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Introduction to Hazardous Areas and HA Classification (repeat)

Thursday, 9 February 2023 | Technical Engineering Webinar

Presented By

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Common Questions/FAQs



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Alexandra Gregory

EIT Lecturer & AECOM Principal Engineer

- Chartered Professional Engineer (CPEng) with Engineers Australia
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- National Engineering Register (NER)

Agenda

1	Welcome and Introduction
2	Introduction to Hazardous Areas
3	Classification Terminology
4	Properties of Hazardous Materials
5	Hazardous Area Classification Process
6	Conclusion and Q&A



Introduction to Hazardous Areas

What is a Hazardous Area? An area in which an explosive atmosphere is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of potential ignition sources

Can be caused by

- Gases/Liquids
- Dusts
- Mining (Methane)

What are some examples?

- Refuelling or petrol stations
- Metal surface grinding (especially aluminium dusts)
- Aircraft refuelling and hangars
- Hospital operating theatres
- Processing plants
- Sewerage treatment plants
- Gas pipelines
- Woodworking areas
- Sugar refineries

Hazardous Classification Standards (Australia)

- AS/NZS 60079.10.1:2022 – Gas/Vapour/Mist
(IEC 60079-10-1:2020 (ED.1.0) MOD)
- AS/NZS 60079.10.2:2016 – Combustible Dusts
(IEC 60079-10-2:2015 (ED.2.0) MOD)
- AS/NZS 60079.14:2022 – Design selection, erection and initial inspection
(IEC 60079-14:2013 (ED.5.0) MOD)
- AS/NZS 60079.20.1 – Material properties
(IEC 60079-20-1:2010, Ed. 1.0 (Withdrawn))

Introduction to Hazardous Areas

The above hazardous areas do not include **Explosive Hazardous Areas (EHAs)** which are covered under a separate set of regulations (eg eDEOP for Defence)

Dangerous Goods are substances that are corrosive, flammable, explosive, spontaneously combustible, toxic, oxidising or water reactive.

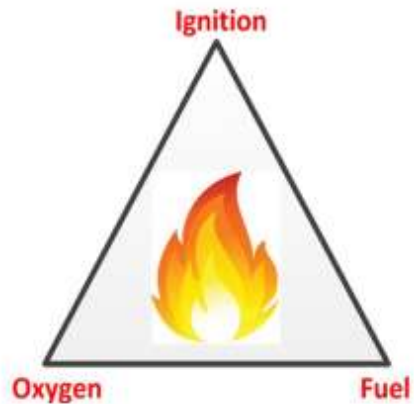
Classification of dangerous goods is described in the *Australian code for the Transport of Dangerous Goods by Road and Rail*, which is closely aligned with international requirements of the *United Nations Recommendation on the Transport of Dangerous Goods*, and relevant state legislation, which may provide additional guidance on specific materials.

