

# 9<sup>th</sup> Chemical Process Safety Sharing (CPSS)

## Hazardous Area Classification IEC based

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# Safety Principles



For location where an explosive gas atmosphere may present, action should be taken to eliminate:

- the likelihood of an explosive gas atmosphere occurring around the source of ignition, or
- **the source of ignition.**



# Introduction to IEC 60079-10s

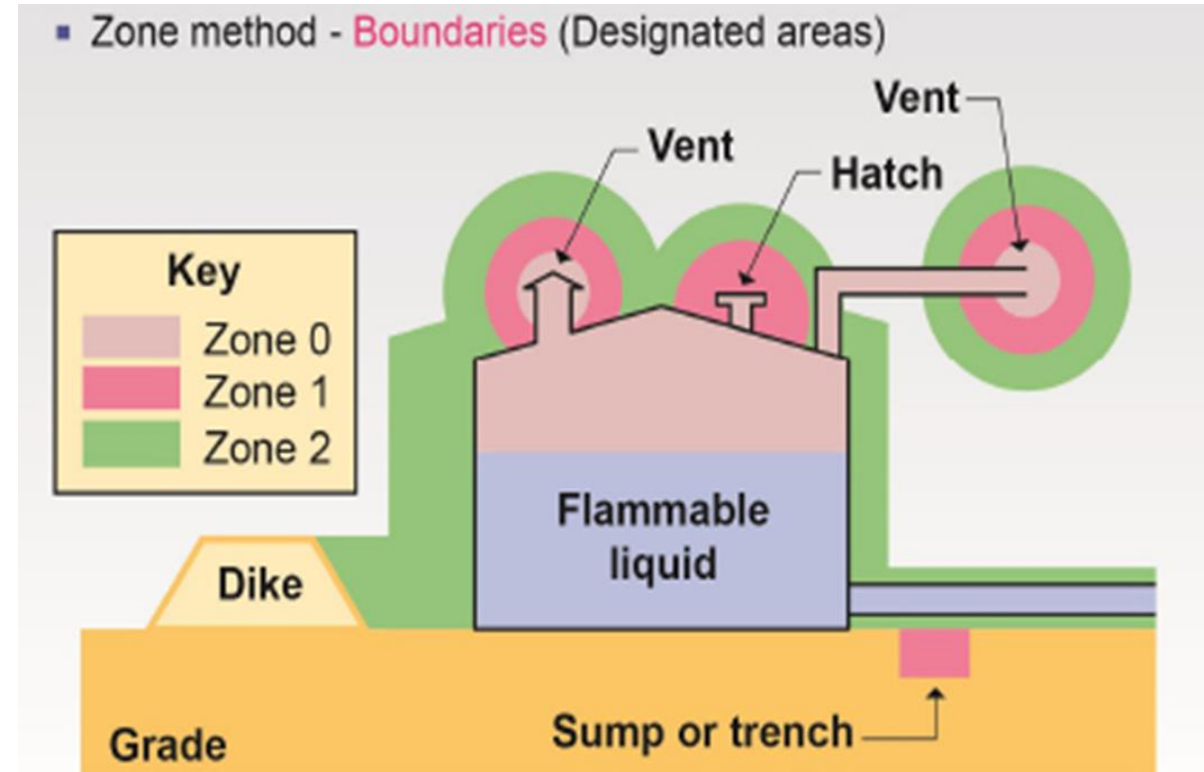


- Zone based method
- 60079-10-1 – Explosive **gas** atmospheres\*
- 60079-10-2 – Explosive **dust** atmospheres

# Zone Definition



- Zone 0 - Area in which an **explosive gas atmosphere is present continuously**, or for long periods, or frequently.
- Zone 1 - Area in which an **explosive gas atmosphere is likely to occur occasionally** in normal operation.
- Zone 2 - Area in which an **explosive gas atmosphere is not likely to occur** in normal operation, but, if it does occur, will exist for a short period only



Ref.: <https://blog.isa.org/design-industrial-control-panels-hazardous-locations>

# Classification Methods Allowed



## Sources of release method

Manual calculation method

Computer software  
e.g. PHAST or CFD

## Use of industry codes and national standards

API RP 505  
API 59A  
NFPA 496 / 497  
EI 15

## Simplified method

Industry experience  
and appropriate to  
the particular plant.

