

Electrical Level 3



Hazardous Locations 26304-14



Objectives

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

1. Define the various classifications of hazardous locations.
2. Describe the wiring methods permitted for branch circuits and feeders in specific hazardous locations.
3. Select seals and drains for specific hazardous locations.
4. Select wiring methods for Class I, Class II, and Class III hazardous locations.
5. Follow *National Electrical Code*[®] (*NEC*[®]) requirements for installing explosionproof fittings in specific hazardous locations.



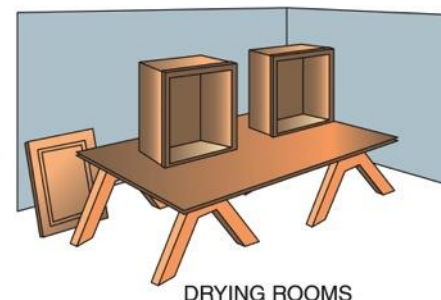
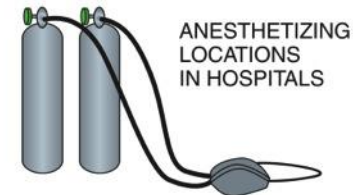
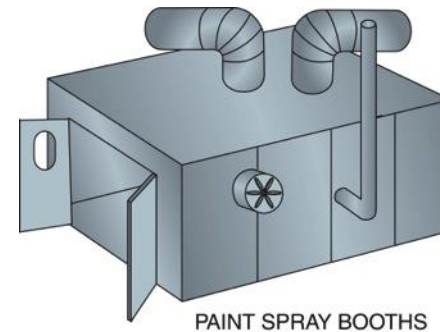
Performance Tasks

1. Using two rigid metal conduit nipples, a sealing fitting, three pieces of No. 12 THHN conductor, and a packing fiber/sealing kit, perform the following operations:
 - Secure one conduit nipple in each end of the seal.
 - Make sure the required amount of threads are engaged.
 - Pull the three THHN conductors through the nipples and seal so that about 6" is protruding from each nipple.
 - Pack the fiber as per the instructions furnished with the sealing kit.
 - Mix the sealing compound.
 - Position the unit in the required location and pour in the sealing compound.



Introduction

- Class I atmospheres contain flammable gases or vapors in quantities sufficient to be explosive or ignitable. They are divided into two divisions (1 and 2) and four groups (A – D).
- Class II atmospheres contain combustible dust. They are divided into two divisions (1 and 2) and three groups (E – G).

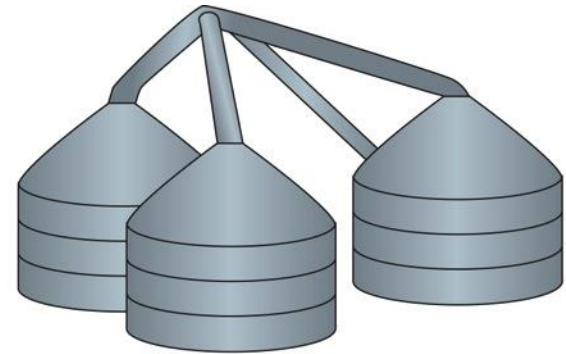


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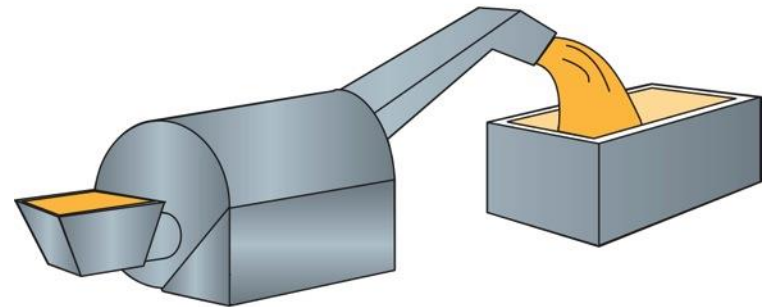
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Class II Locations

- Class II, Division 1 locations contain combustible dust in quantities sufficient to produce explosive or ignitable mixtures. Examples include grain handling and storage plants and rooms containing grinders and pulverizers.
- Class II, Division 2 locations also contain combustible dust, but not in ignitable quantities under normal conditions.



GRAIN-HANDLING AND STORAGE PLANTS



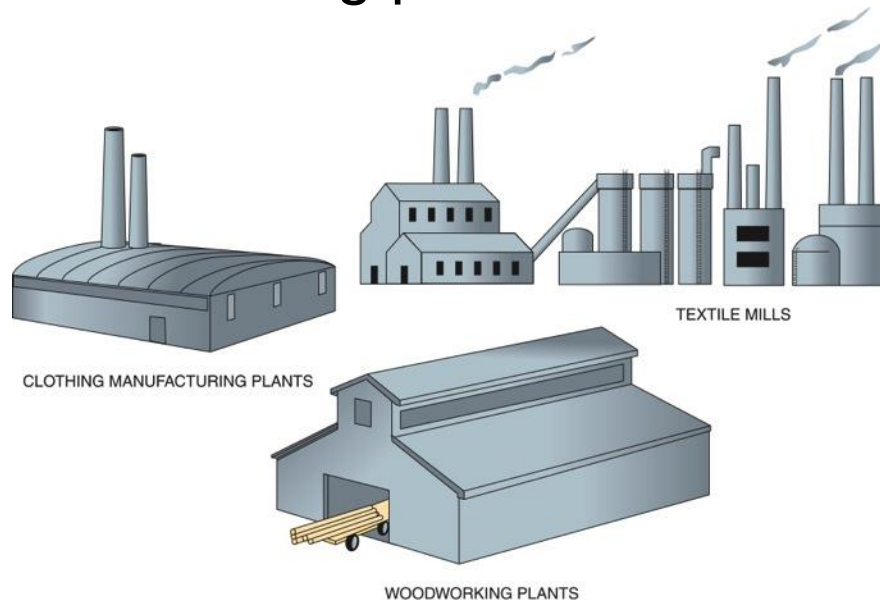
ROOMS CONTAINING GRINDERS AND PULVERIZERS

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Class III Locations

- Class III locations include the presence of easily ignitable fibers or flyings, but not in ignitable quantities under normal conditions.
- Examples include textile mills, clothing manufacturing plants, and woodworking plants.



