

Electrical Area Classification 102 Practical Field Experience

IEEE Houston CED

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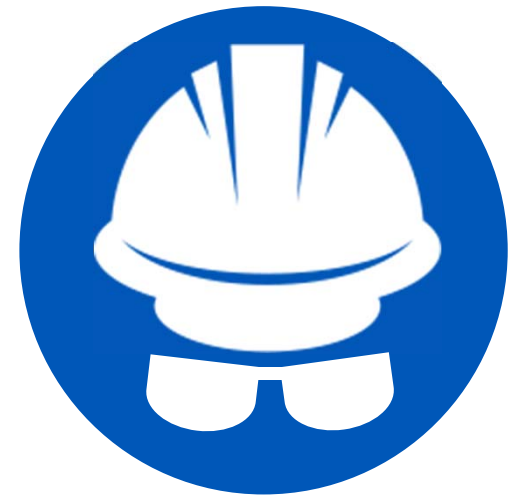
- 6 years US Navy, USS Toledo (SSN 769)
 - BSEE, University of Houston
 - 30+ EAC Projects

Safety Moment- Eye Protection



The National Safety Council estimates that there are at least **130,000** work related eye injuries causing temporary or permanent disability each year.

Eye injuries can be prevented. Whenever there is a potential hazard to your eyes or your face, use the proper PPE. Clean, maintain, and use your eye protection and it will take care of you.



Field Guide to Electrical Area Classification Problems

Standards:
NFPA 497
API RP500
NEC Ch. 500



COMMON EAC INSTALLATION ERRORS

Adequate Ventilation

- An Outside Location
- Enclosed areas provided with at least six (6) air exchanges per hour
- Building/Room *substantially* open:
 - Roofed over with NO walls
 - Roofed over and closed on ONLY one side

Ventilation Calculation Example

Building design
to 17,440 CFM.
Building volume
is 340,000 ft³.



$$\left(\frac{\text{Exchange}}{170' \times 100' \times 20'} \right) \times \left(\frac{17,440 \text{ ft}^3}{\text{min}} \right) \times \left(\frac{60 \text{ min}}{\text{hour}} \right) < 3.1 \frac{\text{Exchanges}}{\text{Hour}}$$

Common EAC Installation Errors

Setting Up Ventilation

Natural Gas Piping



Flammable & Combustible Liquids

3.1.15

flammable liquid (Class I Liquid)

Any liquid that has a closed-cup flash point below 37.8 °C (100 °F), as determined by the test procedures and apparatus specified in NFPA 30. See 5.2. Flammable (Class I) liquids are subdivided into Classes IA, IB, and IC (reference NFPA 30).

3.1.6

combustible liquid (Class II, IIIA, and IIIB Liquids)

Any liquid that has a closed-cup flash point at or above 37.8 °C (100 °F), as determined by the test procedures and apparatus outlined in NFPA 30. Combustible liquids are subdivided as follows:

3.1.6.1

Class II liquids

Liquids having flash points at or above 37.8 °C (100 °F) and below 60 °C (140 °F).

3.1.6.2

Class IIIA liquids

Liquids having flash points at or above 60 °C (140 °F) and below 93 °C (200 °F).

3.1.6.3

Class IIIB liquids

Liquids having flash points at or above 93 °C (200 °F).

Flammable & Combustible Liquids

5.2.3 Class II Liquids

5.2.3.3 Where combustible liquids are processed or stored at temperatures at or above their flash points, they should be treated as flammable liquids. Some Class II liquids may have flash points lower than those listed in standard material property tables. For example various grades of diesel or fuel oils are available. These grades may meet various specifications, such as ASTM D975, *Standard Specification for Diesel Fuel Oils*, No. 2, with grades of minimum flash points from 38 °C (100.4 °F) to 52 °C (125.6 °F) or ASTM D2069 Standard Specifications for Marine Fuels, DMS through DMC, which have a range of minimum flash points from 43 °C (109.4 °F) to 60 °C (140.0 °F). Knowledge of the different grades and flash points and the actual temperatures at which these materials are processed or stored is necessary in order to properly classify these areas.

Flammable & Combustible Liquids

Diesel Fuel Tank



MSDS

5. FIRE-FIGHTING MEASURES

Clear fire area of all non-emergency personnel.

Flash point : > 38 °C / 100 °F

Upper / lower : 1 - 6 %(V)

Flammability or

Explosion limits

Auto ignition temperature : > 220 °C / 428 °F

Specific Hazards : Hazardous combustion products may include: A complex mixture of airborne solid and liquid particulates and gases (smoke). Oxides of sulphur. Unidentified organic and inorganic compounds. Carbon monoxide may be evolved if incomplete

