



Hazardous Area Classification in Oil & Gas Industry

A Fire Prevention Tool

SFPE ENGINEERING TECHNOLOGY CONFERENCE

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New Orleans, LA





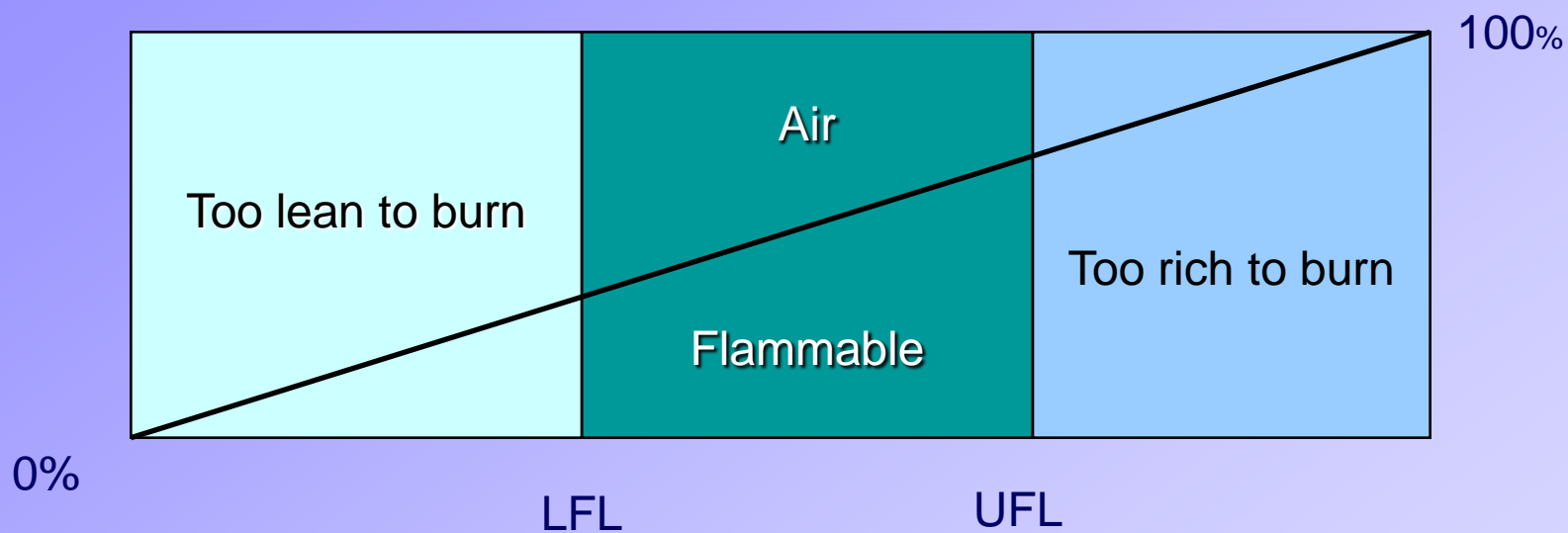
Overview



Oil and gas plants handle flammable materials



Flammable Range



LFL Lower Flammable Limit

UFL Upper Flammable Limit

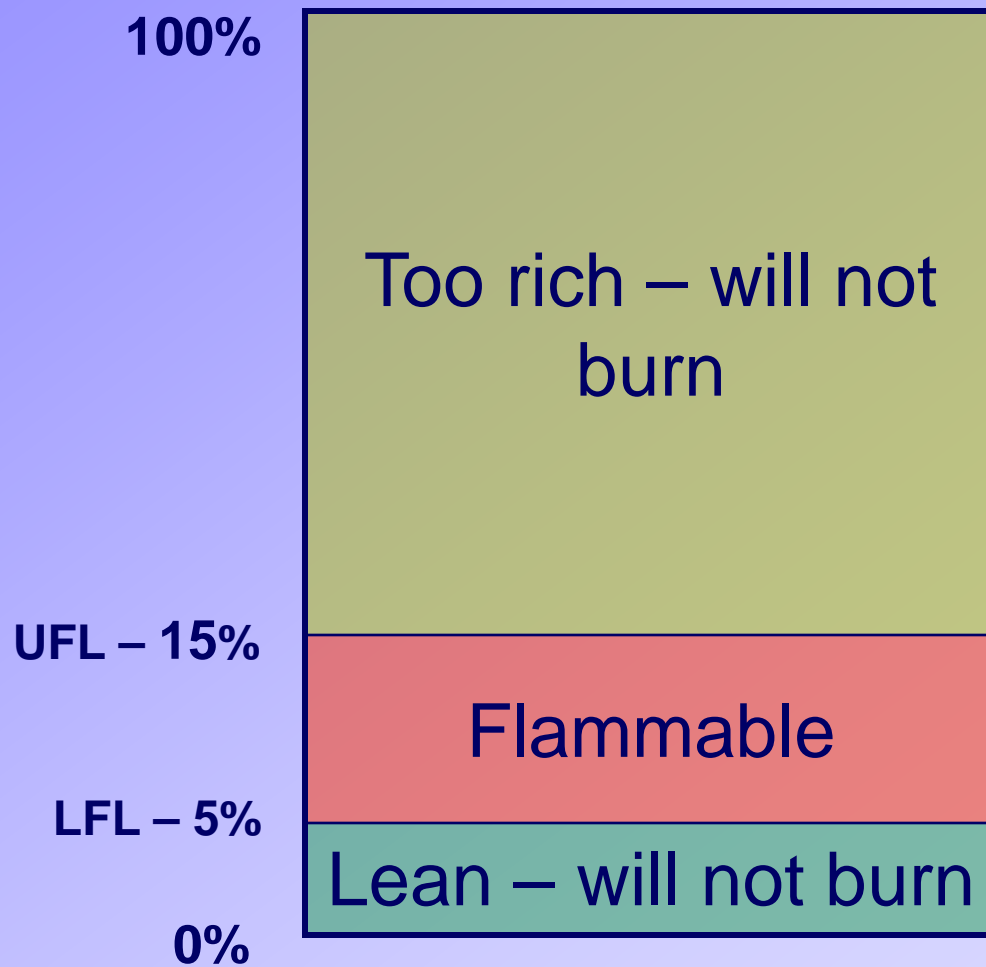


Flammable Range of Few Materials

Material	LFL (Vol %)	UFL (Vol %)
Methane	5	15
Ethane	3	15.5
Propane	2	9.5
Butane	1.5	8.5
Hydrogen	4	75.6



