



BHARAT FLAMEPROOF MANUFACTURING INDUSTRY PVT. LTD.

We Aims to Give Protection

WORLD CLASS FLAMEPROOF EQUIPMENT

TYPES OF ELECTRICAL EQUIPMENT SUITABLE FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES

Different techniques are used to prevent electrical equipment from igniting explosive atmosphere. There are restrictions on where these different types of equipment can be used as follows :	European Area Of Use Designation Standard	IS/IEC Area of use Designation Standard	USA Area of use Designation Standard
Flameproof Enclosure - An enclosure used to house electrical equipment, which when subject to an internal explosion will not ignite a surrounding explosive atmosphere.	Zones 1 & 2 Exd EN 60079-1	Zones 1 & 2 Exd IS/IEC 60079-1	Class 1 Divisions 1 & 2 UL 60079-1
Intrinsic safety - A technique whereby electrical energy is limited such that any sparks or heat generated by electrical equipment is sufficiently low as to not ignite an explosive atmosphere.	Zones 0, 1 & 2 E xi EN 60079-11	Zones 1 & 2 Exi IS/IEC 60079-11	Class 1 Divisions 1 & 2 UL 60079-11
Increased safety - This equipment is so designed as to eliminate sparks and hot surfaces capable of igniting an explosive atmosphere.	Zones 1 & 2 EExe EN 60079-7	Zones 2 * Exe IS/IEC 60079-7	Class 1 UL 60079-7
Purged & Pressurised - Electrical equipment is housed in an enclosure which is initially purged to remove any explosive mixture, then pressurized to prevent ingress of the surrounding atmosphere prior to energisation.	Zones 1 & 2 EExp EN 60079-2	Zones 1 & 2 Exp IS/IEC 60079-2	Class 1 Divisions 1 & 2 ISA 60079-2
Encapsulation - A method of exclusion of the explosive atmosphere by fully encapsulating the electrical components in an approved material.	Zones 0, 1 & 2 EExmd EN 60079-18	Zones 1 & 2 Exm IS/IEC 60079-18	Class 1 UL 60079-18
Oil Immersion - The electrical components are immersed in oil, thus excluding the explosive atmosphere from any sparks or hot surface.	Zones 1 & 2 EExo EN 60079-6	Zones 1 & 2 Exo IS/IEC 60079-6	Class 1 Divisions 2 UL 60079-6
Powder Filling - Equipment is surrounded with a fine powder, such as quartz which does not allow the surrounding atmosphere to come into contact with any sparks or hot surface.	Zones 1 & 2 EExq EN 60079-5	Zones 1 & 2 Exq IS/IEC 60079-5	Class 1 UL 60079-5
Non - Sparking - Sparking contacts are sealed against ingress of the surrounding atmosphere, hot surface are eliminated.	Zones 1 & 2 EExn EN 60079-15	Zones 1 & 2 Exn IS/IEC 60079-15	Class 1 UL 60079-15
Special Protection - Equipment is certified for use in a Potentially Explosive Atmosphere but does not conform to a type of protection listed above.	Zones 0,1 & 2 *Exs	Zones 1 & 2 Exs	Class 1

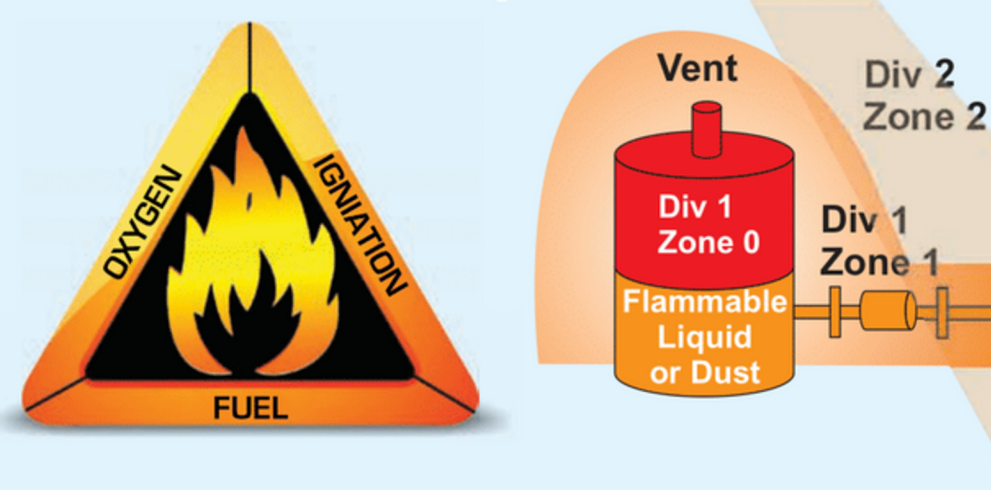
* This type of protection is only recognised by National Authorised, Not as a European-wide of protection

