



MODULE II

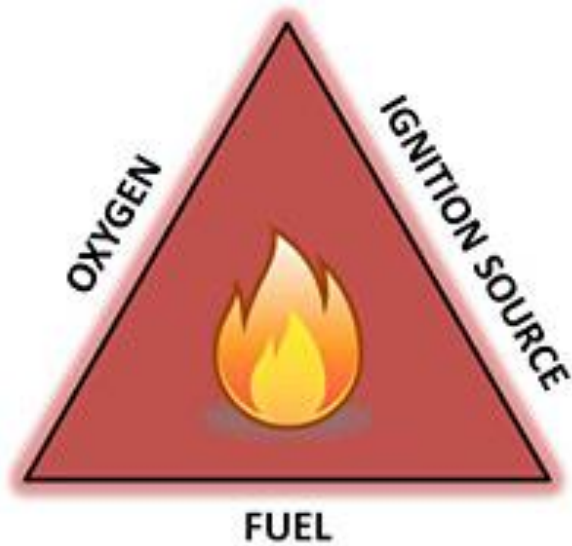
Classification of explosion protected electrical equipment



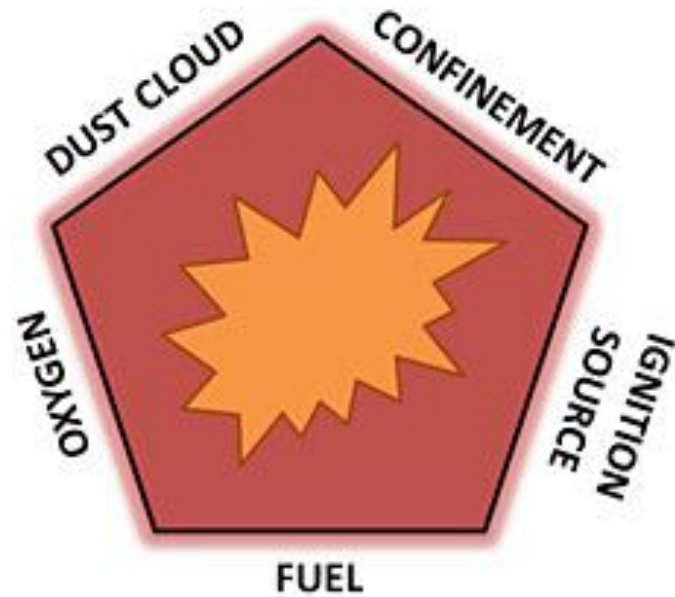
- **Fire triangle**
- **Gas groups and their characteristics**
- **Classification of zones**



Conditions of explosion occurrence



FIRE TRIANGLE



EXPLOSION PENTAGON



Oxygen-rich atmosphere

23,5
%
2



In industry flammable substances are:

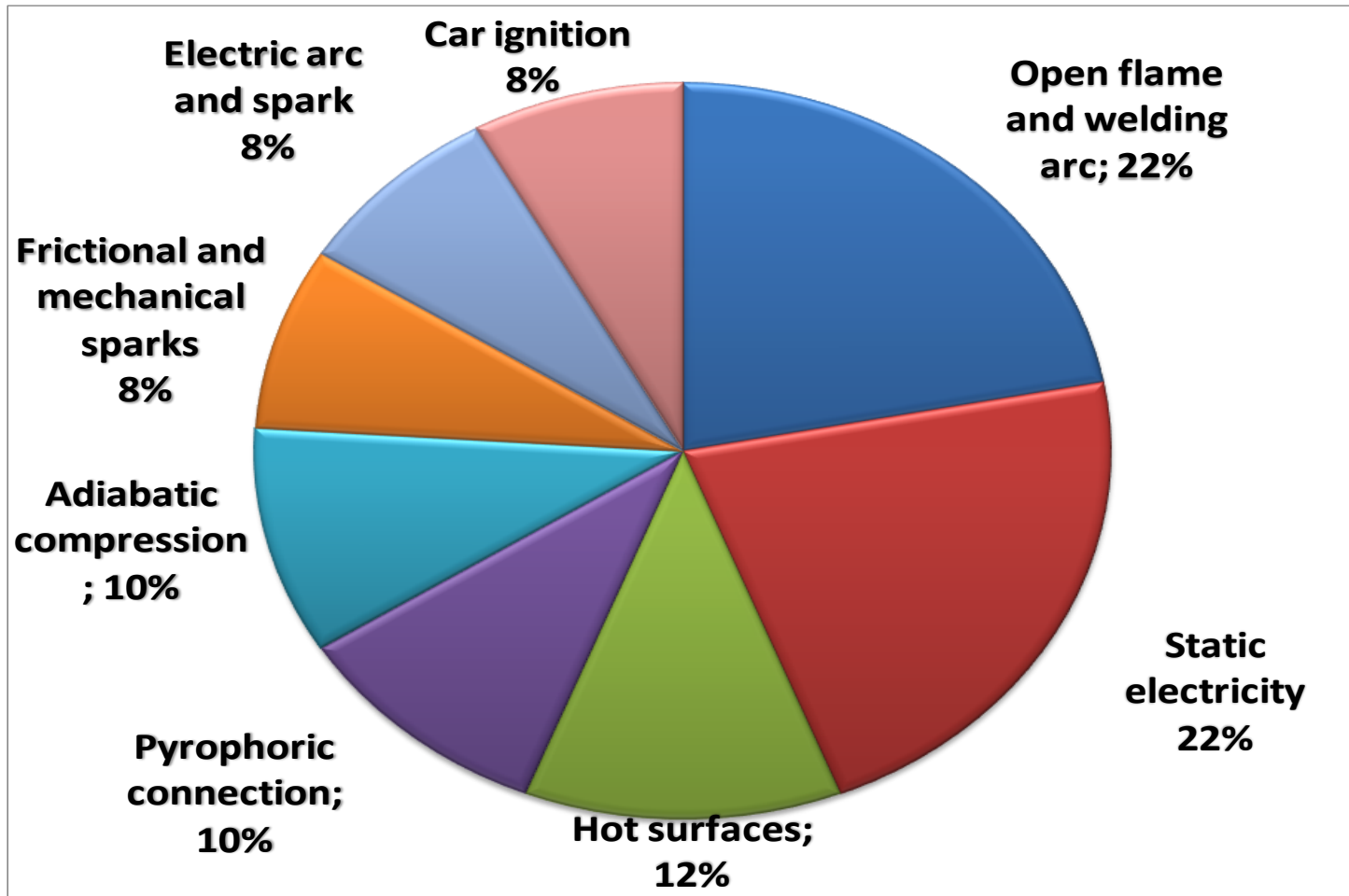
Gases
Vapors
Explosive Dust

MODULE I

Principles and Parameters Of Explosion Protection



Ignition sources





II A (Methanol, propane

II B (Ethylene, hydrogen sulfide...)