Flammable Range - Methane





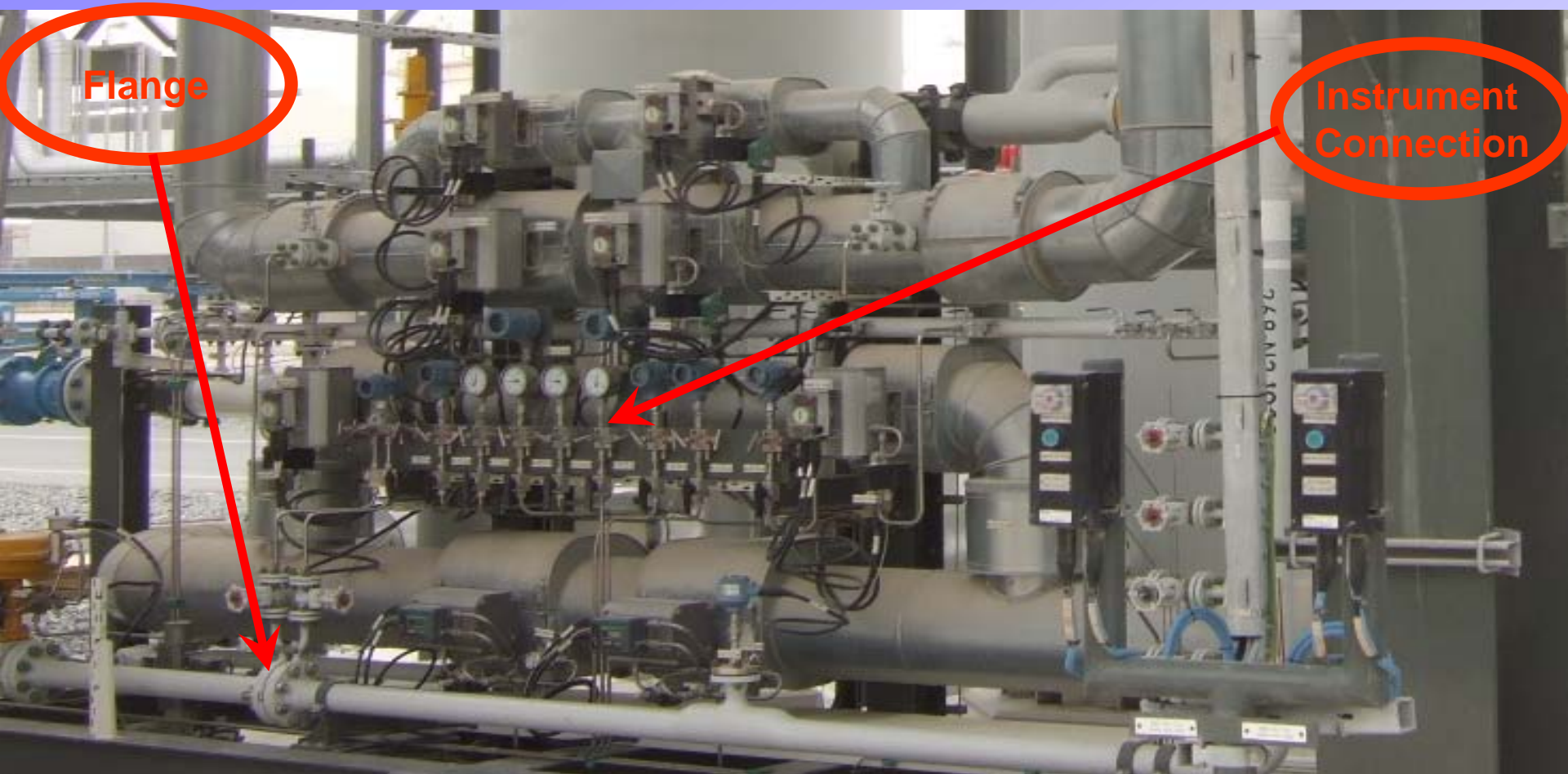
Source of Release

- A point from which a flammable gas, vapor or liquid may be released into atmosphere.

