

# SELECTION OF Ex EQUIPMENT FOR HAZARDOUS AREAS

Training for Maintenance Personnel



SAFETY OF PERSONNEL AND PROTECTION OF PLANT AND EQUIPMENT

## CORE OBJECTIVES

The purpose of this presentation is to equip the student to establish and maintain a safe work environment in hazardous locations in order to comply with the legal requirements as stipulated in the OHS Act (85 of 1993) and applicable standards.

.

**In this presentation we will be focusing on the following:**

- **What are hazardous areas/locations or classified areas**
- **Legal requirements according to OHS Act 85 of 1993**
- **Classification of hazardous areas in short**
- **Gas groups for surface industry and mines**
- **Protection techniques or methods**
- **Temperature classes**
- **Selection of correct equipment for use in hazardous area**

## HAZARDOUS LOCATION BY DEFINITION

Location determined by national regulations or by the risk assessment of the plant or mine, where there might be a significant risk of the ignition of gas, dust or vapour.

Also, an area/location in which an explosive gas atmosphere or combustible dust, in the form of a cloud is present, or may be expected to be present, in quantities such as that it will require special precautions for the construction, installation and use of equipment in that area or location.

What equipment is required for use in a hazardous area for safe work or operations?

You need equipment that will not become an ignition source for the flammable substances present in the hazardous area.

As you might be aware of what causes a fire or an explosion; from the fire triangle



## WHERE SHOULD AREA CLASSIFICATION BE DONE?

- **Oil & gas production and processing plants**
- **Oil refineries**
- **Petrochemical and Chemical processing plants**
- **Gas pipelines and distribution centres**
- **Re-fuelling stations or petrol stations**
- **Underground coal mines**
- **Hospital operating theatres**
- **Sewerage treatment plants**
- **Grain handling and storage and processing (flour-milling industry)**
- **Sugar refineries**
- **Light metal working, where metal dust and fine particles can appear**
- **Woodworking areas**

# ELECTRICAL MACHINERY REGULATIONS

## (EMR 9(1))

Every employer or user shall identify all hazardous locations and classify them in accordance with the relevant health and safety standard incorporated into these Regulations under section 44 of the act.

## EMR 9(2)

- No person may use electrical machinery in locations where there is danger of fire or explosion owing to the presence, occurrence or development of explosive or flammable articles, or where explosive articles are manufactured, handled or stored, unless such electrical machinery, **with regard to its construction relating to the classification** of the hazardous locations in which it is to be used, meets the requirements of the safety standard
  - Equipment selection must follow the area classification
  - Equipment must be appropriate to the area classification
    - Type of protection – Ex d
    - Gas/Dust group - IIC
    - Temperature class – T3
    - Explosion Protection Level (EPL) - Gb

