



Hazardous (Classified) Locations

2014 NEC

Part 1: Introduction and History, Chapter One, Chapter Two



Presentation by:

International Association of Electrical Inspectors



International Association of Electrical Inspectors

**HAZARDOUS
LOCATIONS**

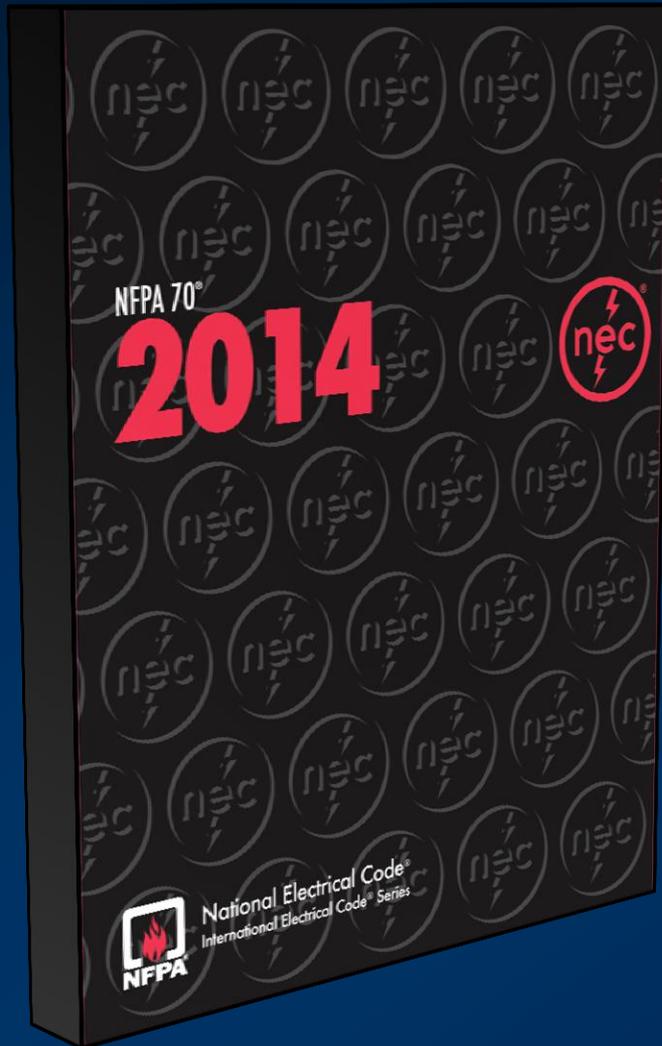


Course Content (Chapters)

Introduction and History

1. Classification of Areas and Locations
2. Methods of Protection
3. Protection Techniques for Hazardous (Classified) Locations
4. Equipment in Hazardous (Classified) Locations
5. Wiring Methods and Requirements
6. Requirements for Special Occupancies

National Electrical Code®



- Electrical wiring and equipment installations in hazardous (*classified*) locations
- Based on the 2014 *National Electrical Code*
- Engineering, design, installation, and enforcement perspectives are incorporated into the program



MANUFACTURED BY:
VEEDER-ROOT, 125 POWDER FOREST DR.
SIMSBURY, CT 06070 U.S.A.

INVENTORY MEASUREMENT SYSTEM FOR USE WITH EQUIPMENT
SPECIFIED IN THE INSTALLATION INSTRUCTIONS. SEE
INSTALLATION INSTRUCTIONS: 576013-879



ASSOCIATED APPARATUS
APPAREILLAGE CONNEXE

INPUT POWER RATINGS:
120 VAC, 50/60 Hz
2.0 A Max

FORM NO. 0848290-022
SERIAL NO. F01172735305001

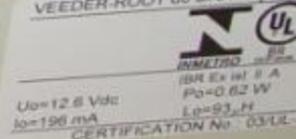
THIS EQUIPMENT COMPLIES
WITH THE REQUIREMENTS IN
PART 15 OF FCC RULES FOR A
CLASS A COMPUTING DEVICE.
OPERATION OF THIS
EQUIPMENT IN A RESIDENTIAL
AREA MAY CAUSE
UNACCEPTABLE
INTERFERENCE TO RADIO AND
TV RECEPTION REQUIRING
THE OPERATOR TO TAKE
WHATEVER STEPS ARE
NECESSARY TO CORRECT THE
INTERFERENCE.

WARNING
MORE THAN ONE LIVE
CIRCUIT. SEE DIAGRAM

AVERTISSEMENT
PLUS D'UN CIRCUIT SOUS
TENSION VOIR SCHEMA

MODEM. FOR CONNECTION TO
TELEPHONE EQUIPMENT
SUBJECT TO LOCAL
REGULATIONS. MAX. SHORT
CIRCUIT CURRENT 0 AMPS.
MAX. OPEN CIRCUIT V IS 0
VOLTS.

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TLS - 350



Predetermined Classified Areas in the *NEC*

- The *NEC* includes several predetermined hazardous (classified) locations associated with the various special occupancies and conditions covered in Chapter 5
- Where the extent of the hazardous (classified) location is already predetermined and known, one can proceed with design and installation of electrical equipment and systems in these locations
- An example can be found in *NEC* Tables 514.3(B)(1) and (B)(2) that provide the extent of the hazardous (classified) locations associated with motor fuel dispensing facilities



Requirements for Special Occupancies





NO SMOKING

DIESEL

INGUISHER



Photo from IAEI Archives

Hazardous Location Occupancies in the *NEC*



- Hazardous (*Classified*) Locations covered:
 - Article 511 Commercial Garages, Repair, and Storage
 - Article 513 Aircraft Hangars
 - Article 514 Motor Fuel Dispensing Facilities
 - Article 515 Bulk Storage Plants
 - Article 516 Spray Application, Dipping, Coating, and Printing Processes
 - Article 517 Health Care Facilities

Article 511 Commercial Garages, Repair, and Storage



- 511.1 Scope
- 511.2 Definitions
- 511.3 Classification of Locations
- 511.4 Wiring and Equipment in Class I Locations
- 511.7 Wiring and Equipment installed above Class I Locations
- 511.9 Sealing
- 511.10 Special Equipment
- 511.12 Ground-Fault Circuit-Interrupter Protection for Personnel
- 511.16 Grounding and Bonding Requirements



Commercial Garages, Repair, and Storage

- Scope of Article 511
 - Article 511 applies to occupancies that include service and repair locations for self-propelled vehicles that use volatile flammable liquids or flammable gases for power
 - Additional information about requirements for parking structures is provided in the following references standards:
 - NFPA 88A-2015 *Standard for Parking Structures*
 - NFPA 30A-2012 *Code for Motor Fuel Dispensing Facilities and Repair Garages*

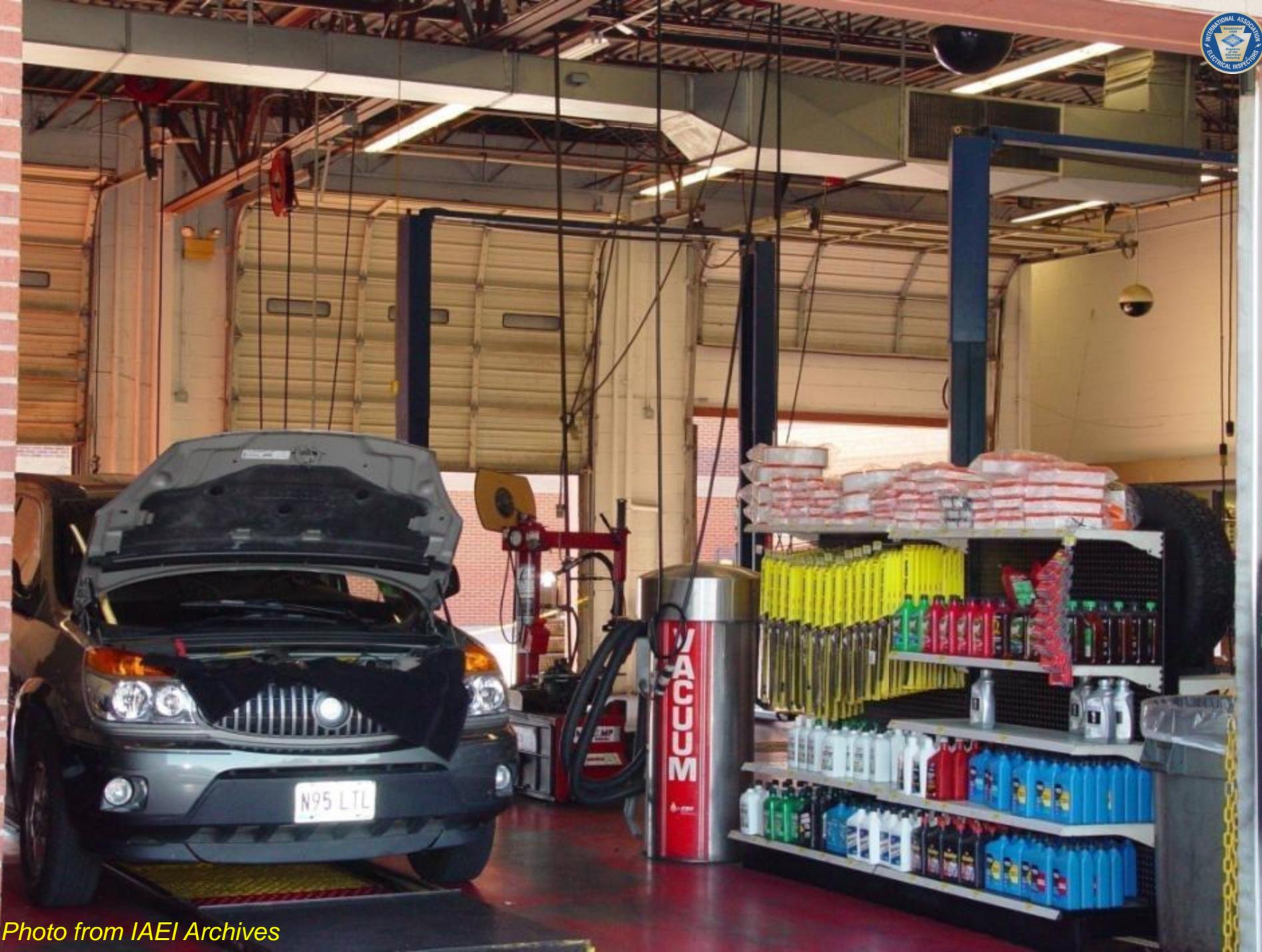


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Definition of Major Repair Garage

- **Major Repair Garage.** A building or portions of a building where major repairs, such as engine overhauls, painting, body and fender work, and repairs that require draining of the motor vehicle fuel tank are performed on motor vehicles, including associated floor space used for offices, parking, or showrooms.
- Definition from 511.2 [NFPA 30A-2012, 3.3.12.1]



Definition of Minor Repair Garage

- **Minor Repair Garage.** A building or portions of a building used for lubrication, inspection, and minor automotive maintenance work, such as engine tune-ups, replacement of parts, fluid changes (e.g., oil, antifreeze, transmission fluid, brake fluid, air-conditioning refrigerants, etc.), brake system repairs, tire rotation, and similar routine maintenance work, including associated floor space used for offices, parking, or showrooms.
- Definition from 511.2 [NFPA 30A-2012, 3.3.12.2]



Commercial Garages, Repair, and Storage

- Area Classification, General
 - Where Class I liquids or gaseous fuels are stored, handled, or transferred, electrical wiring and electrical utilization equipment shall be designed in accordance with the requirements for Class I, Division 1 or 2 hazardous (*classified*) locations as classified in accordance with 500.5 and 500.6, and Article 511
 - A Class I location shall not extend beyond an unpierced wall, roof, or other solid partition that has no openings
 - Section 511.3 was restructured to provide a more logical layout for the 2008 *NEC*
- See 511.3 and NFPA 30A-2012 8.3.5, 8.3.2



Commercial Repair Garages, Etc. *(cont.)*

- Parking Garages
 - Garages used for parking or storage are not required to be classified but ventilation must be provided
 - See NFPA 88A-2012 *Standard for Parking Structures*
 - Two concerns are that the ventilation rate is sufficient and the means of exhaust is located where any hazardous material is likely to be present
 - Article 511 applies to occupancies that include service and repair locations for self-propelled vehicles that use volatile flammable liquids or flammable gases for power
- See 511.3(A)



Commercial Repair Garages, Etc. (*cont.*)

- Repair Garages, With Dispensing
 - Major and minor repair garages that **dispense liquid or gaseous fuels** with flash points below 38°C (100°F) are required to have dispensing functions and components classified in accordance with Table 514.3(B)(1) in addition to classification required by 511.3
 - Where Class I liquids (*other than fuels*) are dispensed, the area within 900 mm (3 ft) in all directions is classified as Class I, Division 2
- See 511.3(B)



Commercial Repair Garages, Etc. *(cont.)*

- Major Repair Garages
 - Where liquid or gaseous fuels are not dispensed in a major repair garage (*but transferring of these fuels is performed*) the area shall be classified as provided in 511.3(C)(1), (2), and (3)

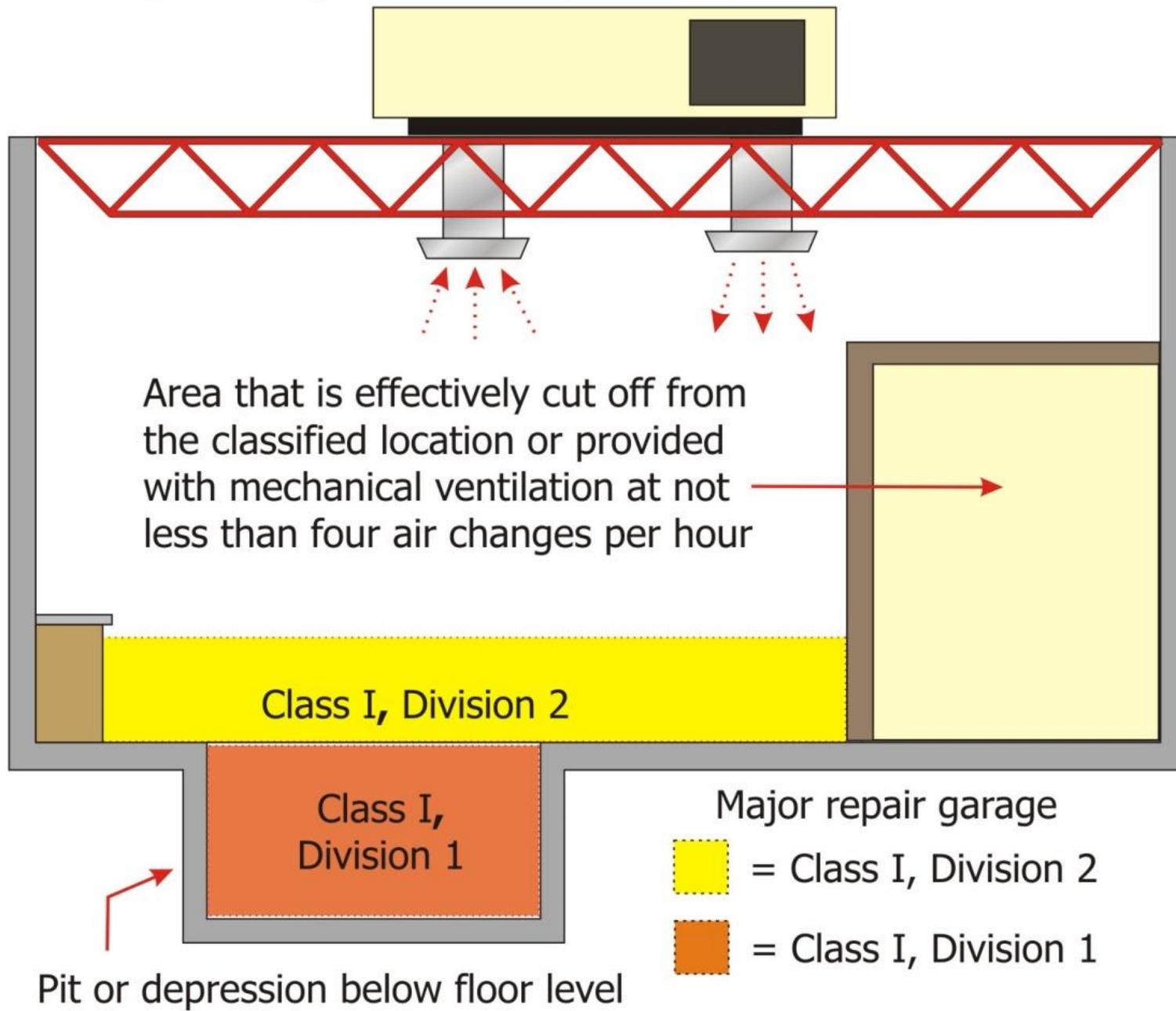


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Major Repair Garage Area Classification





SERVICE EXPERTS



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Major Repair Garage Floor Areas

- Ventilation Provided
 - **Unclassified** – Where air is exchanged at a minimum of four air changes per hour, and the air is taken from within 300 mm (12 in.) of the floor
Not Applicable in Wisconsin. See SPS 316.511(1)
- Ventilation Not Provided
 - **Class 1, Division 2** – Where air is not exchanged at a minimum of four air changes per hour, the entire floor area up to 450 mm (18 in.) above the floor
- See 511.3(C)(1)(a) and (b)