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Think About It – Identifying Hazardous Locations

This fixture is installed in a grain conveyor tunnel. What class, division, and group would be applied to this installation?



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Applications

Hazardous Area	Class Subdivisions	Groups
	Class I Divisions	Class I, Division Groups
Class I: Material present is a flammable gas or vapor	Division 1: Locations in which hazardous concentrations of flammable gases or vapors are present normally or frequently	Group A: Atmospheres containing acetylene
	Division 2: Locations in which hazardous concentrations of flammable gases or vapors are present as a result of infrequent failure of equipment or containers	Group B: Atmospheres containing hydrogen, manufactured gases containing more than 30% hydrogen by volume, or gases or vapors of equivalent hazard Group C: Atmospheres containing ethylene, cyclopropane, or gases or vapors of equivalent hazard Group D: Atmospheres containing propane, gasoline, or gases or vapors of equivalent hazard
	Class I Zones	Class I, Zone Groups
	Zone 0: Locations in which combustible material is present continuously or for long periods	Group IIC: Atmospheres containing acetylene or hydrogen or other gases or vapors meeting Group IIC criteria
	Zone 1: Locations in which combustible material is likely to be present normally or frequently because of repair or maintenance operations or leakage	Group IIB: Atmospheres containing acetaldehyde, ethylene, or other gases or vapors meeting Group IIB criteria
	Zone 2: Locations in which combustible material is not likely to occur in a normal operation and, if it does occur, will exist only for a short period	Group IIA: Atmospheres containing propane, gasoline, or other gases or vapors meeting Group IIA criteria
	Class II Divisions	Class II, Division Groups
Class II: Material present is a combustible dust	Division 1: Locations in which hazardous concentrations of combustible dust are present normally or may exist because of equipment breakdown or where electrically conductive combustible dusts are present in hazardous quantities	Group E: Atmospheres containing combustible metal dusts including aluminum, magnesium, and other metals of similar hazards
	Division 2: Locations in which hazardous concentrations of combustible dust are not normally suspended in the air but may occur as a result of infrequent malfunction of equipment or where dust accumulation may interfere with safe dissipation of heat or may be ignitable by abnormal operation of electrical equipment	Group F: Atmospheres containing combustible carbonaceous dusts, including carbon black, charcoal, coals, or dusts that have been sensitized by other materials so that they present an explosion hazard Group G: Atmospheres containing combustible nonconductive dusts not included in Group E or F, including flour, grain, wood, and plastic
	Class III Divisions	
Class III: Material present is an ignitable fiber or flying	Division 1: Locations in which easily ignitable fibers or materials producing combustible flyings are handled, manufactured, or used	No Groups
	Division 2: Locations in which easily ignitable fibers are stored or handled, except in the manufacturing process	



1.4.0

Application Rules for Class I, Division 1

Components	Characteristics	NEC® Reference
Boxes, fittings	Explosionproof and threaded for connection to conduit	<i>NEC Section 501.10(A)</i>
Wiring methods	Rigid metal conduit, steel intermediate metal conduit, Type MI cable, and, under certain conditions, ITC and MC cable	<i>NEC Section 501.10(A)</i>
Flexible connections	Class I, explosionproof	<i>NEC Section 501.10(A)(2)</i>
Sealoffs	Approved for purpose	<i>NEC Sections 501.15(A), (C), and (D)</i>
Liquid-filled transformers	Installed in an approved vault outside the area	<i>NEC Section 501.100(A)(1)</i>
Panelboards, circuit breakers, fuses, switches	Class I enclosure*	<i>NEC Section 501.115(A)</i>
Dry-type transformers	Class I, Division 1 enclosure or outside the area	<i>NEC Sections 501.100(A)(2) and 501.120(A)</i>
Motors and generators	Class I, Division 1, totally enclosed, or submerged	<i>NEC Section 501.125(A)</i>
Lighting fixtures (luminaires)	Approved for Class I, Division 1	<i>NEC Section 501.130(A)</i>
Portable lamps	Class I, Division 1, approved as a portable assembly	<i>NEC Section 501.130(A)</i>
Utilization equipment	Class I, Division 1	<i>NEC Section 501.135(A)</i>
Receptacles	Approved for the location	<i>NEC Section 501.145</i>
Alarm systems	Class I, Division 1	<i>NEC Section 501.150(A)</i>

*Class 1, Division 1 enclosures include explosionproof or purged and pressurized enclosures per *NEC Section 501.105(A)*.



