide a junction point for four intersecting conduits.
- Type FS and FD boxes are precision molded, gasketed fittings used in industrial environments.



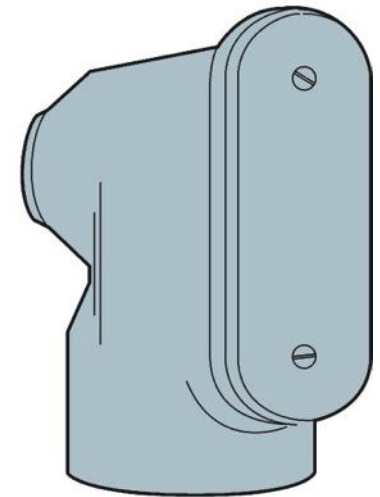
26205-14_F08.EPS

Elbows

- Pulling elbows are used to facilitate cable installation. They do not provide sufficient space for wiring connections.
- An entrance ell (SLB) contains an offset that attaches to the support surface.



(A) PULLING ELBOW



(B) ENTRANCE ELL

26205-14_F09.EPS

3.0.0 – 3.8.0

Mogul

- Moguls have a raised access cover to provide better access for installation and maintenance.
- Larger moguls may contain built-in rollers to facilitate cable installation.



26205-14_F10.EPS

4.0.0 – 4.2.0

Handholes

- Handholes are larger boxes used to provide access for conductor installation, operation, and maintenance.
- Handholes are often installed with underground conduit used for traffic lights, streetlights, and landscaping lights. They must be installed and constructed to protect against environmental damage and traffic or other loads.



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4.0.0 – 4.2.0

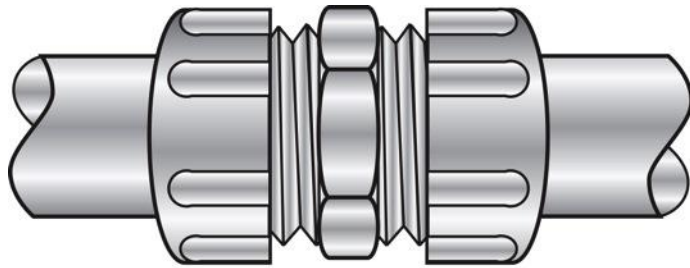
Handhole Containing Traffic Signal Wiring

- Handholes must be effectively bonded and constructed to ensure that they remain safe and reliable for the lifetime of the intended application.
- A solid footing is essential to prevent structural failure.

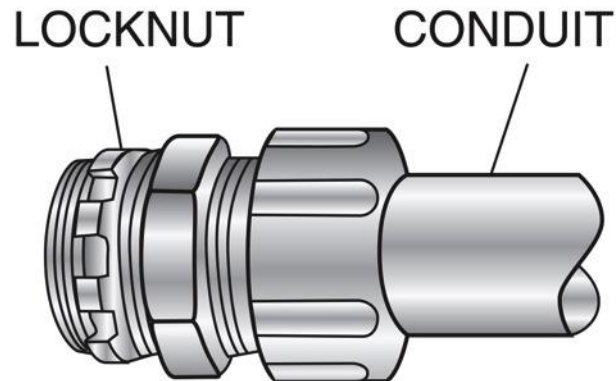


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Fittings



COUPLING



CONNECTOR

26205-14_F13.EPS

- EMT is too thin for threading and uses either setscrew or compression fittings.
- Compression fittings listed as raintight can be used outdoors or in wet locations.

5.0.0 – 5.3.0

Setscrew Fittings

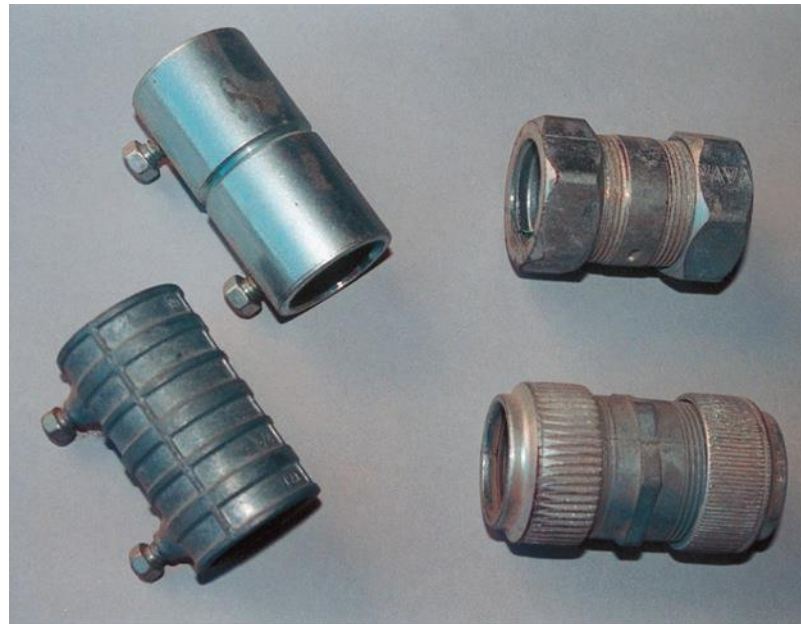
- EMT setscrew fittings can only be used in dry locations.
- EMT requires connectors at each termination point. They can be of the setscrew or compression type, and include a locknut and bushing to protect the conductors at the connection point.