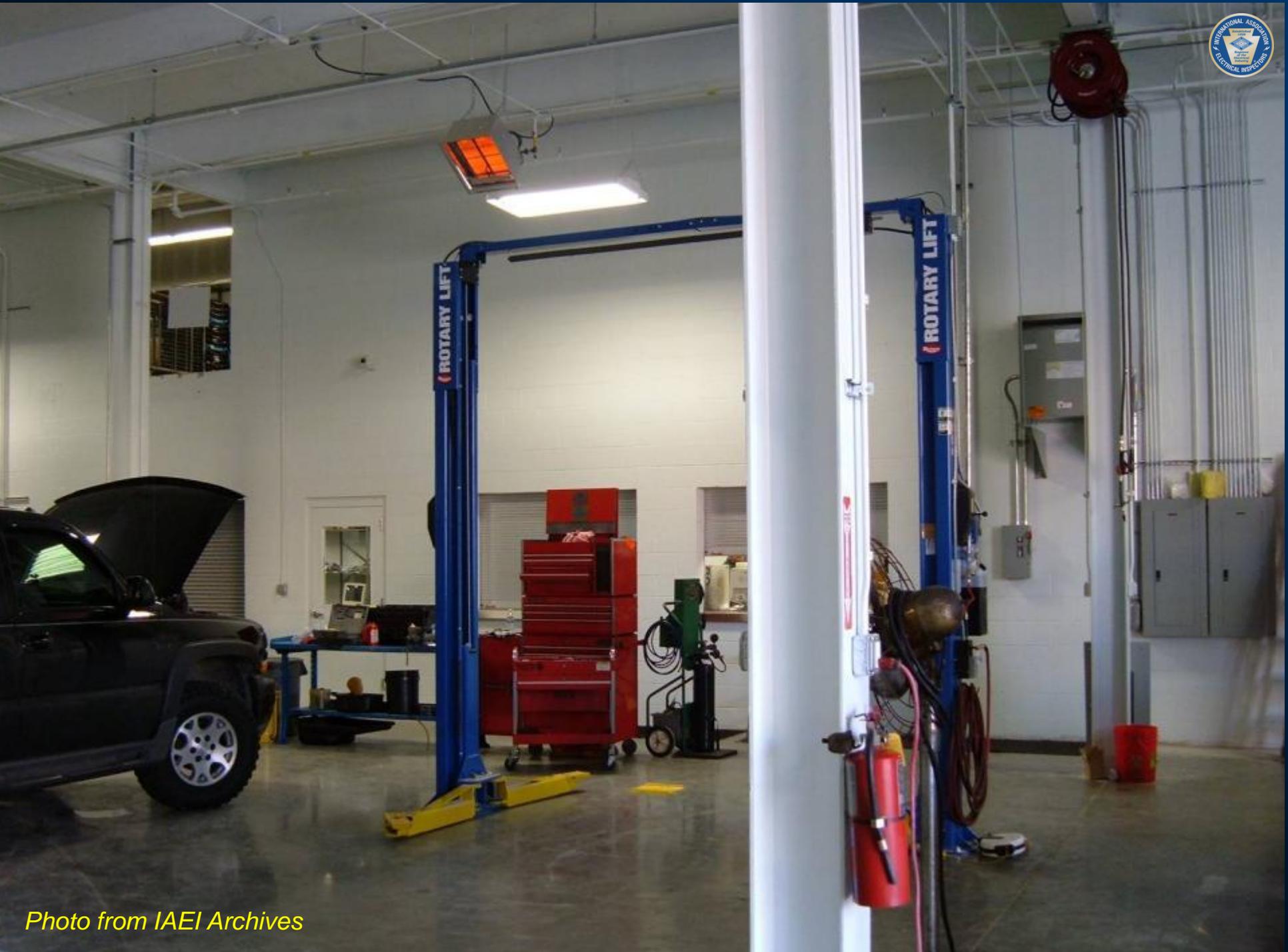


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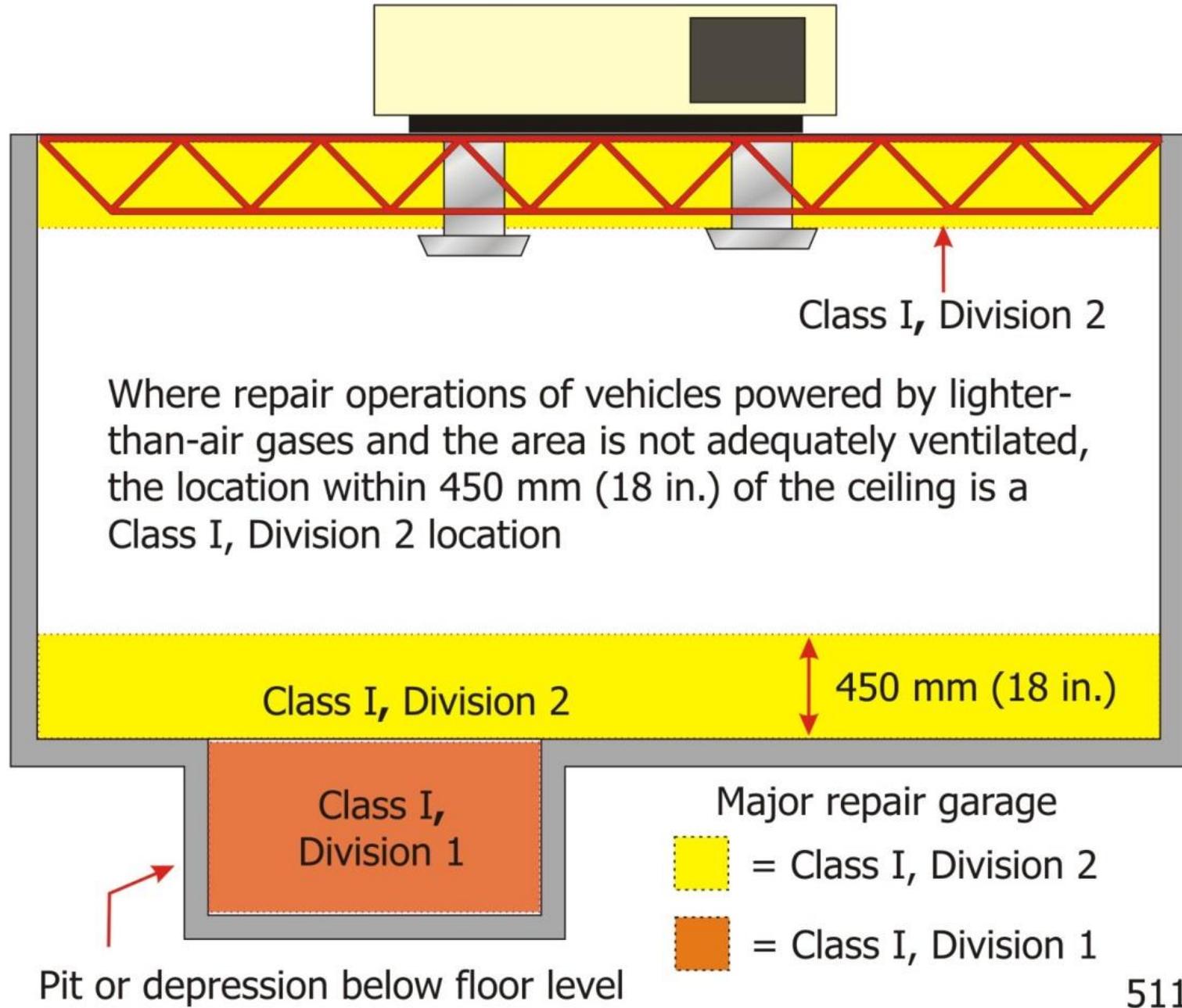
Major Repair Garage Ceiling Areas

- Ventilation Provided
 - **Unclassified** where ventilation is provided to exhaust the ceiling area at all times that the building is occupied or when vehicles using lighter-than-air gaseous fuels are parked below this area
 - Ventilation is provided: **See SPS 316.511(2) for additional requirements.**
 - From a point not less than 450 mm (18 in.) from the highest point in the ceiling
 - At a rate of not less than $0.3 \text{ m}^3/\text{min}/\text{m}^2$ (1 cfm/ft²) of ceiling area

Ventilation Not Provided

- **Class I, Division 2** locations when not ventilated as describe above in accordance with 511.3(C)(2)(a)

Major Repair Garage Classified Ceiling Areas

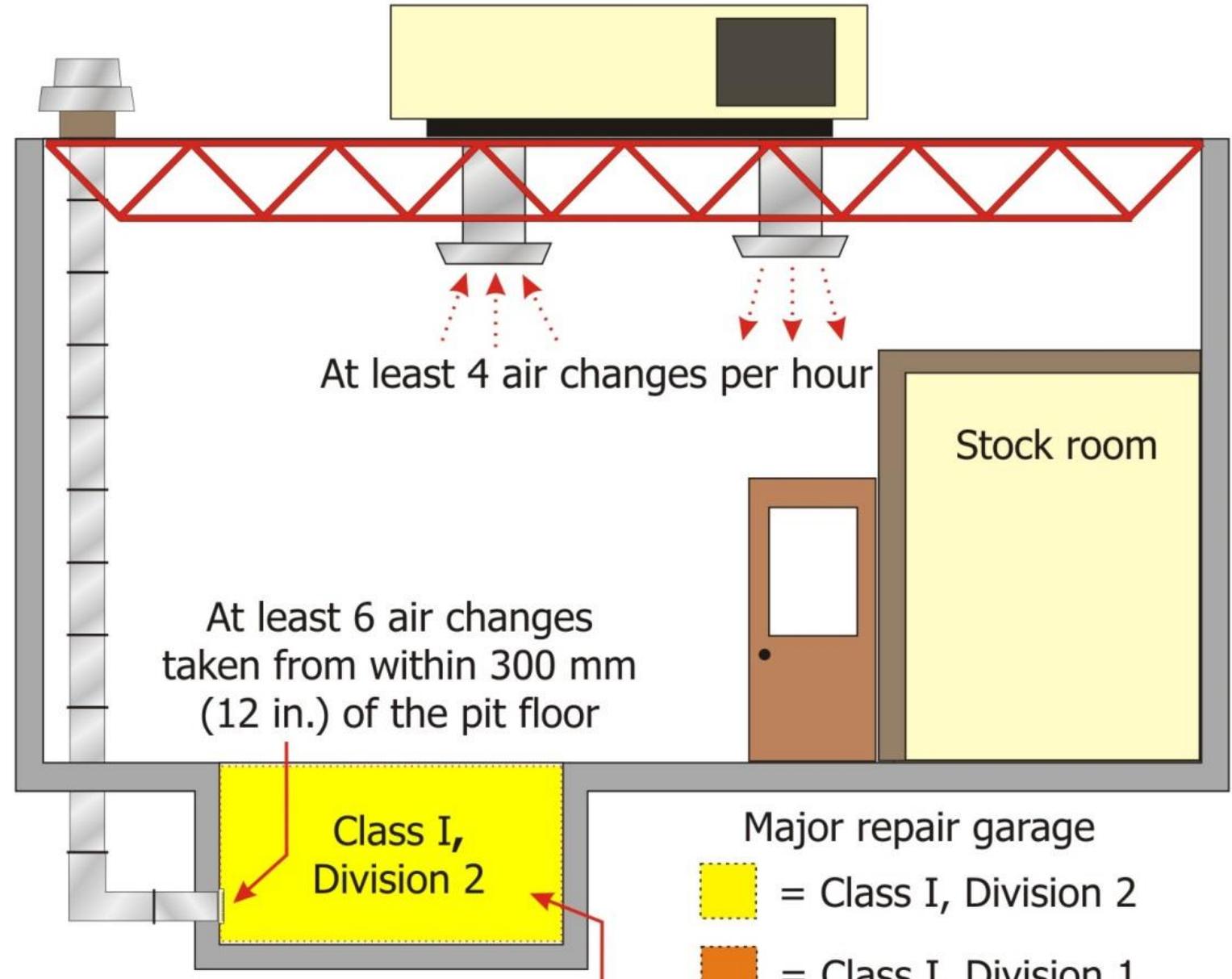




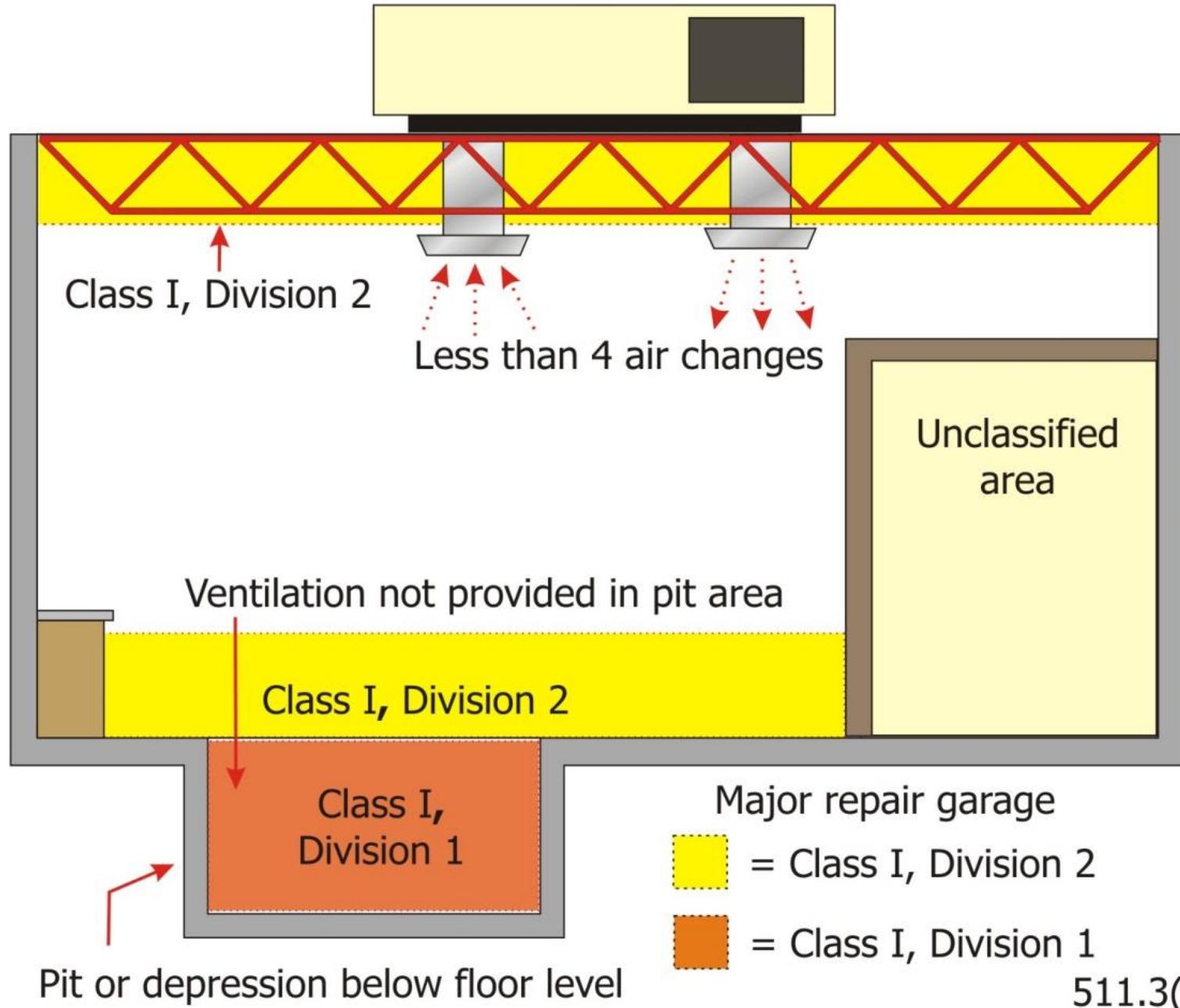
Major Repair Garage Pit Areas

- In Lubrication or Service Rooms
 - **Ventilation Provided**
 - The pit area shall be a **Class I, Division 2** location where there is mechanical ventilation providing a minimum of **six air changes per hour**
 - **Ventilation Not Provided**
 - Where ventilation is not provided, any pit or depression below floor level shall be a **Class I, Division 1** location extending up to the floor level
- See 511.(C)(3)

Major Repair Garage Pit Classification



Major Repair Garage Pit Classification



511.3(C)(3)(b)



Commercial Repair Garages, Etc. *(cont.)*

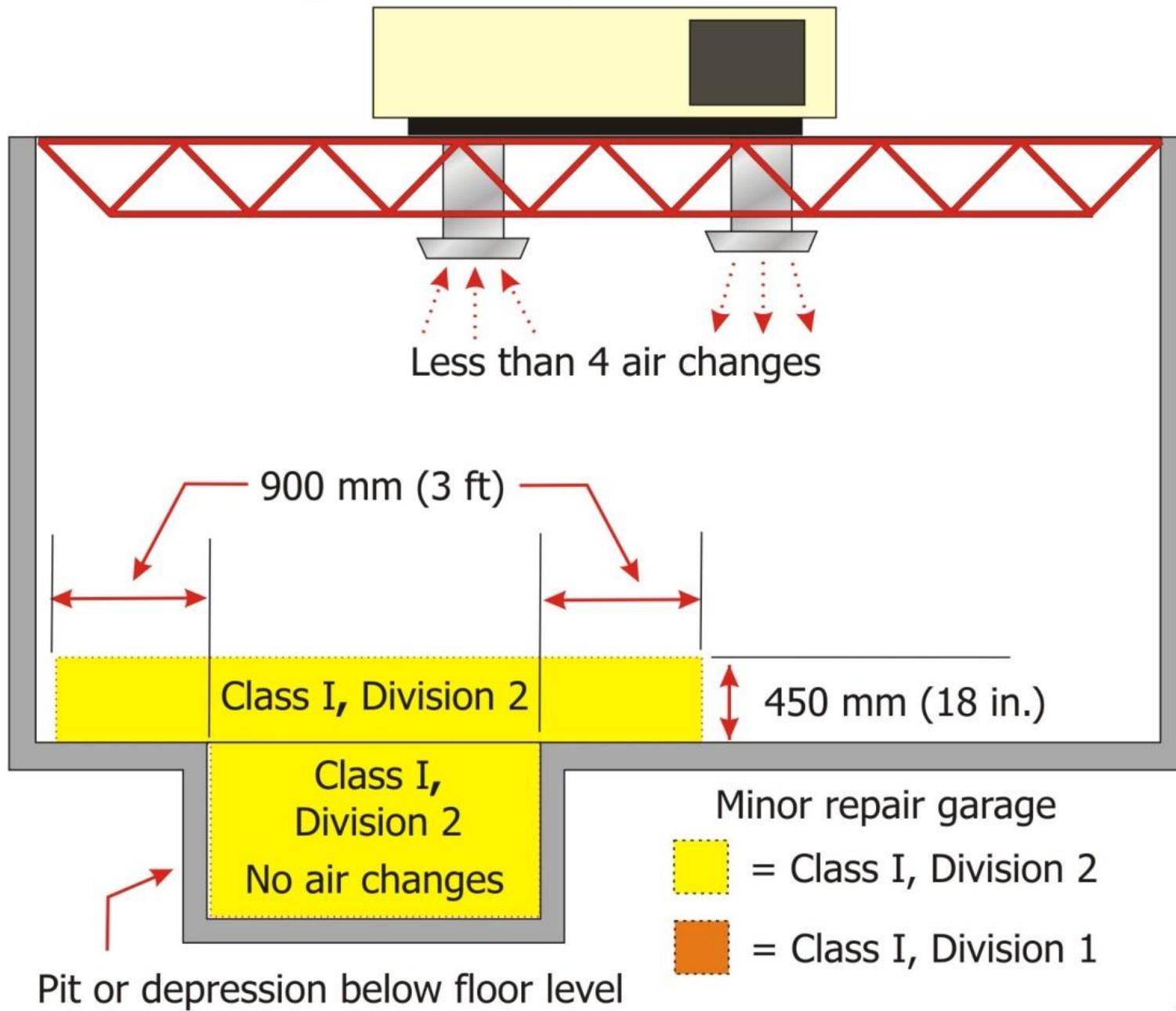
- Minor Repair Garages
 - Classification of lubrication and service areas of **minor repair garages** shall be in accordance with 511.3(D)(1), (D)(2), and (D)(3)
 - Minor repair garages without pits, belowgrade work areas, or subfloor areas are unclassified locations in accordance with 511.3(D)(1)
 - Minor repair garages with pits, belowgrade work areas, or subfloor areas shall be classified according to either 511.3(D)(1)(a) or (b)