Introduction to Hazardous Areas

Causes of Explosions

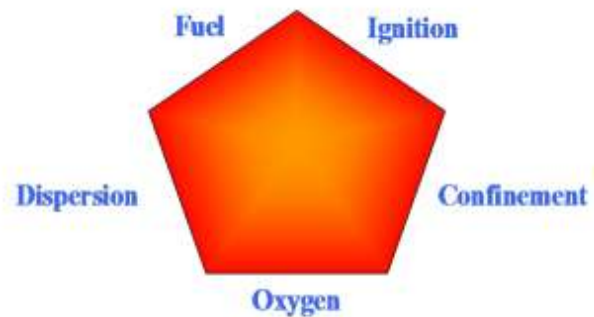
Infernal Triangle

Figure 3 The Infernal Triangle



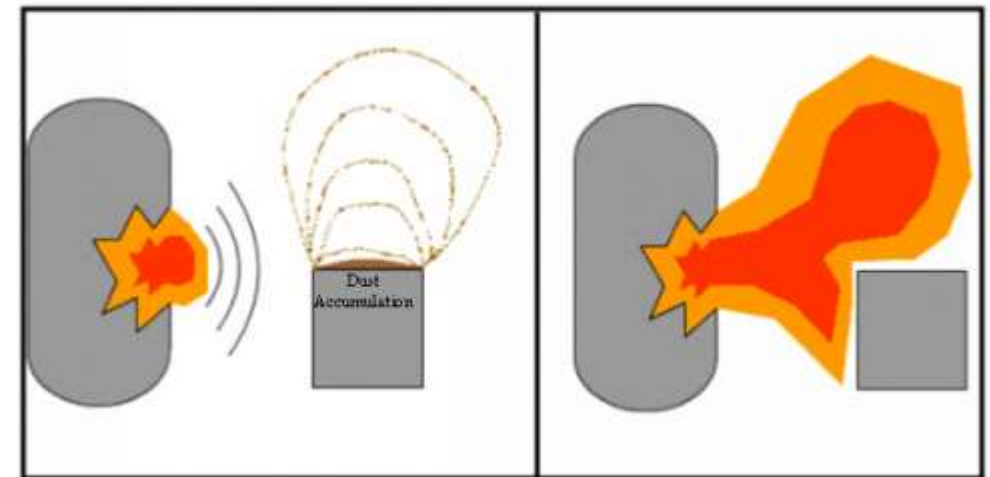
Dust Pentagon

and The Dust Pentagon



Dust Explosion

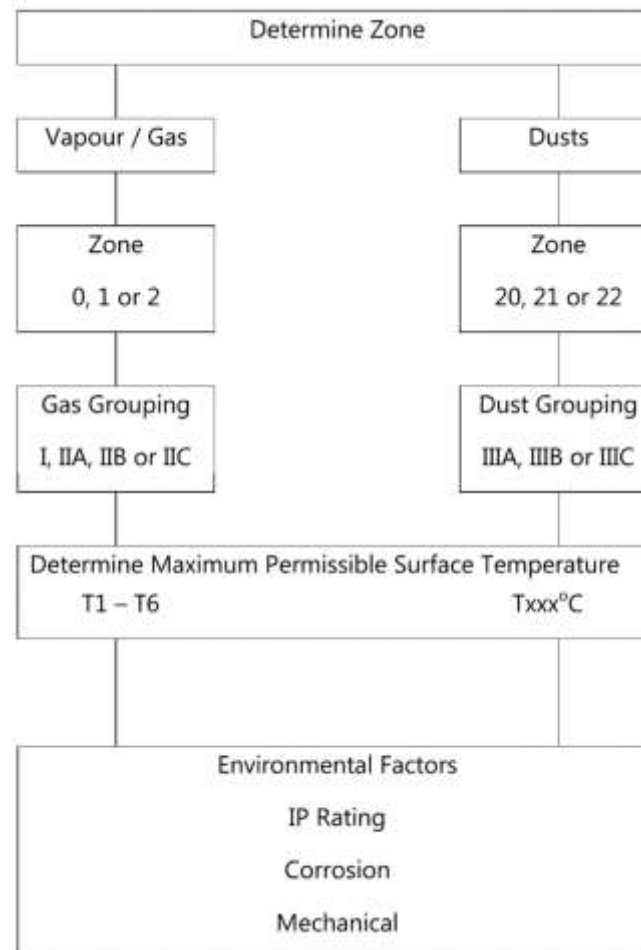
Figure 9 Dust Explosion



2012 Gas Plant Explosion – Mexico



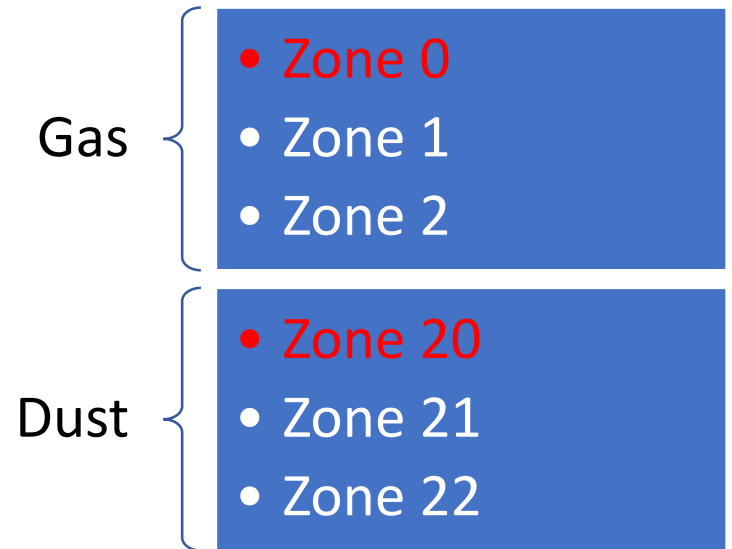
Classification Terminology – Overview



Classification Terminology - Zones

Probability of a hazardous area being forming within certain areas and the duration it exists (0 is most likely - 2 less likely, NH no risk).