ex. flanges, instrument connections, pump seals, etc

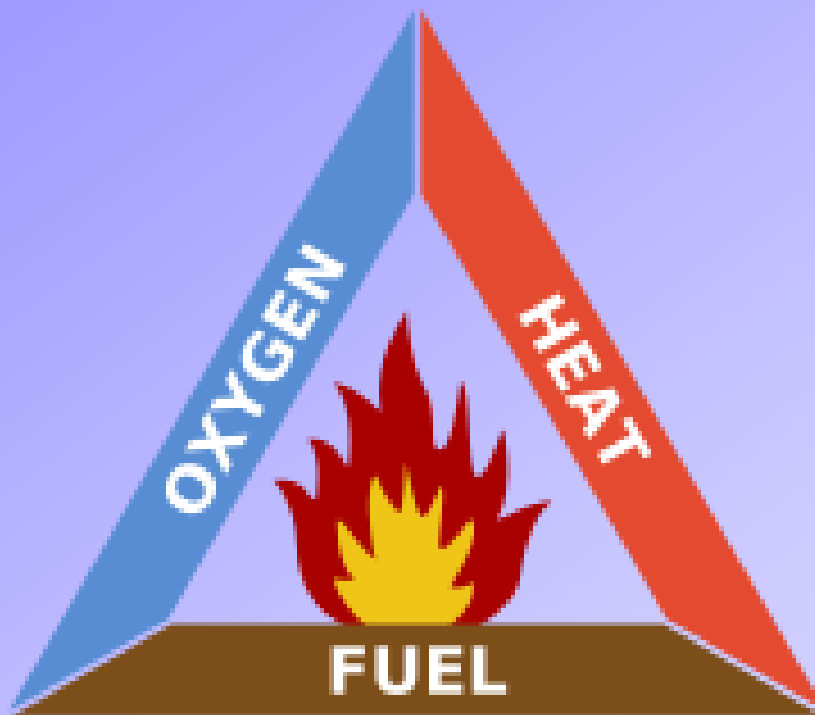


Sources of Release





Fire Triangle

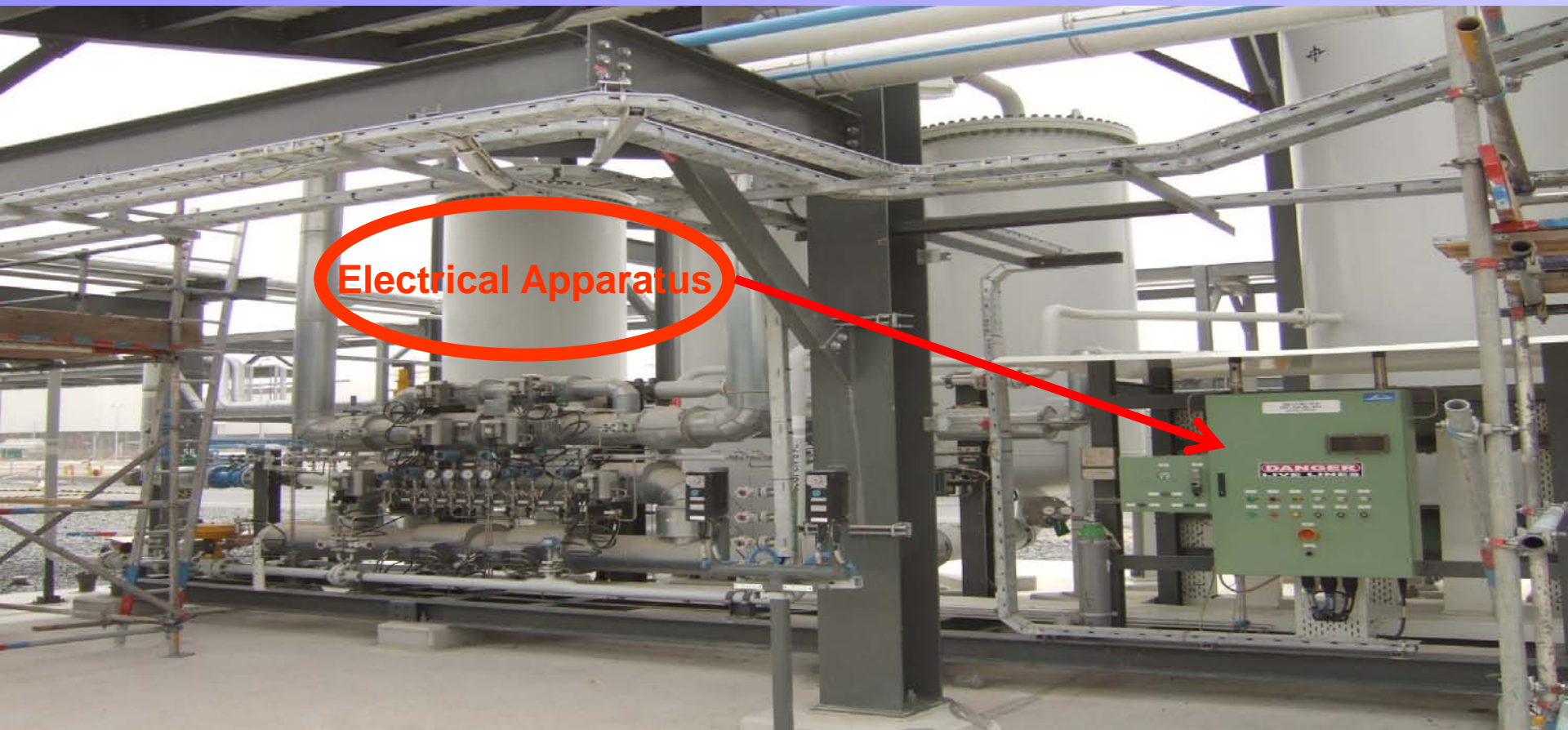


Simultaneous occurrence of all three sources causes fire.

Cutting off any one, extinguishes fire.



Ignition Source