II C (Hydrogen, acetylene

IEC 60079-20

Explosive environments. Characteristics of substances for the classification of gas and steam. Test methods and data

Criteria for grouping gases

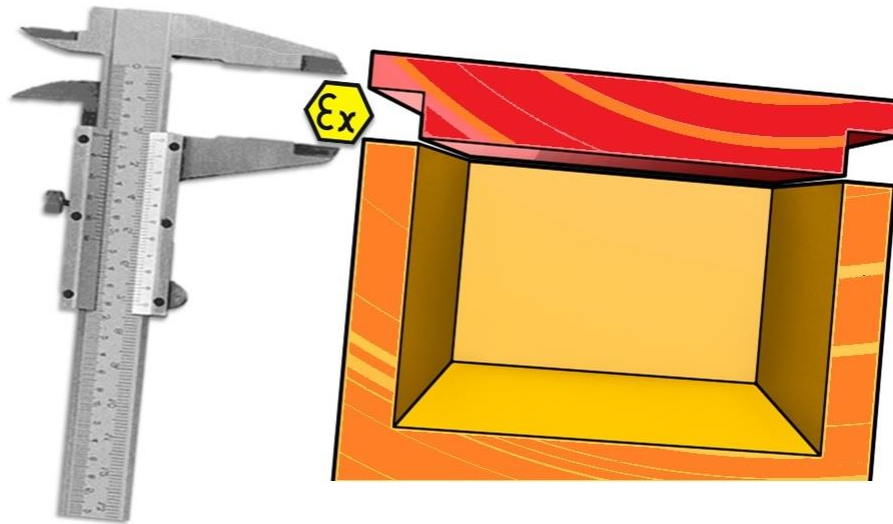


Gas group	MESG	MIC*CH ₄
II A	>0.9 mm	> 0.8
II B	0.5 – 0.9 mm	0.45 – 0.8
II C	< 0.5 mm	< 0.45

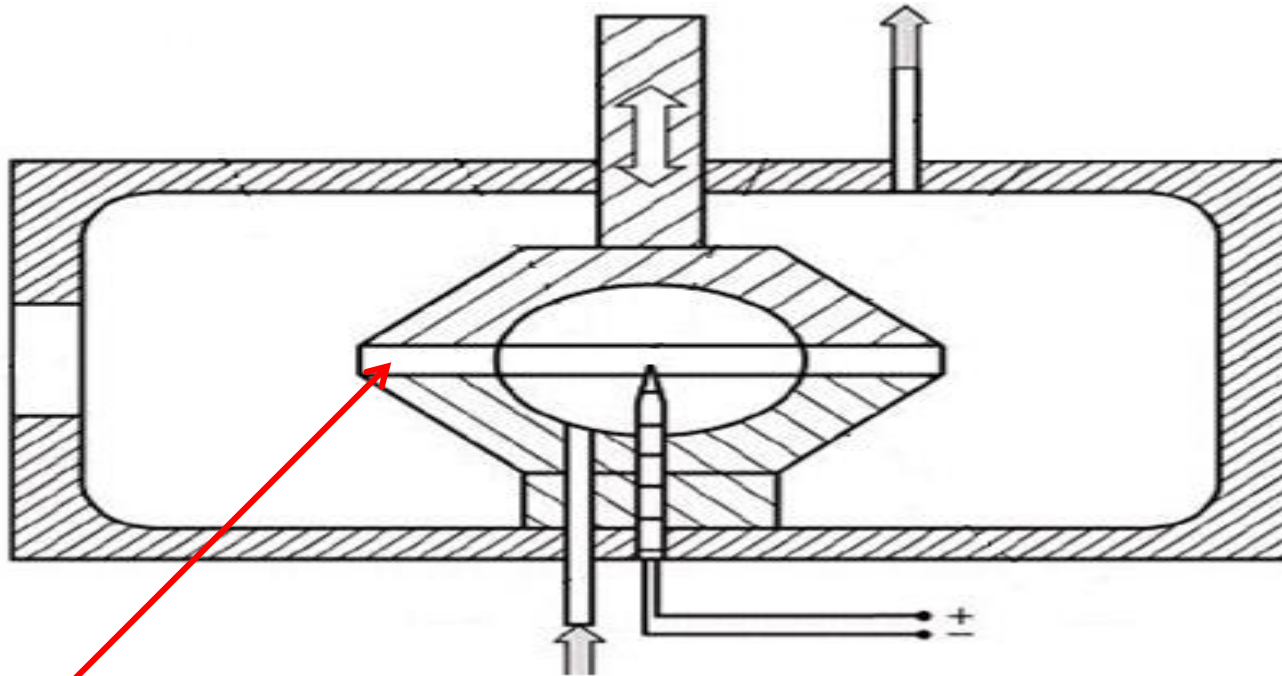
Maximum Experimental Safe Gap



The maximum gap between the two parts of the inner chamber, which, under the above test conditions, prevents the ignition of the external gas mixture through a 25 mm long ignition path when the internal mixture is ignited for all concentrations of gas or steam in the air.



MESG test installation :



The maximum gap between the housing and the cover of the equipment that will not lead to the spread of an explosion from the inside of the shell to the external environment

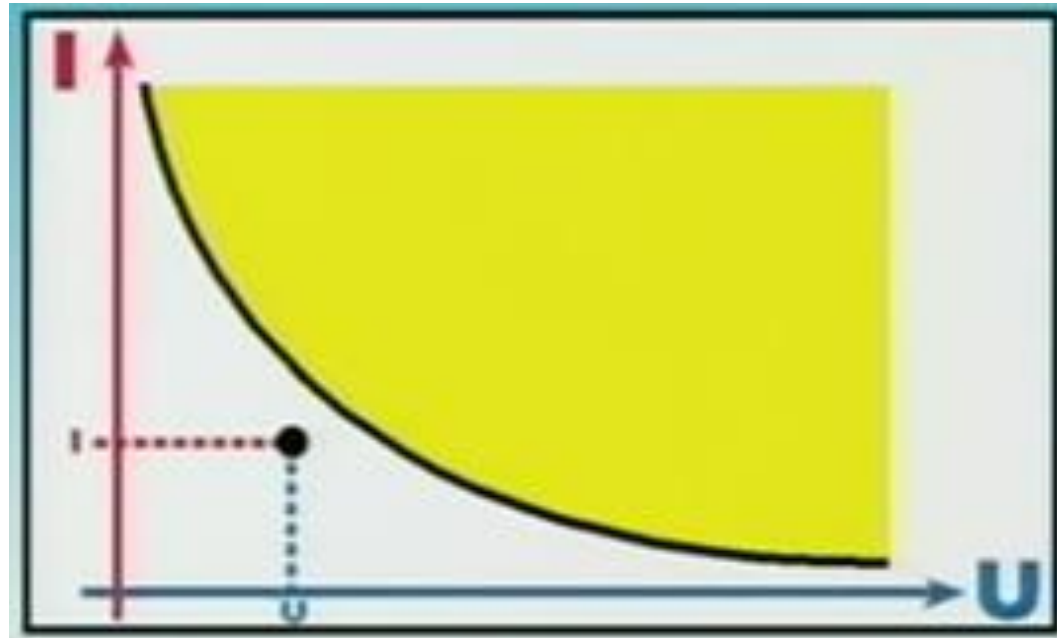
Maximum Experimental Safe Gap



MESG		
II A	Propane	0.92 mm
	AmmoniaMethyl	3.18 mm
	Mercaptan	1.15 mm
II B	Ethylene	0.65 mm
	Hydrogen sulfide	0.83 mm
	Ethanol	0.89 mm
II C	Hydrogen	0.29 mm
	Carbon disulfide	0.34 mm
	Acetylene	0.37 mm

MIC

the ratio between the minimum ignition current of the test gas or steam and the minimum ignition current of methane (CH₄)



Minimum ignition current



MIC		
II A	Butane	0.94 *CH ₄
	Methanol	0.82 *CH ₄
	Benzene	1*CH ₄
II B	Ethylene	0.53*CH ₄
	Ethanol	0.88*CH ₄
	Methyl Ethyl ketone	0.92*CH ₄
II C	Hydrogen	0.25*CH ₄
	Acetylene	0.28*CH ₄
	Carbon disulfide	0.39*CH ₄