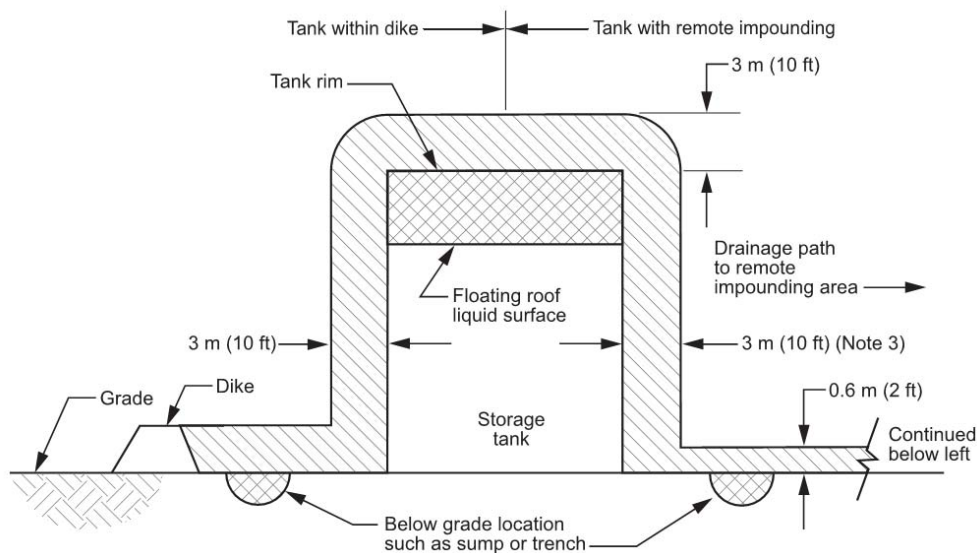
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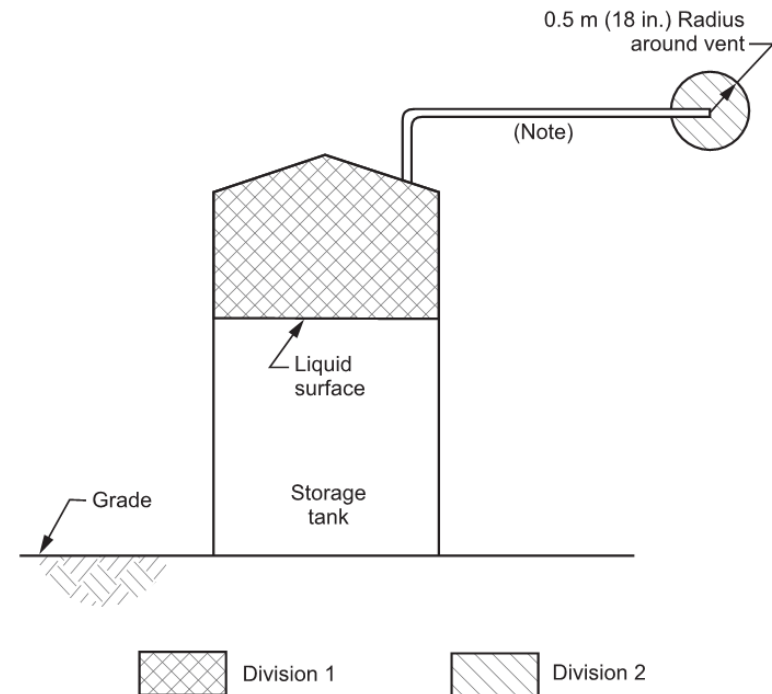
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Flammable & Combustible Liquids

Flammable Liquid



Combustible Liquid



Flammable & Combustible Liquids



Flammable & Combustible Liquids

MATERIAL SAFETY DATA SHEET

Diesel Fuel (All Types)

MSDS No. 9909

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES:

FLASH POINT: > 125 °F (> 52 °C) minimum PMCC
AUTOIGNITION POINT: 494 °F (257 °C)
OSHA/NFPA FLAMMABILITY CLASS: 2 (COMBUSTIBLE)
LOWER EXPLOSIVE LIMIT (%): 0.6
UPPER EXPLOSIVE LIMIT (%): 7.5