## ELECTRICAL MACHINERY REGULATIONS

**To ensure legal compliances at all time – EMR 9(3) requires that:**

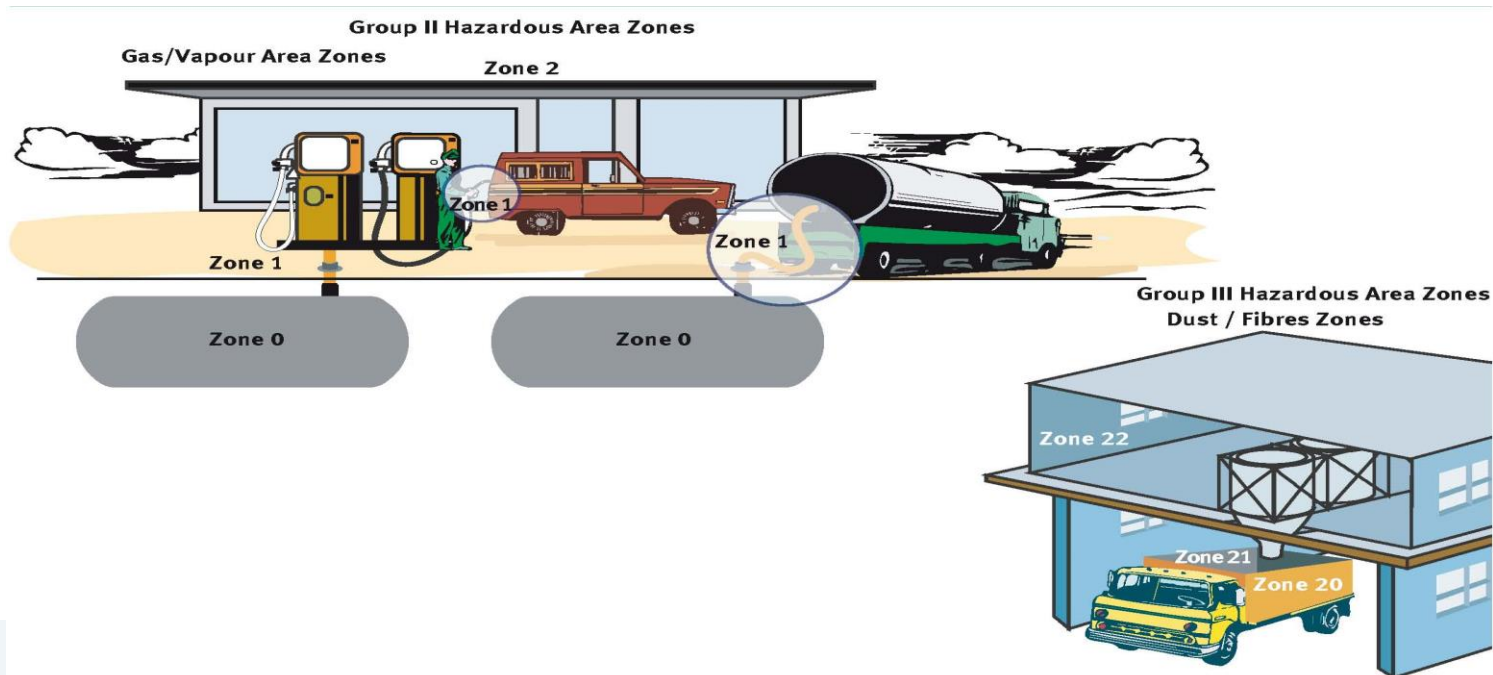
- every employer or user referred to in sub regulation (1) shall be in possession of a certificate in a form acceptable to the chief inspector



## AREA CLASSIFICATION

- Area classification is:
  - a method of analysing and classifying the explosive environment,
  - to facilitate proper selection and installation of apparatus/equipment to be used safely in that environment,
  - takes into account gas groups and temperature classes.

### Zones for Flammable Gas and Dust environments





# ZONES IN CLASSIFIED AREAS

Zone allocation	Definition
Zone 0	Represent an area in which a continuous release will be present during normal operation for long periods (e.g. vapour space above flammable liquids)
Zone 1	Represent an area where the possibility of the formation of a flammable atmosphere is expected during normal operation but only for a short period. (e.g. vents)
Zone 2	Represent the possibility of a leakage not to expect during normal operation and if so only for a short period (e.g. a flanged connection)
Zone 20	Represent an area in which a continuous release will be present during normal operation for long periods (e.g. transfer points on coal/wax conveying systems)
Zone 21	Represent an area where the possibility of the formation of a flammable atmosphere is expected during normal operation but only for a short period. (e.g. immediate surrounding areas)
Zone 22	Represent the possibility of a leakage not to expect during normal operation and if so only for a short period (e.g. badly vented areas/inside buildings)

# OLD MARKING AND NEW MARKING

Comparison Between Zones and Classes/Divisions		
Standards	NEC 505	NEC 500
Atmosphere		
Gases, vapors	Zone 0 Zone 1	Class I, Div. 1
	Zone 2	Class I, Div. 2
Dusts	Zone 20 Zone 21	Class II, Div. 1
	Zone 22	Class II, Div. 2

## GASES AND VAPOURS (GROUP I/II)

Industry	Gas Group	Substance	MIE	Selection of equipment
<b>Mining Industry</b> <b>Group I</b>	I	Methane	200µJ	Equipment only suitable for mines unless it is additional approved for surface: Marked I/IIC
<b>Surface Industry</b> <b>Group II</b>	IIA	Propane	180 µJ and higher	IIA; IIB and IIC certified equipment may be used in an IIA area.
	IIB	Ethylene	60 µJ -180 µJ	IIB and IIC certified equipment may be used in an IIB area.
	IIC	Hydrogen	20 µJ – 60 µJ	Only IIC certified equipment is allowed to be used in an IIC area.