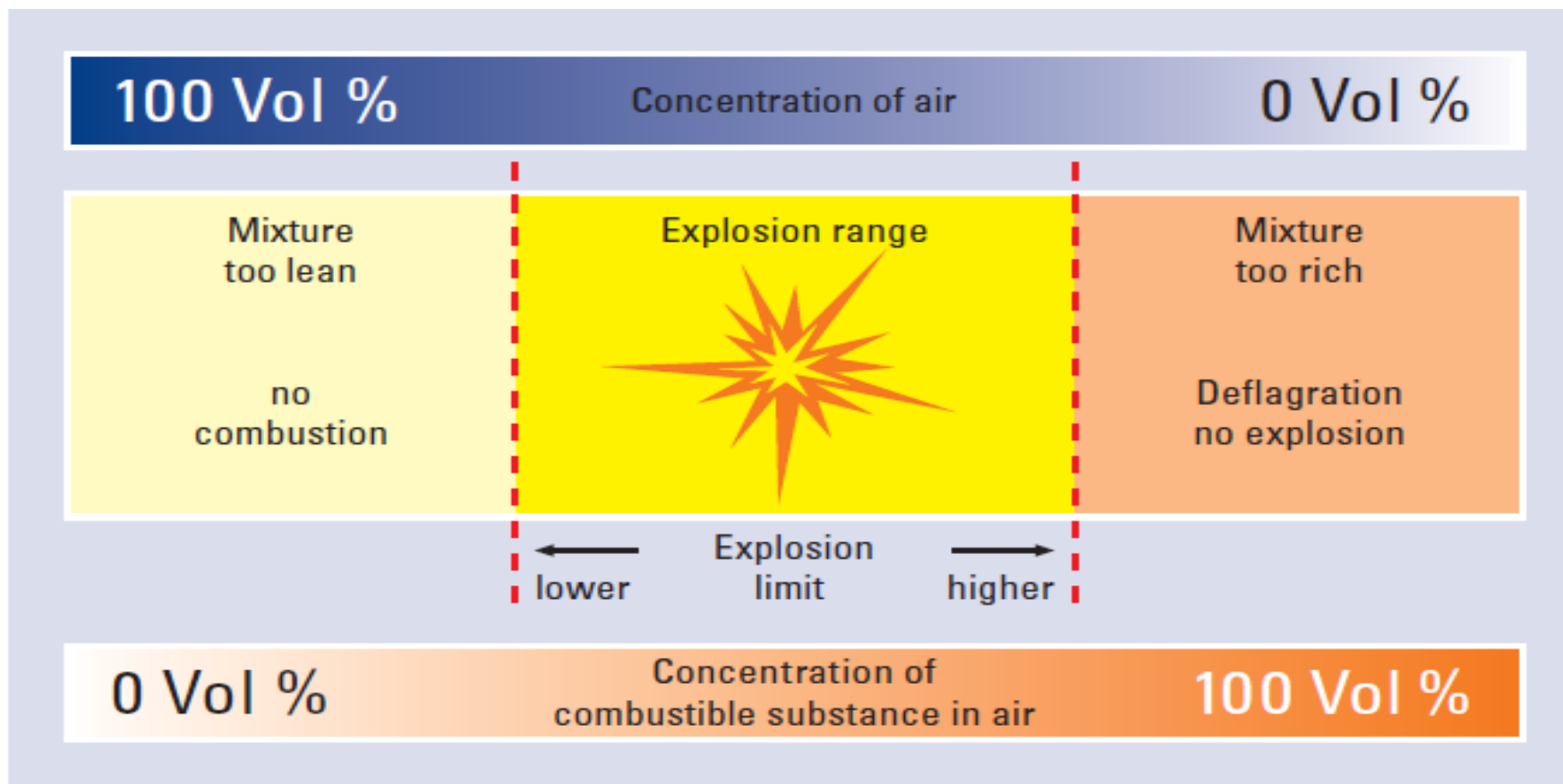
Minimum ignition current



Gas	MIE, мкДж	Gas group
Acetylene	19	IIC
Hydrogen	19	IIC
Ethylene	85	IIB
Methanol	290	IIA
Propane	260	IIA
Carbon disulfide	9	IIC



Explosive Limits





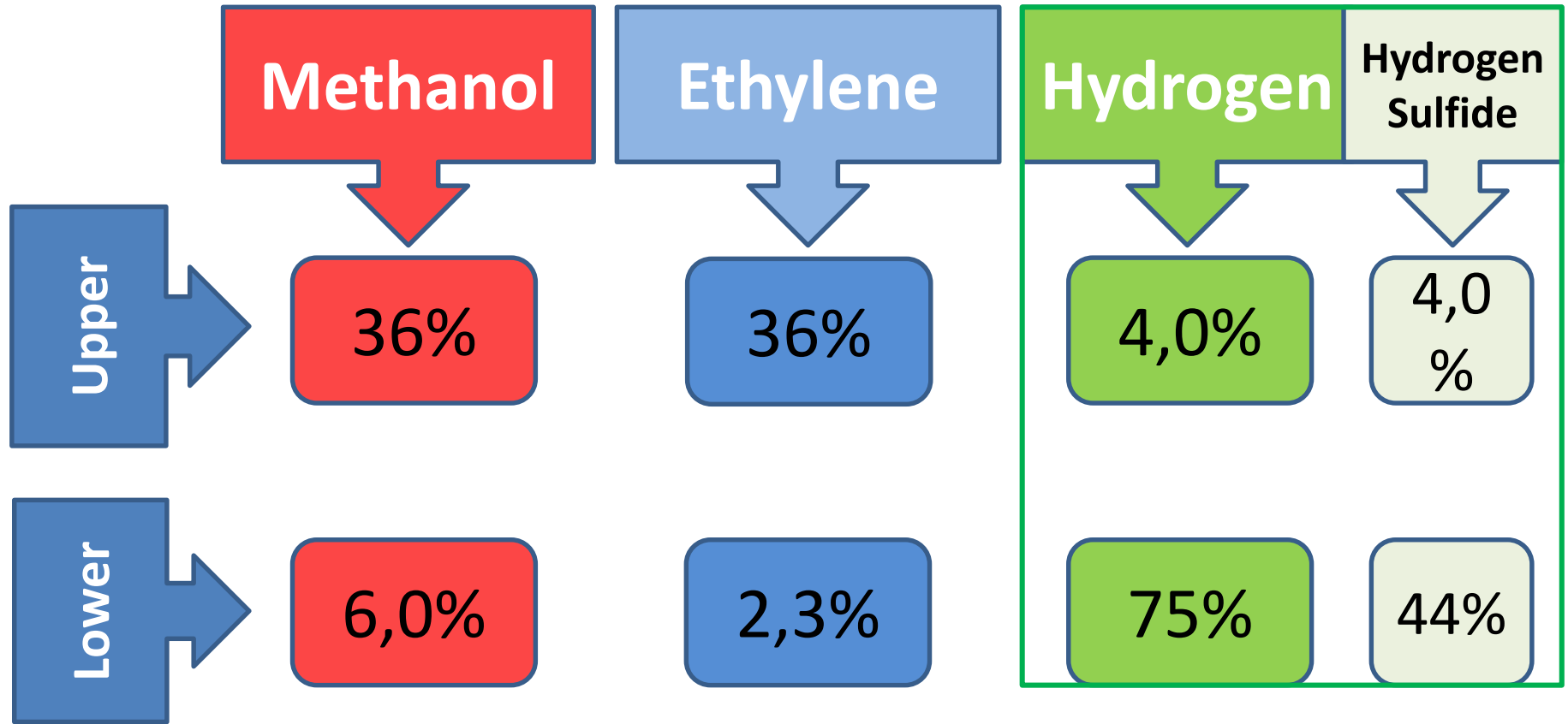
Lower explosive concentration limit:

the concentration of flammable gases, vapors or fog in the air, below which an explosive gas environment will not be formed;

Upper explosive concentration limit :

the concentration of flammable gases, vapors or fog in the air, above which an explosive gas environment will not be formed.