Common EAC Installation Errors

Natural Gas Boilers Indoors

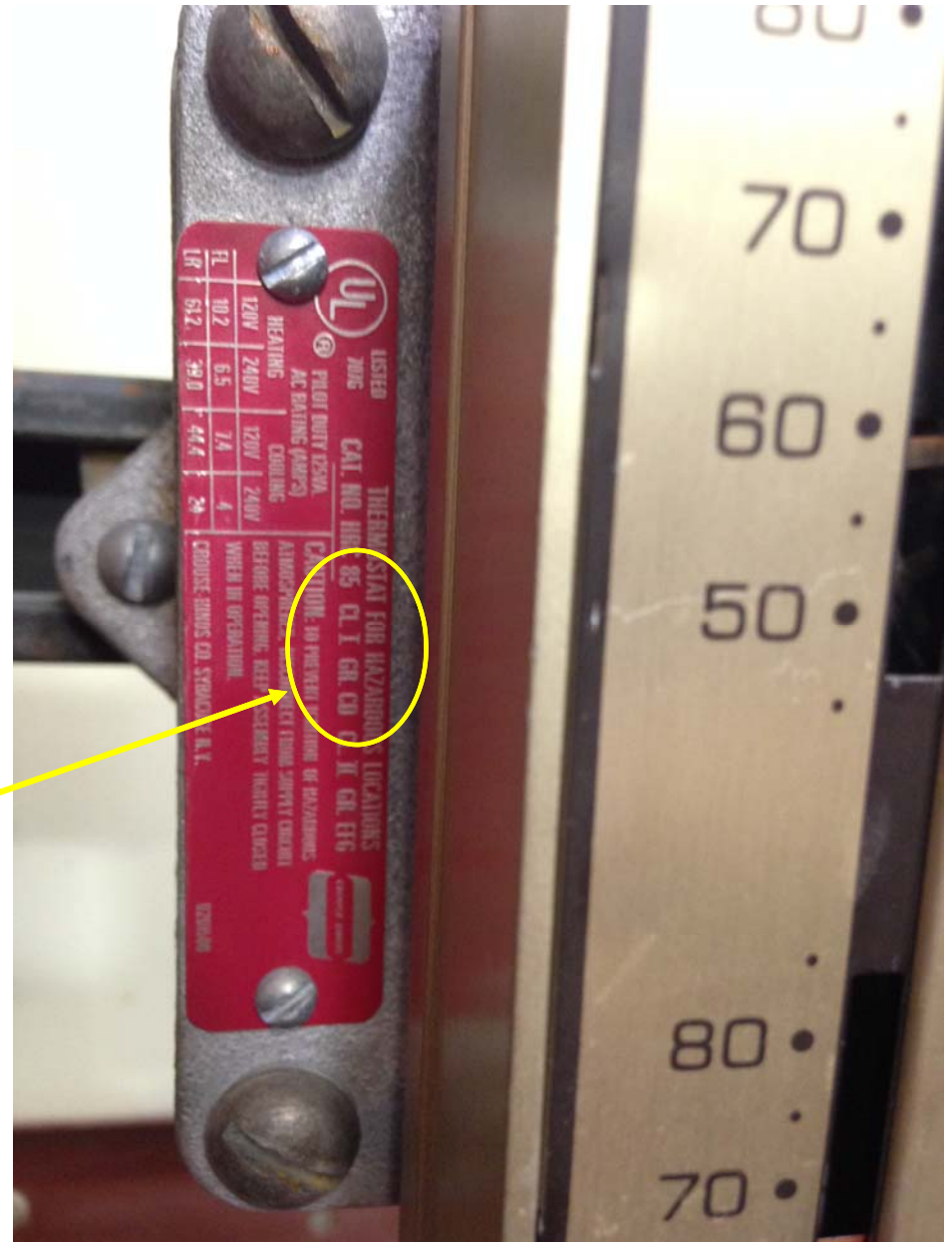
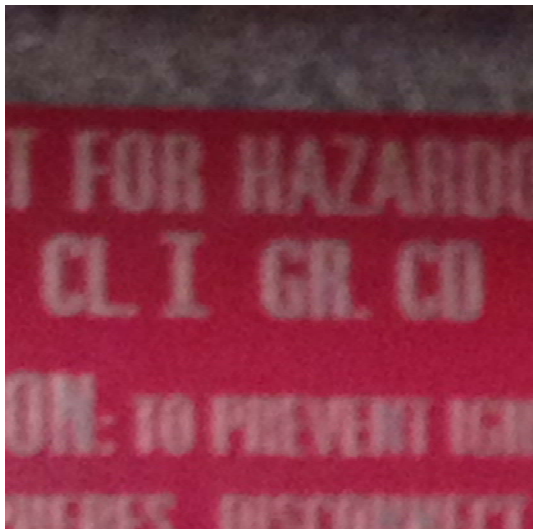
- ▶ Inadequately ventilated indoor location
- ▶ Lack of any LEL gas monitoring
- ▶ General purpose equipment all around



Common EAC Installation Errors

Incorrect Gas Group Classification

Installed in an Acetylene manufacturing facility



Common EAC Installation Errors

Incorrect Gas Group Classification

Installed in a Hydrogen Use Location



Common EAC Installation Errors



Wattage	Type 7 Class I, Div. 1 & 2 Gas Groups	Type 9 Class II, Div. 1 Dust Groups
6.1, 10.1, 17.1	A, B, C, D	E, F, G
16.1, 20.1	A, B, C, D	E, F
10.6, 11.6	A, B, C, D	E, F, G

Common EAC Installation Error

Conduit Seals Missing

- ▶ Conduit seals should be installed within 18" of the electrical device enclosure.
- ▶ Conduit seals should be installed within 10' of a Division 2 to unclassified boundary.



Common EAC Installation Errors

Flammable Sources Placed in Bad Areas

- ▶ In-Service Hydrogen cylinder installed within 8 ft of control room ventilation inlet.
- ▶ Multiple non-vaportight boundaries between H2 and personnel spaces.