1.4.0

Application Rules for Class I, Division 2

Components	Characteristics	NEC® Reference
Flexible connections	Class I, explosionproof	<i>NEC Section 501.10(B)</i>
Wiring methods	Rigid metal conduit, steel intermediate metal conduit, Types MI, MC, MV, TC, ITC, or PLTC cables, or enclosed gasketed busways or wireways	<i>NEC Section 501.10(B)</i>
Sealoffs	Approved for purpose	<i>NEC Sections 501.15(B), (C), and (E)</i>
Boxes, fittings	Do not have to be explosionproof unless current interrupting contacts are exposed	<i>NEC Section 501.10(B)(4)</i>
Liquid-filled transformers	Approved vault outside the area	<i>NEC Sections 501.100(B) and 450.26</i>
Panelboards	Class 1 enclosure* with exceptions	<i>NEC Section 501.115(B)</i>
Switches, motor controls, circuit breakers	Class I enclosure*	<i>NEC Section 501.115(B)(1)</i>
Fuses	Class I enclosure* with exceptions	<i>NEC Section 501.115(B)(3)</i>
Dry-type transformers	Class I, general purpose except switching mechanism Division 1 enclosures	<i>NEC Section 501.120(B) and 501.100(B)</i>
Motors and generators	General purpose unless motor has sliding contacts, switching contacts, or integral resistance devices; if so, use Class I, Division 1	<i>NEC Section 501.125(B)</i>
Lighting fixtures (luminaires)	Protected from physical damage	<i>NEC Section 501.130(B)(1)</i>
Portable lamps	Explosionproof	<i>NEC Section 501.130(B)(4)</i>
Utilization equipment	Depends on equipment type	<i>NEC Section 501.135(B)</i>
Receptacles	Approved for the location	<i>NEC Section 501.145</i>
Alarm systems	Class I, Division 2	<i>NEC Section 501.150(B)</i>

*Class 1, Division 2 enclosures include explosionproof or purged and pressurized enclosures per *NEC Section 501.105(B)*.



1.4.0

Application Rules for Class II, Division 1

Components	Characteristics	NEC® Reference
Wiring methods	Rigid metal conduit, steel intermediate metal conduit, or Types MI and, under certain conditions, MC cables listed for use in Class II, Division 1 locations	<i>NEC Section 502.10(A)(1)</i>
Flexible connections	Extra-hard usage cord, liquid-tight, and others	<i>NEC Section 502.10(A)(2)</i>
Boxes, fittings	Class II boxes required when using taps, joints, or other connections; otherwise, use dust-tight boxes with threaded openings	<i>NEC Section 502.10(A)(3)</i>
Liquid-filled transformers	Install in an approved vault	<i>NEC Section 502.100(A)(1)</i>
Dry-type transformers	Class II, vault	<i>NEC Section 502.100(A)(2)</i>
Circuit breakers, fuses, switches, motor controls, panelboards	Dust/ignitionproof enclosure	<i>NEC Section 502.115(A)</i>
Motors and generators	Class II, Division 1 or totally enclosed pipe-ventilated	<i>NEC Section 502.125(A)</i>
Lighting fixtures (luminaires), portable lamps	Class II, identified for location	<i>NEC Section 502.130(A)</i>
Utilization equipment	Class II, identified for location	<i>NEC Section 502.135(A)</i>
Receptacles	Class II, identified for location, permanent wiring	<i>NEC Section 502.145(A)</i>



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Application Rules for Class II, Division 2

Components	Characteristics	NEC® Reference
Wiring methods	Rigid metal conduit, steel intermediate metal conduit, electrical metallic tubing (EMT), Types MI, MC, TC, ITC, or PLTC cables, or enclosed dust-tight busways or wireways	<i>NEC Section 502.10(B)(1)</i>
Flexible connections	Extra-hard usage cord, liquid-tight, and others	<i>NEC Section 502.10(B)(2)</i>
Boxes, fittings	Dust-tight	<i>NEC Section 502.10(B)(4)</i>
Liquid-filled transformers	Install in vault	<i>NEC Section 502.100(B)(1)</i>
Dry-type transformers	Class II or vault	<i>NEC Section 502.100(B)(3)</i>
Panelboards, circuit breakers, fuses, switches, motor controls	Dust-tight enclosure	<i>NEC Section 502.115(B)</i>
Motors and generators	Class II, Division 1 or totally enclosed types	<i>NEC Section 502.125(B)</i>
Lighting fixtures (luminaires)	Identified for location	<i>NEC Section 502.130(B)</i>
Portable lamps	Identified for location	<i>NEC Section 502.130(B)(1)</i>
Utilization equipment	Dust-tight enclosure	<i>NEC Section 502.135(B)</i>
Receptacles	Identified for location, permanent wiring	<i>NEC Section 502.145(B)</i>



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Next Session... Application Rules for Class III, Divisions 1 and 2

Components	Characteristics	NEC® Reference
Wiring methods	RMC, IMC, EMT, PVC, RTRC, Types MI and MC cables, enclosed dust-tight busways or wireways, and tray cables	NEC Section 503.10(A)(1)
Boxes, fittings	Dust-tight	NEC Section 503.10(A)(2)
Flexible connections	Extra-hard usage cord and other flexible conduit/fittings	NEC Section 503.10(A)(3)
Liquid-filled transformers	Install in an approved vault	NEC Section 503.100 and 502.100(A)
Dry-type transformers	Dust-tight enclosure	NEC Section 503.100 and 502.100(B)
Panelboards, circuit breakers, fuses, switches, motor controls	Dust-tight enclosure	NEC Section 503.115
Motors and generators	Totally enclosed, with exceptions	NEC Section 503.125
Lighting fixtures (luminaires)	Tight enclosure with no openings	NEC Section 503.130
Portable lamps	Unswitched, guarded with tight enclosure for lamp	NEC Section 503.130(D)
Utilization equipment	Class III	NEC Section 503.135
Receptacles	Minimize accumulation of fibers or flyings	NEC Section 503.145

Delayed Action Receptacles



2.0.0 – 2.2.0

Next Session... Delayed Action Receptacles

- In hazardous atmospheres, any source of energy can ignite an explosion, including the small arcs normally produced by switches, pushbuttons, circuit breakers.
- Explosionproof fittings and wiring methods are designed to prevent the ignition of flammable liquids or gases by sealing arcs and other energy sources in an explosionproof body.