Explosion limits



Explosion limits



Gas	LEL	UEL
Acetylene	2.3	100
Kerosene	0.7	5.0
Carbon disulfide	0.6	60.0
Ammonia	15.0	33.6
Nitromethane	7.3	63.0
Butane	1.4	9.3



Ignition temperature

DEFINITION:

The lowest temperature at which a material can spontaneously ignite and sustain combustion, when mixed with air at normal pressure, without the ignition initiated by any spark, flame or extraneous ignition source. i.e. when making contact with a hot surface.



Ambient Temperature ratings and other environmental conditions for safe use

DEFINITION:

Ambient temperature is the air temperature of any object or environment where equipment is installed.

- for equipment installed in Kazakhstan should be as per design documentation.

What else?:

- IP rating
- Additional for safe use (e.g. additional cover from dirt/shrinks/vibration protection etc.) – will discuss later

MODULE II

Principles and Parameters Of Explosion Protection



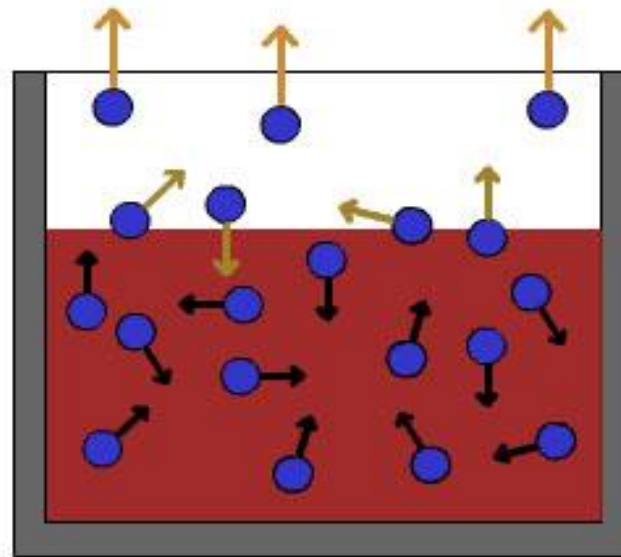
Ignition temperature of some gases

Combustible material or chemical product.	Celsius degree	Combustible material or chemical product.	Celsius degree
Acetone	539	Methane (natural gas)	580
Acetylene	305	Methanol	440
Gasoline	280	Naphtha	550
Butane	420	Nitroglycerine	254
Carbon disulphide	105	Oil	400
Carbon monoxide	607	Dry pinewood	427
Ethyl ether	160	Phosphorus, structureless	260
Ethane	515	Propylene	458
Ethylene	440	Propellant explosive	288
Ethanol	365	Toluene	530
Hydrogen	560	Styrene	490

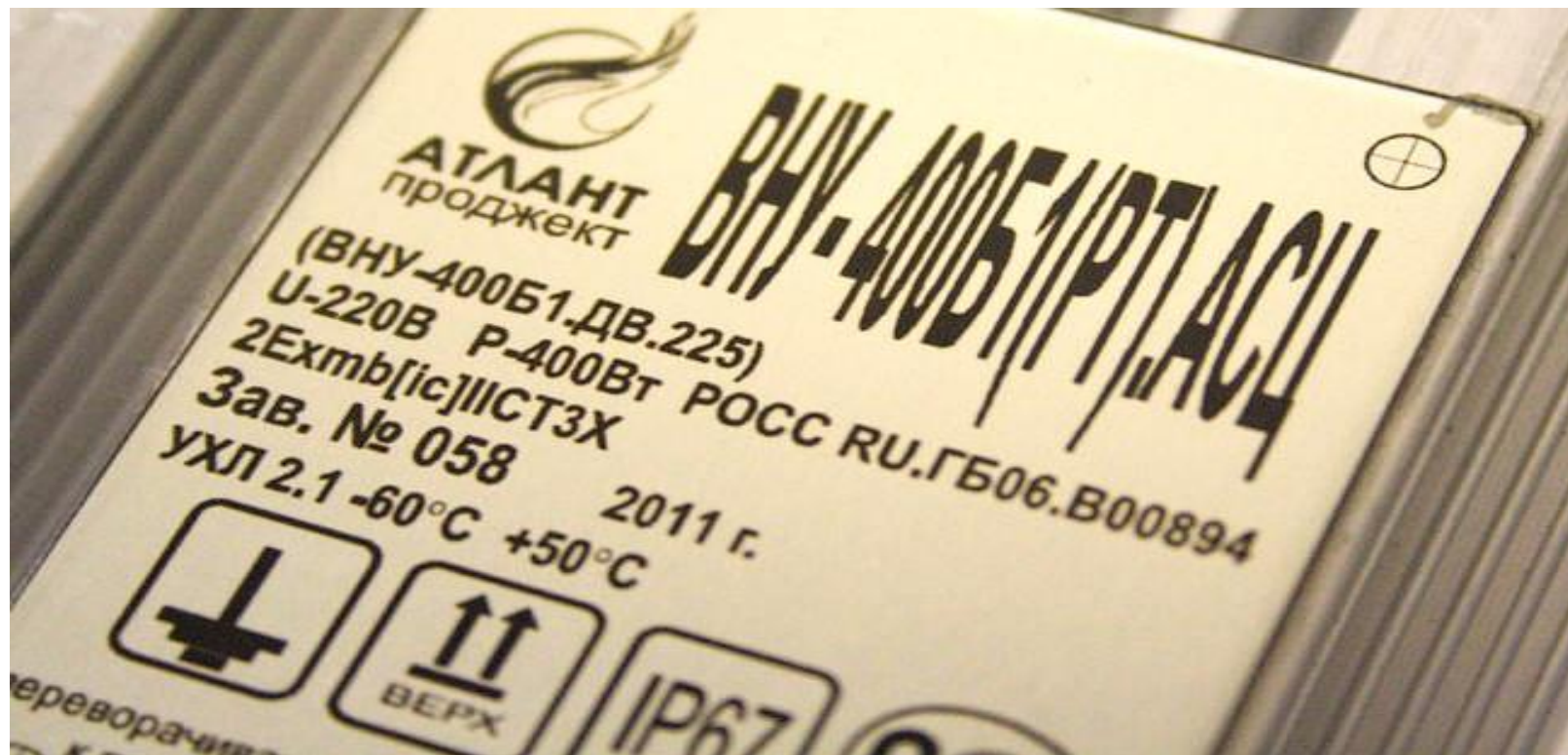
Flash point



The lowest temperature of a volatile condensed substance at which vapors above the surface of the substance are able to flare up in the air under the influence of an ignition source



Temperature class



Temperature class



Temperature class	Maximum temperature
T1	450
T2	300
T3 (FGP)	200
T4	135
T5	100
T6	85



IEC 60079-10-1

Classification of areas - Explosive gas atmospheres.



Hazardous area (for an explosive gas environment):

Part of an enclosed or open space in which an explosive gas mixture is present or may form in a volume that requires special protection measures during the design, manufacture and operation of equipment.

Explosive zones are divided into classes depending on the frequency and duration of the presence of an explosive gas environment in them



ZONE 0



Exm



Exi

A zone, in which an explosive gas mixture is present continuously or for a long period of time. A place, where an explosive atmosphere is present more than 1000 hours per year.