Aim of Area Classification

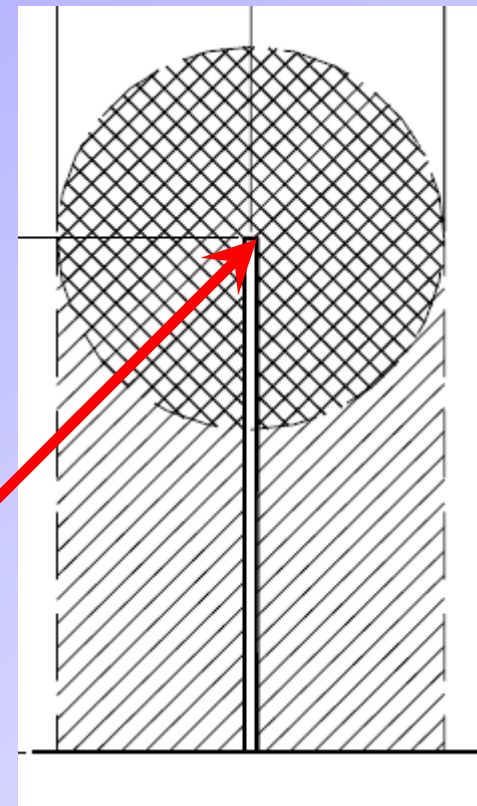
- To avoid ignition of releases that may occur from time to time
- The approach is to reduce to an acceptable level the probability of coincidence of a flammable atmosphere and an electrical or other source of ignition.