Common EAC Installation Errors

Flammable Gas Vent Proximity

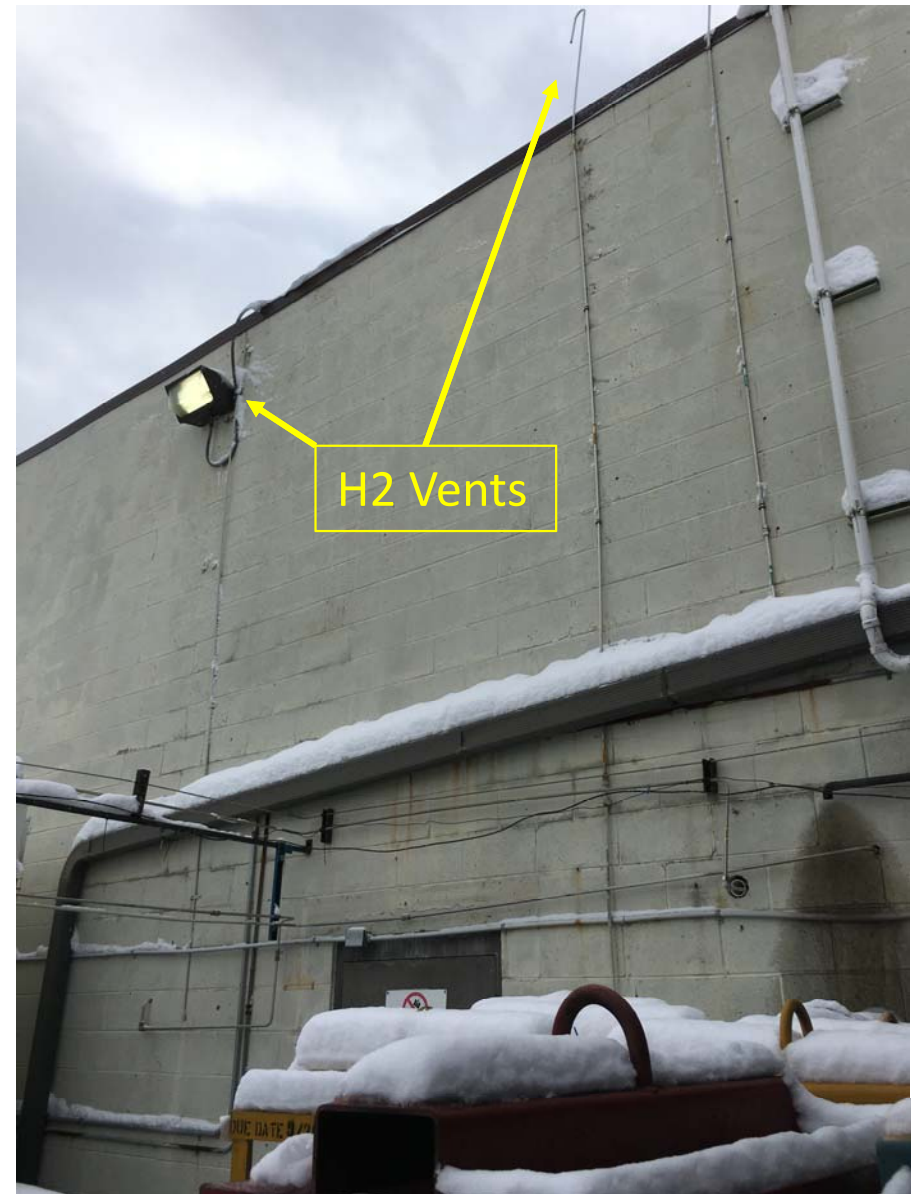
Hydrogen gas vent adjacent to ventilation inlet for rectifier room



Common EAC Installation Errors

Flammable Gas Vent Proximity

Hydrogen venting directly at general purpose lighting



Common EAC Installation Errors

Flammable Gas Vent Location



Rechargeable Batteries

38

API RECOMMENDED PRACTICE 500

8.2.6.6 An enclosed location containing rechargeable batteries is unclassified provided all batteries are vented either directly or indirectly to the outside of the enclosed area.

8.2.6.8 An enclosed, inadequately ventilated area containing batteries is classified as follows:

8.2.6.8.1 Division 2 provided (a) ventilation is at least 25 % that required for adequate ventilation, and (b) the battery charging system is designed to prevent inadvertent overcharging.

8.2.6.8.2 Division 1 if the criteria specified by 8.2.6.8.1 is not met.

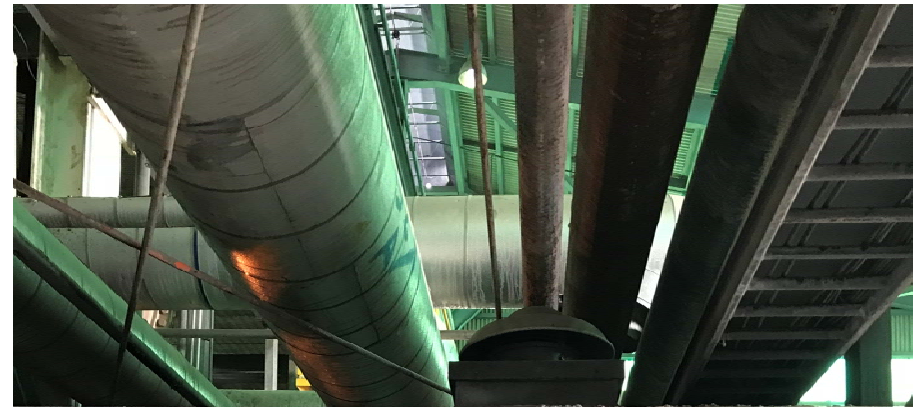
NOTE A Division 1 classification normally would prohibit the installation of batteries in the area. Check applicable requirements.