OVER **10%**
PRESENCE OF AN EXPLOSIVE
MIXTURE

or

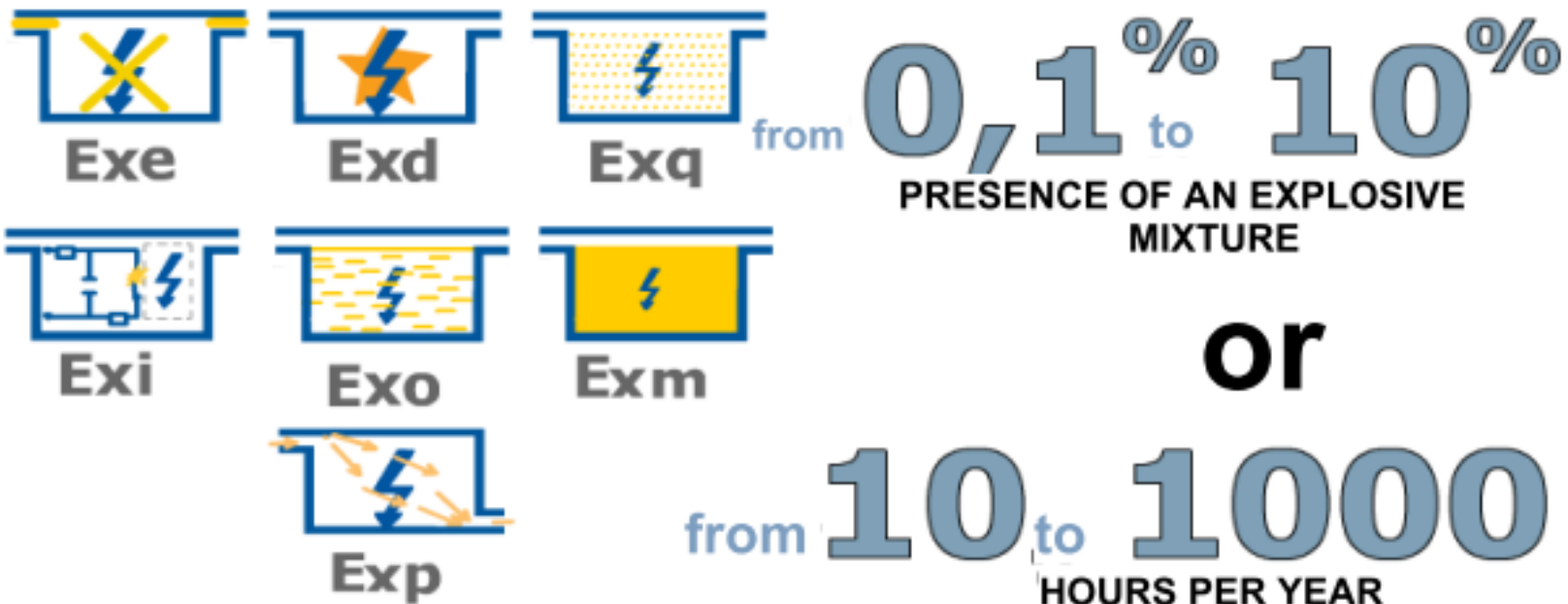
1000
HOURS PER YEAR

NOT IEC standard requirement. These values used are place time limits on to these zones, but none have been officially adopted

Classification of hazardous areas



ZONE 1



A zone, where an explosive gas mixture can be present in normal operation.

A place, where an explosive atmosphere is present from 10 to 1000 hours per year.



ZONE 2



Exe



Exd



Exq



Exi



Exo



Exm



Exp



Exn

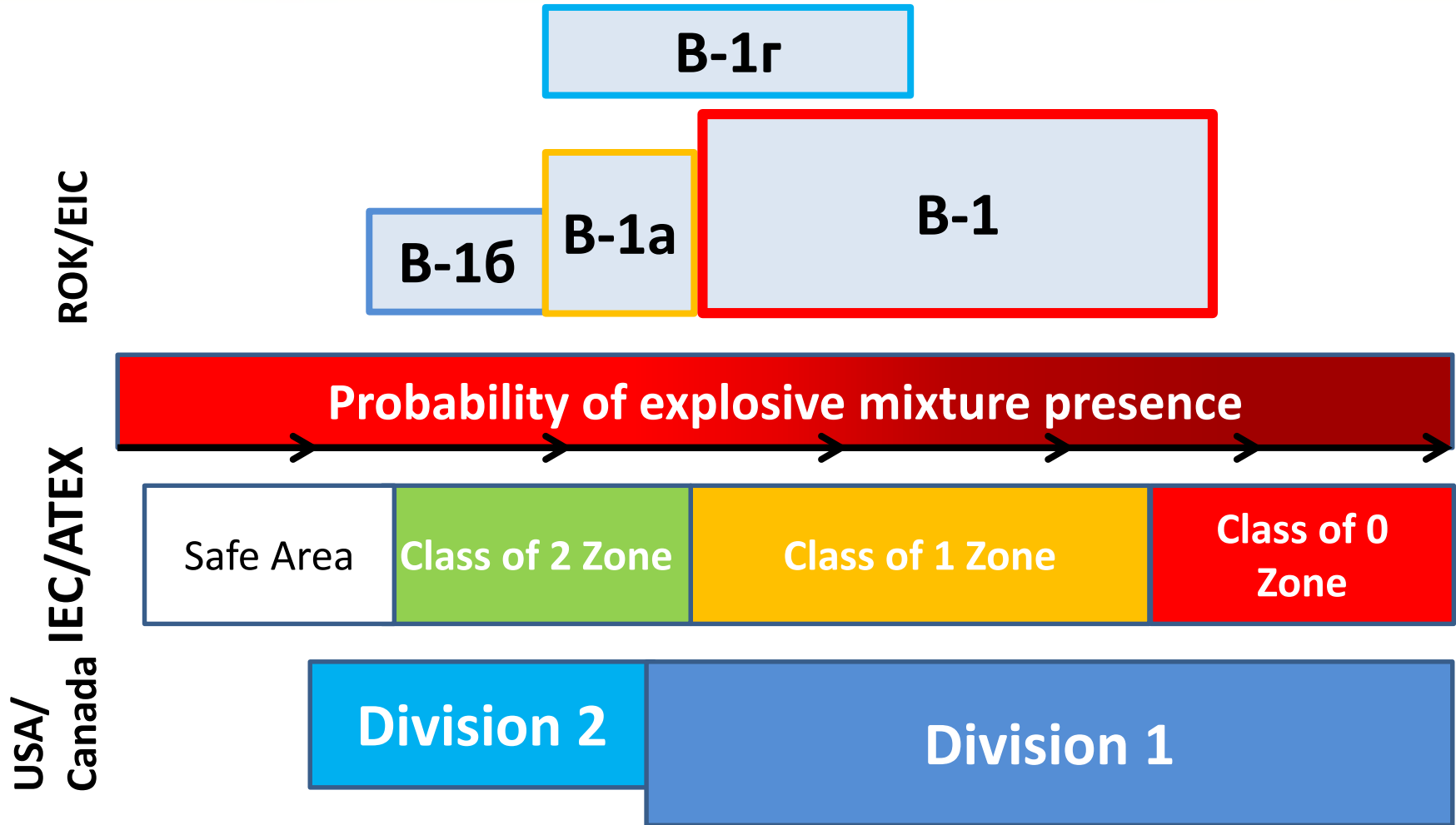
LESS THAN **0,1%**
PRESENCE OF AN EXPLOSIVE
ATMOSPHERE

or

LESS THAN **10**
HOURS PER YEAR

A place, where the explosive atmosphere is unlikely to occur in normal operation, but if it does occur, it will only occur infrequently and be present for a short period.
A place, where the explosive atmosphere is present less than 10 hours per year.