Minor Repair Garage Floor Areas

- Ventilation Provided
 - **Unclassified** – Where air is exchanged at a minimum of four air changes per hour and the air is taken from within **300 mm (12 in.)** of the floor
- Ventilation Not Provided
 - **Class I, Division 2** – The floor area up to a level of **450 mm (18 in.)** above any unventilated pit, belowgrade work area, or subfloor work area and extending a distance of **900 mm (3 ft)** horizontally from the edge of any such pit, belowgrade work area, or subfloor work area
- See 511.3(D)(1)

Minor Repair Garage Area Classification





Minor Repair Garage Ceiling Areas

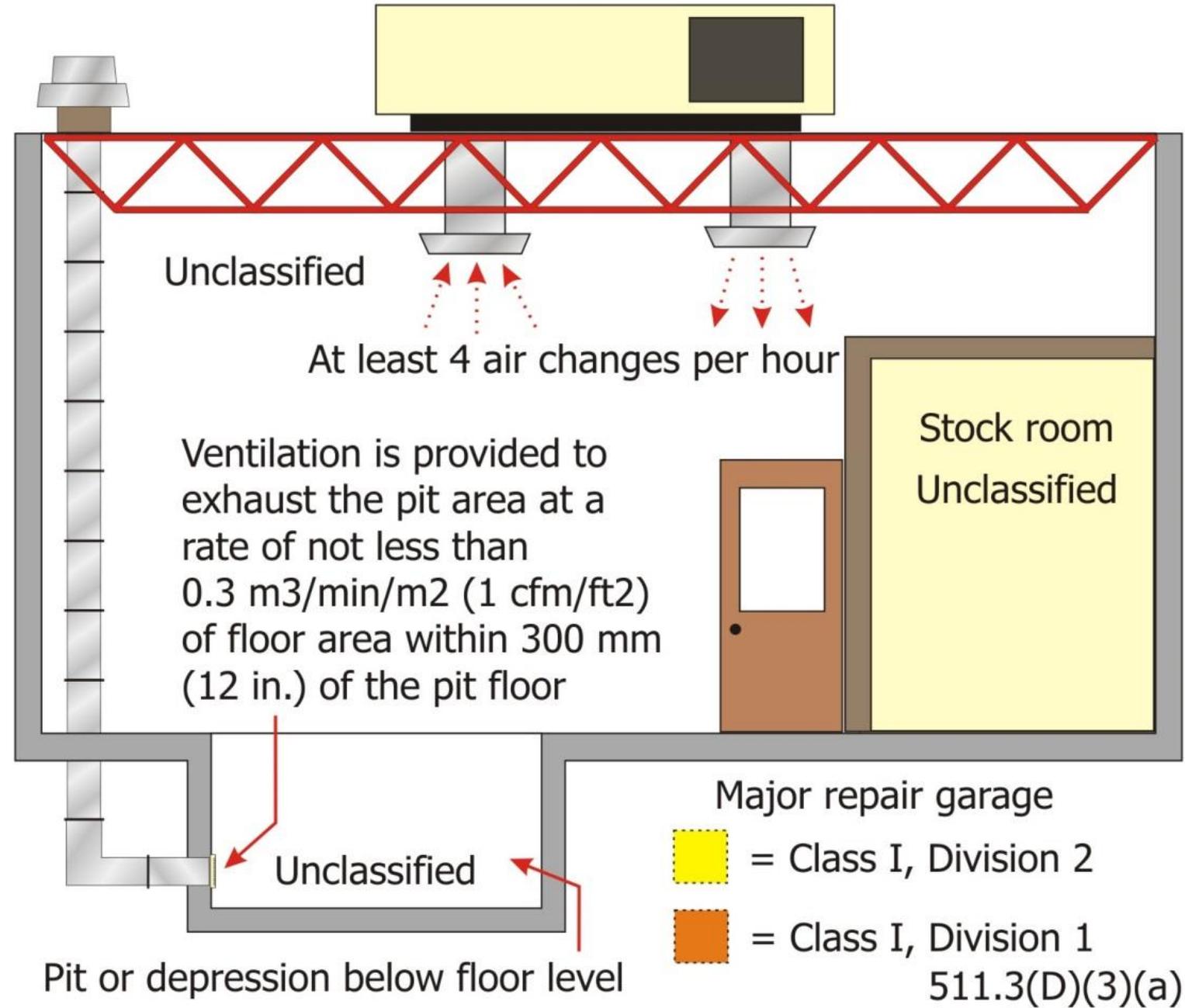
- Unclassified Locations – Where lighter-than-air gaseous fuels (such as natural gas or hydrogen) will not be transferred
- See 511.3(D)(2)



Minor Repair Garage Pit Areas

- In Lubrication or Service Rooms
 - Ventilation Provided
 - **Unclassified** – Where ventilation is provided to exhaust the pit area at a rate of not less than $0.3 \text{ m}^3/\text{min}/\text{m}^2$ ($1 \text{ cfm}/\text{ft}^2$) of floor area at all times that the building is occupied, or when vehicles are parked in or over this area and where exhaust air is taken from a point within 300 mm (12 in.) of the floor of the pit, belowgrade work area, or subfloor work area
- See 511.3(D)(3)(a)

Minor Repair Garage Pit Classification

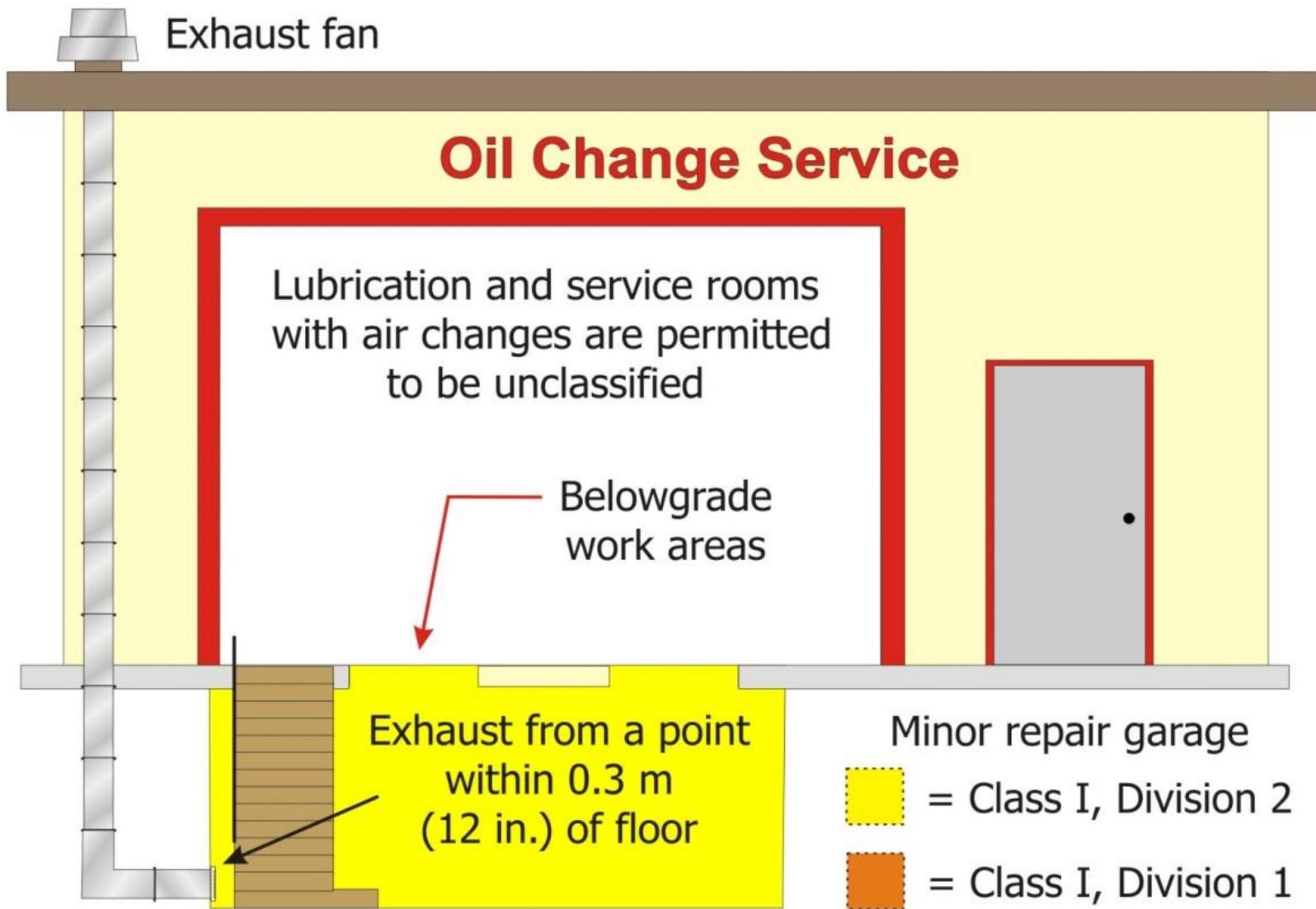




Minor Repair Garage Pit Areas *(cont.)*

- In Lubrication or Service Rooms *(cont.)*
 - Ventilation Not Provided
 - Where ventilation is not provided in accordance with 511.3(D)(3)(a), any pit or depression below floor level shall be a **Class I, Division 2** location that extends up to the floor level
- See 511.3(D)(3)(b)

Minor Repair Garage Pit Areas



Pit or work area Class I, Division 2 unless exhaust provided (1 cfm/square ft) (*Unclassified*)

511.3(D)(3)(a) and (b)



Commercial Repair Garages, Etc. *(cont.)*

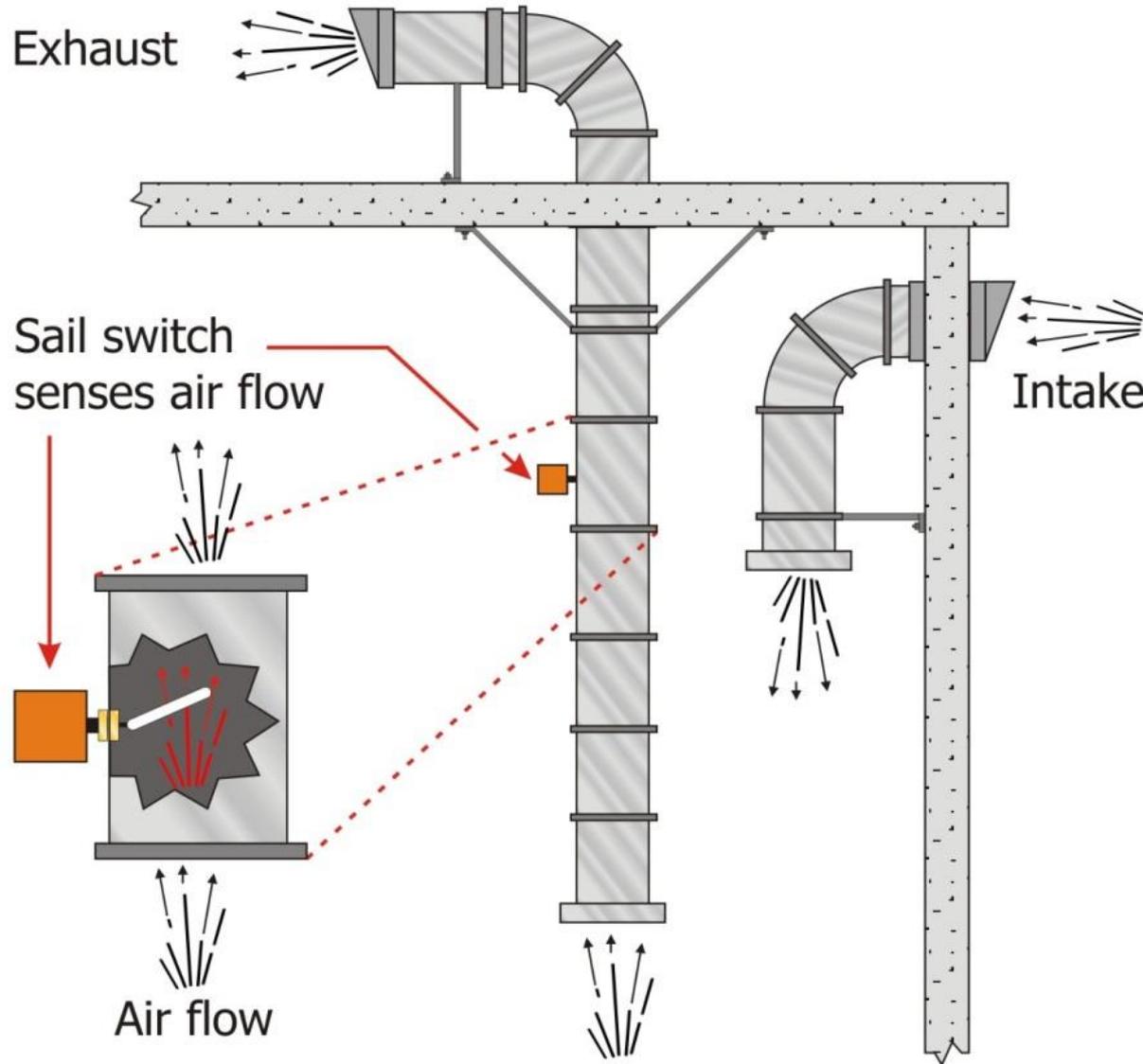
- Unclassified Locations
 - Any area adjacent to a classified location in which flammable vapors are not likely to be released is not required to be classified where:
 - Mechanically ventilated with a rate of at least four air changes per hour or...
 - Designed with positive pressure or...
 - Where cut off by walls or partitions
 - Examples: Stock rooms, switchboard or electrical rooms, bathrooms, etc
 - Areas used for storage of or dispensing alcohol-based windshield washer fluids are not required to be classified unless specifically classified in 511.3(E)(2)



Commercial Repair Garages, Etc. *(cont.)*

- Wiring and Equipment in Class I Locations
 - Wiring and equipment installed in Class I locations as classified in 511.3 must meet the applicable requirements of Article 501
 - Where fuel-dispensing equipment (*other than LPG, which is prohibited*) are located within buildings, the requirements of Article 514 apply
 - Where mechanical ventilation is provided in the dispensing area, the control must be interlocked so the dispenser will not operate when the ventilation is not operating
- See *NEC* 511.4(B)(1)

Methods of Ventilation Interlocks



Sail switch interlocked with dispenser circuits to prevent operation if air is not flowing



Commercial Repair Garages, Etc. *(cont.)*

- Portable Lighting Equipment
 - Portable lighting equipment is required to be equipped with a hook, handle, lampholder, and substantial guard attached to the lampholder or handle
 - All exterior surfaces of this equipment that may come in contact with battery terminals must be made of nonconductive material or effectively insulated
 - The lampholders shall not include a switch or a receptacle in the assembly
 - The outer shell must be made of molded composition or other suitable material



Commercial Repair Garages, Etc. (*cont.*)

- Portable Lighting Equipment (*cont.*)
 - Unless the lamp and its cord are designed to prevent them from being used in classified locations, the equipment must be identified for **Class I, Division 1 locations**
- See *NEC* 511.4(B)(2)



Commercial Repair Garages, Etc. *(cont.)*

- Wiring Above Class I Locations
 - Fixed wiring above Class I locations is permitted to be installed using the following wiring methods:
 - Metal raceways
 - Rigid nonmetallic conduit (*see 511.7*)
 - Electrical nonmetallic tubing
 - Flexible metal conduit
 - LFMC or LFNMC
 - MC, AC, MI, manufactured wiring systems, or PLTC in accordance with Article 725
 - Type TC or ITC cable in accordance with Article 727



Commercial Repair Garages, Etc. *(cont.)*

- Wiring Above Class I Locations *(cont.)*
 - Cellular metal floor raceways and concrete cellular floor raceways are permitted for supplying ceiling outlets or extensions to an unclassified area below the floor level
 - No extensions or connections from these types of raceways are permitted to extend into or through any Class I location
 - Pendants are required to be made of cord suitable for the type of service and listed for hard usage
- See 511.7