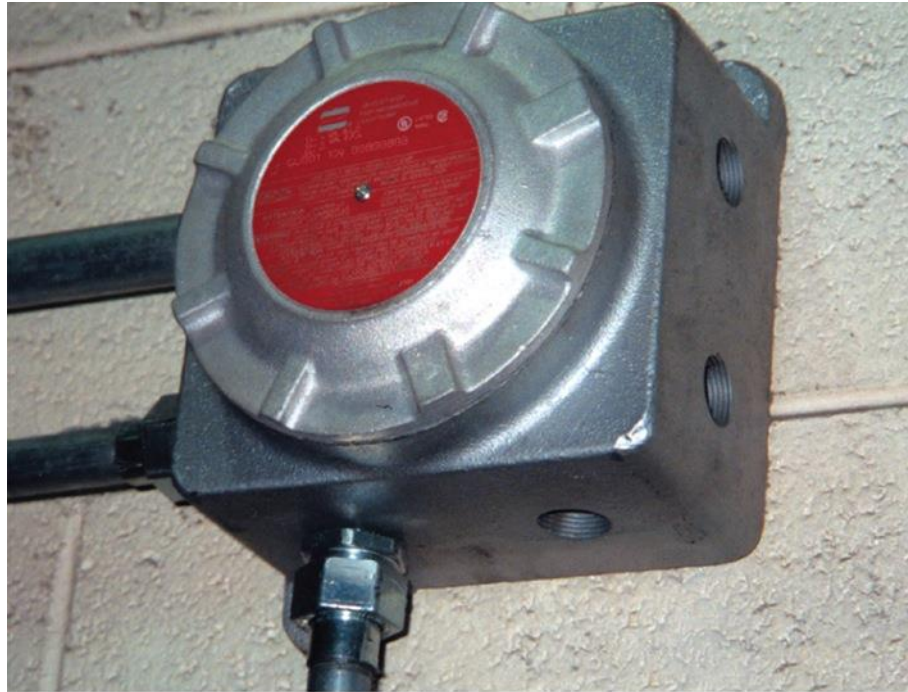
Explosionproof Equipment



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2.0.0 – 2.2.0

Explosionproof Equipment

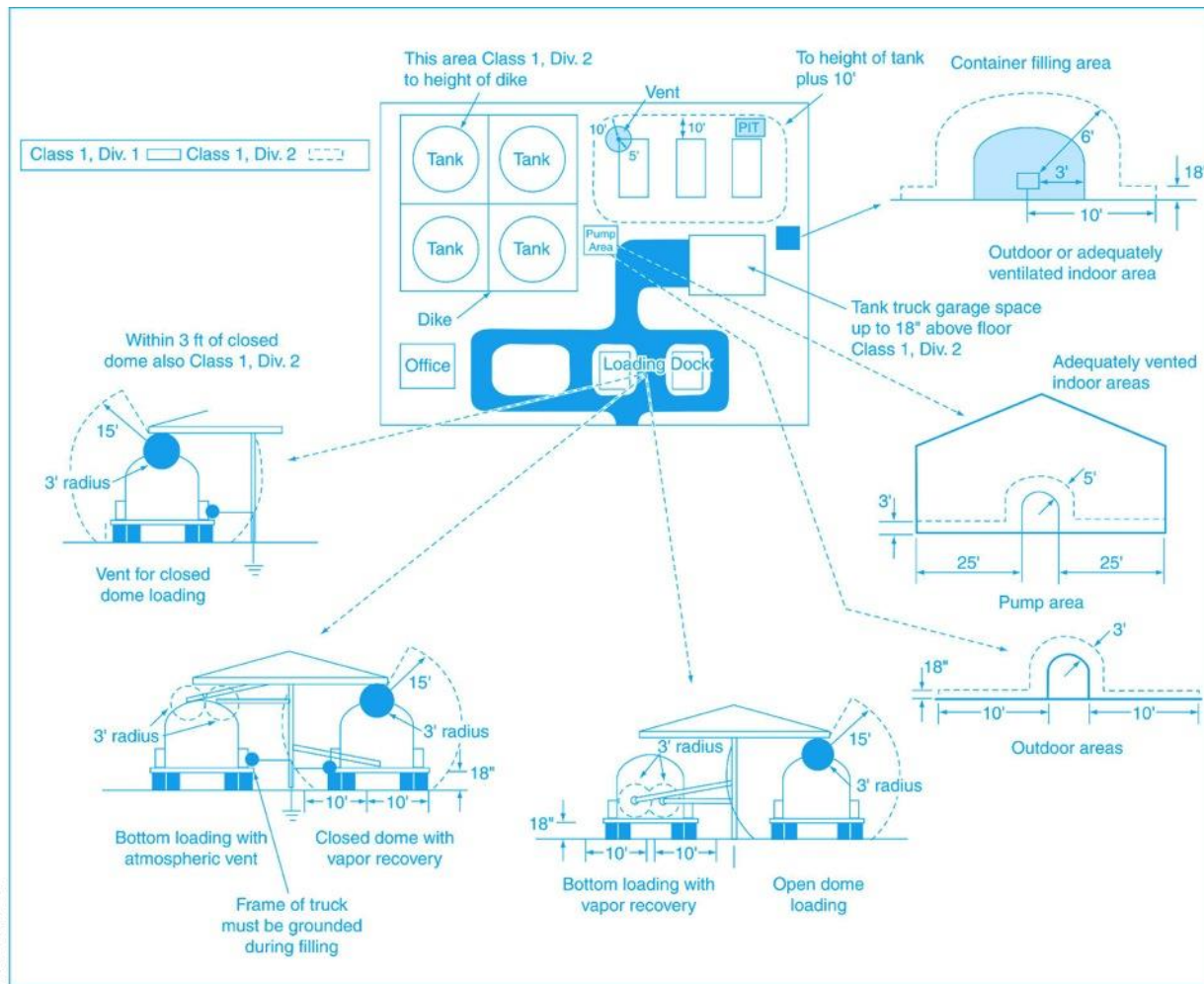


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What's wrong with this picture?