Classification of hazardous areas



Classification of hazardous areas



Class B-1 zones — zones located in rooms where flammable gases or LVH vapors are released in such quantities and with such properties that they can form explosive mixtures with air under normal operating conditions.

Zones of class B-1a and B-1b are zones located in premises where explosive mixtures of flammable gases or LVH vapors with air are not formed during normal operation, but are possible only as a result of accidents or malfunctions.

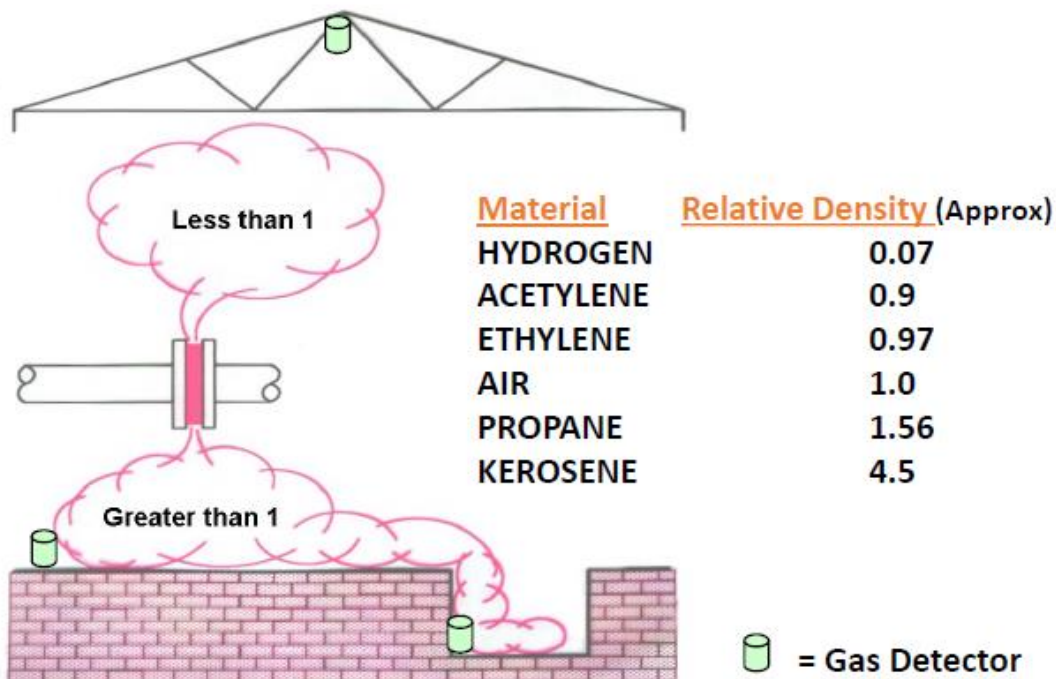


Zones of class B-1r-space for outdoor installations:

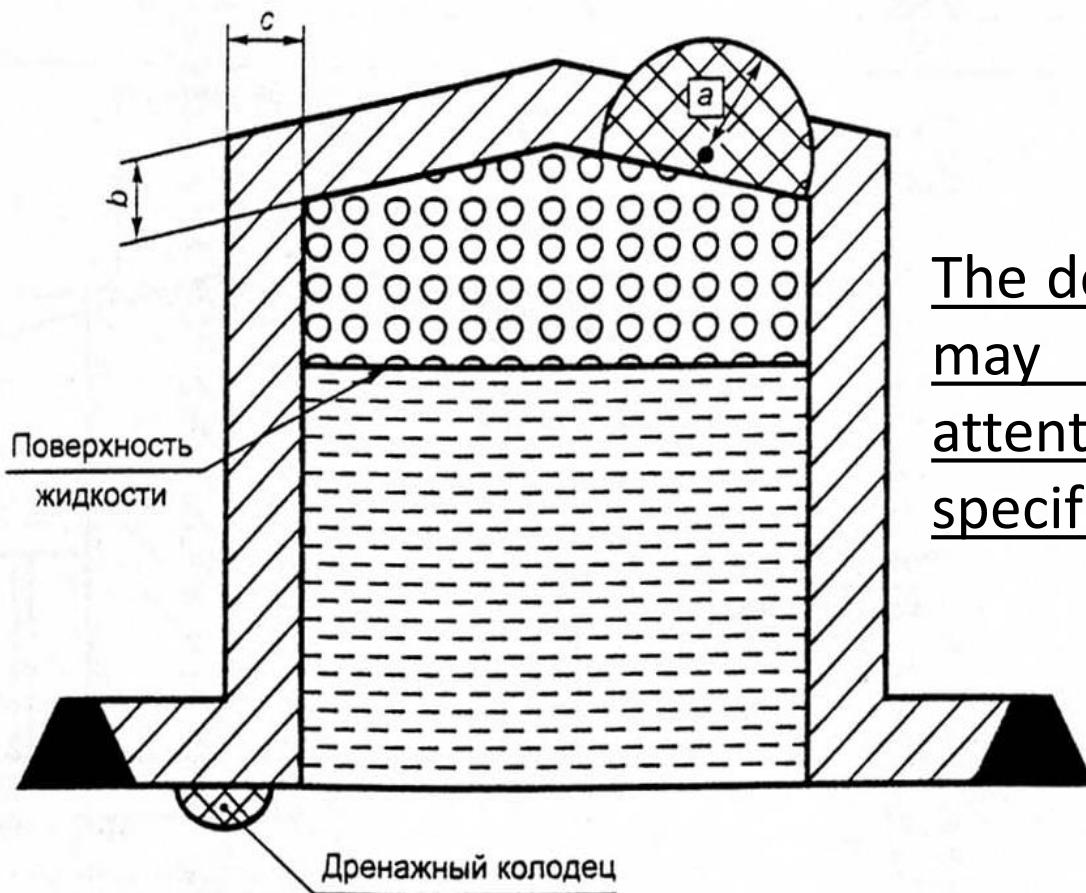
- Process plants containing flammable gases or LVH (with the exception of outdoor ammonia compressor units)
- Above-ground and underground tanks with LVH or combustible gases (gas tanks),
- Trestles for discharging and loading of flammable liquids,
- Open oil traps,
- Settling ponds with floating oil film, etc.

Relative Density




COMPARISON OF A GAS/VAPOUR WITH AIR
PLACEMENT OF GAS DETECTORS & VENTILATION



Classification of hazardous areas



The designation of explosive zones may be different, please pay attention to the drawing specification

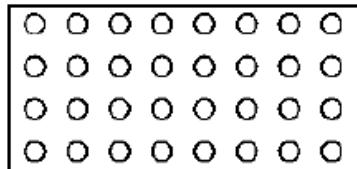
 - зона класса 0;  - зона класса 1;  - зона класса 2