# DUSTS AND FIBRES (GROUP III)



<b>Dusts and Fibers (Group III) Surface</b>	<b>IIIA</b>	<b>Combustible flying's</b>
	<b>IIIB</b>	<b>Non-conductive dust</b>
	<b>IIIC</b>	<b>Conductive dust</b>

## PENLIGHT BATTERY ENERGY



# GAS PROPERTIES TABLE

	1 Gas or vapour	2 Ignition temperature °C	3 Temperature Class	4 Explosive limit in air % (volume fraction)		6 Typical flash point °C	7 Relative density (air = 1)
				Upper	Lower		
<b>Subgroup IIA continued</b>							
28.	Chloro-ethylene	415	T2	33,0	3,60	-78 gas	2,15
29.	Methanol	386	T2	36,5	5,5	11	1,1
30.	<b>Ethanol</b>	<b>363</b>	<b>T2</b>	19,0	3,1	12	1,59
31.	Butan-j-ol	359	T2	12,0	1,70	29	2,55
32.	iso-Butanol	427	T2	–	1,5	27,8	2,6
33.	n-Butanol	343	T2	–	1,5	28,9	2,6
34.	Amyl alcohol	371	T2	–	1,0	52,8	3,0
35.	<b>Ethyl nitrite</b>	<b>95</b>	<b>T6</b>	50,0	3,0	-35,0	2,60
36.	Ammonia	630	T1	33,6	15,0	–	0,59
<b>Subgroup IIB</b>							
37.	<b>Ethylene</b>	<b>425</b>	<b>T2</b>	36,0	2,3	< -6,7	0,97
38.	<b>Diethyl ether</b>	<b>160</b>	<b>T4</b>	36	1,70	-45	2,55
39.	<b>Ethylene oxide</b>	<b>435</b>	<b>T2</b>	100	2,60	< -18	1,52
40.	Carbon monoxide <sup>e</sup>	605	T1	74,0	10,90	gas	0,97
41.	Buta-1,3-diene	430	T2	16,3	1,40	-85 gas	1,87
42.	Coal gas (town gas) <sup>f</sup>	649	T1	31,0	5,5	–	–
43.	Coke-oven gas <sup>f</sup>	–	T1	34,0	4,4	–	–
<b>Subgroup IIC</b>							
44.	Acetylene	305	T2	100	2,30	gas	0,90
45.	<b>Carbon disulphide</b>	<b>95</b>	<b>T6</b>	60,0	0,60	-30	2,64
46.	<b>Hydrogen</b>	<b>560</b>	<b>T1</b>	<b>77,0</b>	<b>4,00</b>	gas	<b>0,07</b>
47.	Water gas	–	T1	70,0	6,0	1,2	–

# SURFACE TEMPERATURE CLASSES OF EQUIPMENT & IGNITION TEMPERATURES OF FLAMMABLE SUBSTANCES

Explosion proof equipment, installed within the Ex area, is divided into 6 temperature classes (T1 to T6).

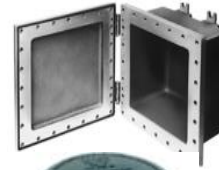
The temperature class on equipment is the maximum permissible surface temperature of the equipment, in relation to + 40°C ambient temperature on any surface area.

Temperature class	Max admissible surface temperatures in °C on group II electrical apparatus	Ignition temperatures of flammable substances in °C
T 1	450 (T1 - T6)	> 450
T 2	300 (T2 - T6)	> 300 ≤ 450
T 3	200 (T3 - T6)	> 200 ≤ 300
T 4	135 (T4 - T6)	> 135 ≤ 200
T 5	100 (T5 - T6)	> 100 ≤ 135
T 6	85 (T6)	> 85 ≤ 100

The surface temperature of equipment should never be above the ignition temperature of the flammable substance in the hazardous area.