26205-14_F14.EPS

Think About It: Setscrew and Compression Fittings

This picture shows both setscrew and compression fittings. Which type provides a better connection? Why?



26205-14_SA03.EPS

5.0.0 – 5.3.0

Rigid Metal Conduit with Coupling

- RMC, IMC, and aluminum all have sufficient wall thickness to permit threading and use various types of threaded connectors.
- Double locknuts are used at conduit-to-box connections.



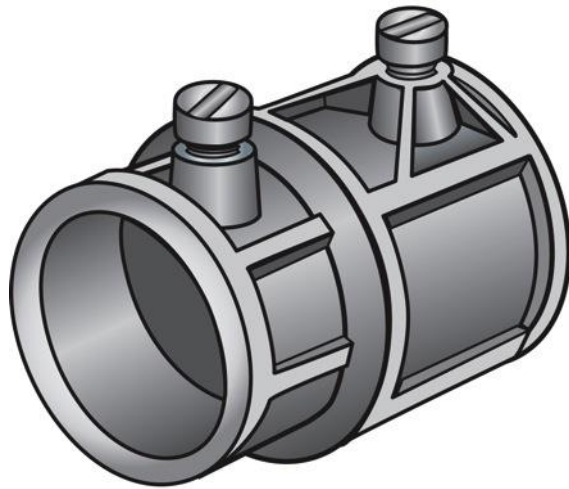
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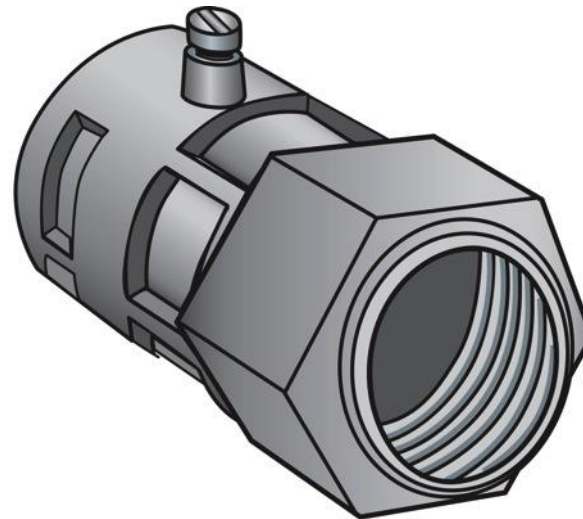
5.0.0 – 5.3.0

Combination Couplings

Combination couplings are used to transition between rigid and flexible conduit such as at motors.



FLEXIBLE TO EMT



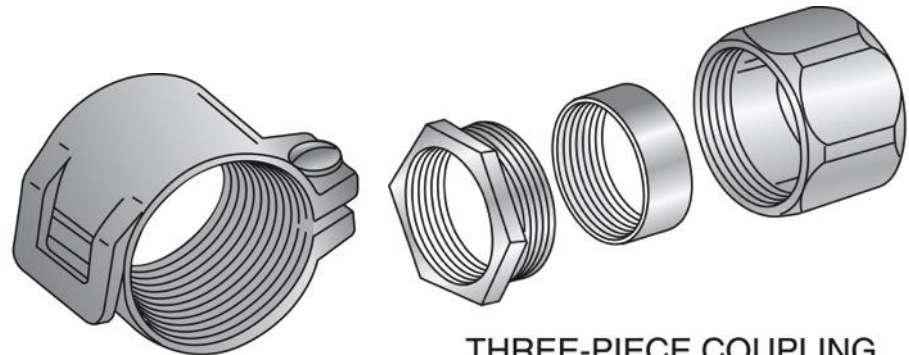
FLEXIBLE TO RIGID

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5.0.0 – 5.3.0

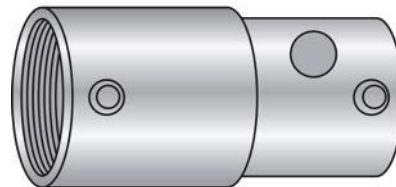
Metal Conduit Couplings

- A variety of couplings are available for different applications.
- Threadless (setscrew) couplings are not permitted in most hazardous locations, but can be used outdoors or in concrete if listed for the application.