Area Classification

Zones – Preferred Markings

Small Circles



Zone 0

45° Cross Hatching

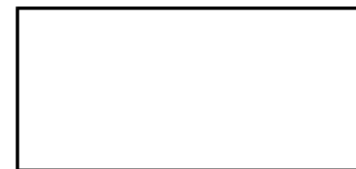


Zone 1



Zone 2

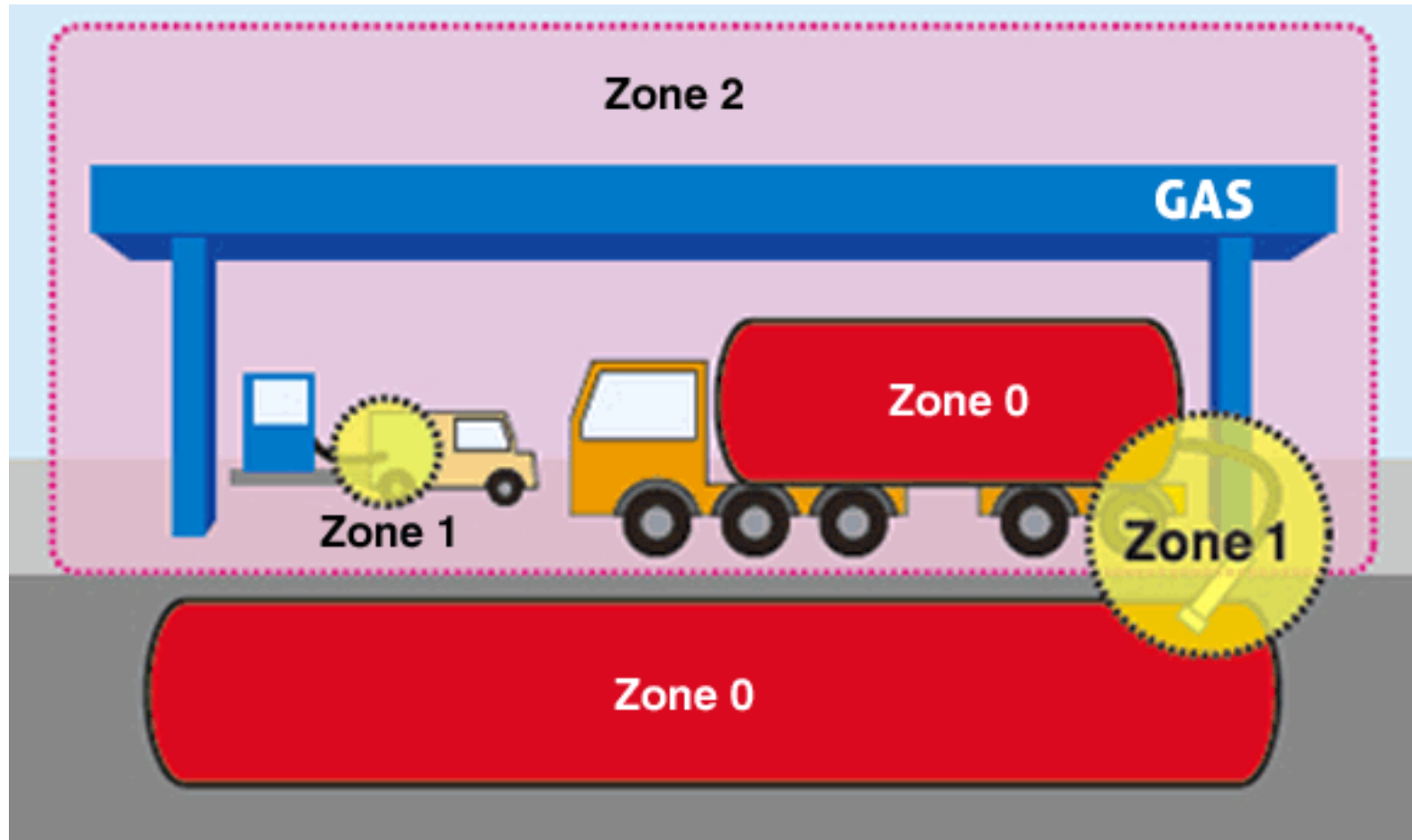
45° Slanting Lines



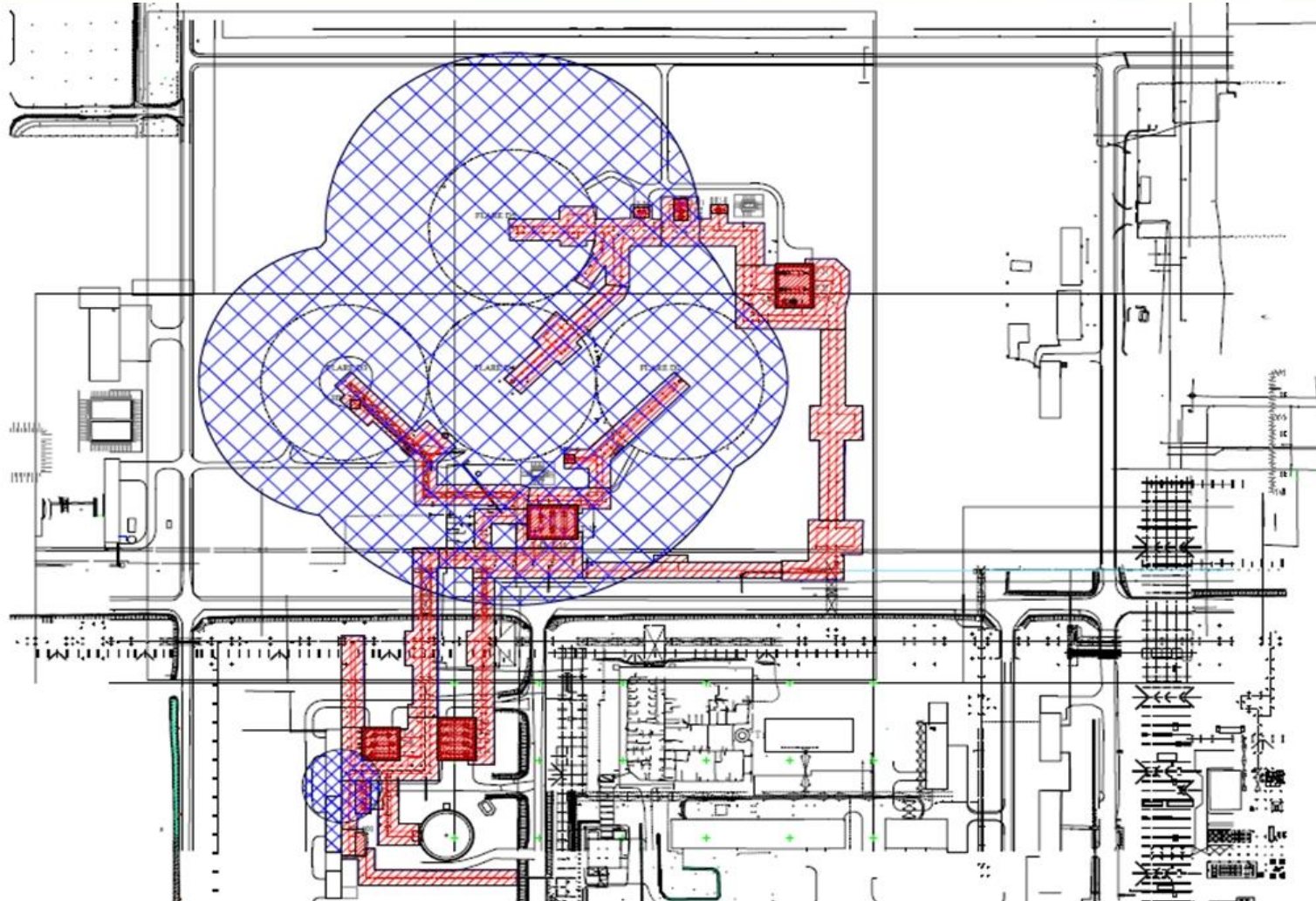
Non Hazardous Zone

Always refer to the Key of the drawing