# EXPLOSION PROTECTION TECHNIQUES / METHODS

1. Ex d > Flameproof



2. Ex e > Increased Safety



3. Ex i > Intrinsic Safety (Energy limiting)



4. Ex m > Encapsulation

5. Ex n/ nA /N > Non Sparking (Ex ec)



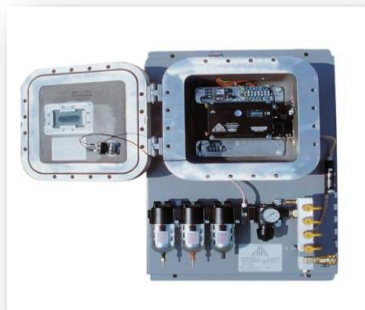
6. Ex o > Oil filled

7. Ex P > Pressurization



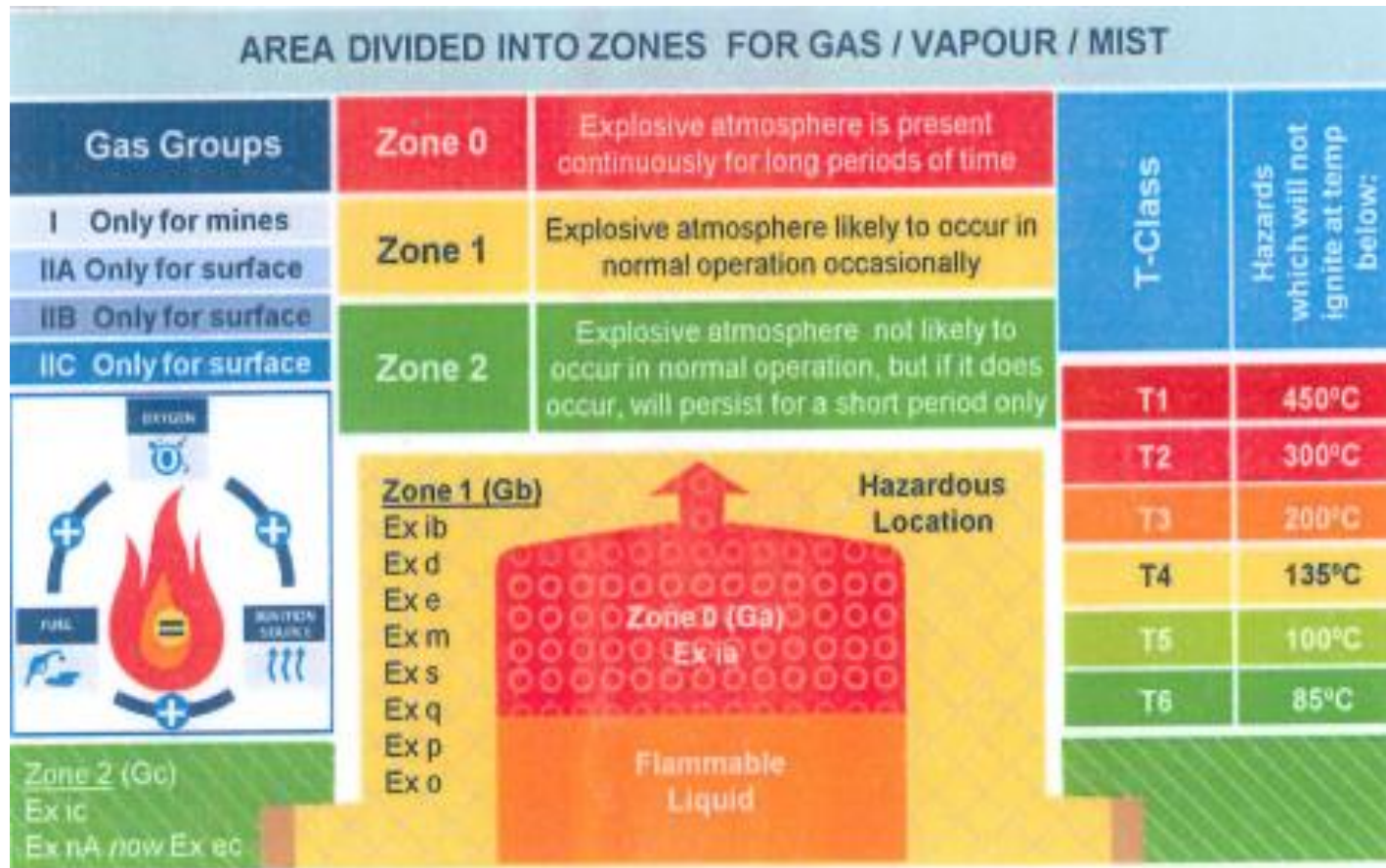
8. Ex q > Powder/Sand filled

9. Ex S > Special protection




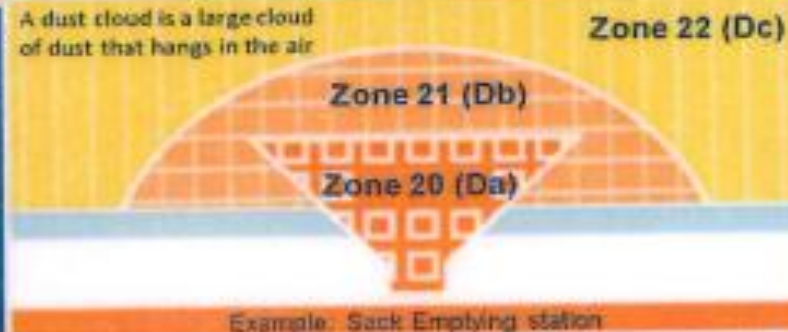


# SUMMARIZED EXPLOSION PREVENTION INFORMATION(GAS AREAS)



# SUMMARIZED EXPLOSION PREVENTION INFORMATION(DUST AREAS)

**AREA CLASSIFICATION DIVIDED INTO ZONES FOR DUST / FIBRES / FLYING'S**

Dust Groups	Zone 20	Zone 21	Zone 22