3.0.0 – 3.2.0

Floor Plan of a Hazardous Location



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3.0.0 – 3.2.0

Portable Conduit Threader

- **NEC Section 344.28** requires a taper of $\frac{3}{4}$ " per foot for threaded conduit in hazardous locations. Either metric or National Pipe Taper (NPT) threads are used.
- All connections must be made with five threads fully engaged and wrench-tight to prevent sparking when fault current flows through the system.



(A) PORTABLE CONDUIT THREADER



(B) STANDARD CONDUIT DIES (NPT)

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3.0.0 – 3.2.0



(A) SEALOFF FITTINGS



(B) EXPLOSIONPROOF SEAL



(C) EXPLOSIONPROOF
CONDUIT BODY

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Typical Fittings Approved for Hazardous Areas

All boxes, fittings, and joints in hazardous locations must use threaded connections and be an approved, explosionproof type listed for the location.

3.0.0 – 3.2.0

Explosionproof Flexible Connector

Explosionproof flexible connectors are designed to withstand vibration and are often used at motor terminals in hazardous locations.



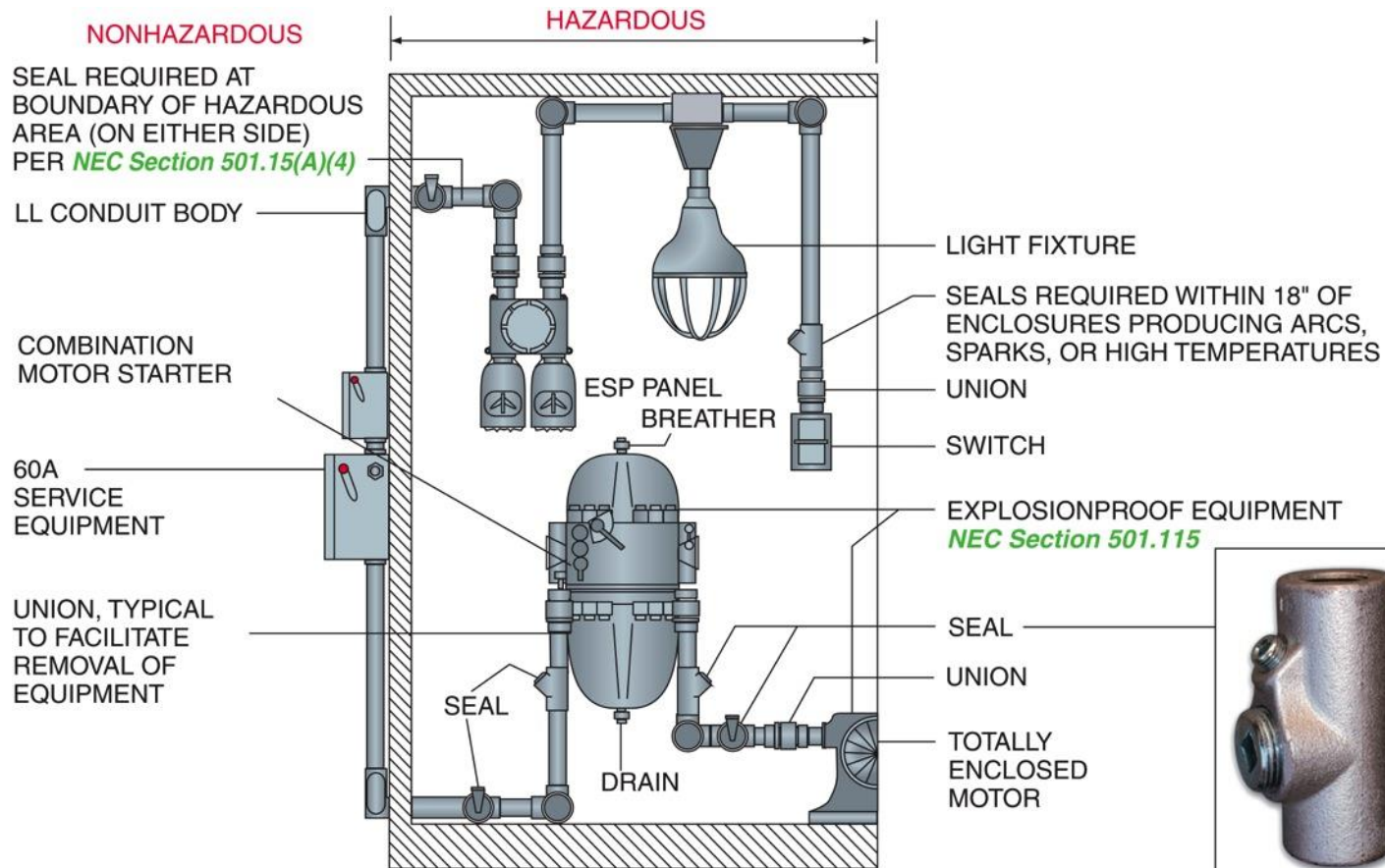
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Hazardous Locations 26304-14



3.3.0 – 3.3.1

Seals and Drains



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3.3.2

Drains

- In humid or wet locations where moisture may enter a conduit system, the raceways should be inclined toward a low point with integral drains whenever possible.
- If the raceways cannot be inclined toward a drain, special drain/seal fittings can be installed.