Conservative

## Combination of methods



# Sources of release method



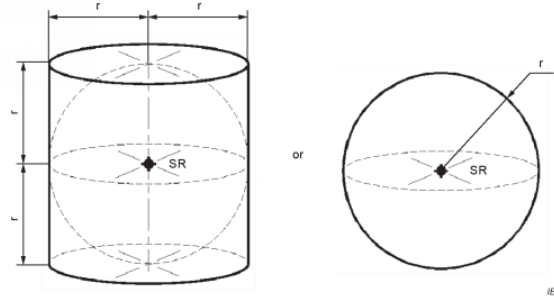
- Calculation of release rate
- Determining zone type
- Estimating the extent of hazardous zone
- Documentation

# Shape of Hazardous Area

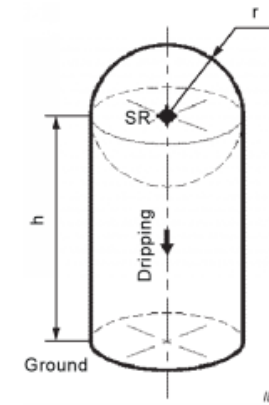


Depend on characteristic of release fluid, pressure, temperature

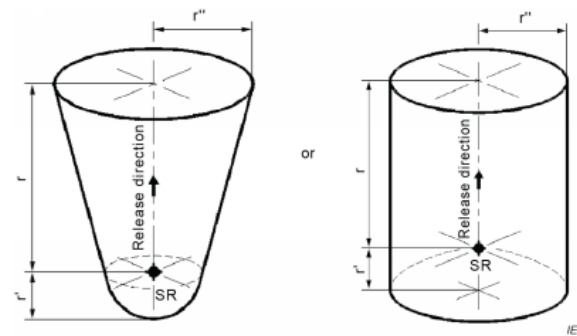
Gaseous Release at **Low Pressure**



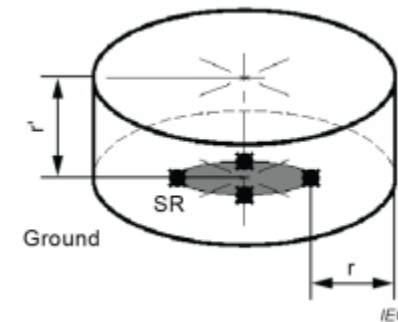
**Liquefied Gas** under Pressure



Gaseous Release at **High Pressure**



**Liquid Pool**



# Determination Type of Zone



Grade of release	Effectiveness of Ventilation						
	High Dilution			Medium Dilution			Low Dilution
	Availability of ventilation						
	Good	Fair	Poor	Good	Fair	Poor	Good, fair or poor
<b>Continuous</b>	Non-hazardous (Zone 0 NE) <sup>a</sup>	Zone 2 (Zone 0 NE) <sup>a</sup>	Zone 1 (Zone 0 NE) <sup>a</sup>	Zone 0	Zone 0 + Zone 2 <sup>c</sup>	Zone 0 + Zone 1	Zone 0
<b>Primary</b>	Non-hazardous (Zone 1 NE) <sup>a</sup>	Zone 2 (Zone 1 NE) <sup>a</sup>	Zone 2 (Zone 1 NE) <sup>a</sup>	Zone 1	Zone 1 + Zone 2	Zone 1 + Zone 2	Zone 1 or zone 0 <sup>c</sup>
<b>Secondary<sup>b</sup></b>	Non-hazardous (Zone 2 NE) <sup>a</sup>	Non-hazardous (Zone 2 NE) <sup>a</sup>	Zone 2	Zone 2	Zone 2	Zone 2	Zone 1 and even Zone 0 <sup>d</sup>
<p><sup>a</sup> Zone 0 NE, 1 NE or 2 NE indicates a theoretical zone which would be of negligible extent under normal conditions.</p> <p><sup>b</sup> The Zone 2 area created by a secondary grade of release may exceed that attributable to a primary or continuous grade of release; in this case, the greater distance should be taken.</p> <p><sup>c</sup> Zone 1 is not needed here. I.e. small Zone 0 is in the area where the release is not controlled by the ventilation and larger Zone2 for when ventilation fails.</p> <p><sup>d</sup> Will be Zone 0 if the ventilation is so weak and the release is such that in practice an explosive gas atmosphere exists virtually continuously (i.e. approaching a 'no ventilation' condition).</p> <p>'+' signifies 'surrounded by'.</p> <p>Availability of ventilation in naturally ventilated enclosed spaces is commonly not considered as good.</p>							