- Zone 0 – an area in which explosive gas atmosphere is **present continuously**, or is expected to be present for long periods of time
** this is the most onerous**
- Zone 1– an area in which explosive gas atmosphere is **likely to occur** in normal operation occasionally
- Zone 2 – an area in which explosive gas atmosphere is **not likely to occur** in normal operation and if it does it will exist for short period only or abnormal conditions



Classification Terminology – Material Group

In addition to the probability of an explosive atmosphere being present (as defined by the Zone), the **properties** of the material causing the hazard are also considered.

Groups are related to the hazard.

- Group I = Coal Mines (Methane) and Coal Dust
- Group II = Explosive Gas Atmospheres
- Group III = Combustible Dust Atmosphere

Classification Terminology - Sub-Groups

Sub-groups are defined by energy levels

For Group II (GAS), there are three subgroups

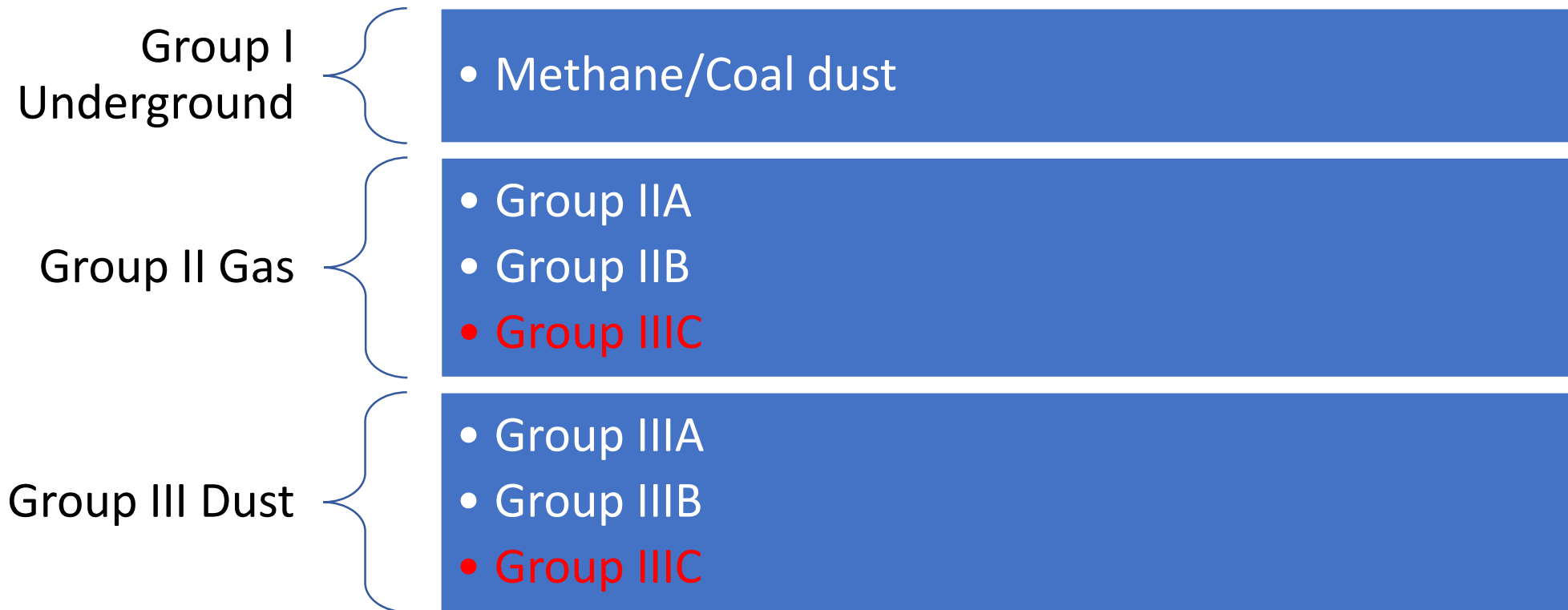
- Group IIA = Methane and Propane
- Group IIB = Ethylene
- Group IIC = Hydrogen and Acetylene *** this is the most onerous***

DUST - Combustible Dust Atmosphere

- Group IIIA: Large particles (flyings) - requires IP5X
- Group IIIB: Non-conductive ($> 1\text{k}\Omega$) - requires IP5X
- Group IIIC: Conductive ($< 1\text{k}\Omega$) - requires IP6X *** this is the most onerous***

Classification Terminology

Putting it all together



Properties of Hazardous Materials

Flammable Verse Combustible

< 61 degrees – flammable

> 61 degrees - combustible (high flash point) --> No zones required for combustible

You need EX rated equipment for Flammable material as it is considered 'Hazardous'. You do not need Ex rated equipment for Combustible.