Common EAC Installation Errors

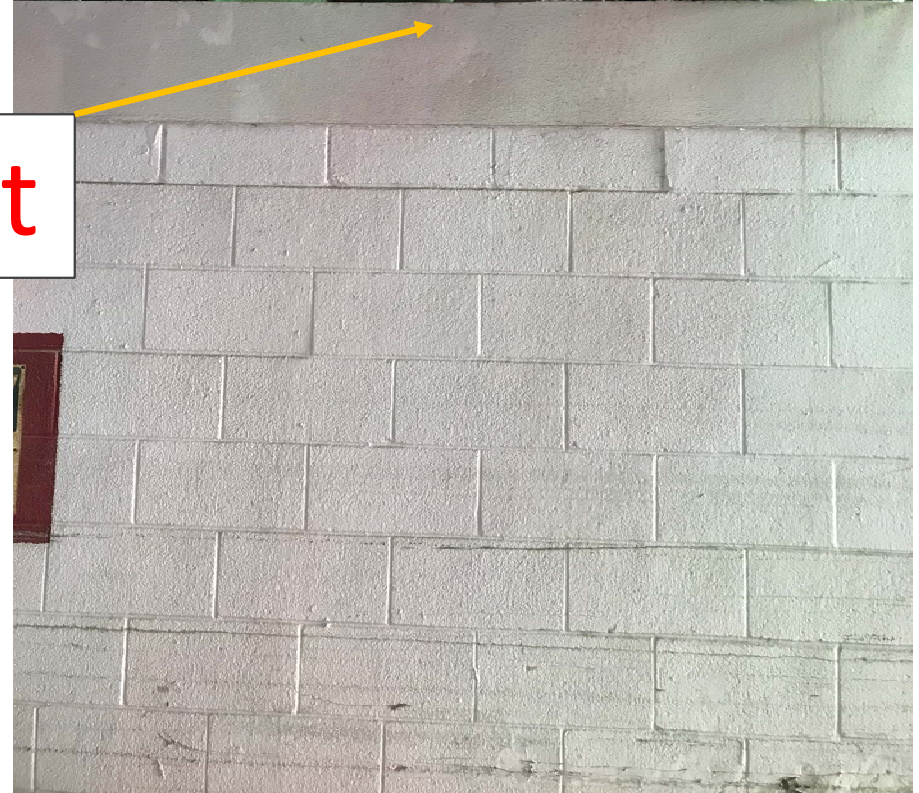
Unventilated
rechargeable
batteries in a
switchgear
room