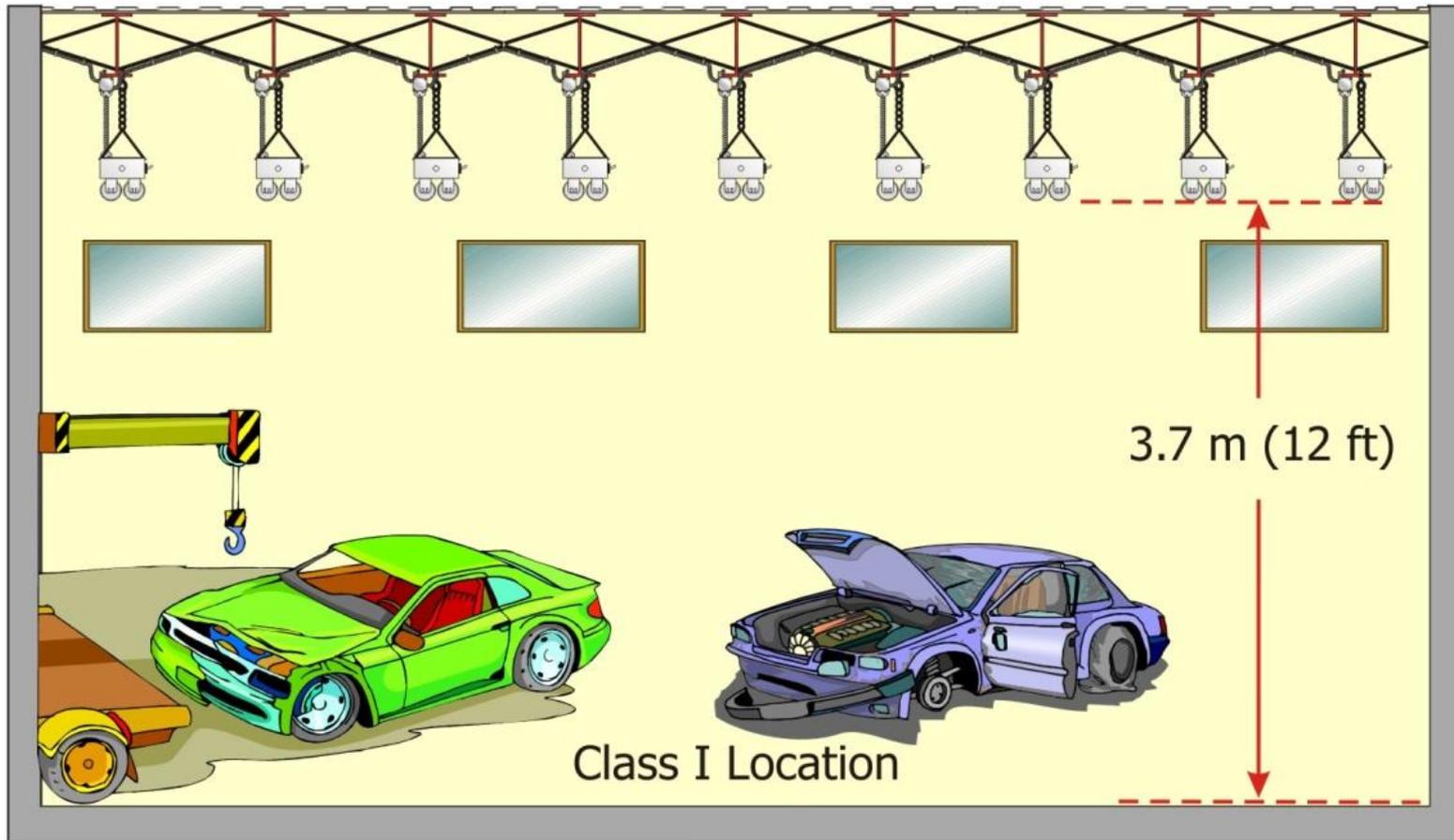


Commercial Repair Garages, Etc. (*cont.*)

- Equipment Above Class I Locations
 - Arcing equipment located less than **3.7 m (12 ft)** above floor level shall be of the **totally enclosed type** or so constructed so as to prevent escape of sparks or hot metal particles
 - Fixed lighting located over the vehicle driving lanes is required to be not less than **3.7 m (12 ft)** above floor level or be of the **totally enclosed type** or constructed so as to prevent escape of sparks or hot metal particles
- See *NEC* 511.7(B)

Fixed Lighting Above Class I Locations

Lighting in commercial repair garages above Class I locations



Fixed lighting located over the vehicle driving lanes is required to be not less than **3.7 m (12 ft)** above floor level or be of the **totally enclosed type** or constructed so as to prevent escape of sparks or hot metal particles



Photo from IAEI Archives



Commercial Repair Garages, Etc. *(cont.)*

- Sealing Requirements
 - Seals in accordance with 501.15 and 501.15(B)(2) are required to be provided for commercial garages, repair, and storage areas
 - Seals are required to be located at the vertical as well as the horizontal boundaries of the defined Class I locations
- See 511.9



Commercial Repair Garages, Etc. *(cont.)*

- Special Equipment
 - Chargers, control equipment, and batteries are not permitted to be located in locations classified in accordance with 511.3
 - **Electric Vehicle charging equipment** generally must meet the requirements of Article 625
 - All flexible cords of vehicle charging equipment are required to be identified for extra-hard usage
 - Connectors are to be readily accessible, and the points of connection of plugs shall not be in classified locations
- See 511.10



Commercial Repair Garages, Etc. *(cont.)*

- GFCI Protection Requirements
 - GFCI protection for personnel shall be required for 125-volt, single-phase, 15- and 20-ampere receptacles in areas where the following equipment is to be used:
 - Electrical diagnostic equipment
 - Electrical hand tools
 - Portable lighting equipment
- See 511.12



Commercial Repair Garages, Etc. *(cont.)*

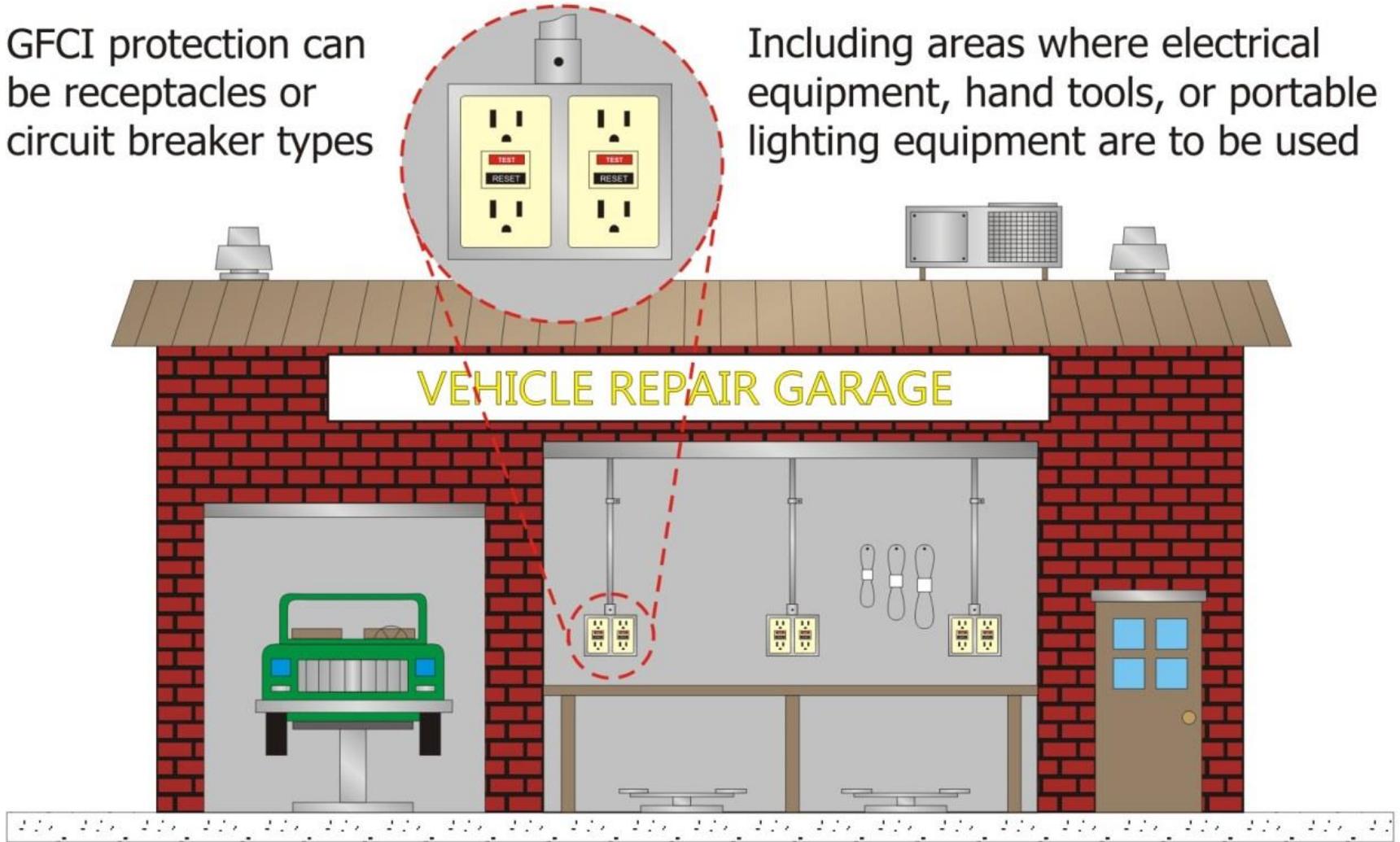
- GFCI Protection Requirements *(cont.)*
 - Keep in mind that GFCI protection is required for all 125-volt, single-phase, 15- and 20-ampere receptacles installed in all non-dwelling unit garages, service bays, and similar areas
 - This would apply whether “electrical diagnostic equipment, electrical hand tools, or portable lighting equipment” are to be used or not
 - This GFCI provision would not apply to vehicle exhibition halls and showrooms
- See 210.8(B)(8)

GFCI Protection Required

GFCI protection required in all non-dwelling unit garages, service bays, and similar areas (*other than vehicle exhibition halls and showrooms*)

GFCI protection can be receptacles or circuit breaker types

Including areas where electrical equipment, hand tools, or portable lighting equipment are to be used



125-volt, 15- and 20-ampere receptacles required to be GFCI-protected

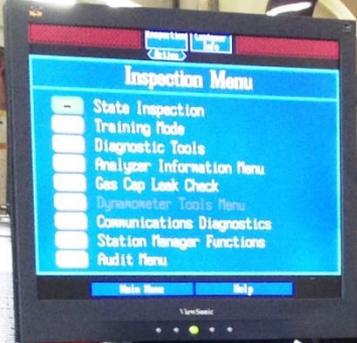


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Commercial Repair Garages, Etc. *(cont.)*

- Grounding and Bonding Requirements
 - All metal raceways, cables with metal sheaths or armor, and all non-current-carrying metal parts are required to be grounded regardless of the voltage
 - Grounding and bonding in Class I locations are required to meet the requirements of 501.30
 - Circuits supplying portable equipment or pendants must meet the requirements for grounded conductors in 511.16(B)(1)
- See 511.16(A) and (B)



Article 514 Motor Fuel Dispensing Facilities

- 514.1 Scope
- 514.2 Definitions
- 514.3 Classification of Locations
- 514.4 Wiring and Equipment in Class I Locations
- 514.7 Wiring and Equipment Above Class I Locations
- 514.8 Underground Wiring
- 514.9 Sealing
- 514.11 Circuit Disconnects
- 514.13 Provisions for Maintenance and Service of Dispensing Equipment
- 514.16 Grounding and Bonding



Motor Fuel Dispensing Facilities

- Applicability
 - Article 514 applies to facilities where fuel dispensing occurs
 - Various types of fuels in self-propelled vehicles including, but not limited to:
 - Propane (LPG)
 - Compressed natural gas (CNG)
 - Liquefied natural gas (LNG)



Motor Fuel Dispensing Facilities (*cont.*)

- Applicability (*cont.*)
 - Article 514 covers the following types of dispensing facilities:
 - Gasoline stations
 - Propane dispensing stations
 - Watercraft fueling stations
 - Group (fleet) fueling stations



Photo from IAEI Archives

- Compressed natural gas dispensing equipment (*mechanical type*)
- Classification of hazardous location is provided in Table 514.3(B)(2)
- Class I, Division 2 location within 1.5 m (5 ft) of the CNG dispenser enclosure (*where enclosed*)
- The area within a CNG dispenser enclosure is classified as a Class I, Division 1 location



Definition

- **Motor Fuel Dispensing Facility.** That portion of a property where motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles or marine craft or into approved containers, including all equipment used in connection therewith.
- [*NEC* 514.2 and *NFPA* 30A:3.3.11]



Motor Fuel Dispensing Facilities (*cont.*)

- Classification of Locations
 - For flammable liquids, area classification is permitted to be performed using either the Division or Zone system
 - If flammable liquids with a flash point below 38°C (100°F) are not dispensed (*handled*), the AHJ may determine that the area is unclassified (*See the definition of unclassified in 500.2*)
 - Combustible liquids (*such as diesel fuel*) are not flammable liquids
 - Do not give off sufficient vapor to form an ignitable mixture with air (*at normal temperatures*)



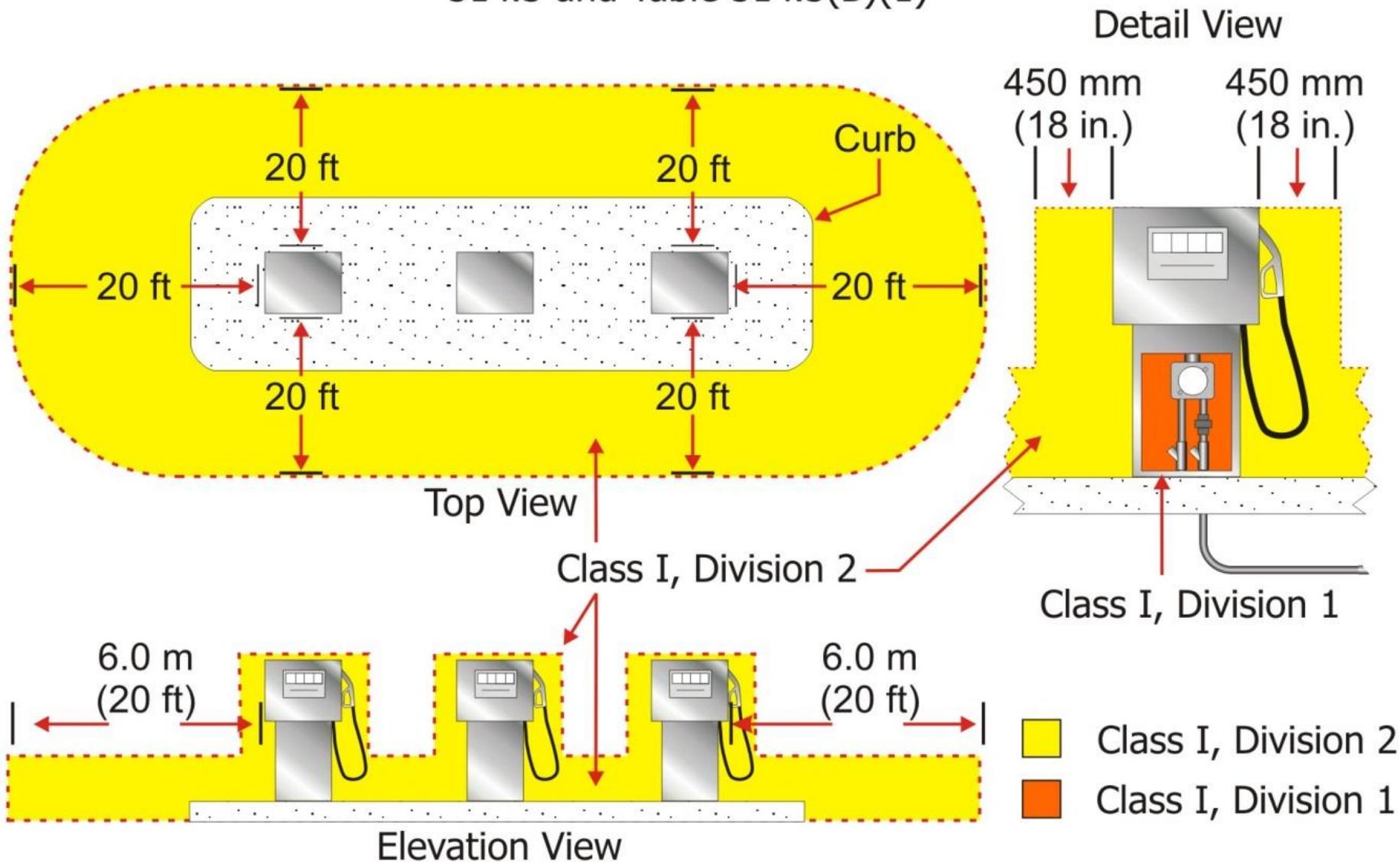
Motor Fuel Dispensing Facilities (*cont.*)

- Classification of Locations (*cont.*)
 - The authority having jurisdiction (AHJ) may not require classification (*This could be a group not just an individual*)
 - The extent of classified locations associated with fuel dispensing facilities that handle, store, or dispense Class I liquids is provided in Table 514.3(B)(1)
 - A Class I location shall not extend beyond an unpierced wall, roof, or other solid partition
 - See 514.3(B)(1) and Table 514.3(B)(1)

Motor Fuel Dispensing Facilities Area Classification



514.3 and Table 514.3(B)(1)





Gasoline Dispensing Equipment

Photo from IAEI Archives

Classification of hazardous locations is provided in Table 514.3(B)(1)

Class I, Division 2 location, 450 mm (18 in.) above grade out to a distance of 6.0 m (20 ft) horizontally in all directions

The area within a gasoline dispenser enclosure is classified as a **Class I, Division 1 location**

The area within a pit or box below the dispenser (*grade level*) is a **Class I, Division 1 location**