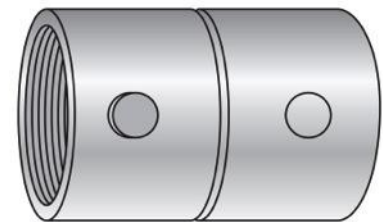


HINGED COUPLING

THREE-PIECE COUPLING



EMT TO RIGID

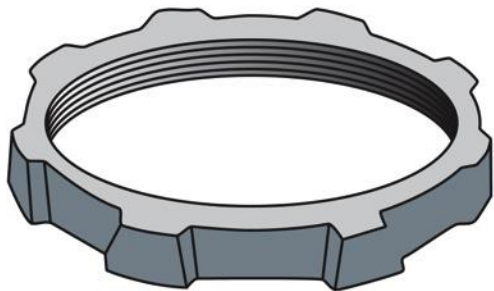


CONCRETE-TIGHT SETSCREW

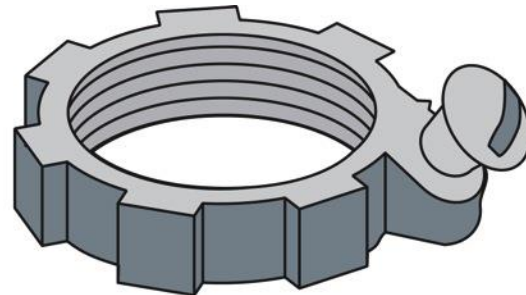
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Common Types of Locknuts

- Locknuts are typically installed on both the inside and outside walls of an enclosure connection.
- A grounding locknut may be required if bonding jumpers are used in the enclosure.
- Sealing locknuts are available to make watertight connections where required.



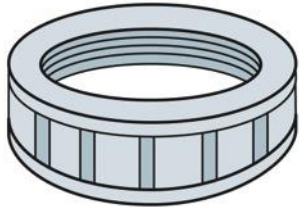
STANDARD LOCKNUT



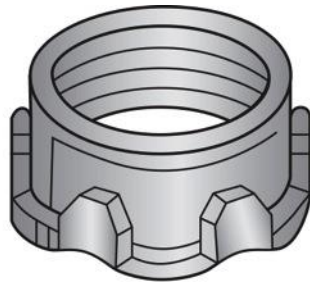
GROUNDING LOCKNUT

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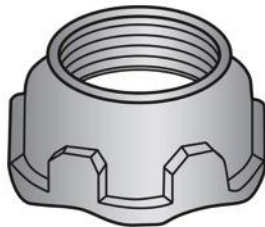
Typical Bushings Used at Termination Points



PLASTIC
INSULATING BUSHING



METALLIC
BUSHING

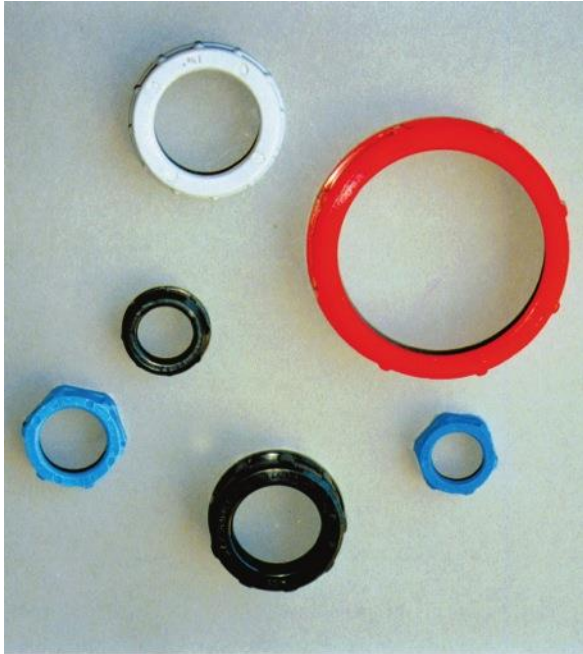


INSULATED
METALLIC BUSHING

26205-14_F19.EPS

- Bushings can be made of metal, plastic, or fiber.
- Bushings protect conductors from the sharp edges of conduit and enclosures.