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3.3.3

Selection and Installation of Seals and Drains



ELBOW
SEAL



DRAIN
SEAL



SEAL FOR USE
AT ANY ANGLE

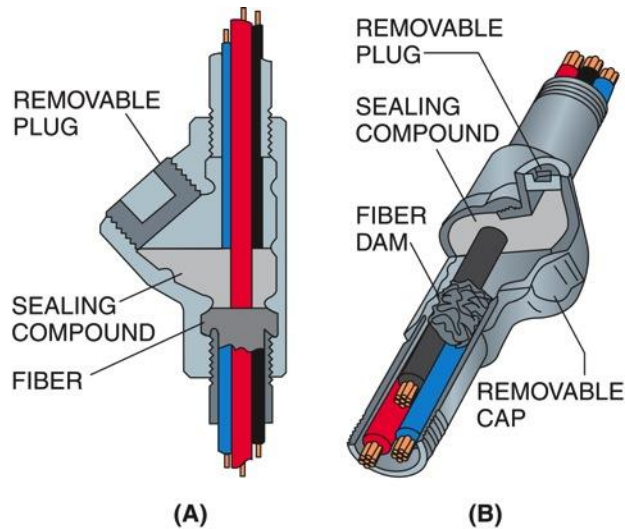


SEAL WITH
DRAIN COVER

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- Sealoff fittings must be selected for the specific class, division, and group of the hazardous location.
- Seals are available in a variety of shapes and sizes for different applications and mounting locations.

3.3.4



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(C)

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Sealing Compounds and Dams

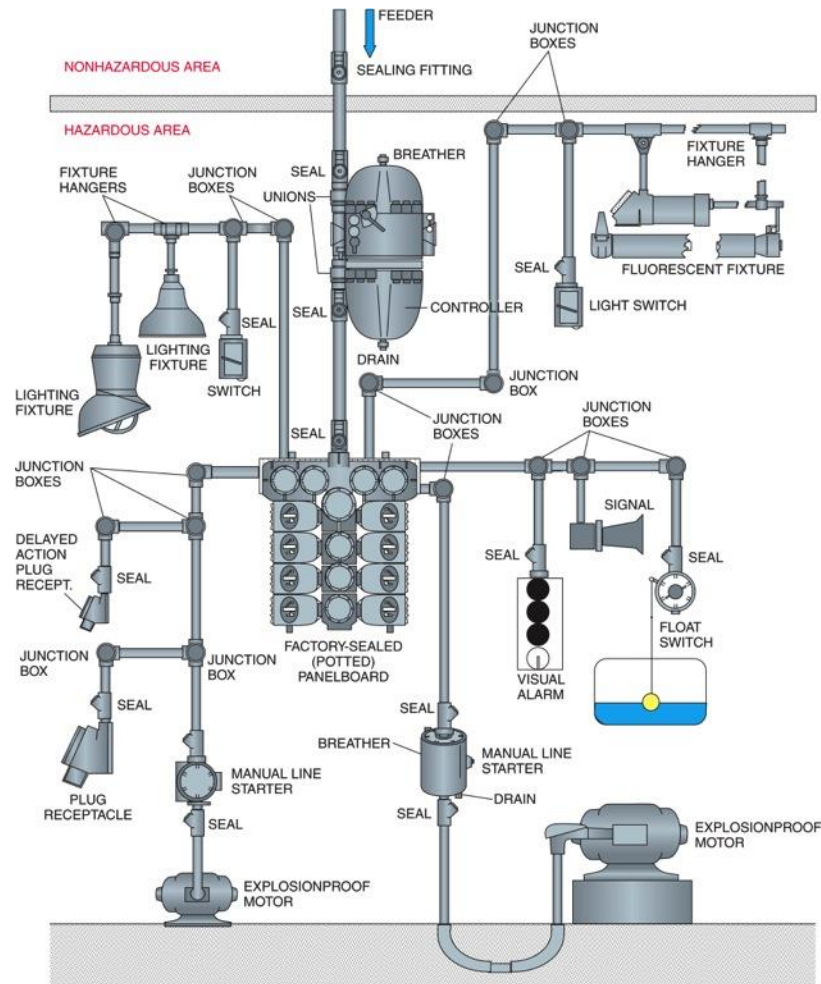
- Poured seals may only be made by qualified personnel following the manufacturer's instructions for the fitting in use.
- Ensure that the sealing compound is compatible with the packing material, type of fitting, and conductors used in the system.

Performance Task

This session will conclude with trainees practicing installing sealoff fittings and pouring seals.