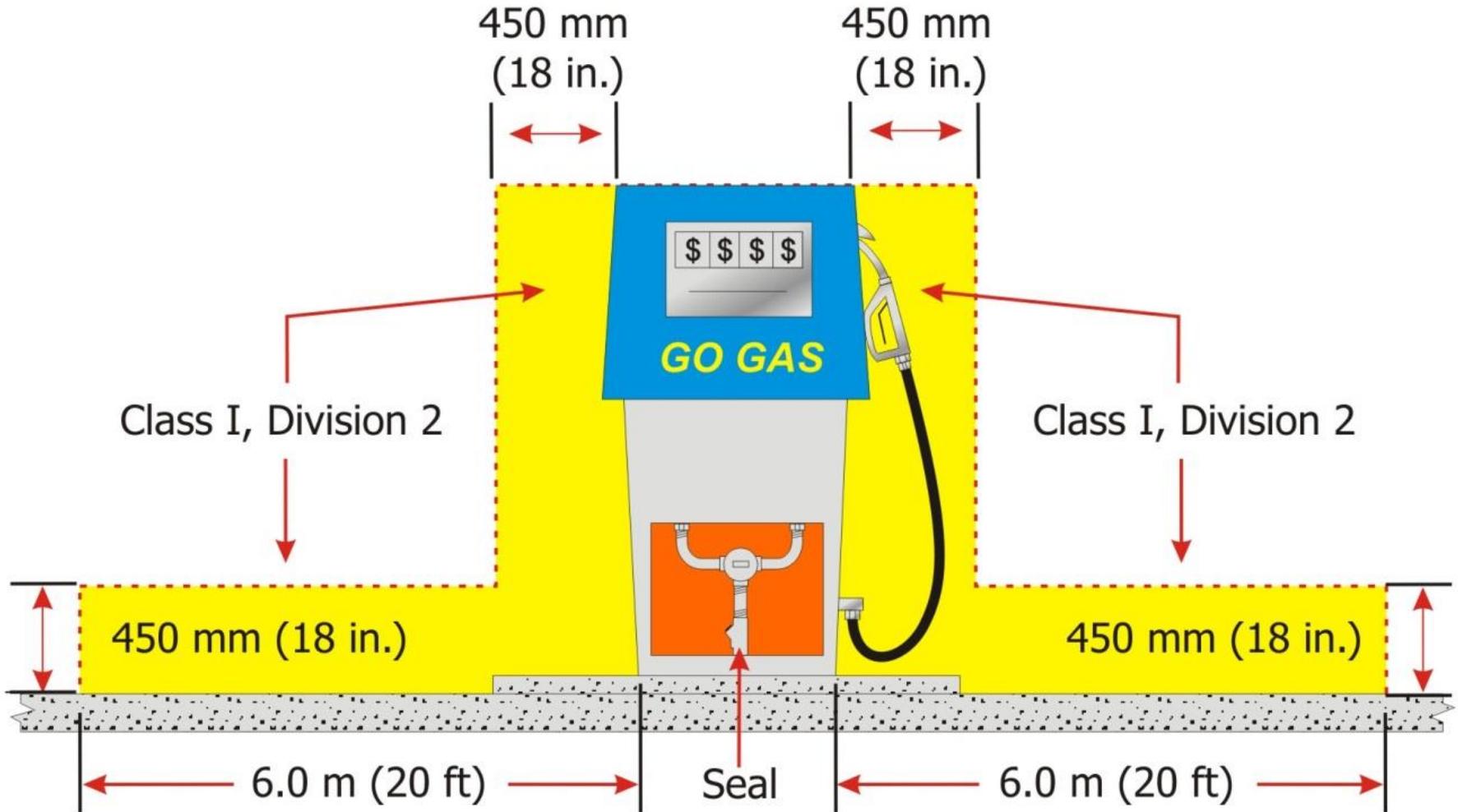


Photo from IAEI Archives

Area Classification at Gasoline Dispensers



■ Class I, Division 2 ■ Class I, Division 1



Unclassified location below ground

Area Classification at Gasoline Dispensers



Hose-High Style Dispenser Shown

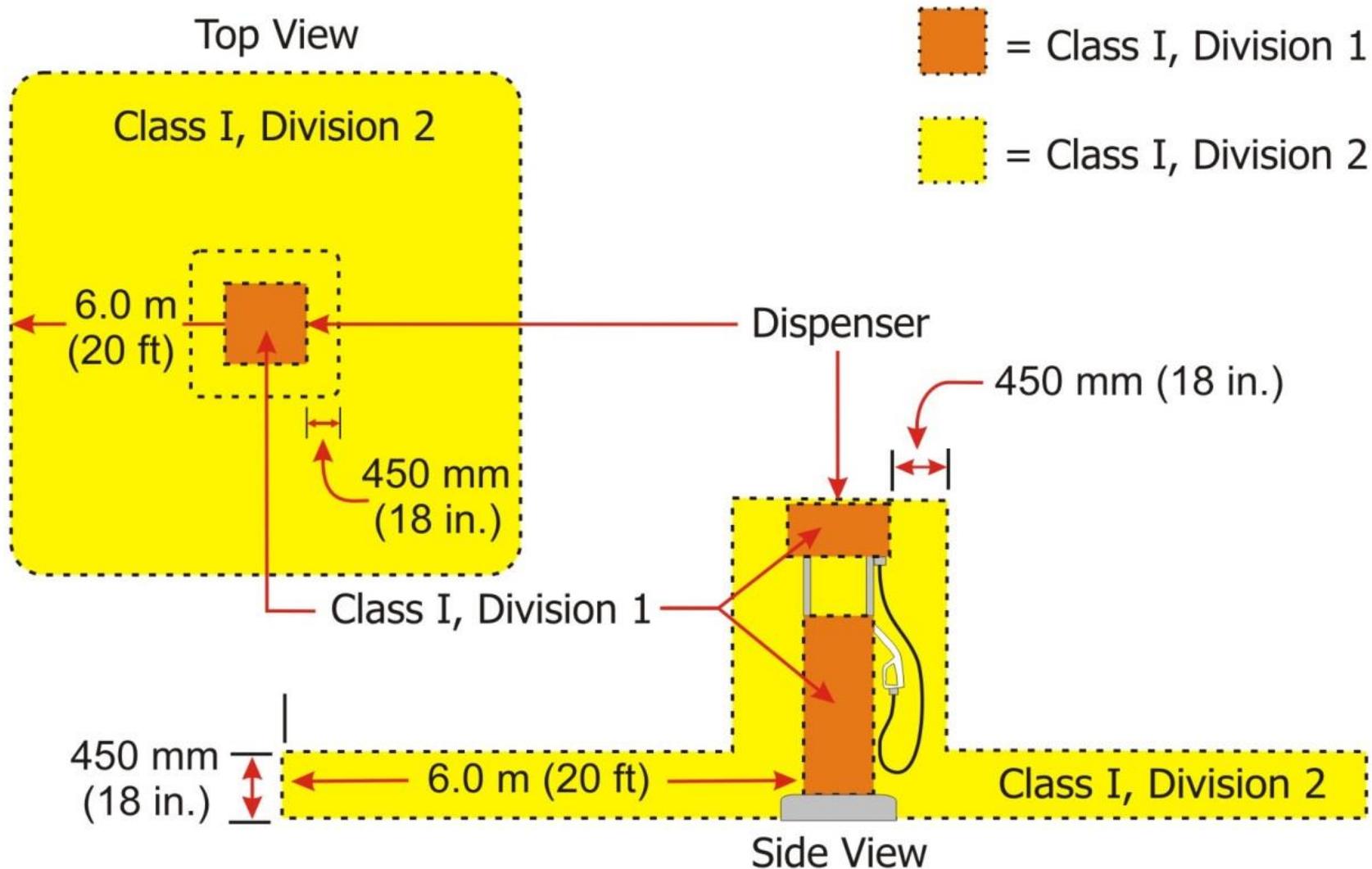
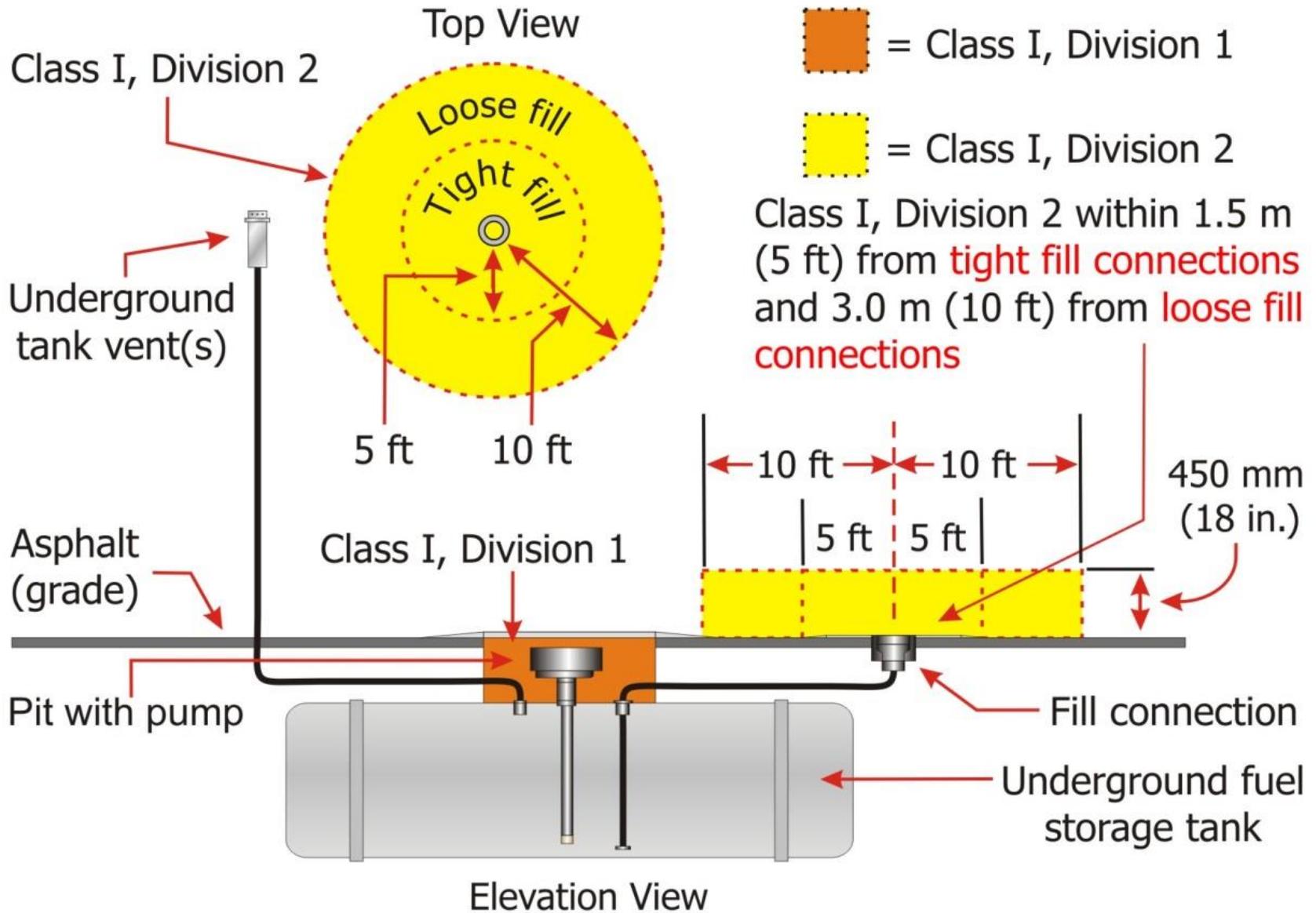




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Classification at Underground Tanks and Vents



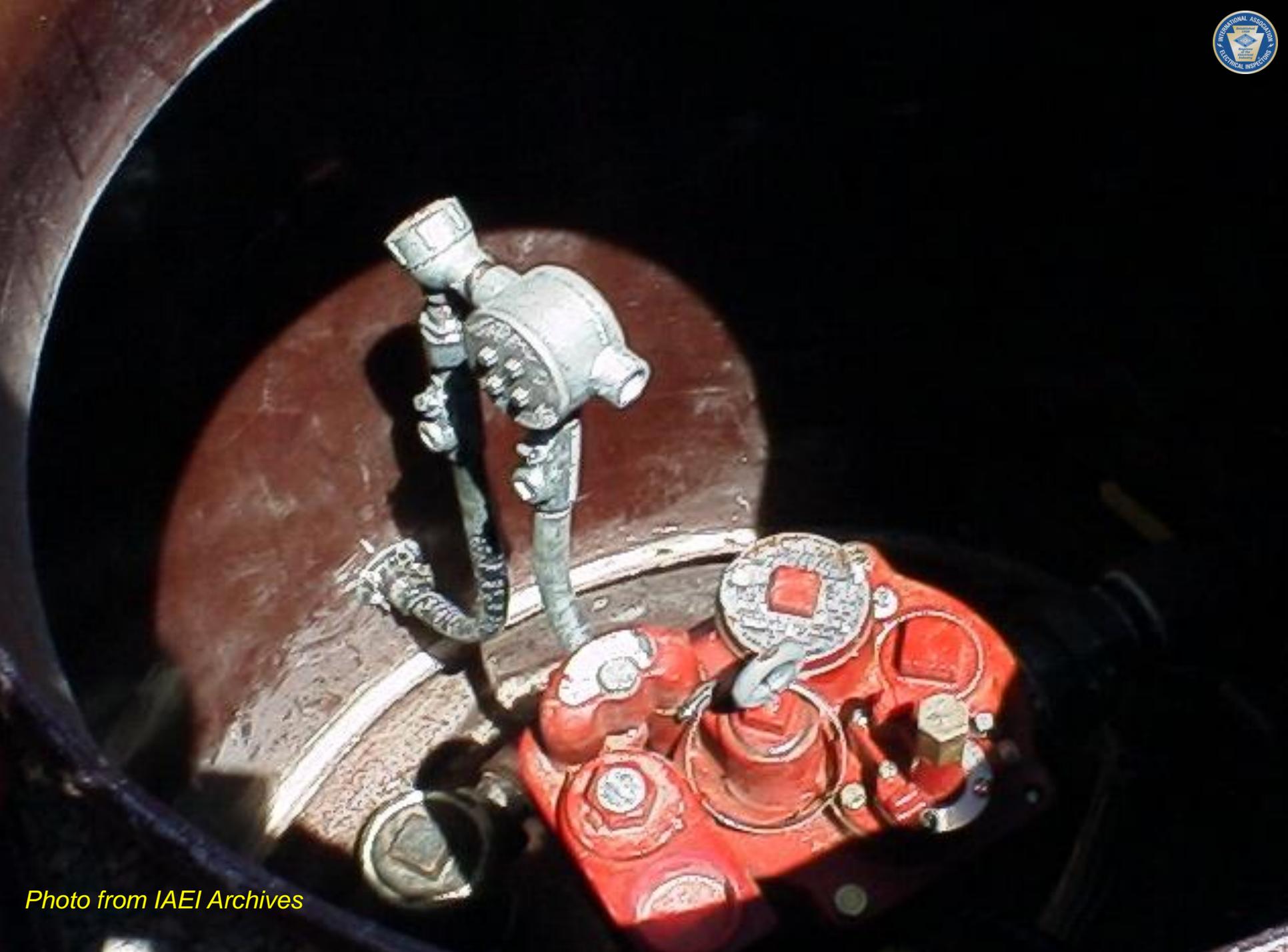


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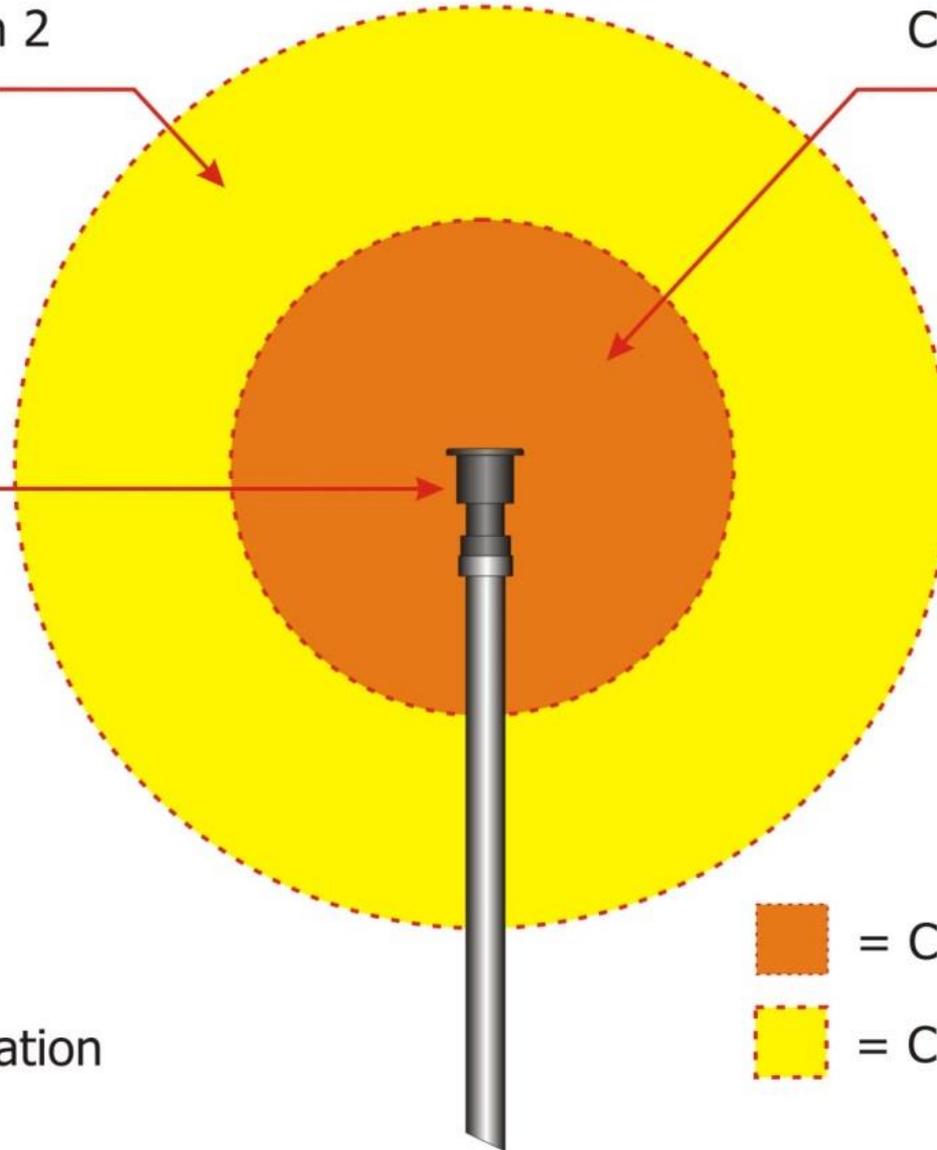
Area Classification at Tank Vents



Class I, Division 2
1.5 m (5 ft) to
3.0 m (10 ft)
extending in
all directions

Class I, Division 1
1.5 m (5 ft)
extending in
all directions

Gasoline
tank vent



Unclassified location

-  = Class I, Division 1
-  = Class I, Division 2

**Luminaire listed for
a Class I, Division 1
location ???**





Motor Fuel Dispensing Facilities (*cont.*)

- Classification of Locations (*cont.*)
 - Extent of classified locations for fuel dispensing facilities that handle, store, or dispense the following gaseous fuels provided in Table 514.3(B)(2):
 - Compressed natural gas (CNG)
 - Liquefied natural gas (LNG)
 - Liquefied petroleum gas (LPG)
 - Zone area classification system is not applicable to these fuels
- See 514.3(B)(2) and Table 514.3(B)(2)]