Common EAC Installation Errors



Vent



Common EAC Installation Errors



Common EAC Installation Errors

New Process installations affect existing electrical equipment



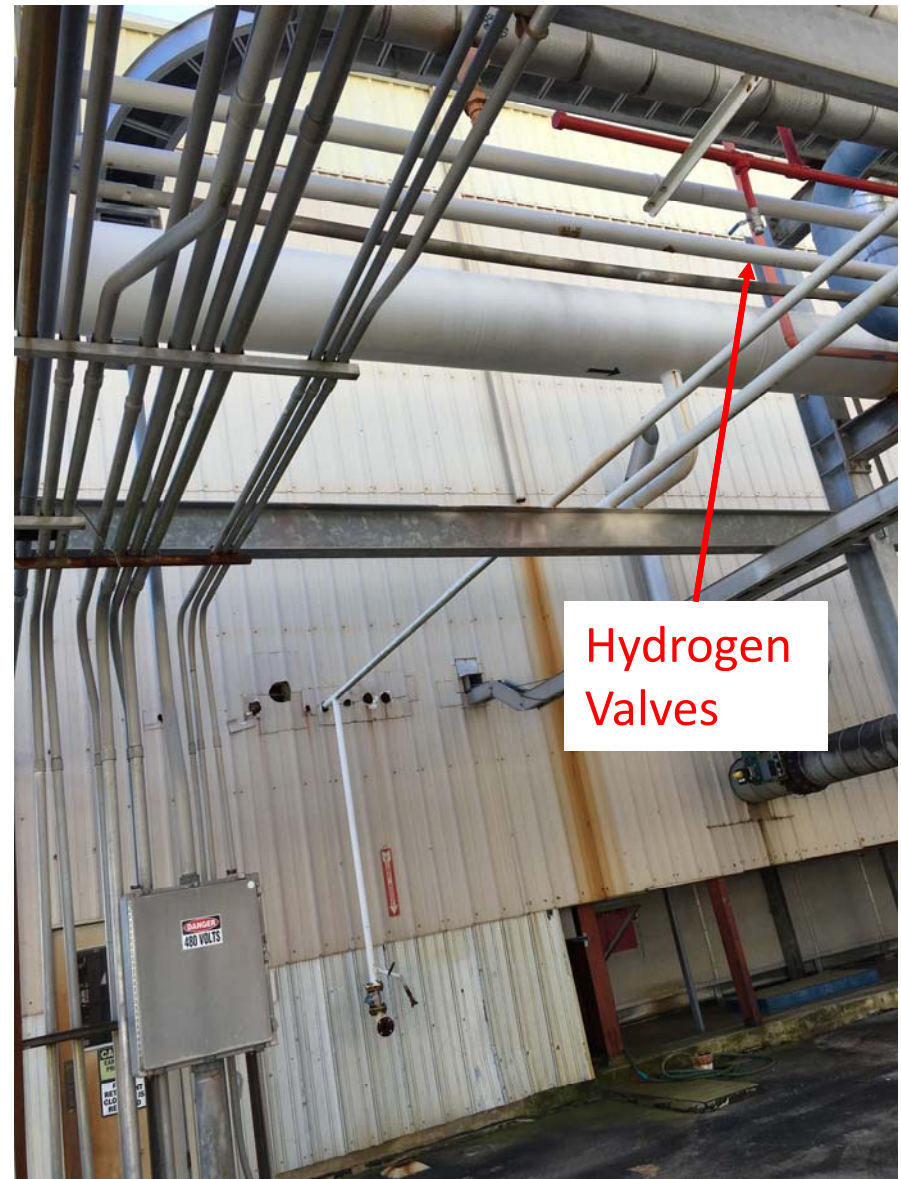
Common EAC Installation Errors



Ammonia Refrigeration

Common EAC Installation Errors

Unsealed conduits passing through Division 2 locations



Flexible Metal Conduit

NEC 501.30: Grounding and Bonding, Class I, Divisions 1 & 2

(B) Types of Equipment Grounding Conductors. Flexible metal conduit and liquidtight flexible metal conduit shall include an equipment bonding jumper of the wire type in compliance with 250.102.

Exception: In Class I, Division 2 locations, the bonding jumper shall be permitted to be deleted where all of the following conditions are met:

- (1) Listed liquidtight flexible metal conduit 1.8 m (6 ft) or less in length, with fittings listed for grounding, is used.*
- (2) Overcurrent protection in the circuit is limited to 10 amperes or less.*
- (3) The load is not a power utilization load.*

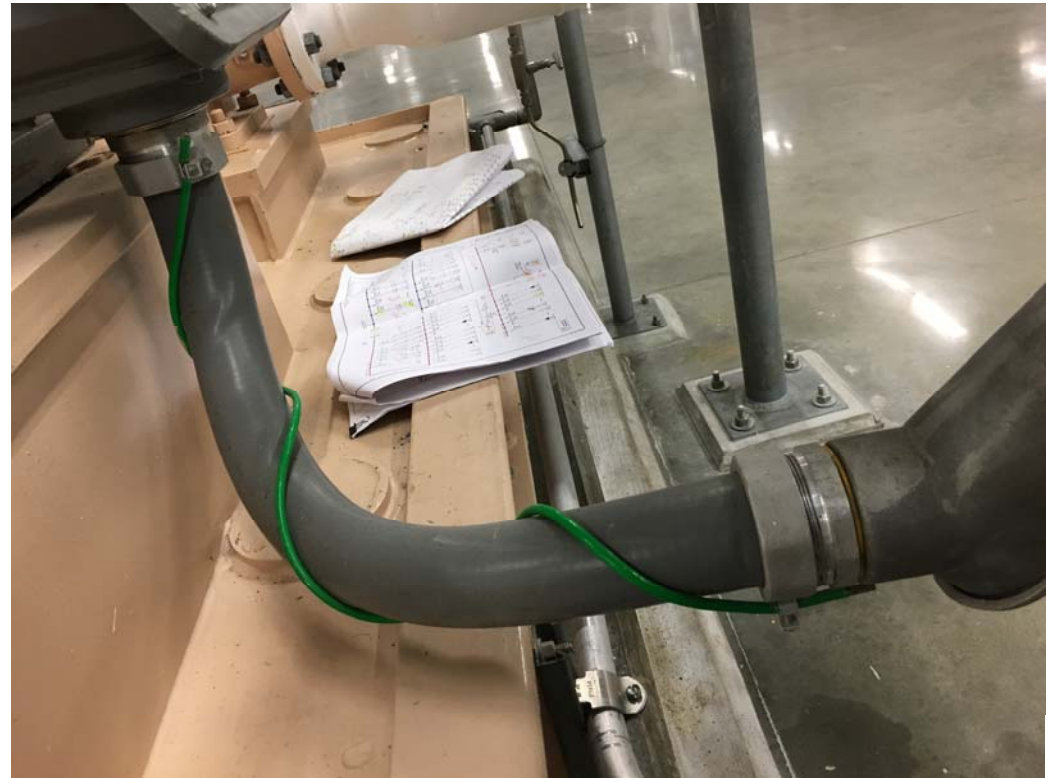
Flexible Metal Conduit

NEC 501.30: Grounding and Bonding, Class I, Divisions 1 & 2

Acetylene Compressor



VS



EAC Installation Errors



EAC Usage Errors

Bypassing Safety



EAC Usage Errors

Bypassing Safety



BURNS  MCDONNELL SM

Class I Subdivisions

Division 1

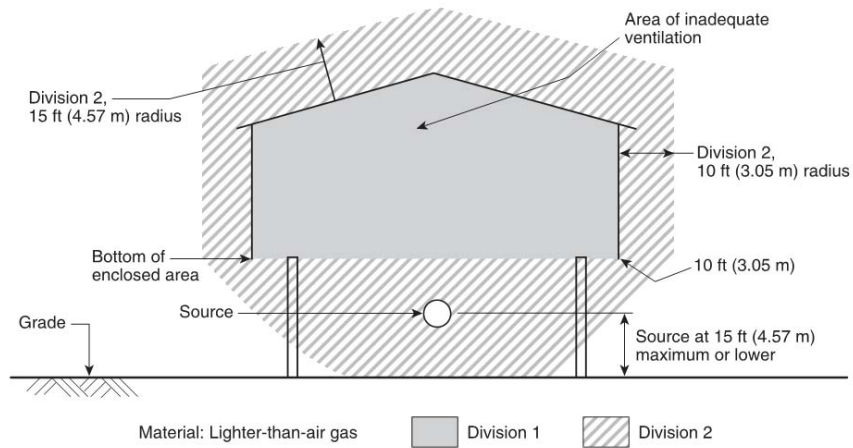


FIGURE 5.9.9(b) Inadequately Ventilated Compressor Shelter. The material being handled is a lighter-than-air gas.