# Extent zone of Fuel Gas Vessel



- Fluid: Natural Gas (MW = 19)
- Pressure: 45 Barg
- Temperature: 38°C

- Zone 2
- Extent zone = 3 m

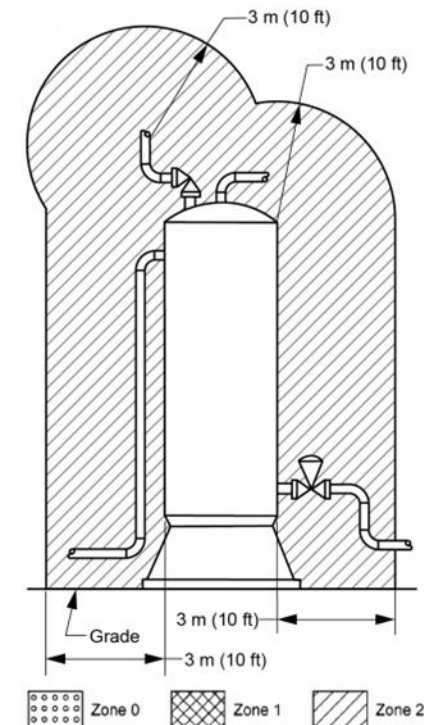


Figure 48—Hydrocarbon Pressure Vessel or Protected Fired Vessel in a Non-enclosed, Adequately Ventilated Area



- Hole cross sectional area: 0.25 mm<sup>2</sup>
- Release rate = 1.6 x 10<sup>-3</sup> kg/s

$$W_g = C_d S p \sqrt{\gamma \frac{M}{ZRT} \left( \frac{2}{\gamma+1} \right)^{(\gamma+1)/(\gamma-1)}} \quad (\text{kg/s})$$

- Volumetric release characteristic = 0.042 m<sup>3</sup>/s

$$Q_C = \frac{W_g}{\rho_g \times LFL}$$

- For a lighter than air release in an unobstructed area, a ventilation velocity of 0.5 m/s at grade would be appropriate, → **Medium Dilution**

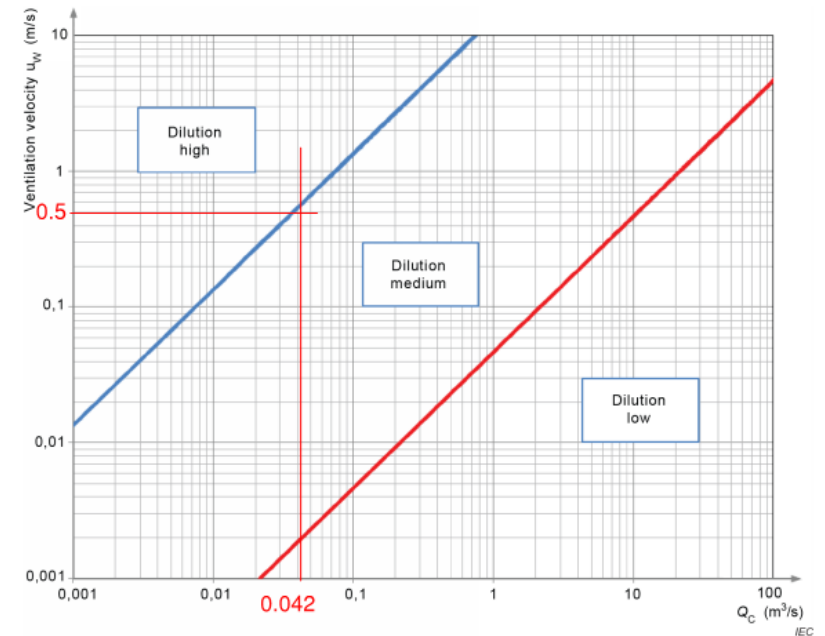


Figure C.1 – Chart for assessing the degree of dilution

# Zone Type



Table D.1 – Zones for grade of release and effectiveness of ventilation

Grade of release	Effectiveness of Ventilation						
	High Dilution			Medium Dilution			Low Dilution
	Availability of ventilation						
	Good	Fair	Poor	Good	Fair	Poor	Good, fair or poor
<b>Continuous</b>	Non-hazardous (Zone 0 NE) <sup>a</sup>	Zone 2 (Zone 0 NE) <sup>a</sup>	Zone 1 (Zone 0 NE) <sup>a</sup>	Zone 0	Zone 0 + Zone 2 <sup>c</sup>	Zone 0 + Zone 1	Zone 0
<b>Primary</b>	Non-hazardous (Zone 1 NE) <sup>a</sup>	Zone 2 (Zone 1 NE) <sup>a</sup>	Zone 2 (Zone 1 NE) <sup>a</sup>	Zone 1	Zone 1 + Zone 2	Zone 1 + Zone 2	Zone 1 or zone 0 <sup>c</sup>
<b>Secondary<sup>b</sup></b>	Non-hazardous (Zone 2 NE) <sup>a</sup>	Non-hazardous (Zone 2 NE) <sup>a</sup>	Zone 2	Zone 2	Zone 2	Zone 2	Zone 1 and even Zone 0 <sup>d</sup>