Photo from IAEI Archives



Photo from IAEI Archives

DANGER
FLAMMABLE
STORAGE



Photo from IAEI Archives



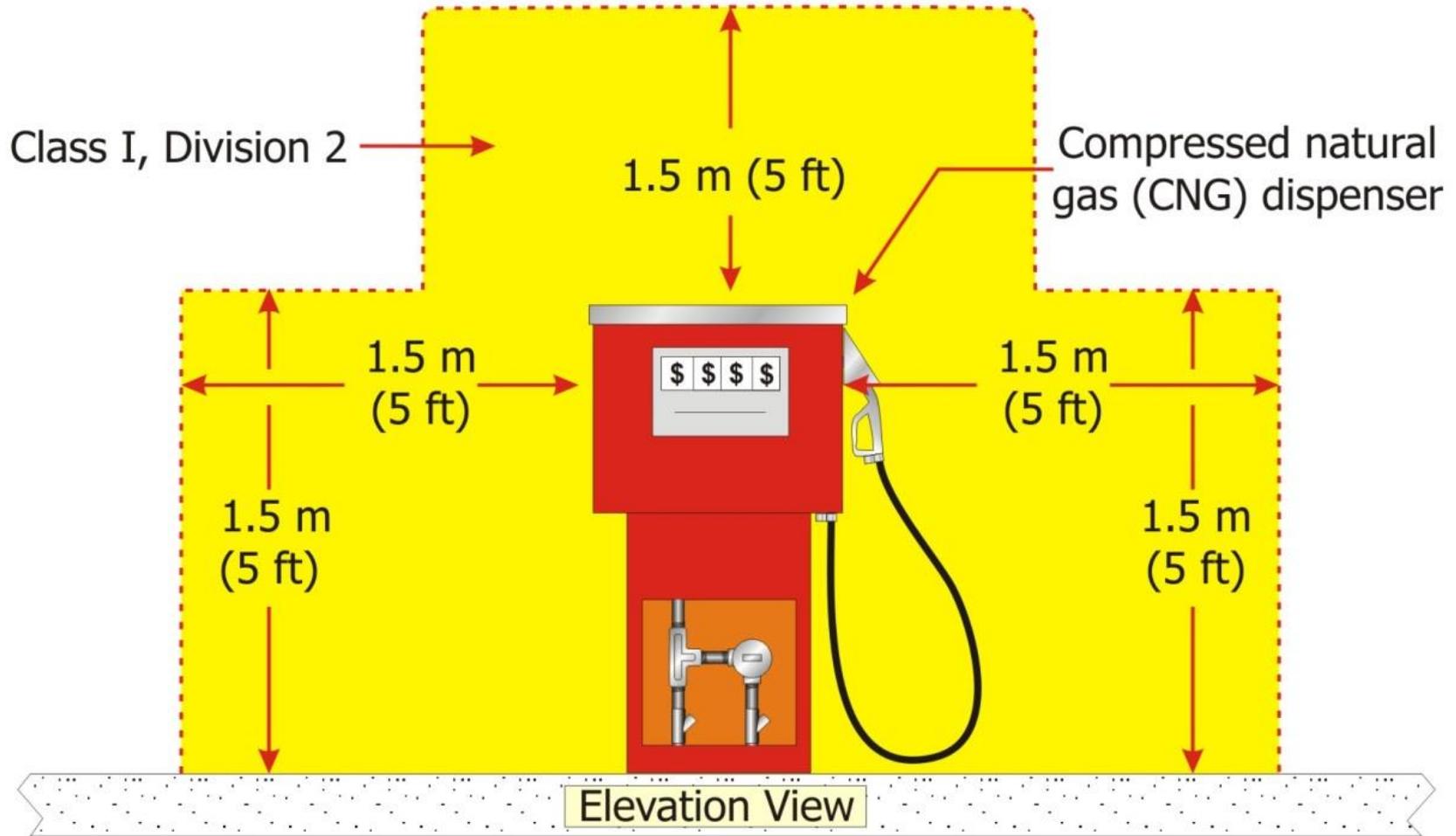
Motor Fuel Dispensing Facilities (*cont.*)

- Compressed Natural Gas Dispensers
 - Area classification is covered at 514.3(B)(2), which references to Table 514.3(B)(2)
 - **Class I, Division 1 location:**
 - Space within dispenser enclosure
 - **Class I, Division 2 location:**
 - 1.5 m (5 ft) in all directions from dispenser enclosure
 - See also NFPA 52 for additional information



Photo from IAEI Archives

Area Classification at CNG Dispensers



-  = Class I, Division 2
-  = Class I, Division 1

Note: This drawing shows the area classification in outdoor locations

Where compressed natural gas dispensers are located indoors, the entire room is required to be Class I, Division 2 (*adequately ventilated*)



Motor Fuel Dispensing Facilities (*cont.*)

- Classification of Locations (*cont.*)
 - Where CNG or LNG dispensing equipment is located under a canopy or enclosure, required to be designed to prevent accumulation of ignitable vapors
 - Where the canopy or enclosure does not meet this design criteria, all electrical equipment installed beneath the canopy or enclosure is required to be suitable for Class I, Division 2 locations
 - Propane (LPG) dispensers are required to be located not less than 1.5 m (5 ft) from any device for Class I liquids
- See 514.3(B)(2)



Motor Fuel Dispensing Facilities (*cont.*)

- Liquefied Petroleum Gas
 - Area classification is covered at 514.3(B)(2), which references Table 514.3(B)(2)
 - The following areas are Class I, Division 1 location:
 - The space within dispenser enclosure
 - Within 450 mm (18 in.) in all directions from dispenser enclosure to an elevation of 1.2 m (4 ft) above the dispenser base
 - The entire pit beneath an LPG dispenser and within 6.0 m (20 ft) horizontally from any edge of dispenser when pit is not mechanically ventilated



Motor Fuel Dispensing Facilities (*cont.*)

- Liquefied Petroleum Gas (*cont.*)
 - The following areas are Class I, Division 2 location:
 - The area up to 450 mm (18 in.) above ground and within 6.0 m (20 ft) horizontally from any edge of the dispenser enclosure
 - This includes any pit or trench when provided with mechanical ventilation



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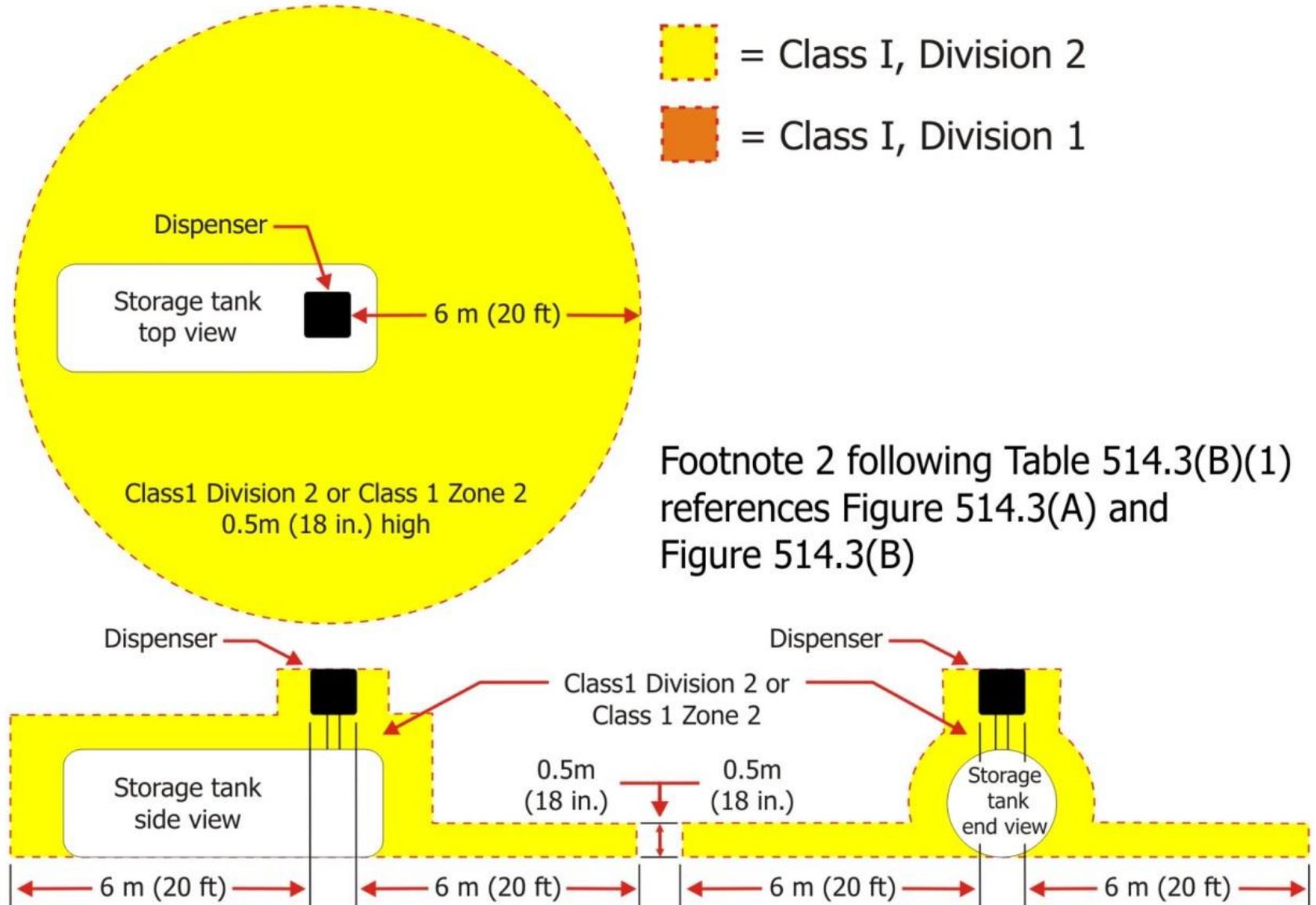
PROPANE TANKS

Photo from IAEI Archives



Photo from IAEI Archives

Figure 514.3(B) Classified Areas Adjacent to Dispenser Mounted on Aboveground Storage Tank



Footnote 2 following Table 514.3(B)(1) references Figure 514.3(A) and Figure 514.3(B)



Motor Fuel Dispensing Facilities (*cont.*)

- Wiring & Equipment in Class I Locations
 - Installed in accordance with the requirements of Article 501 as applicable
 - See the exceptions for underground wiring provided in 514.8 [*under 600 mm (2 ft) of cover-unclassified*]
 - Conductor insulation is required to be suitable for the location and substance (*gasoline and oil*) as indicated in 501.20
 - Bonding of metal raceways is required to meet the requirements in 501.30 (*regardless of the voltage*)



Motor Fuel Dispensing Facilities (*cont.*)

- Wiring & Equipment Above Class I Locations
 - Wiring above Class I locations classified in accordance with 514.3 (*shall comply with 511.7*)
 - Arcing equipment and luminaires are generally required to be located not less than **3.7 m (12 ft)** above floor level or to be of the **totally enclosed type**
 - Wiring methods specified in 511.7(A)(1) are required for fixed wiring
 - Flexible cords are permitted for pendants where suitable for the type of service and listed as extra-hard usage



Photo from IAEI Archives



Wiring above Class I locations classified in accordance with 514.3 (*shall comply with 511.7*)

Arcing equipment and luminaires are generally required to be located not less than **3.7 m (12 ft)** above floor level or be of the **totally enclosed type**

Wiring methods specified in 511.7(A)(1) required for fixed wiring

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Motor Fuel Dispensing Facilities (*cont.*)

- Underground Wiring
 - Threaded **rigid metal conduit** or threaded steel **intermediate metal conduit** are the wiring methods generally required for underground wiring in motor fuel dispensing facilities
 - Area below the surface of a Class I Division 1 or Division 2 location is not considered to be in a Class I Division 1 location (*unclassified*)
 - Any wiring located below the surface of a Class I, Division 1, or Class I, Division 2 location is **required to be sealed** within 3.05 m (10 ft) of the point of emergence above grade
- See 514.8



Motor Fuel Dispensing Facilities (*cont.*)

- Underground Wiring (*cont.*)
 - Only fitting permitted between the sealing fitting and the point of emergence above grade is a listed explosionproof reducer
 - No unions, couplings, boxes, or other fittings are permitted
 - Exception No. 1 permits Type MI cable where installed to meet the requirements in Article 332
 - Exception No. 2 permits Type PVC or Type RTRC to be used where it meets all of the conditions in the exception
- See 514.8 and Exceptions

Underground Wiring at Motor Fuel Dispensing Facilities

Except for listed explosionproof reducers at the conduit seal, there shall be no union, coupling, box, or fitting between the conduit seal and the point of emergence above grade



Listed explosionproof
reducers permitted



Union or other fittings
not permitted

Courtesy of Thomas and Betts

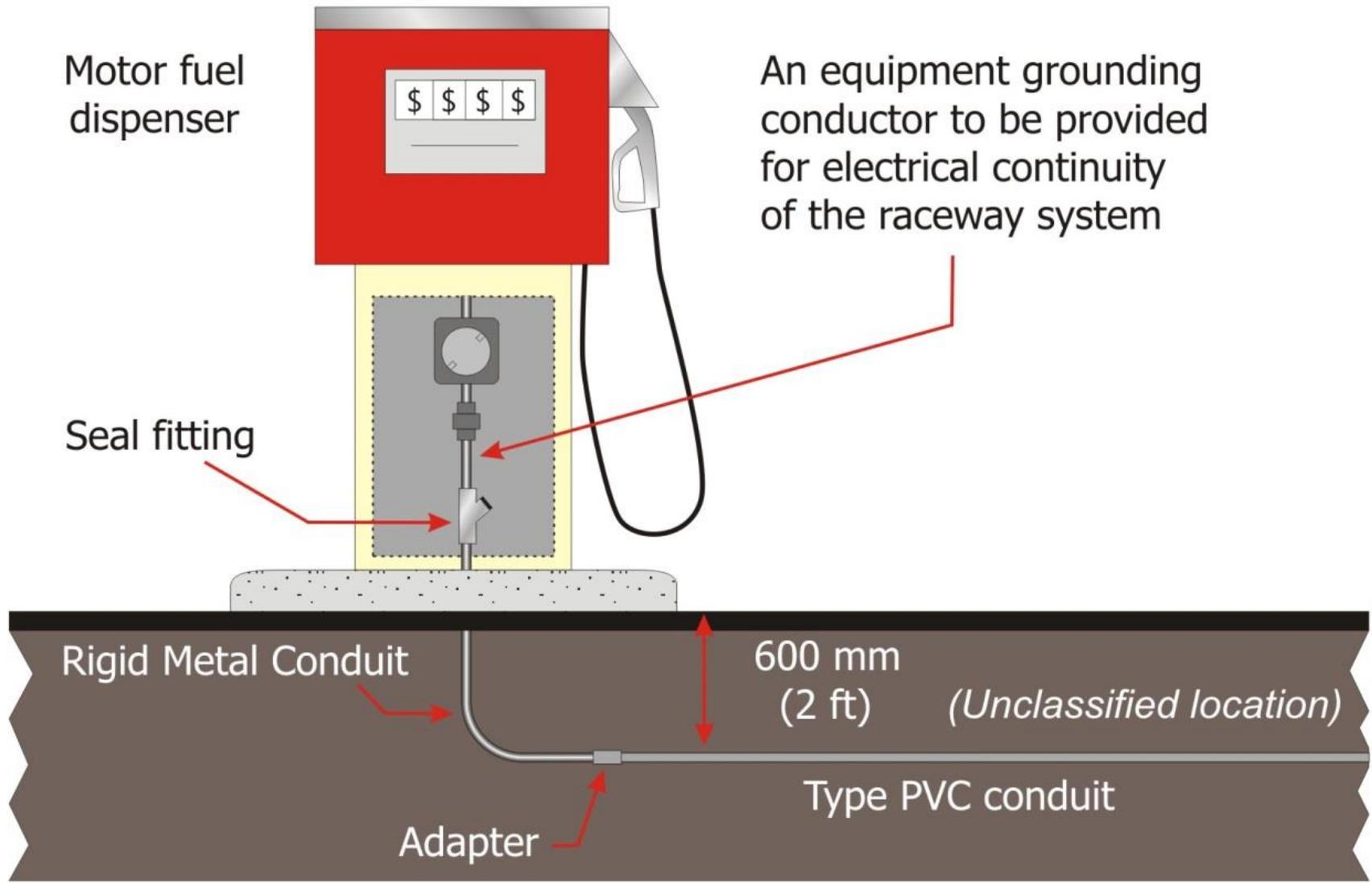
Underground Wiring for Dispensers



Motor fuel dispenser

An equipment grounding conductor to be provided for electrical continuity of the raceway system