Gas v Vapour V Mist

At normal temperature:

Gas – does not occur in liquid form

Vapour – may be in contact with its liquid form

Mist - Cloud of condensed vapour

Properties of Hazardous Materials

Auto Ignition Temperature determines the likelihood of an explosion occurring without an ignition source, for example, as a result of a hot surface. Dust has different temperatures for 'layer' versus 'cloud'

Minimum ignition energy is energy in Joules (watt-sec) required to ignite a substance. A certain minimum energy required is for an explosion to occur.

Flashpoint is an indication of whether a flammable mixture mix of vapour and air is likely to occur above a liquid at a given temperature.

Properties of Hazardous Materials

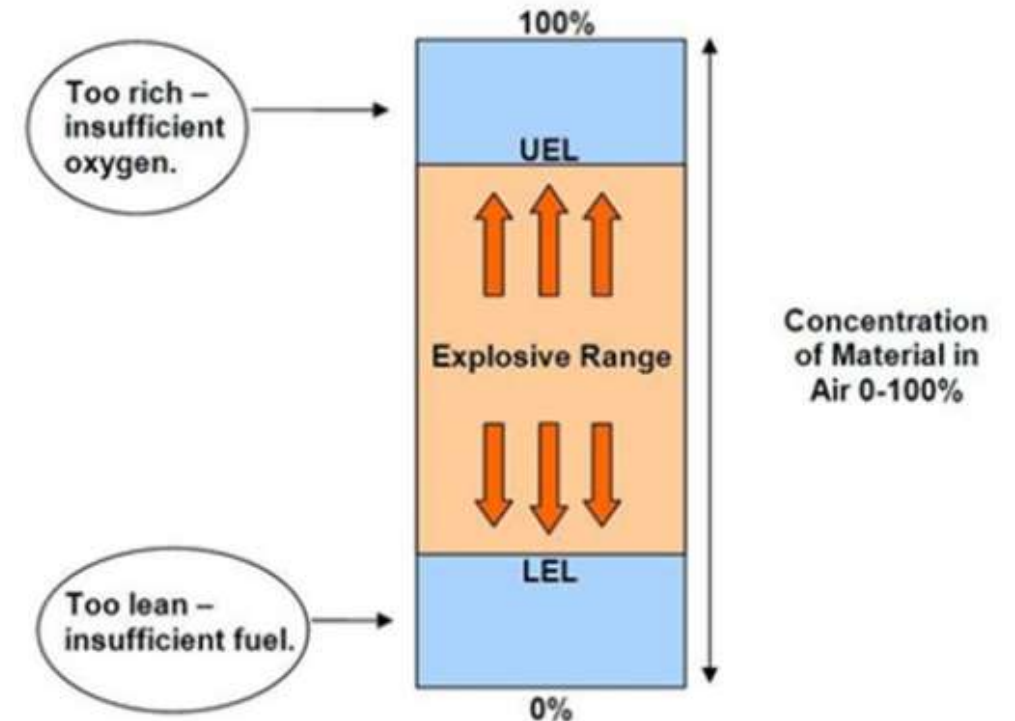
UEL – Upper Explosive Limit

LEL – Lower explosive limit

→ lower the flashpoint the more dangerous the vapour is!

→ Gases do not have a flashpoint because they are already vapours

Figure 6 Explosive Range Explained



Properties of Hazardous Materials

Example of Flammable Liquids and Gases and their properties from AS/NZS 60079.20.1

→ Always refer to the safety data sheet for the specific product

Table 8 Examples of Flammable Liquids and Gases and their Properties

Reference **AS/NZS 60079.20.1** and Safety Data Sheets.