Hazardous Area

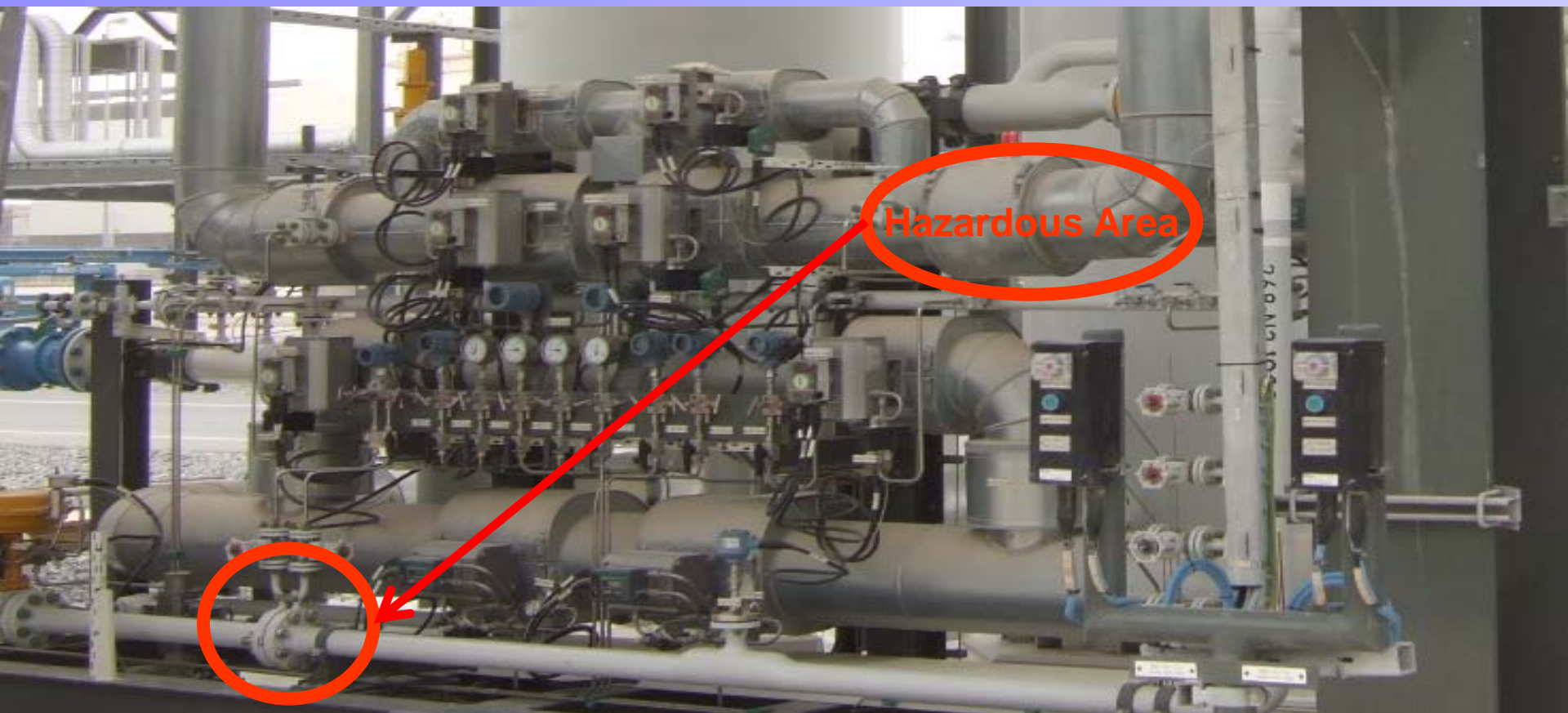
- A three dimensional space in which a flammable atmosphere may be expected to be present at such frequencies as to require special precaution for the design and construction of equipment, and the control of potential ignition sources.

Leak Source





Hazardous Area





Extent of Hazardous Area

- **Direct Example Approach**
limited to common facilities
- **Point Source Approach**
release rates are dependent on process conditions
- **Risk-based Approach**
an option methodology which may reduce the hazardous area determined by the point source approach





Grade of Release

- **Continuous:** A release that is continuous or nearly so.
- **Primary:** A release that is likely to occur periodically or occasionally in normal operation. (Vents, Sample points, etc)
- **Secondary:** A release that is unlikely to occur in normal operation and, in any event, will do so only infrequently and for short periods. (Flanges, Instrument connections, etc)





Subdivision of Hazardous Area

- **Zone 0:** flammable atmosphere is continuously present or present for long periods.
- **Zone 1:** flammable atmosphere is likely to occur in normal operation.
- **Zone 2:** flammable atmosphere is not likely to occur in normal operation and, if it occurs, will exist only for short period.