Seal fitting



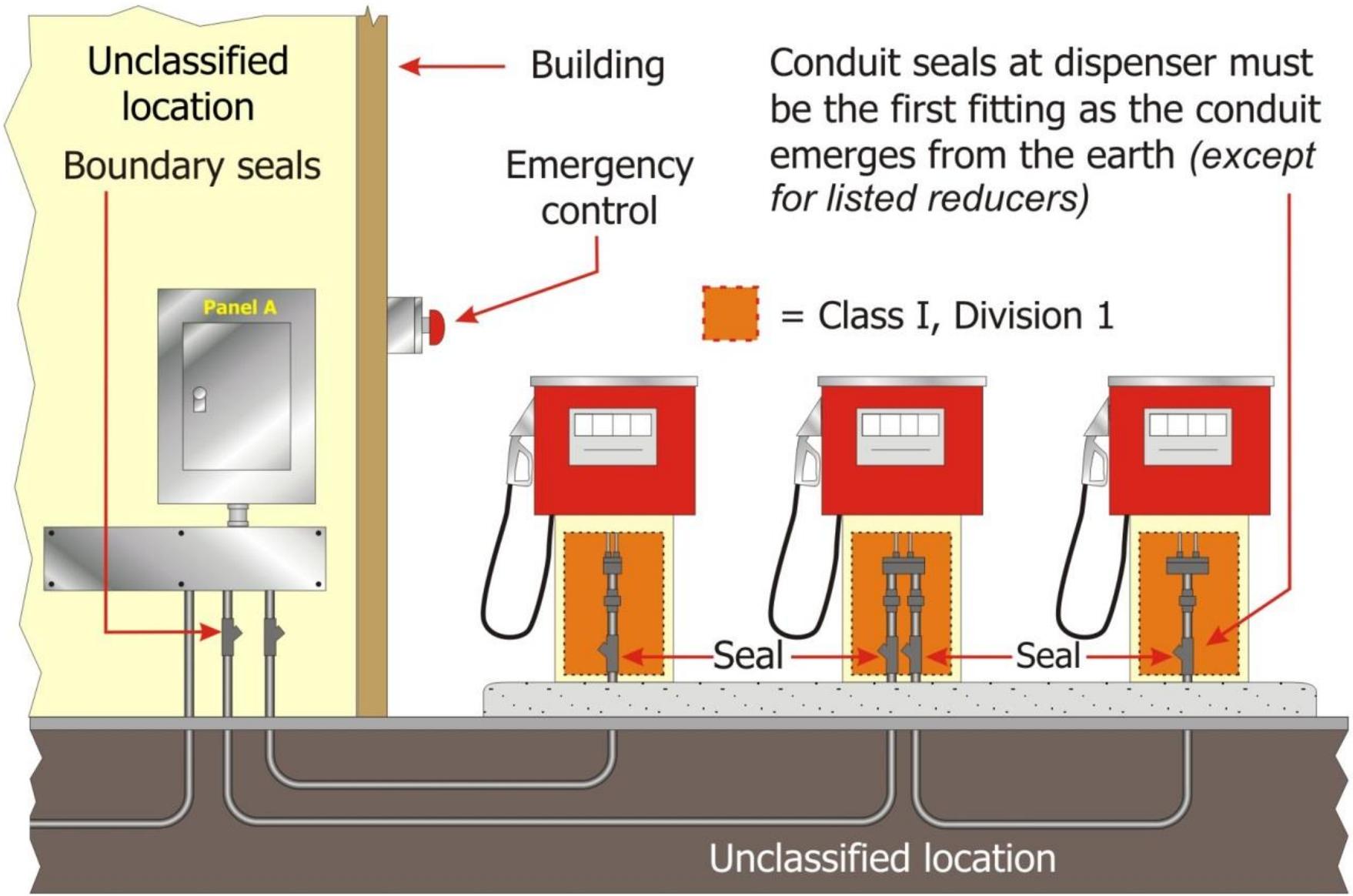
Type PVC and Type RTRC conduit is permitted for underground wiring in accordance with the provisions of 514.8 Ex. No. 2



Motor Fuel Dispensing Facilities (*cont.*)

- Sealing Requirements
 - Each conduit run entering or leaving a dispenser or any cavities or enclosures in direct communication with the dispenser shall be provided with a listed sealing fitting
 - A seal fitting is required to be the first fitting as the conduit emerges from the earth into the dispenser enclosure
- See 514.9

Conduit Seals at Dispensers



Conduit seals required at the dispensing equipment and the boundaries

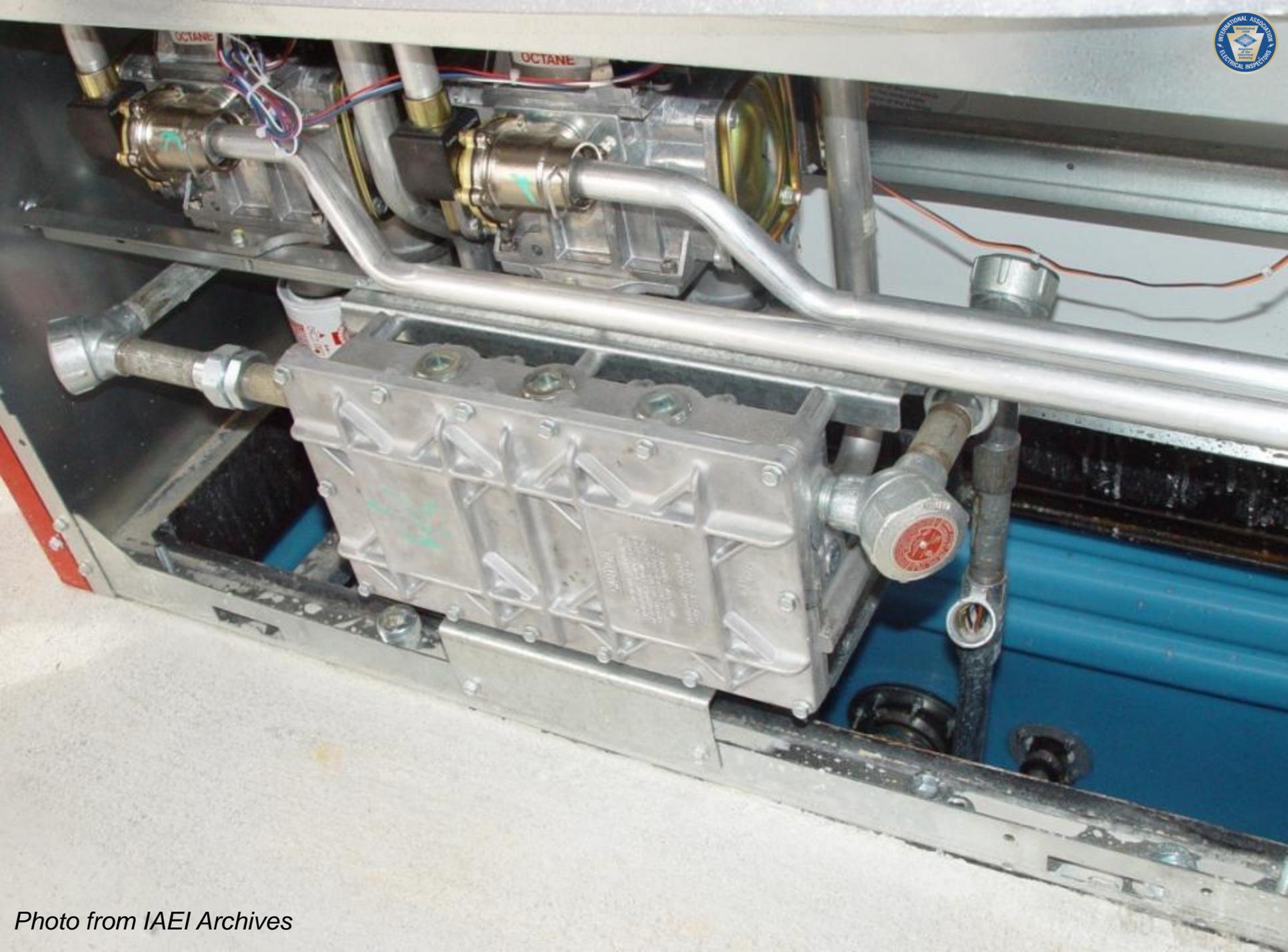


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Motor Fuel Dispensing Facilities (*cont.*)

- Seals at Boundary
 - At boundaries, seals are required at vertical as well as horizontal boundaries of the defined classified locations
 - For underground conduits, the seal is to be installed at the point where the conduit emerges from the earth
- See 514.9(B)

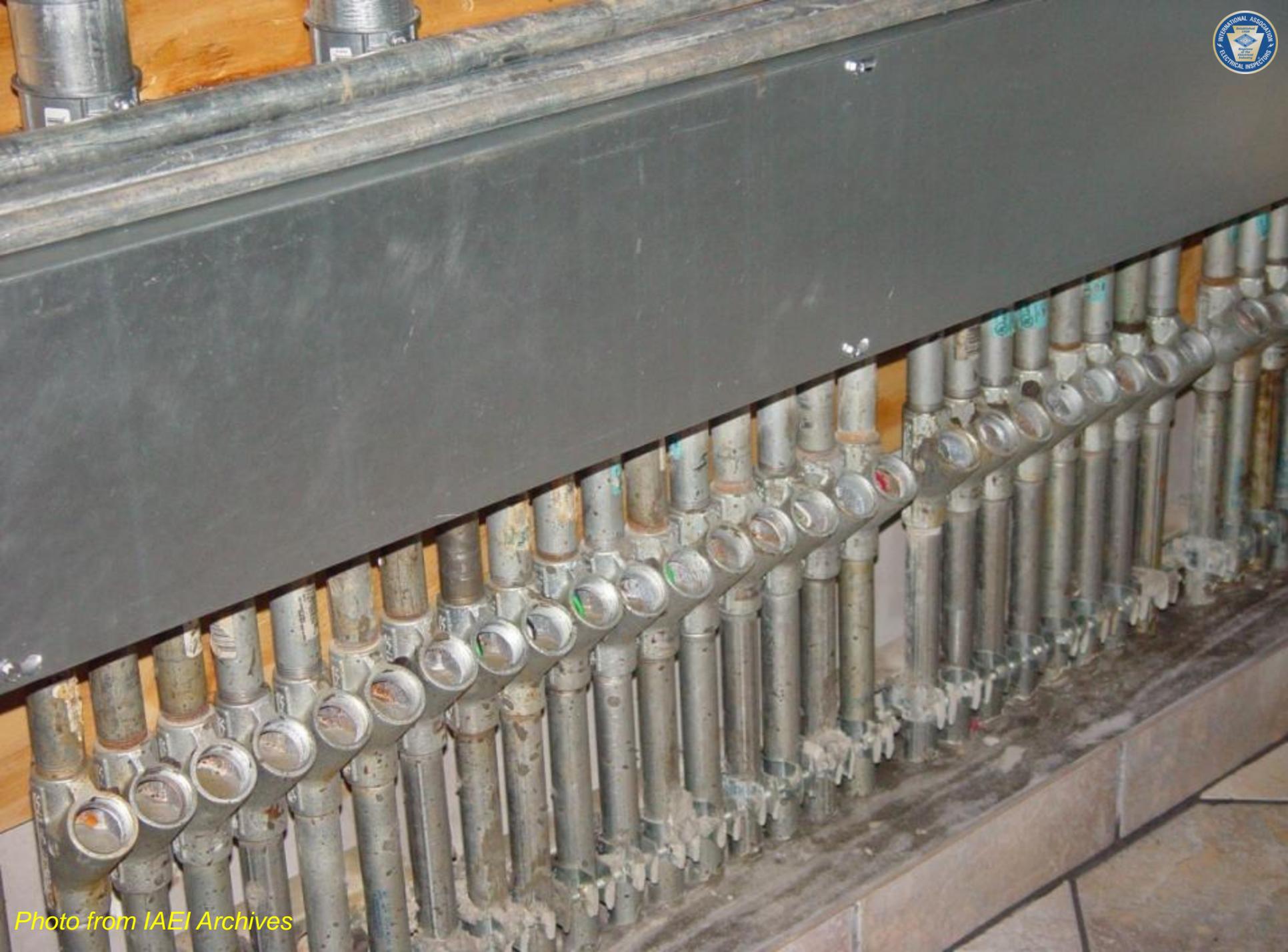


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Motor Fuel Dispensing Facilities (*cont.*)

- Circuit Disconnects
 - 514.11(A) Service or Maintenance Disconnect
 - 514.11(B) Emergency Controls (*Attended*)
 - 514.11(C) Emergency Controls (*Unattended*)
- See 514.11



Motor Fuel Dispensing Facilities (*cont.*)

- Circuit Disconnects (*cont.*)
 - Circuit disconnects are required for dispensing equipment in accordance with 514.11(A)
 - Basic disconnect requirements are as follows:
 - Each circuit leading to or through dispensers must be provided with a clearly identified and readily accessible switch or other approved disconnecting means
 - This would include power, communication, data, and video circuits



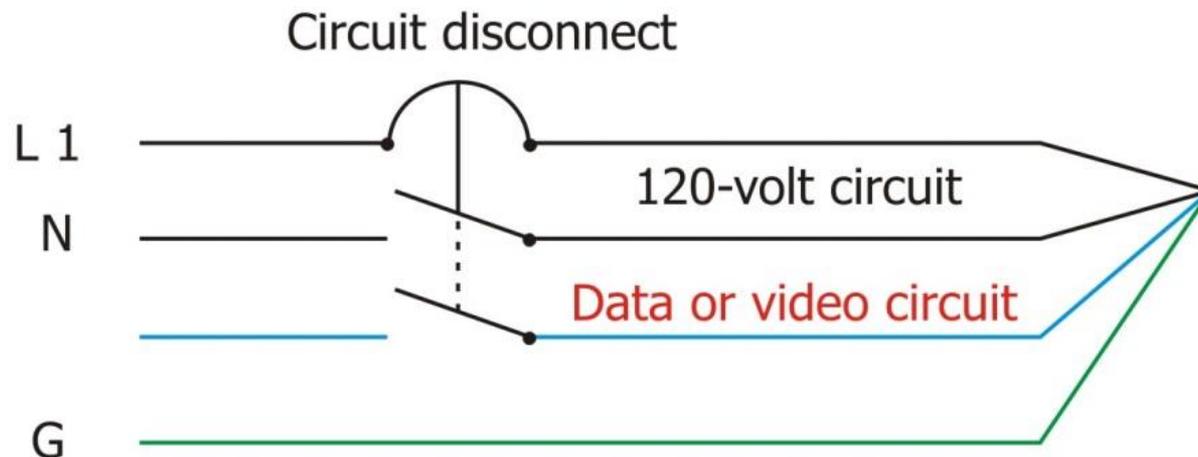
Motor Fuel Dispensing Facilities *(cont.)*

- Circuit Disconnects *(cont.)*
 - Circuit disconnects are required for dispensing equipment in accordance with 514.11(A)
 - Basic disconnect requirements are as follows: *(cont.)*
 - Located remote from dispensing devices
 - Disconnect simultaneously all associated conductors, including the grounded conductor if used *(includes data, video, etc. circuits as well)*
 - Single-pole breakers with handle ties not permitted for this application

Circuit Disconnects for Motor Fuel Dispensing Facilities

Circuit disconnects must open simultaneously all conductors of the associated power (including any grounded conductor), **communication, data, and video circuits** supplying the dispensers

Handle ties on single-pole breakers are not acceptable for this purpose



Same basic requirement for disconnecting all circuits including communication, data, and video circuits occurs at 514.13 (*Provisions for Maintenance and Servicing of Dispensing Equipment*)

514.11(A)

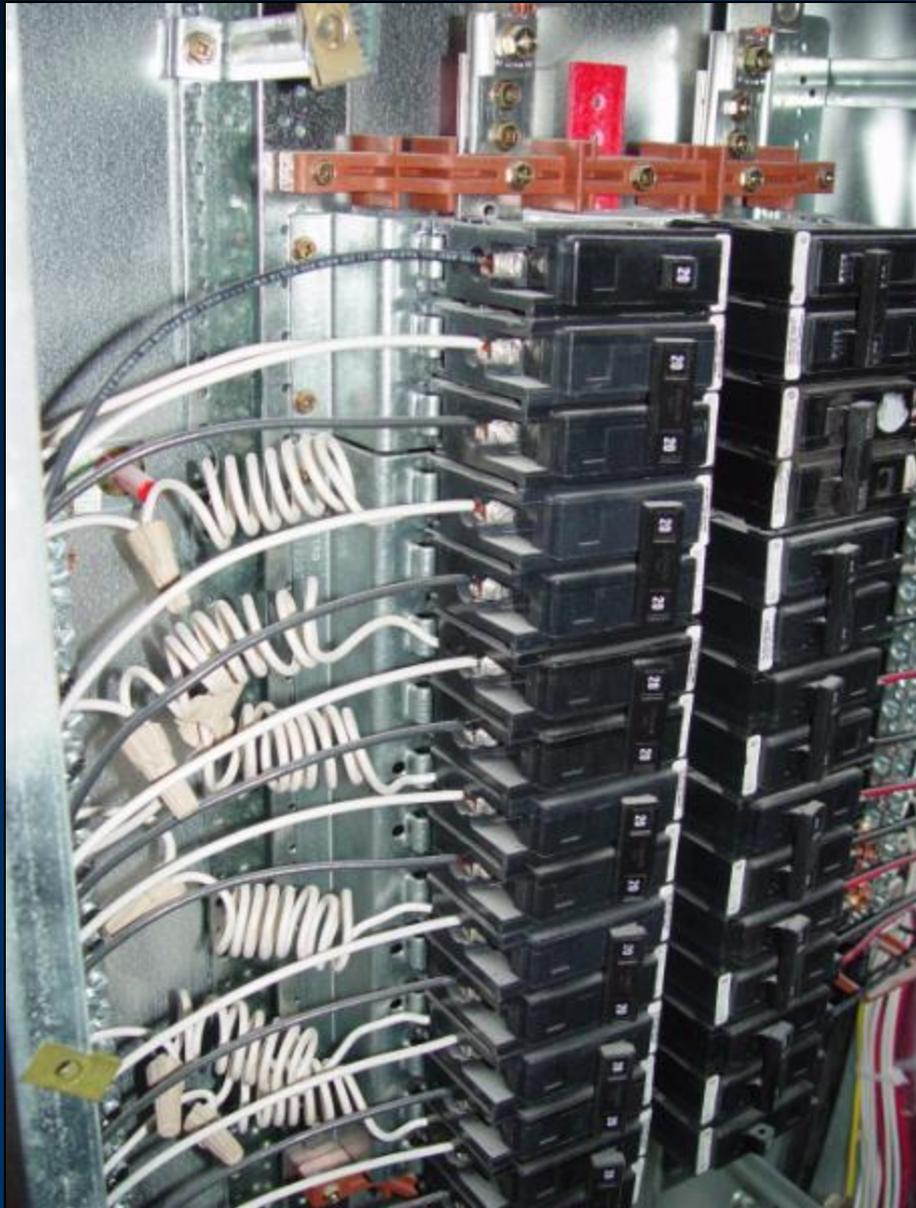


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- Each circuit leading to or through dispensing equipment, including all associated power, communications, data, and video circuits, shall be provided with disconnecting means, to disconnect simultaneously all conductors of the circuits, including the grounded conductor
- Single-pole breakers utilizing handle ties shall not be permitted
- See *NEC 514.11(A)*



Motor Fuel Dispensing Facilities (*cont.*)