Material	Boiling Point (°C at 1 atm)	Flashpoint (°C, closed cup)	Auto Ignition Temperature (°C)	Group II	Explosive Limits (% Fuel)		Relative Vapour Density (Air = 1)
					LEL	UEL	
Acetone	56	-20	465	IIA	2.15	13	2
Acetylene	-83	Gas	305	IIC	2.5	100	0.9
Ammonia	-33	Gas	651	IIA	16	25	0.6
Benzene	80	12	498	IIA	0.9	2.8	2.8
Butane	-1	Gas	372	IIA	1.6	8.4	2
Butyl amine	-6	Gas	312	IIA	1.7	9.8	2.5
Carbon monoxide	-----	Gas	805	IIA	10.9	74	0.97
Ethane	-89	Gas	472	IIA	3	12.5	1
Ethanol	78	12	363	IIIB	3.3	19	1.6
Ethyl methyl ether	7.4	Gas	190	IIIB	2.0	10.1	2.1
Ethylene	-104	Gas	425	IIIB	2.3	36	1
Ethylene oxide	11	-18	435	IIIB	2.6	100	1.5

Properties of Hazardous Materials

Temperature Class

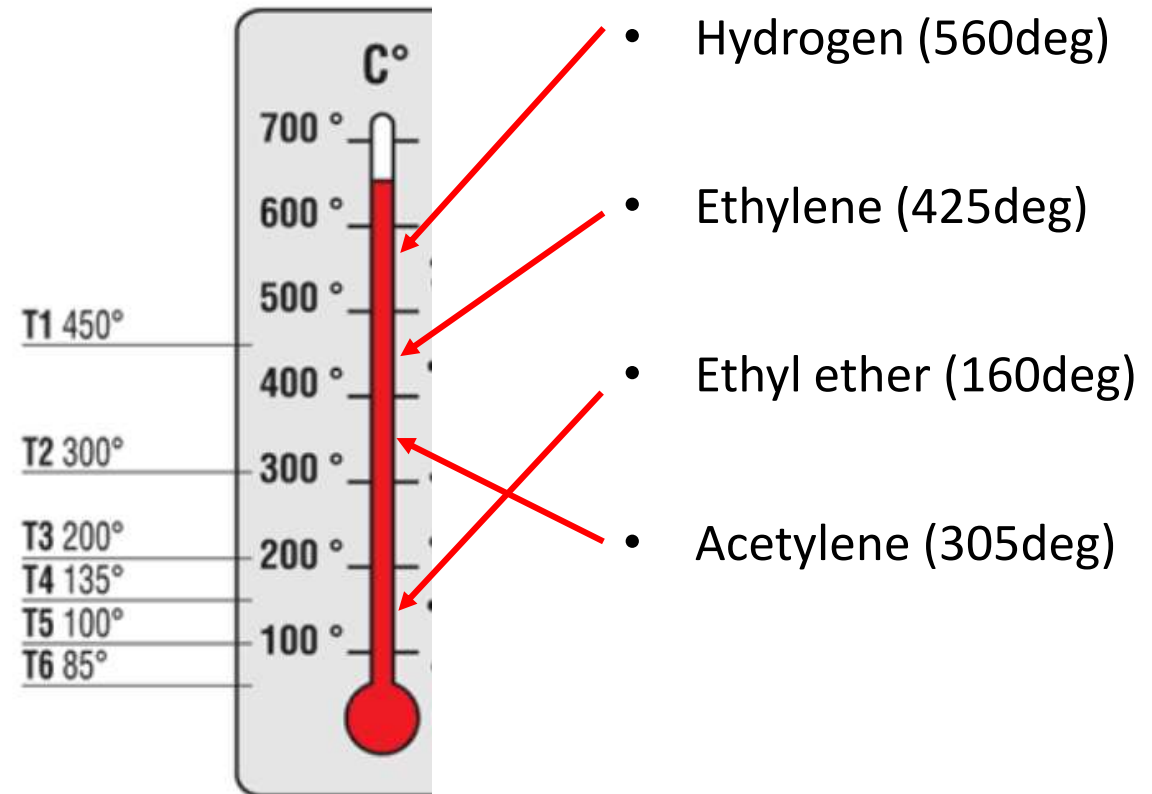
The hazardous area will have an Auto-Ignition Temperature (AIT) - where by the temperature can ignite the flammable gases/vapour without a spark.

Any equipment located within the defined hazardous area must be prevented from reaching the AIT.