Division 2

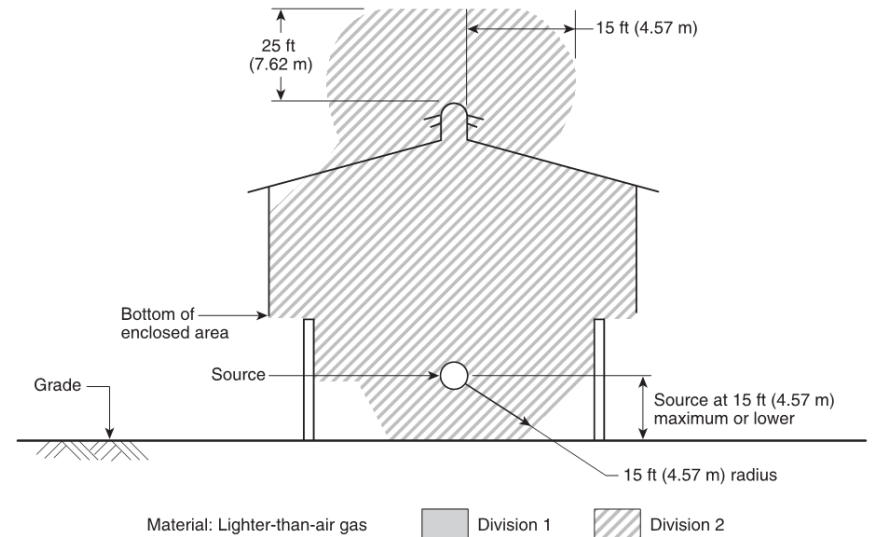
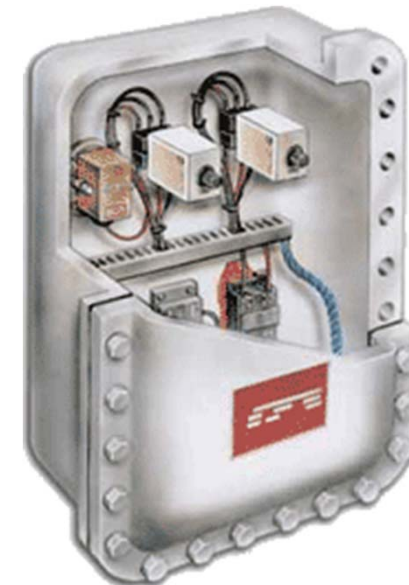
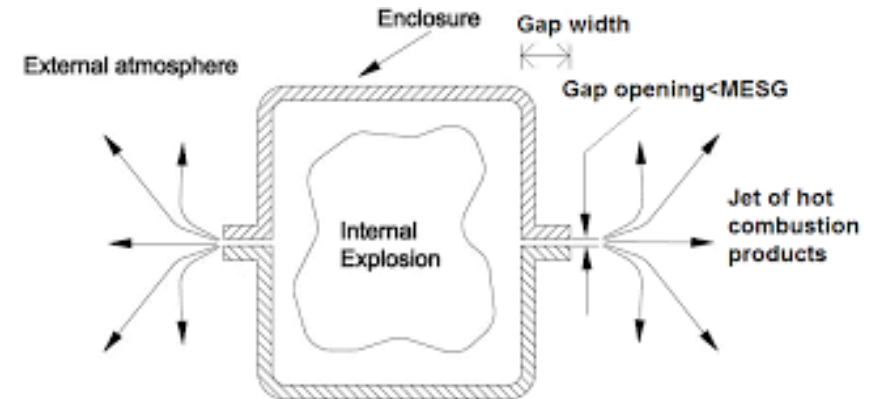


FIGURE 5.9.9(a) Adequately Ventilated Compressor Shelter. The material being handled is a lighter-than-air gas.