Zone and Division

Continuous Release	Primary Release	Secondary Release	Codes and Standards
Zone 0	Zone 1	Zone 2	IEC 60079, IP 15, API 505, NFPA 497
Division 1		Division 2	API 500, NEC Article 500, NFPA 497





Grade of Release and Zone (Division)

Under unrestricted 'open air' conditions:

- Continuous grade normally leads to Zone 0 (Division 1)
- Primary grade normally leads to Zone 1 (Division 1)
- Secondary grade normally leads to Zone 2 (Division 2)





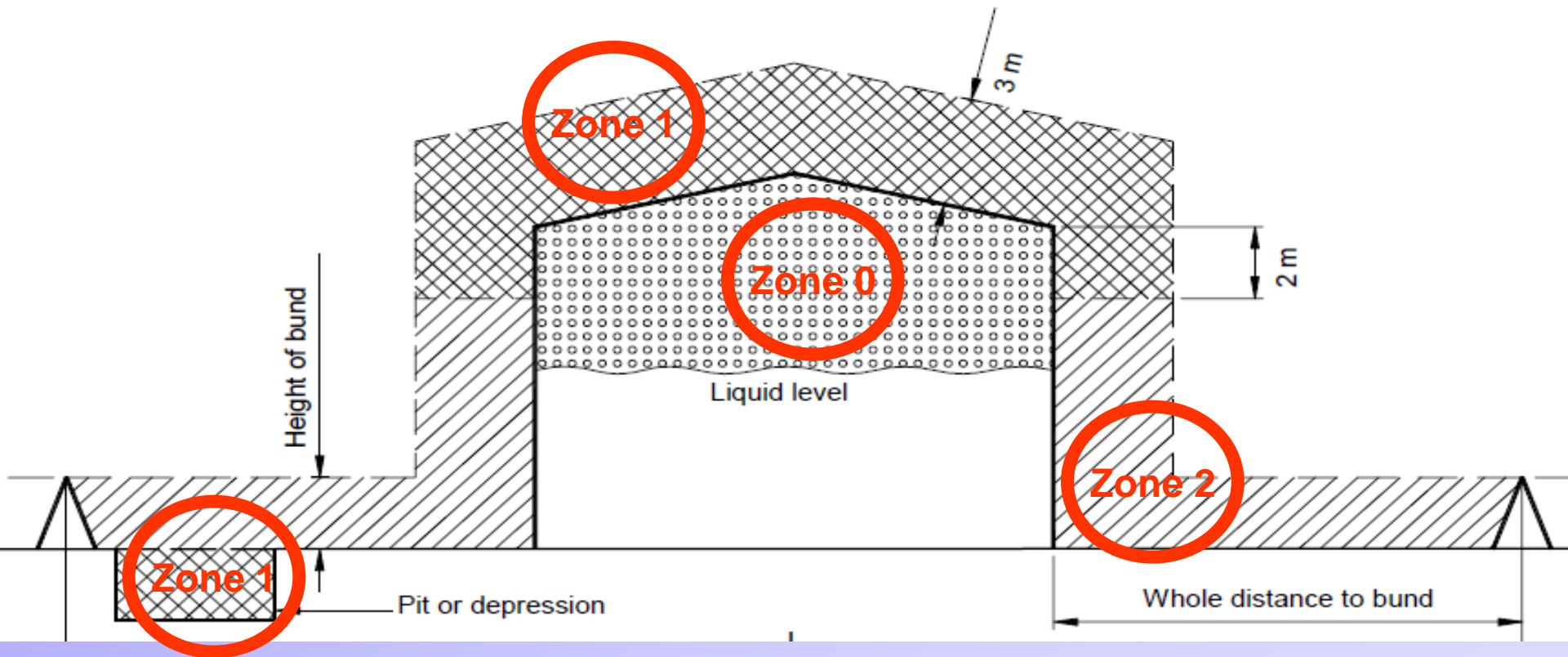
Effect of Ventilation

- The term 'grade of release' and 'zone' are not synonymous.
- Poor ventilation may result in a more stringent zone while, with high ventilation provision, the converse will be true.