Properties of Hazardous Materials

Temperature Class Example

Equipment Temperature Class required by Area Classification	Ignition Temperature of Gas/Vapour (°C)	Allowable Equipment Temperature Classes
T1	450	T1 – T6
T2	300	T2 – T6
T3	200	T3 – T6
T4	135	T4 – T6
T5	100	T5 – T6
T6	85	T6



Hazardous Area Classification Process

Hazardous Areas – Why Classify?

Identify where there is a high probability that an explosive atmosphere may exist so that **control measures** can be implemented

We can reduce the risk through Hierarchy of Controls

- Substitution
- Control
- Mitigation

Hazardous Area Classification Process

Hazardous Areas – Defined by Who?

The standard requires that Hazardous Areas are classified by a competent person. In this instance, a competent person is someone who is qualified (through formally recognised training program)

You must also be deemed competent to

- Select equipment for installation within Hazardous Areas
- Conduct Audits / Inspections of the Hazardous Areas

Competency defined by AS/NZS 60079.14 Explosive atmospheres (IEC 60079-14:2013 (ED.5.0))

Hazardous Area Classification Process

1. Define the Hazard
2. Assess the probability of an explosive atmosphere occurring
3. Produce Documentation

Hazardous Area Classification Process

1. Define the Hazard

Consider Personnel (External) influences

- What maintenance operations impact safety
- Operation procedures
- Processes nearby
- Evacuation procedures

Understand process conditions

- Ambient temperatures
- Process pressures
- Storage / handling

Hazardous Area Classification Process

2. Assess the Probability

Identify source of release / grade of release

- Continuous / intermittent release
- Normal or only during failure

Define Ventilation

- Adequate / not adequate

Define Hazardous 'Zones'

- Zone is the frequency and duration of a release
- E.g Zone 0 / 1 / 2 for Gas or Zone 20 / 21 / 22 for Dust