Gas Groups

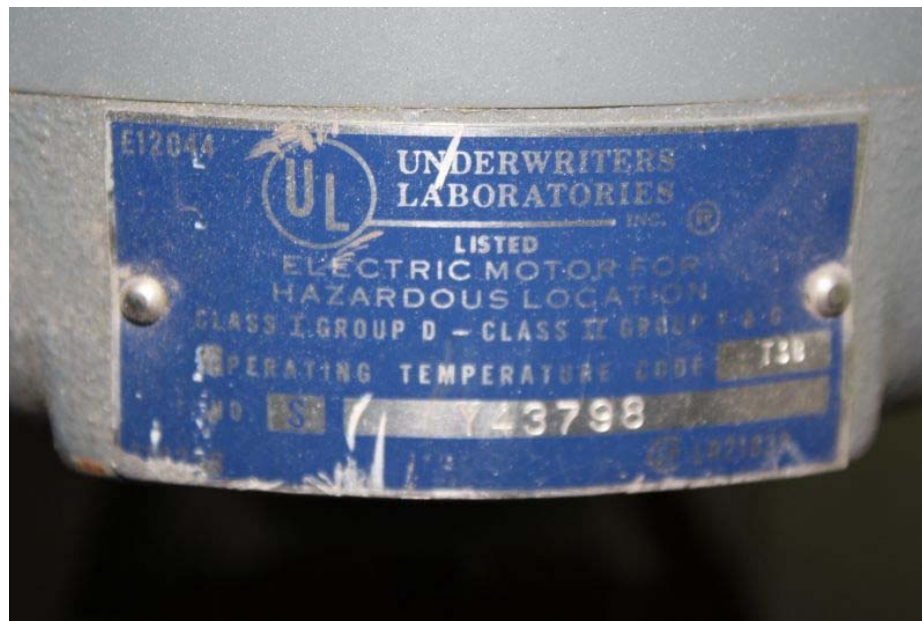
Group	Example Gas
A	Acetylene
B	Hydrogen, Formaldehyde
C	H ₂ S, CO, Methylal, Mercaptans
D	Methane, Ammonia, Propane, IPA



- Maximum Experimental Safe Gap (MESG)
- Minimum Igniting Current (MIC) Ratio
- Minimum Ignition Energy (MIE)

Auto Ignition Temperature (AIT)

- ▶ T-code < (AIT*80%)
- ▶ Example: Pentane AIT = 243C
- ▶ 243C x 0.8 = 194.4C
- ▶ T-code for Pentane areas is T3A



T-Code

Maximum Temperature		Temperature Class (T Code)
°C	°F	
450	842	T1
300	572	T2
280	536	T2A
260	500	T2B
230	446	T2C
215	419	T2D
200	392	T3
180	356	T3A
165	329	T3B
160	320	T3C
135	275	T4
120	248	T4A
100	212	T5
85	185	T6

[70: Table 500.8(C)]

Hydrogen Example

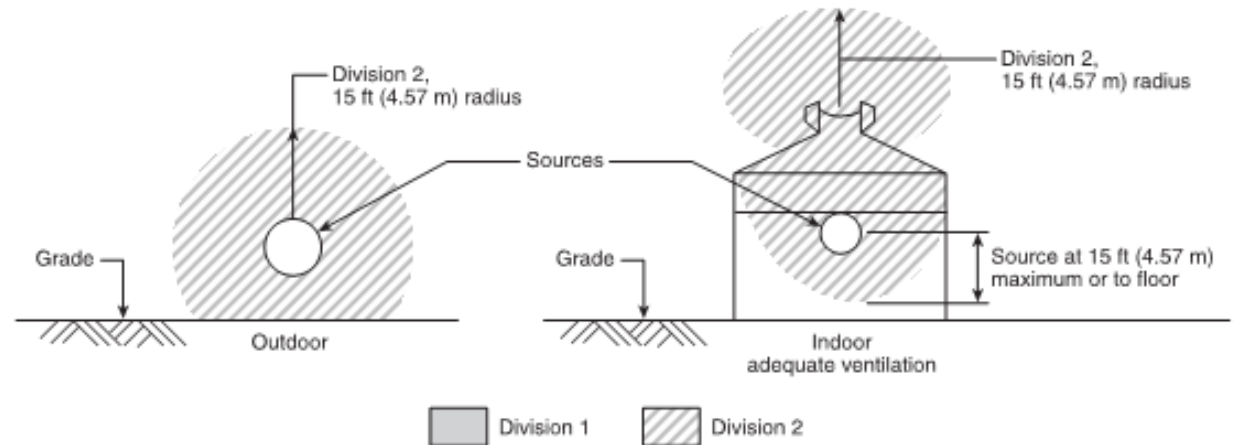


FIGURE 5.9.8(b) Gaseous Hydrogen Storage Located Outdoors or Indoors in an Adequately Ventilated Building. This diagram applies to gaseous hydrogen only.

EAC Boundary:
15'R Class I Division 2, Group B, T2

Combustible Gas Detection Equipment (LEL)

Reduction of EAC

- ▶ Calibration every 3 months!!!
- ▶ Alarm at 20% LEL
- ▶ Alarm + Action at 40% LEL



PM #	Description	Location	Asset	Alias	Status	Frequency	Frequency Units	Turnaround?	Last Start Date	Last COMP. Date	Est Next Due Date
	detect										
P-191325	TRO - LAB GAS DETECTION SYSTEM CALIBRATION (EIS)	L-552639			ACTIVE	3 MONTHS		<input type="checkbox"/>	1/15/16	10/9/15	4/15/16
P-192849	TRO - SIF4 GAS DETECTION SYSTEM CALIBRATION	L-550230			ACTIVE	3 MONTHS		<input type="checkbox"/>	1/1/16	10/1/15	4/1/16
P-192983	TRO - GRAV GAS DETECTION SYSTEM CALIBRATION (EIS)	L-552840			ACTIVE	3 MONTHS		<input type="checkbox"/>	1/15/16	10/9/15	4/15/16

Nitrogen Purging

NFPA 496 – Purged and Pressurized Enclosures



VS