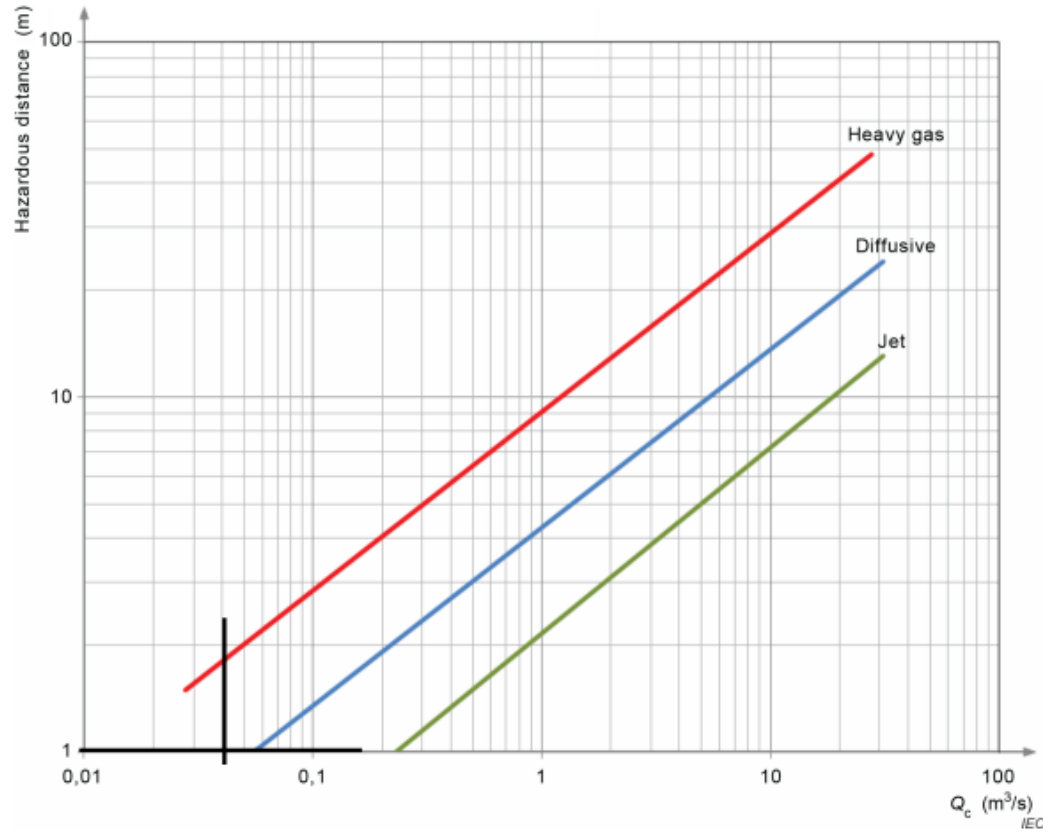


Figure D.1 – Chart for estimating hazardous area distances

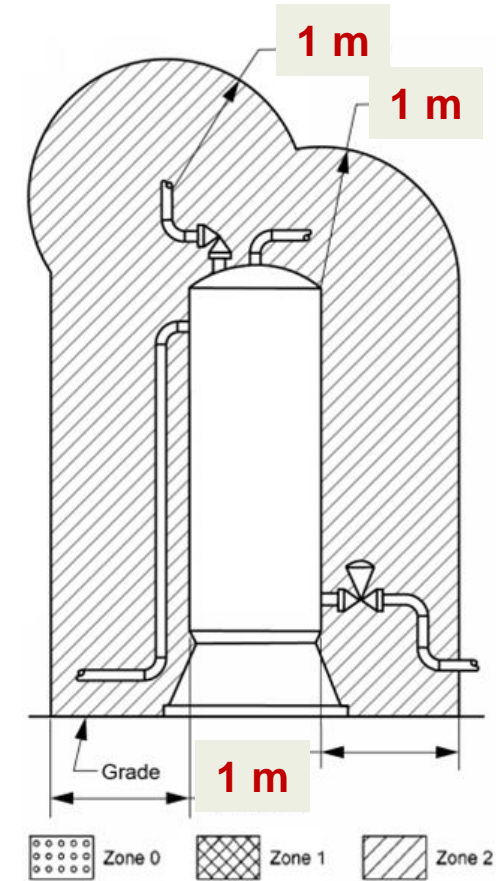


Figure 48—Hydrocarbon Pressure Vessel or Protected Fired Vessel in a Non-enclosed, Adequately Ventilated Area



# Summary Why IEC Standard



- Objective based standard
- Equipment lower cost compared to NEC
- Various suppliers available in Thailand
- Majority of equipment and installations are IEC compliance.



Thank you for your attention