Zone Classification

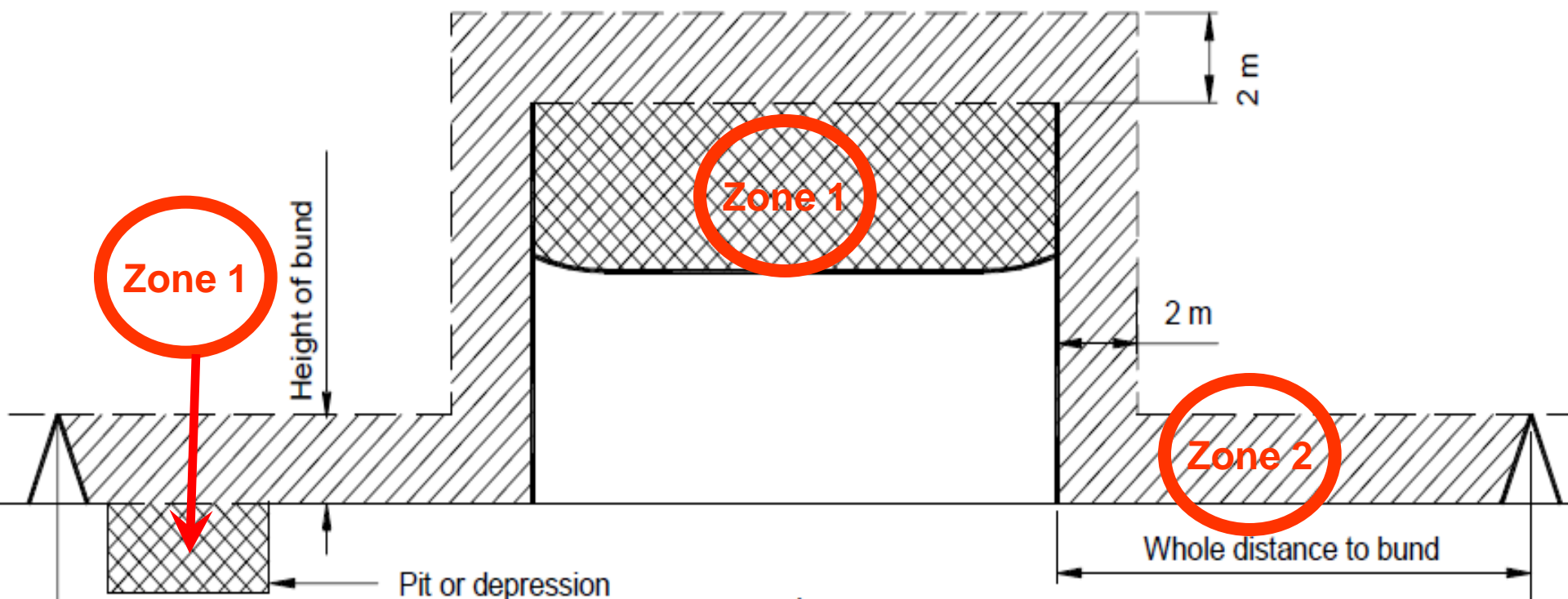
- Cone Roof Storage Tank





Zone Classification

- Floating Roof Storage Tank





Classification of Zone (Division)

- Zone (Division) classification is based on the frequency of release.
- Each zone (division) is further classified into Groups and Temperature Class based on the properties of flammable material processed in that zone (division).



Gas Group

- Flammable materials are sub-divided into groups based on minimum ignition energy required for igniting them.

Typical Gas Hazard	NEC Article 500	IEC
Acetylene	A	IIC
Hydrogen	B	IIC
Ethylene	C	IIB
Propane	D	IIA





Auto-ignition Temperature (AIT)

- Minimum temperature required to initiate or cause self-sustained combustion of the fluid independent of the heating.



Temperature Class

- Temperature Class is assigned to flammable material based on its auto-ignition temperature.

Temperature Class	Auto-ignition Temperature (° C)
T1	>450
T2	>300
T3	>200
T4	>135
T5	>100
T6	>85