5.0.0 – 5.3.0



(A)



(B)

26205-14_F20.EPS

Regular Insulating Bushings and Grounding Insulating Bushings

- Plastic insulating bushings are often color coded by conduit size.
- Grounding bushings are available to permit the installation of a ground wire.

5.0.0 – 5.3.0

Myers-Type (Gasketed) Hub

- Myers hubs are gasketed fittings with an integral O-ring used to provide a watertight seal in wet locations. They are typically found on the top of enclosures where water tends to accumulate.
- Listed watertight enclosures may require the use of Myers hubs at all entry points.



26205-14_F21.EPS

Knockout Punch Kit



26205-14_F22.EPS

- Some enclosures include precut knockouts while others require the use of a knockout punch.
- A manual knockout punch uses a predrilled pilot hole and a die/drive nut to cut a hole in the enclosure.

5.0.0 – 5.3.0

Battery-Powered Knockout Kit

When numerous knockouts are required, battery-powered and hydraulic knockout kits can be used.



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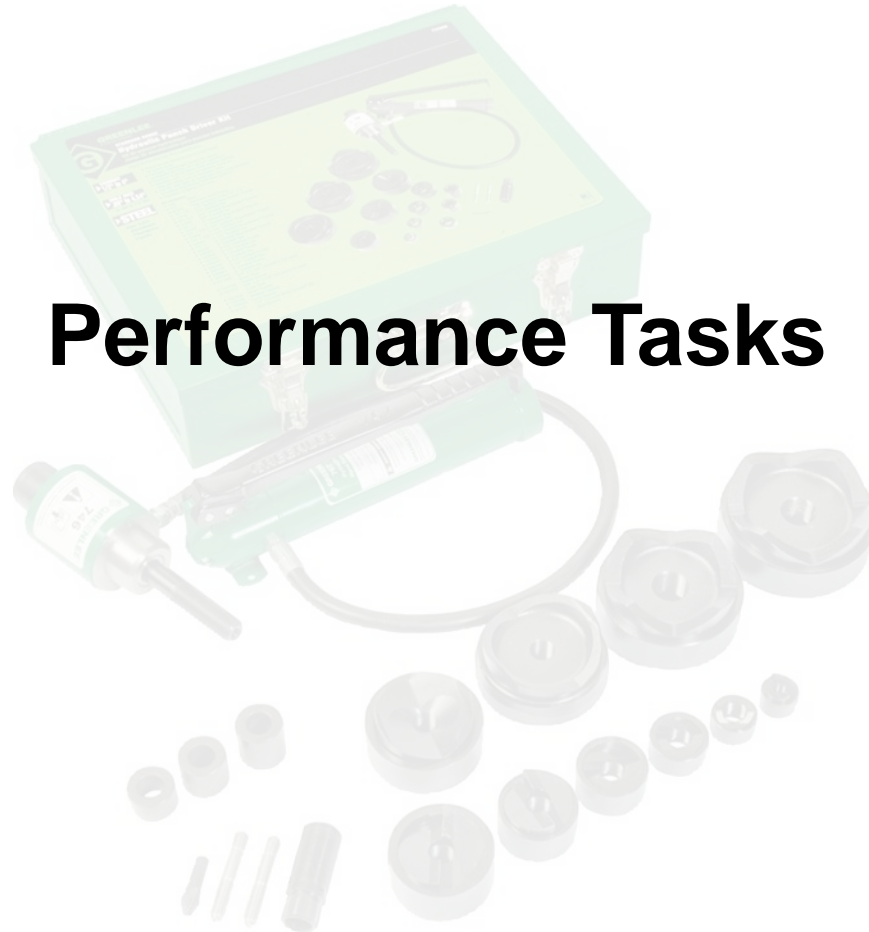
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5.0.0 – 5.3.0

Next Session... Hydraulic Knockout Kit

Performance Tasks



26205-14_F24.EPS

Pull and Junction Boxes 26205-14



Performance Tasks

Next Session...

During this session, trainees practice properly selecting, installing, and supporting pull and junction boxes over 100 cubic inches in size and identifying various conduit bodies and fittings.

Wrap Up



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.