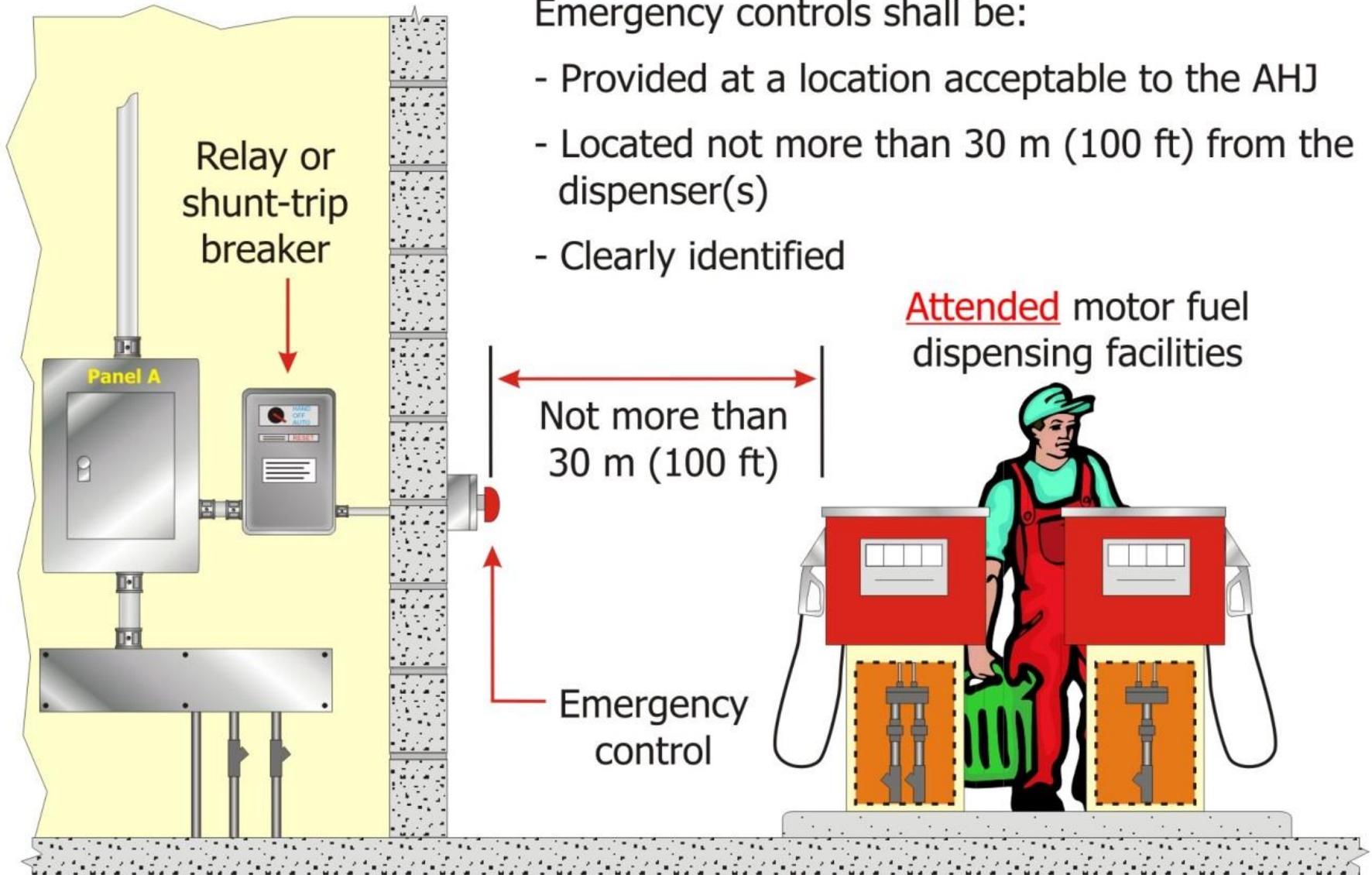
- Emergency Controls (*Attended*)
 - Requirements for emergency controls for **attended motor fuel dispensing facilities** are provided in 514.11(B)
 - The location is required to be acceptable to the AHJ
 - Emergency controls are required to be located not more than **30 m (100 ft)** from dispensers
- See 514.11(B)

Emergency Controls for Fuel Dispensers



Emergency controls shall be:

- Provided at a location acceptable to the AHJ
- Located not more than 30 m (100 ft) from the dispenser(s)
- Clearly identified





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Motor Fuel Dispensing Facilities (*cont.*)

- Emergency Controls (*Unattended*)
 - Requirements for emergency controls for **unattended motor fuel dispensing facilities** are provided in 514.11(C)
 - The location must be acceptable to the AHJ
 - The emergency controls are required to be located more than **6.0 m (20 ft)** but less than **30 m (100 ft)** from dispenser(s)
- See 514.11(C)



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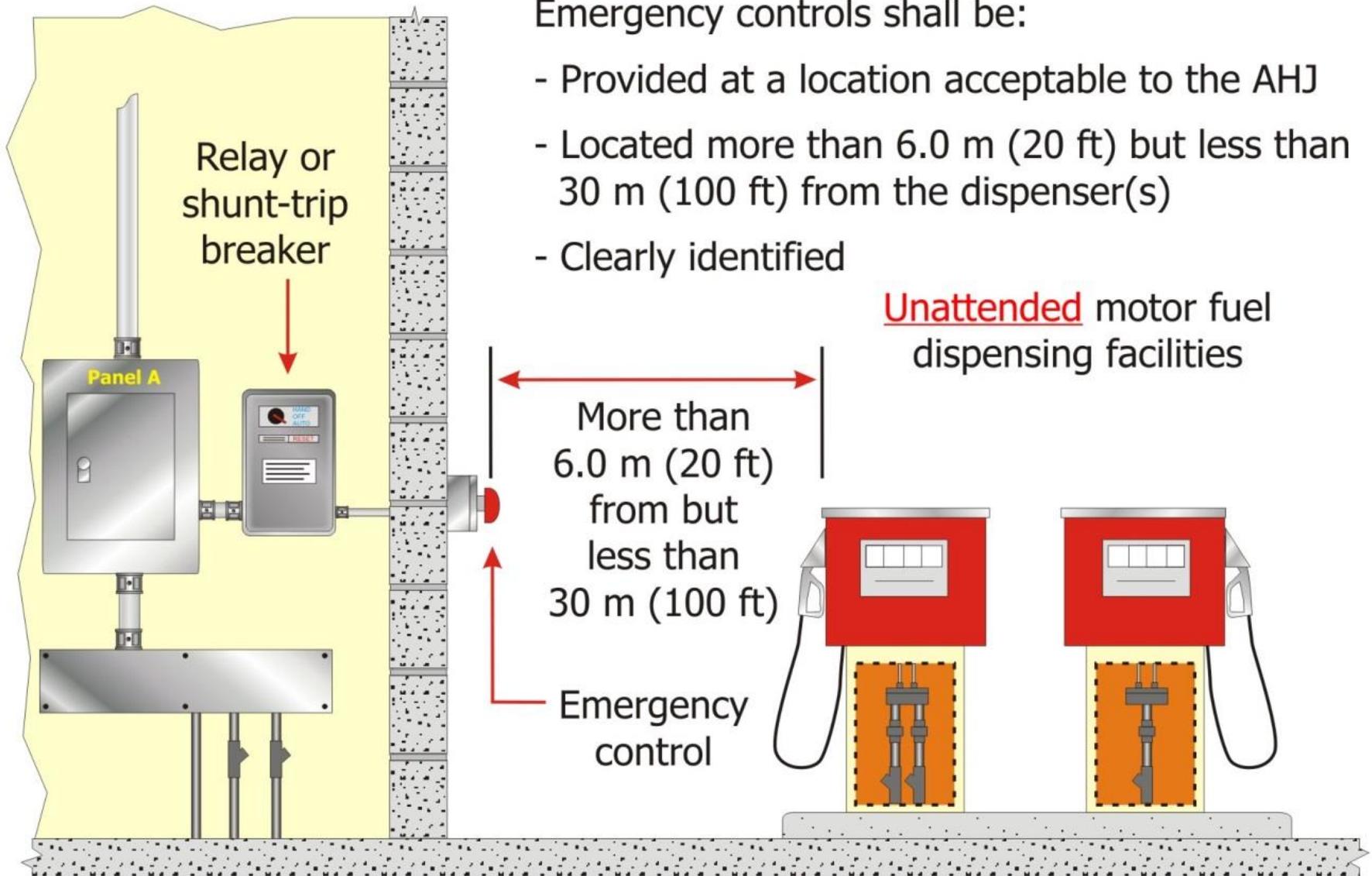
Emergency Controls for Fuel Dispensers



Emergency controls shall be:

- Provided at a location acceptable to the AHJ
- Located more than 6.0 m (20 ft) but less than 30 m (100 ft) from the dispenser(s)
- Clearly identified

Unattended motor fuel dispensing facilities





Motor Fuel Dispensing Facilities (*cont.*)

- Emergency Controls (*Unattended*) (*cont.*)
 - Additional emergency controls are required for each group of dispensers or outdoor controls
 - Emergency controls required to shut off all power to all dispensing equipment at the motor fuel dispensing facility station
 - Manual reset is required in a manner that is approved by the AHJ
- See 514.11(C)



Motor Fuel Dispensing Facilities (*cont.*)

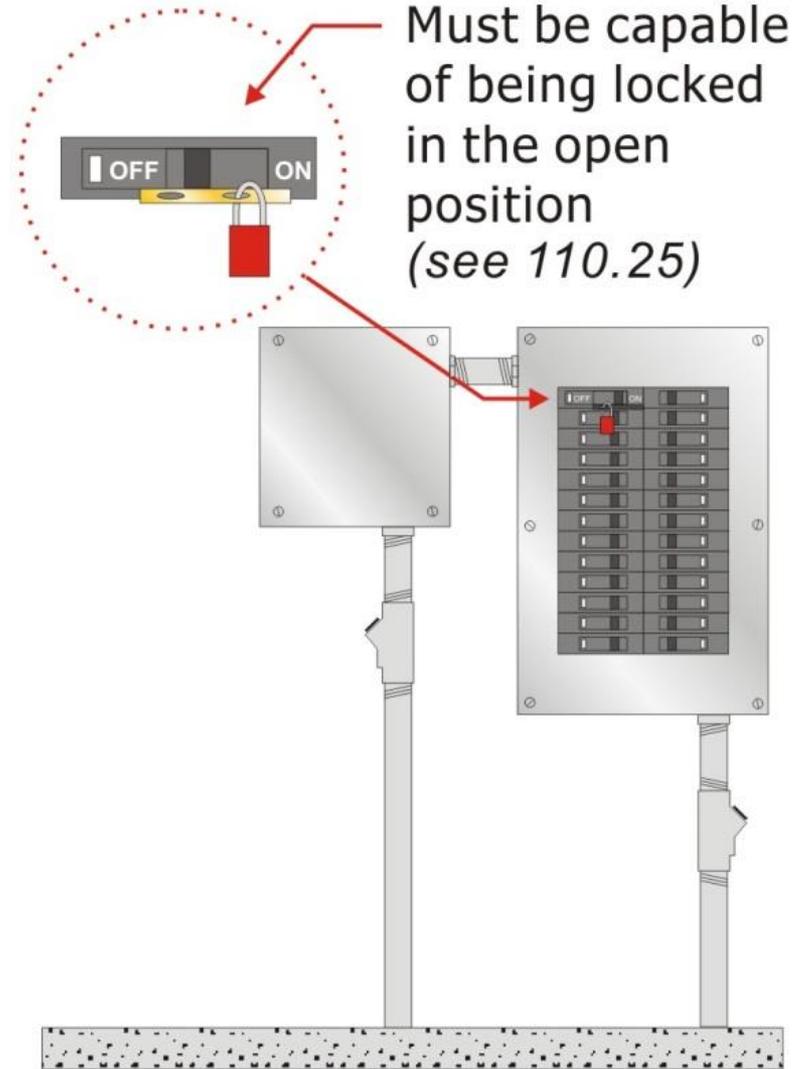
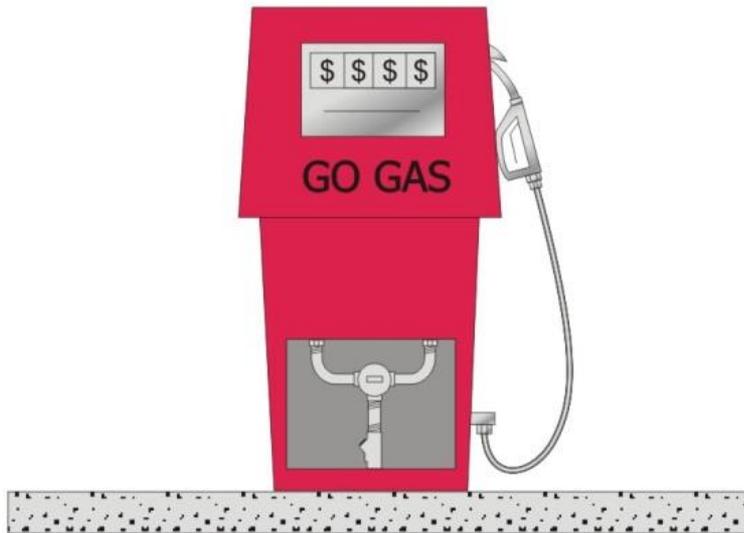
- Maintenance and Service Disconnects
 - Each dispensing device must be provided with a means to remove (*disconnect*) all external voltage sources during periods of maintenance and service of the dispensing equipment
 - This would include **power, communications, data, and video circuits** and includes any feedback
 - Permitted to be located other than inside or adjacent to the dispensing device
 - Required to be capable of being locked in the open position in accordance with 110.25
- See 514.13

Maintenance and Service Disconnect

Each dispensing device must be provided with a means to remove all external voltage sources during periods of maintenance and service

Disconnecting means permitted to be located other than inside or adjacent to the dispensing equipment

Must remove all external voltages including power, communications, data, and video circuits including any feedback





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TYPE THOL

25A

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25A

OFF

SND
HACR
TYPE
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Motor Fuel Dispensing Facilities (*cont.*)

- Grounding and Bonding
 - All metal portions of dispensers, metal raceways, metal-jacketed cables, and non-current-carrying parts of electrical equipment shall be grounded and bonded regardless of the voltage (*see 250.100*)
 - Grounding and bonding in Class I locations shall comply with 501.30(A) and (B)
- See 514.16



Motor Fuel Dispensing Facilities (*cont.*)

- Inherently Safe Circuits and Systems
 - Inherently safe (IS) circuits and systems are often used at motor fuel dispensing facilities for **leak detection monitors** and **tank level indication**
 - The IS system is required to be installed in accordance with the applicable control drawings
 - Control drawings required for installation and inspections of IS circuits and systems



Vapor recovery equipment, leak detection, level indication, etc., are often installed using intrinsically safe circuits and systems

Photo shows a newer dispenser with a vapor recovery system and leak detection system

Make note of the enclosure below grade level under the dispenser and common to the cavity of the dispenser which is a **Class I, Division 1 location**

Photo from IAEI Archives



Motor Fuel Dispensing Facilities (*cont.*)

- Intrinsically Safe Circuits and Systems (*cont.*)
 - The following slides are examples of intrinsically safe circuit control drawings

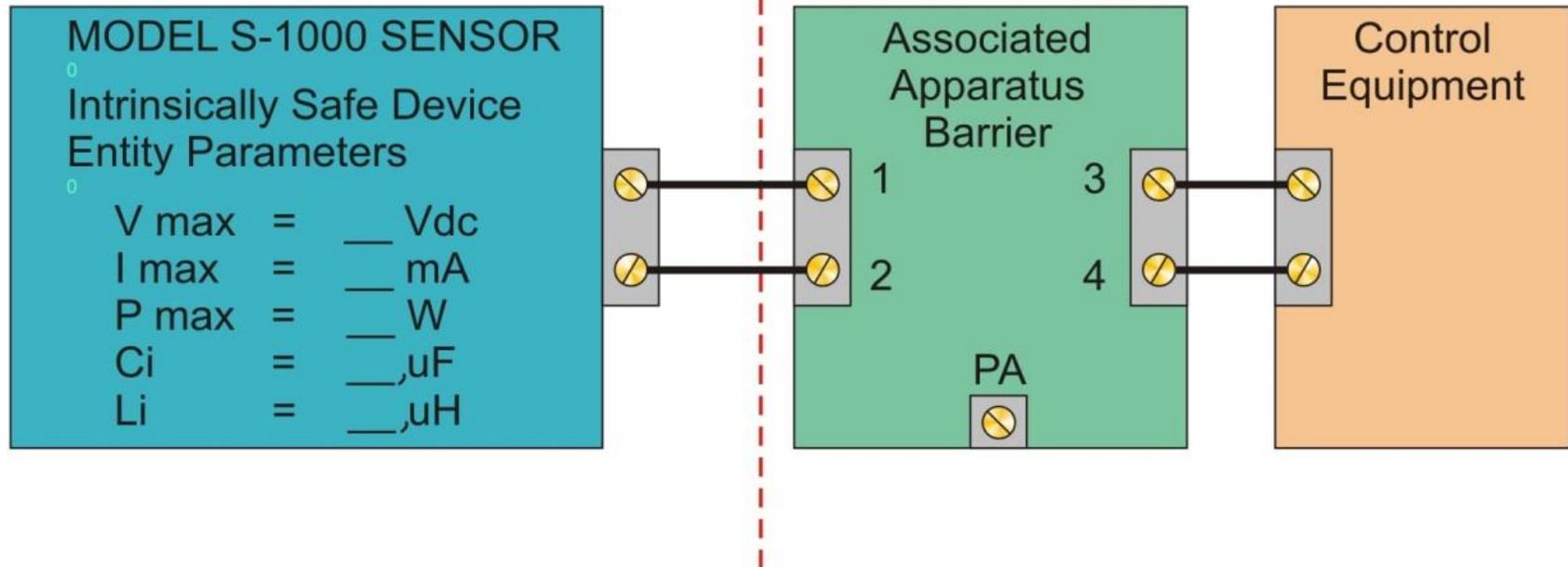
Control Drawing Required

Typical Basic Control Drawing for Intrinsically Safe Circuits

Hazardous (*Classified*) Location

Class I, Division 1, Group A, B, C, D
 Class II, Division 1, Group E, F, G
 Class III, Division 1

Nonhazardous Location





Hazardous (*Classified*) Locations

End of Part 3



Presentation by:

International Association of Electrical Inspectors