<b>III Dust and Fibers</b>			
<b>IIIA Combustible flying's</b>			
<b>IIIB Non-conductive dust</b>			
<b>IIIC Conductive dust</b>			
<b>EXPLOSION PENTAGON</b> 	A dust cloud is a large cloud of dust that hangs in the air.		
	 <p style="text-align: center;">Example: Sack Emptying station</p>		
	<b>Zone 20 – Inside the hopper</b>	<b>Zone 21 – Immediate surroundings (radius of 1m) around the opening</b>	<b>Zone 22 – Area outside Zone 21 due to accumulations of dust</b>

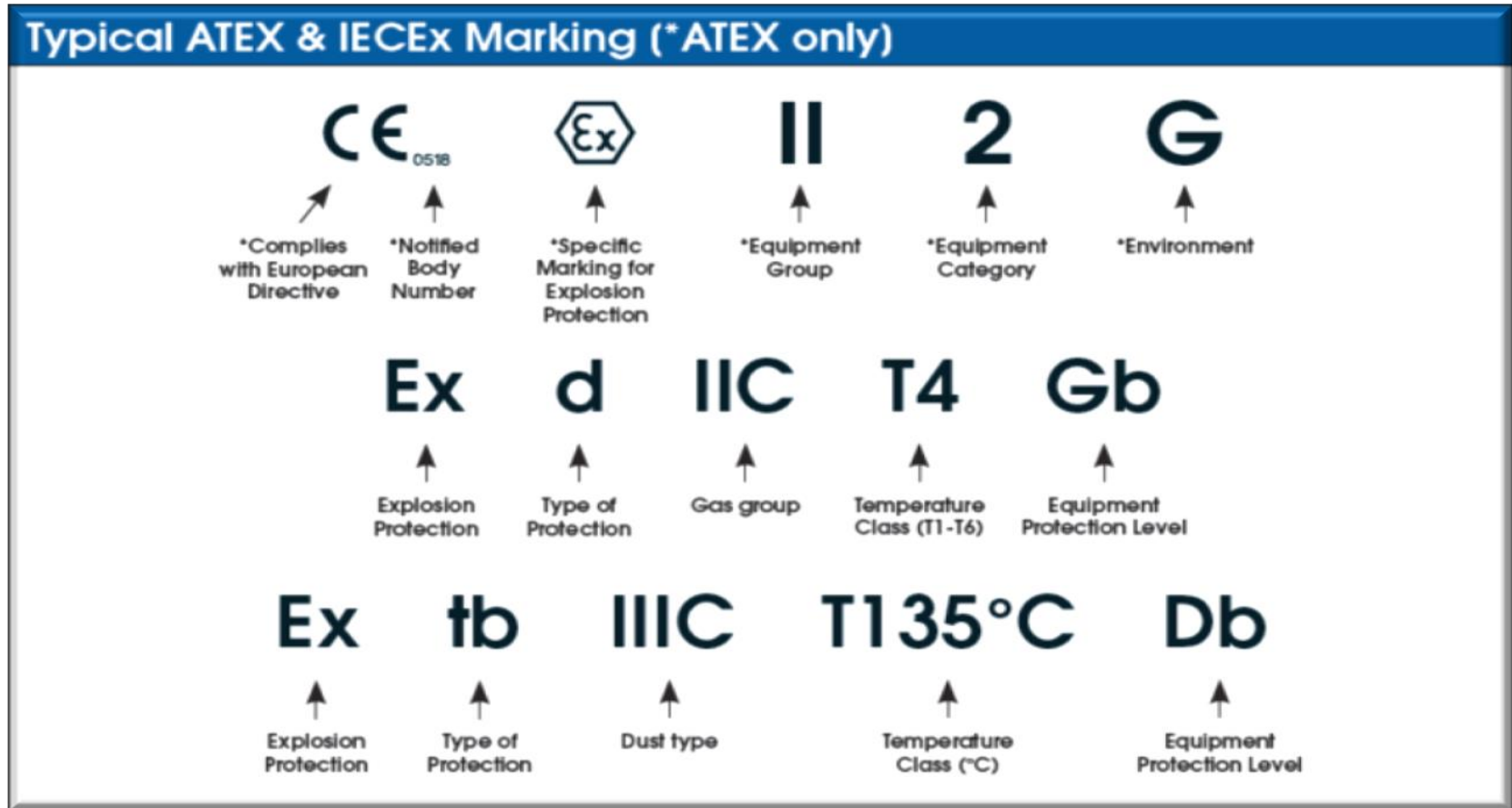
**T \_ °C**  
 Temperature class in degrees Celsius preceded by "T"  
 e.g. T120 °C