3.3.4

Class I, Division 1 Electrical Installation

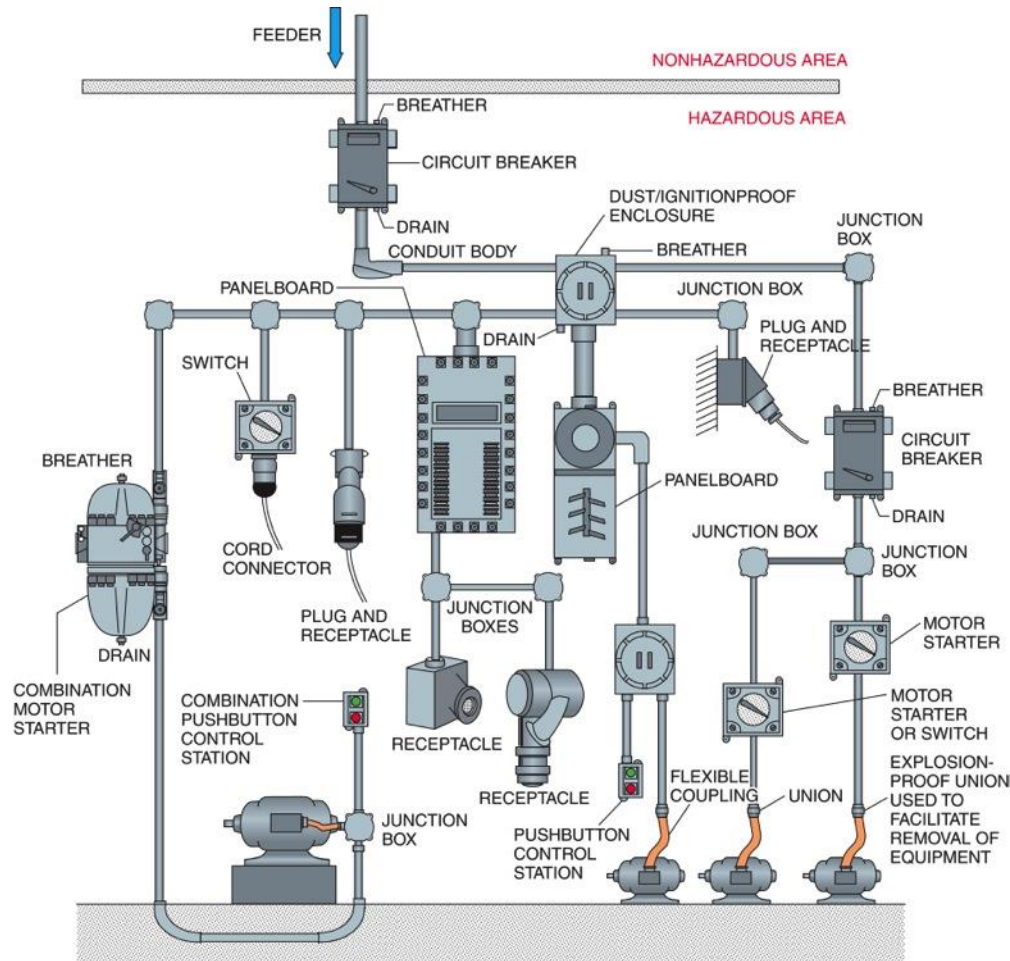


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3.3.4

Class I, Division 2 Electrical Installation



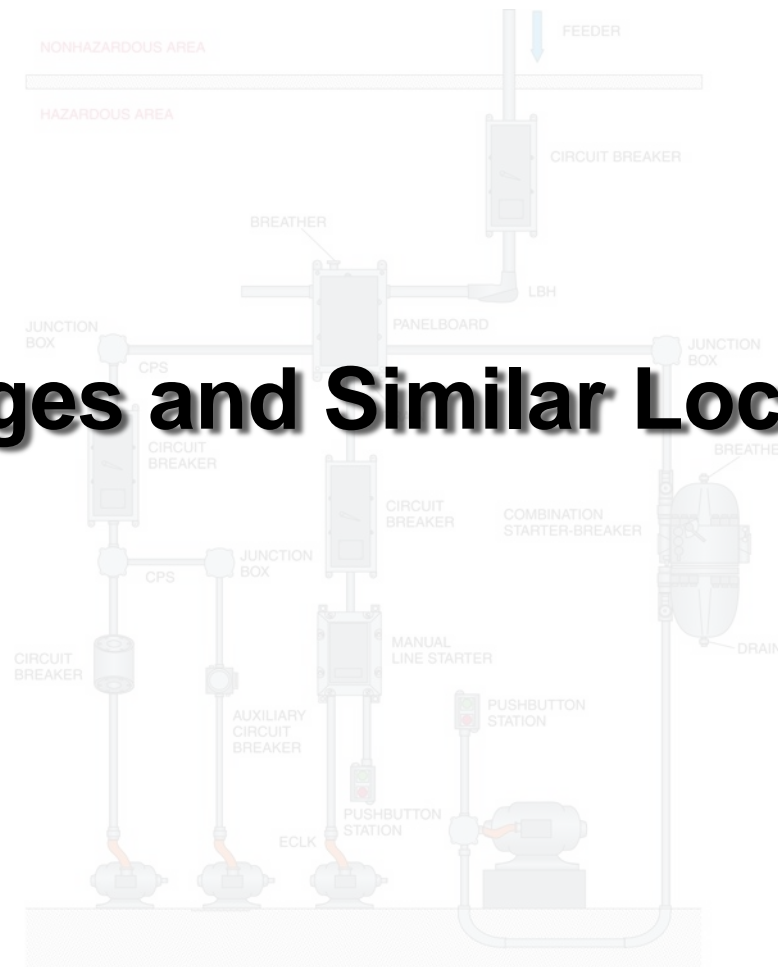
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3.3.4

Next Session... II Power Installation

Garages and Similar Locations

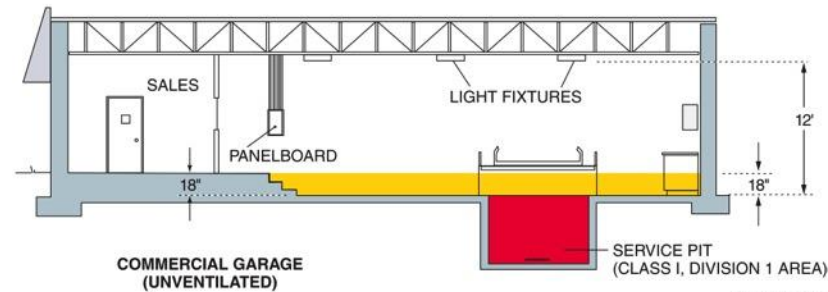
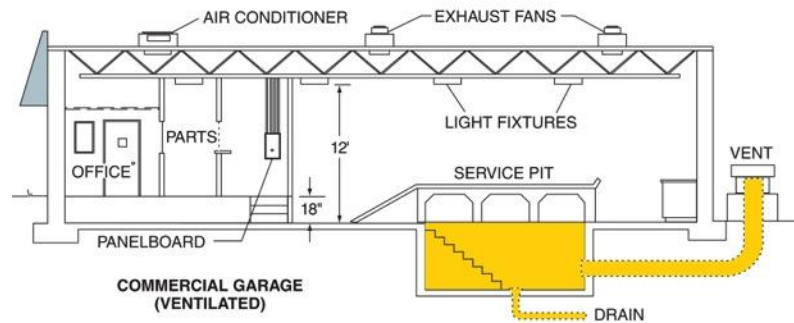
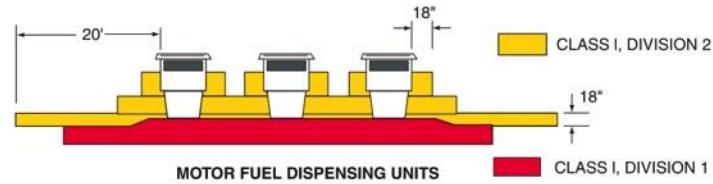