Designations of explosive zones



Designations of explosive zones

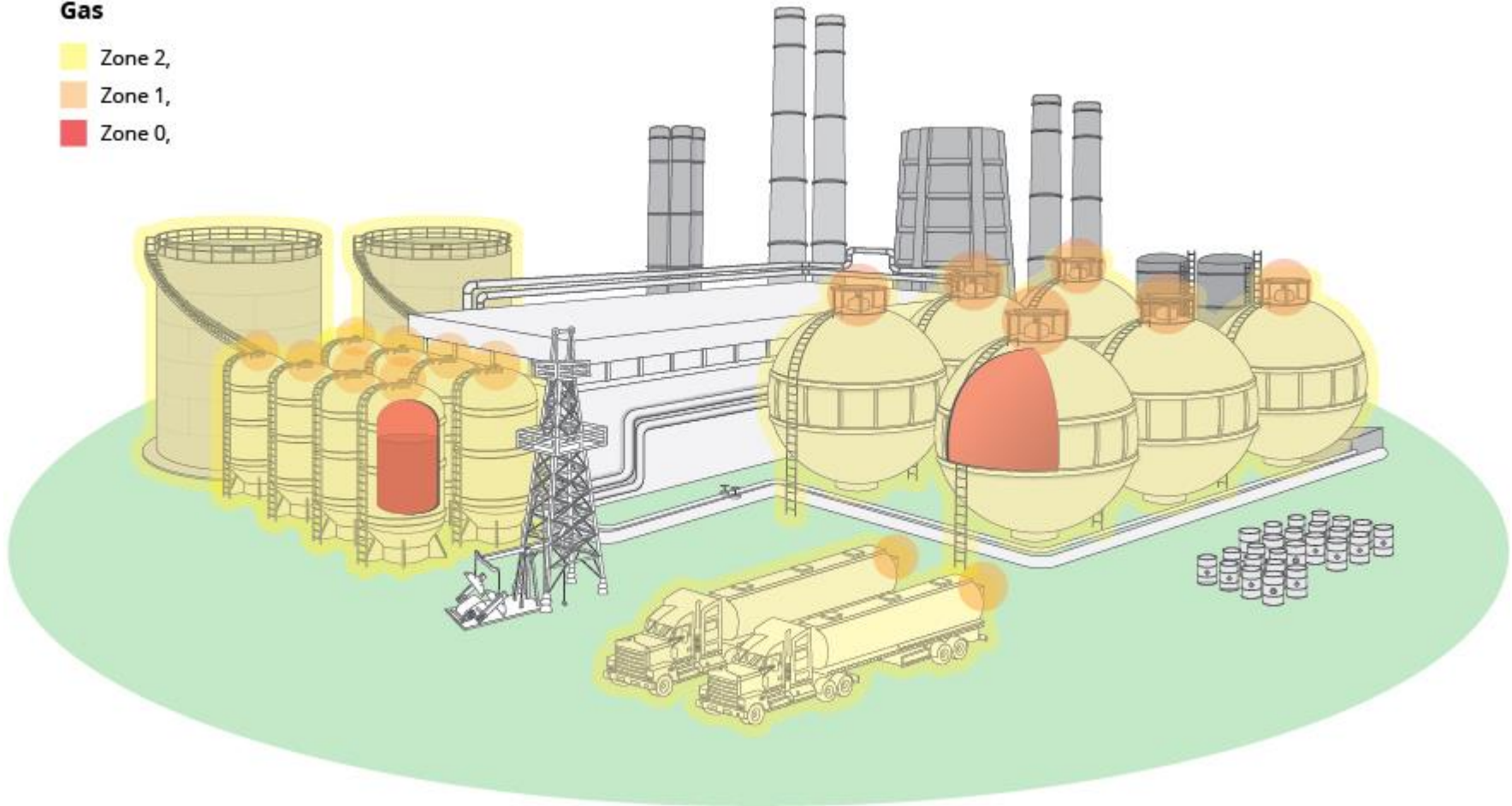


Designations of explosive zones

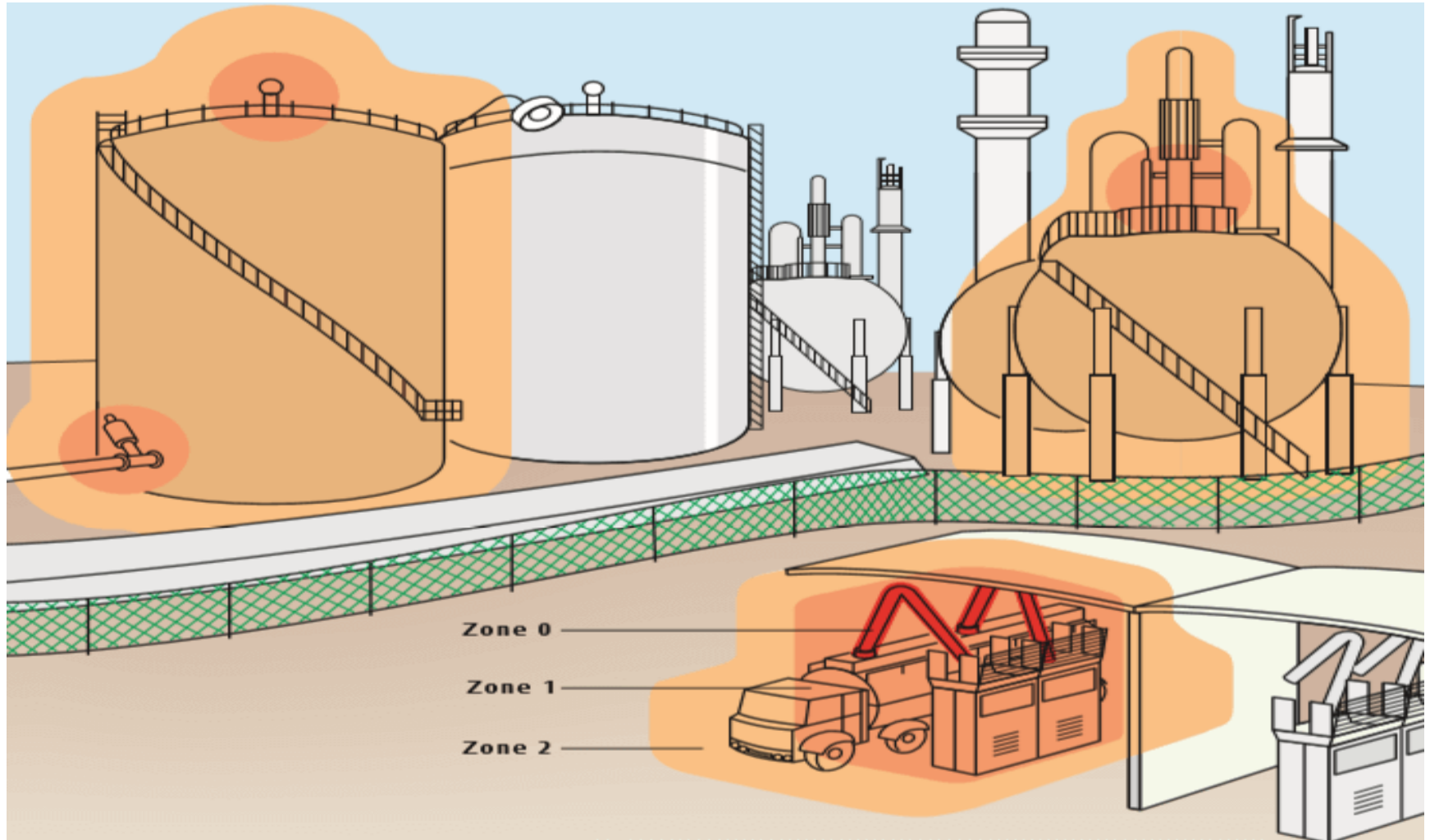


Gas

- Zone 2,
- Zone 1,
- Zone 0,



Designations of explosive zones



MODULE II

Classification of hazardous areas