**T<sub>L</sub> \_ °C**  
 Temperature class in degrees Celsius for dust layer Where "L" is the layer depth in mm  
 e.g. T<sub>500</sub>120 °C

## ZONES AND EQUIPMENT PROTECTION LEVELS (EPL)

Flammable material	Hazardous location	Frequency and duration of explosive atmosphere	Level of protection required	Explosion protection techniques allowed <sup>1</sup>	EPL
Gas/vapour	Zone 0	Continuous	Very high	Ex ia, Ex ma, double protection	Ga
	Zone 1	Normal operation	High	Above plus Ex ib, mb, d, e, px, py, q, o	Gb
	Zone 2	Abnormal operation	Safe in normal operation	Above plus Ex pz, Type "n"	Gc
Dust	Zone 20	Continuous	Very high	"ta" (IP65 enclosures), iaD, maD	Da
	Zone 21	Normal operation	High	Above plus "tb" (IP65 enclosures), ibD, mbD	Db
	Zone 22	Abnormal operation	Safe in normal operation	Above plus" tc" (IP65 enclosures)	Dc

# MARKING OF EX EQUIPMENT FOR GROUP - I/II/III



## EQUIPMENT MARKING



# EQUIPMENT SELECTION AND VERIFICATION

## Equipment selection and verification for hazardous locations

Make use of the chemical properties tables to complete the Gas Group and Temperature Class. Then verify the applicability of the Equipment (EPE) to the Hazardous Location Information. Comment if any of the answers are No.

Equipment (EPE)	Hazardous Location Information							Yes/No
	Classification	Chemical	Gas Group		Temp. Class			
Example:								
Ex nA IIB T2	Zone 1	N	Illuminating Paraffin	IIA	Y	T3	N	N
Comments: EPE protection type (nA) not applicable to the Classification Zone 1. Equipment (EPE) temperature class too high for the location temperature class.								
Ex o IIB T2	Zone 1	Y	Carbon Disulphide	IIC	N	T6	N	N
Comments: Gas group incorrect; temperature class too high.								
Ex m IIB T4	Zone 2	Y	Ethyl Nitrite	IIA	Y	T6	N	N
Comments: Temperature class too high.								
Ex ib II T4	Zone 0	N	Ethylene Oxide	IIB	Y	T2	Y	N
Comments: Protection type can only be used in Zones 1 and 2.								
Ex n IIB T2	Zone 1	N	Acetylene	IIC	N	T2	Y	N
Comments: Protection type incorrect; Gas Group incorrect.								
Ex ib IIB T6	Zone 1	Y	Octane	IIA	Y	T3	Y	Y
Comments:								
Ex e IIB T2	Zone 1	Y	Carbon Disulphide	IIC	N	T6	N	N
Comments: Gas group incorrect; temperature class too high.								

**CLOSURE**

**THANK YOU**