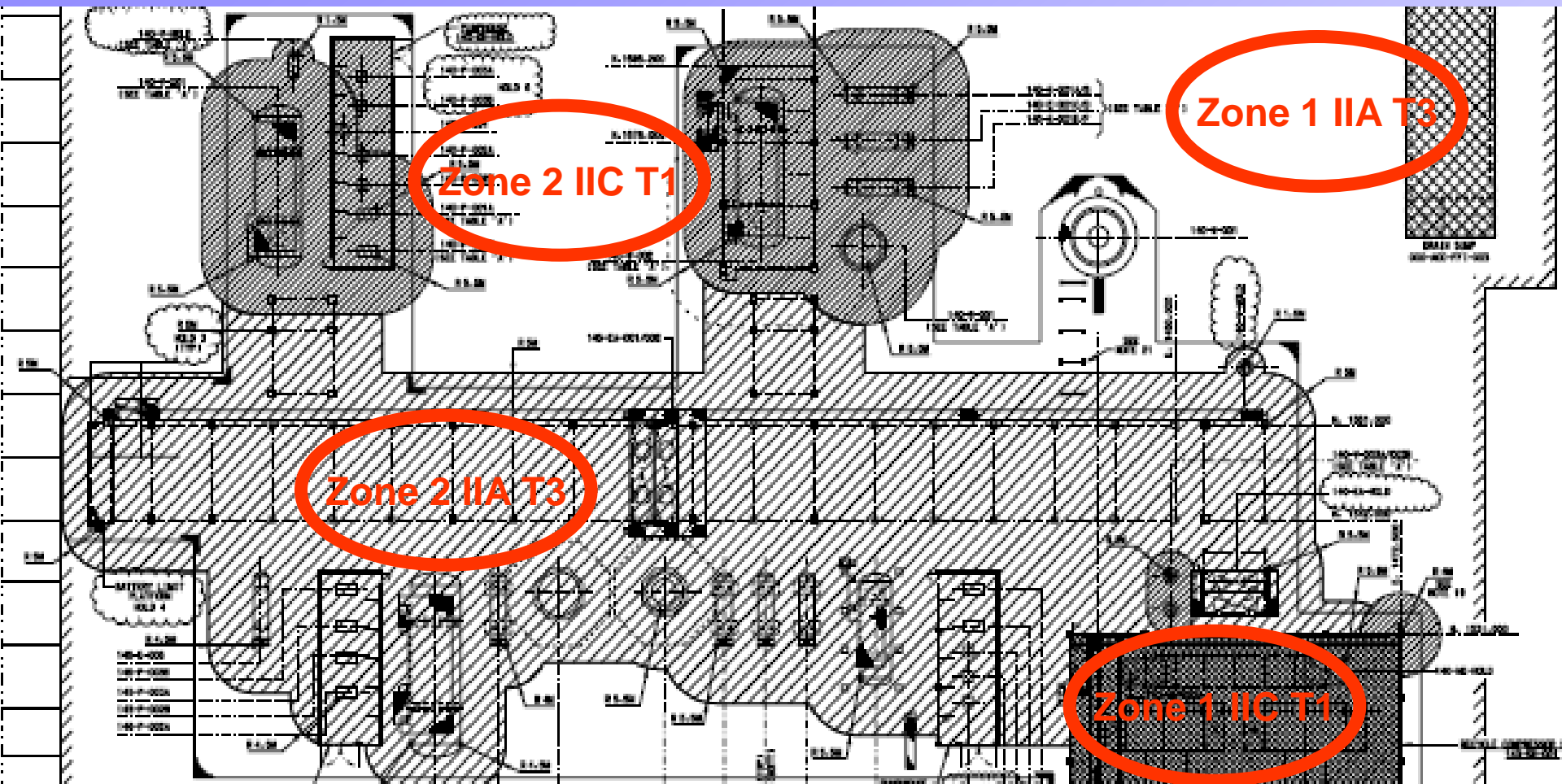
Auto-ignition Temperature (AIT)

Material	AIT (° C)	Temperature Class
Methane	595	T1
Ethane	515	T1
Propane	470	T1
Butane	365	T2
Pentane	285	T3





Area Classification





Battery Room

- Lead acid batteries emit H_2 during charging and create hazardous area
- Battery rooms are classified as Zone 1 Group IIC Temperature Class T1



Selection of Electrical Equipment

Factors to be considered:

- Zone in which the equipment will be used.
- Sensitivity to ignition of the material likely to be present, expressed as a gas group.
- Sensitivity of the material present to ignition by hot surfaces, expressed as a temperature class.



Selection According to Zone Classification

- Equipment suitable for Zone 0 can be used in Zones 0, 1 or 2.
- Equipment suitable for Zone 1 can be used in Zones 1 or 2.
- Equipment suitable for Zone 2 can be used only in Zone 2.





Selection According to Gas Groups

- Grouping becomes more severe in going from IIA to IIB to IIC.
- Group IIB equipment may be used in place of Group IIA equipment.
- Group IIC equipment can be used in place of equipment for both Group IIA and IIB.



Selection According to Temperature Class

Temperature Class	Maximum Surface Temperature (° C)
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

- Equipment having a lower maximum surface temperature class may be used in place of that a higher maximum surface temperature (lower T class), but not conversely.





Equipment Protection

- **Oil Immersed Protection**
Heavy current switchgear and transformers
- **Pressurization or Continuous Dilution**
Analyzers, control boxes, etc
- **Powder-filled Protection**
Electronics, chokes, etc
- **Flame-proof Enclosure**
Motors, lighting, junction boxes, etc





Summary

- Identify the flammable materials.
- Identify sources of release and determine grade of release (and hence Zone 0, 1, 2 or Division 1, 2).
- Determine extent of hazardous area.
- Assign Gas Groups and Temperature Class.
- Select appropriate Electrical apparatus.



Thank you