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Garages and Similar Locations



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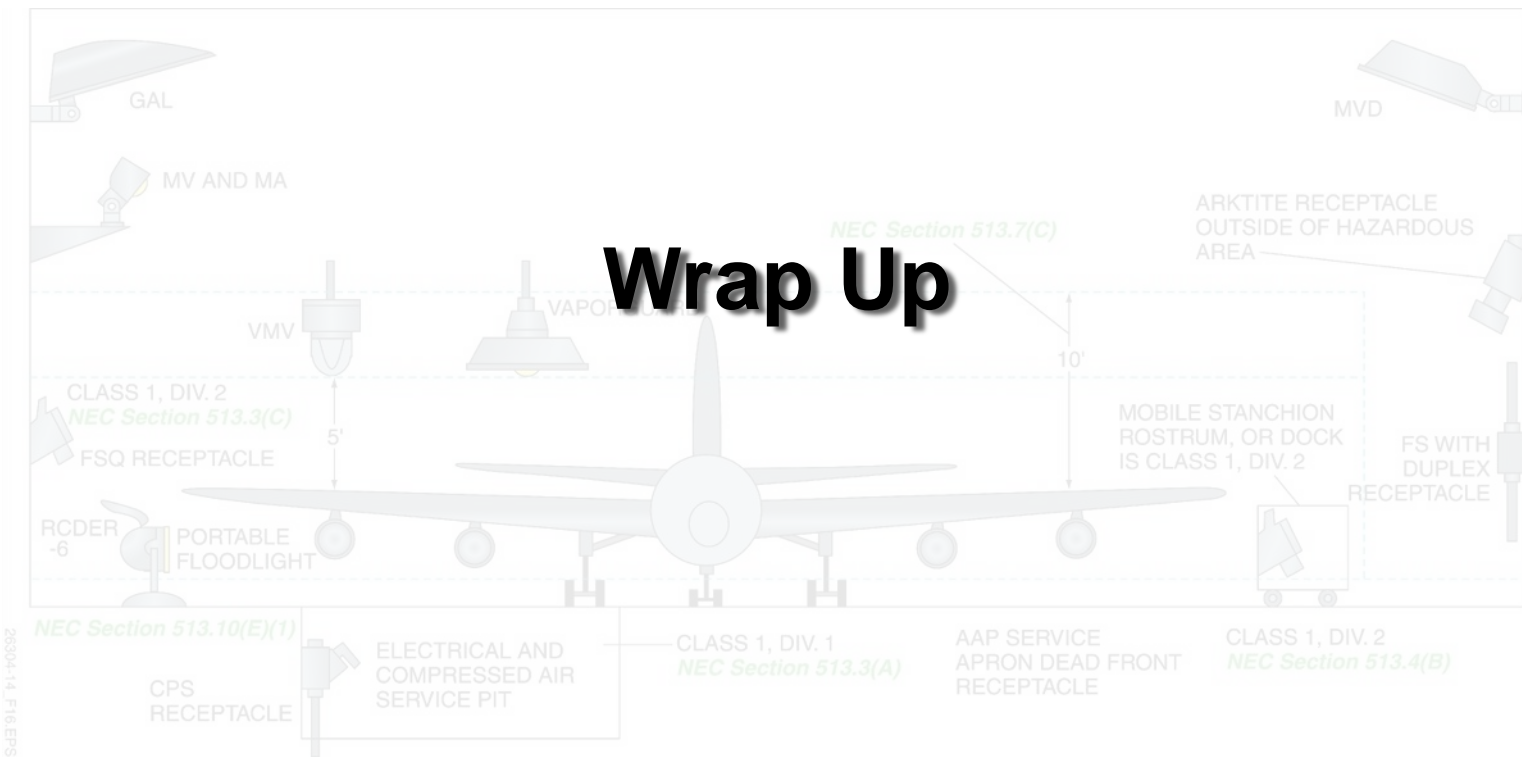
NEC® Application Rules for Motor Fuel

Application	NEC® Regulation	NEC® Reference
Equipment in hazardous locations	All wiring and components must conform to the rules for Class I locations.	<i>NEC Section 514.4</i>
Equipment above hazardous locations	All wiring must conform to the rules for such equipment in commercial garages.	<i>NEC Section 514.7</i>
Gasoline dispenser	A disconnecting means must be provided for each circuit leading to or through a dispensing pump to disconnect all voltage sources, including feedback, during periods of service and maintenance. An approved seal (sealoff) is required in each conduit entering or leaving a dispenser.	<i>NEC Section 514.13</i>
Grounding	Metal portions of all noncurrent-carrying parts of dispensers must be effectively grounded and bonded.	<i>NEC Section 514.16</i>
Underground wiring	Underground wiring installed within 2' of ground level shall be in threaded rigid metal conduit or IMC. If underground wiring is buried 2' or more, rigid nonmetallic conduit may be used along with the types mentioned above; Type MI cable may also be used in some cases.	<i>NEC Section 514.8</i>



5.0.0 – 8.0.0

Next Session... Hazardous Locations; Manufacturer's Data



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.