Hazardous Area Classification Process

Example Classification

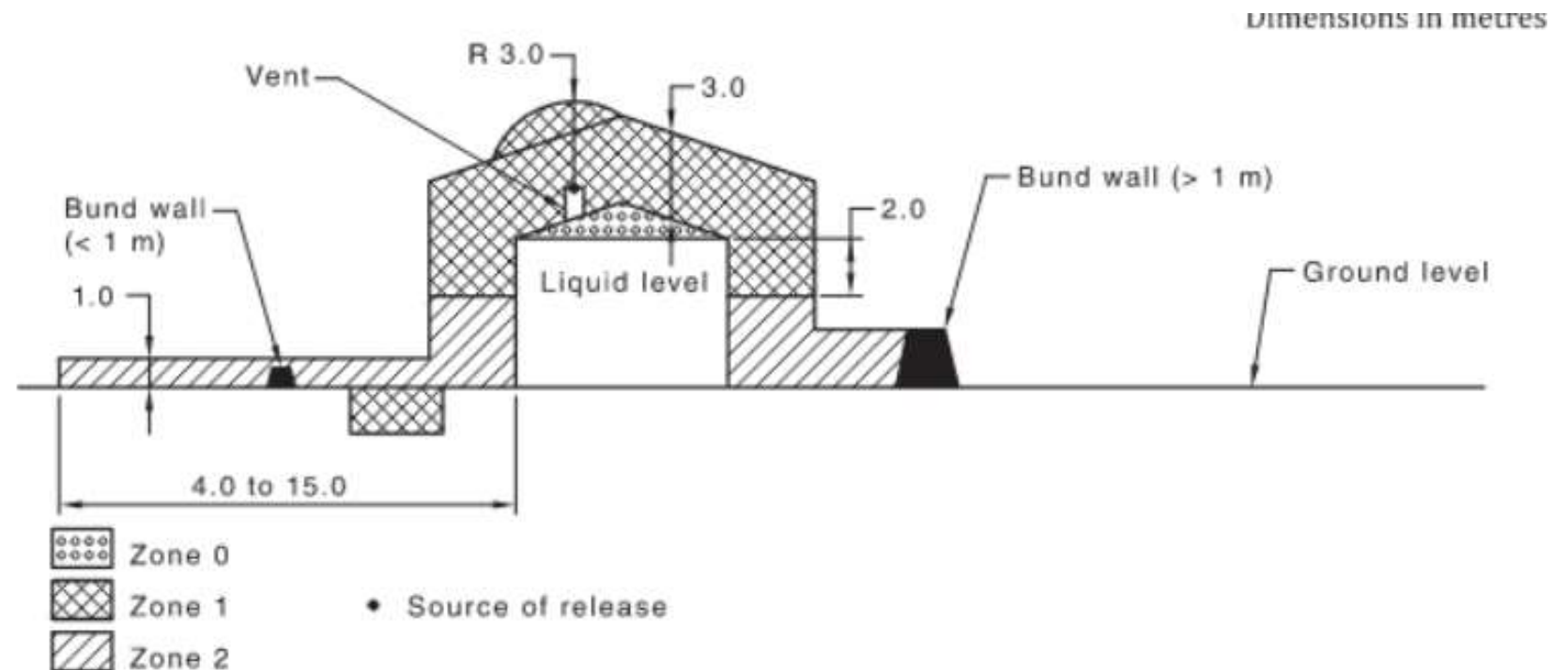


Figure C.3.3 — Above ground fixed roof vented storage tanks, outdoors — GHS Category 1

Hazardous Area Classification Process

3. Document

Classification Report

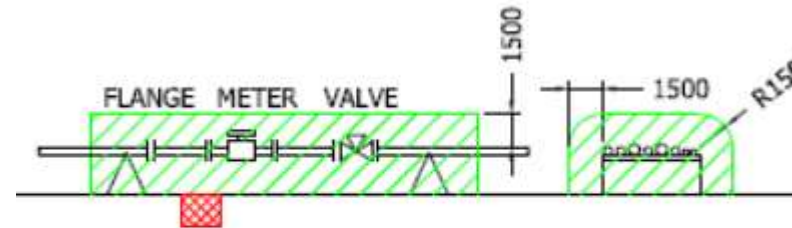
- Report background and captures client comments
- Explanation of assumptions
- Information used (SDS, temperature, pressure, location etc)
- Basis of certification relating to Type, Zone etc

Drawings

- Type and extent of zones
- Temperature class
- Gas Group designation

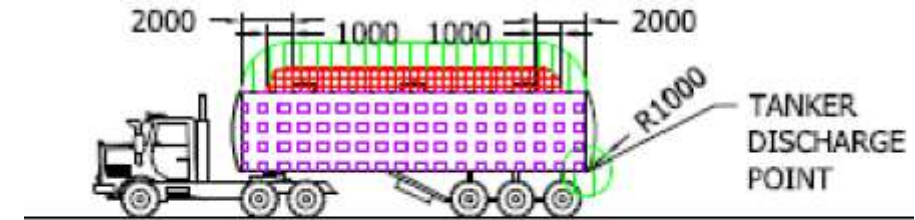
Hazardous Area Classification Process

Examples



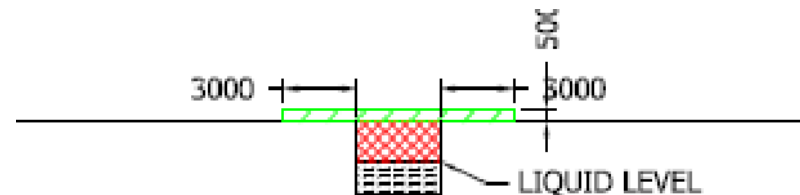
FLAMMABLE LIQUID DETAIL 1A

PLANT PIPELINES IN ADEQUATELY
VENTILATED LOCATIONS
SOURCE OF RELEASE METHOD
AS/NZS 60079.10.1:2009 CLZA.5.2.8



DETAIL 106

TYPICAL TRANSPORT TRUCK
UNLOADING OPERATION ONLY
AS/NZS 61241.10:2005 CL6.3.2, 6.3.3



FLAMMABLE LIQUID DETAIL 4B

OPEN TOPPED EFFLUENT PITS (BELOW GROUND LEVEL)
AS/NZS 60079.10.1:2009 CLZA.5.2.10(b)



- Hazardous Areas may be present in existing or new installations and involve Flammable liquids, vapours, gases or dusts
- Flammable is different to Combustible
- Dangerous goods can include Hazardous materials, but also are separate
- Gas Groups are IIA, IIB and IIC and can be Zone 0, 1 or 2
- Dust Groups are IIIA, IIIB or IIIC and can be Zone 20, 21, 22
- Classification Process: Define the Hazard, Assess the probability, Document

Whenever a hazardous area is encountered seek advice from a “Competent Person”

Thank you

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Q&A

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