PROTECTION CONCEPTS

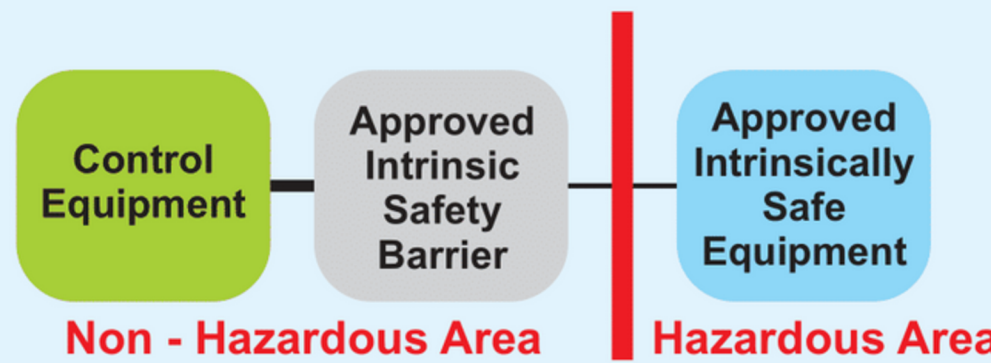
Protection Principle	Types of Protection	Code	Symbol	Zone	IS/IEC Standard	How it works
Prevents transmission of the explosion outside	Flameproof Enclosure	Ex d		1,2	IS/IEC 60079-1	Contain the explosion and quench flame
Prevents High Temperature & Sparks	Increased Safety	Ex e		2	IS/IEC 60079-7	No arcs, sparks or hot surface
Low Current / Voltage Supply	Intrinsic Safety	Ex i * Ex iD*		0,1,2, 20,21, 22	IS/IEC 60079-11	Limit the Energy Of Sparks & Surface Temp.
Positive Pressure Device	Pressurized Apparatus	Ex p Ex pD		1,2, 21,22	IS/IEC 60079-2	Keep the flammable gas away from any hot surface and ignition capable equipment
Encapsulated	Moulding	Ex m* Ex mD*		0,1, 20,21	IS/IEC 60079-18	
Parts Immersed in oil to isolate from explosive atmosphere	Oil Immersion	Ex o		1,2	IS/IEC 60079-6	
Prevents transmission of explosion outside	Powder filling	Ex q		1,2	IS/IEC 60079-5	Contain the explosion and quench flame
As above, but for use in Zone 2	Protection "n" Non Sparking	Ex n		2	IS/IEC 60079-15	Keep the flammable gas away from any hot surface & ignition capable equipment
Dust Explosion Proof	Protection "tD"	Ex t*		20,21, 22	IS/IEC 60079-31	Dust Protection rugged tight Enclosure

COMBUSTION TRIANGLE

ZONE & DIVISIONS



CLASSIFICATION OF IGNITION SOURCES FOR GAS & VAPOUR



ACRONYMS

CIMFR	Central Institute of Mining and Fuel Research
BIS	Bureau of Indian Standards (IS)
CCE	Chief Controller of Explosives
DGMS	Directorate General of Mines Safety
ATEX	Atmosphere Explosible
NEMA	National Electrical Manufacturers Association
FM	Factory Mutual
IEC	International Electrotechnical Commission
UL	Underwriters Laboratories Inc.
IS	Indian Standards
AS	Australian Standards
EU	European Union

HAZARDOUS AREA CHARACTERISTICS

Zone 0	Zone 20	A hazardous atmosphere is highly likely to be present & may be present for long periods of time (>1000 hrs per year) or even continuously
Zone 1	Zone 21	A atmosphere is possible but unlikely to be present for long period of time (>10<1000 hours per year)
Zone 2	Zone 22	A atmosphere is not likely to be present in normal operation or infrequently and for short period of time (<10 hours per year)

CAUSES OF EXPLOSIONS

Explosion Proof When explosive gases or dusts enter an enclosure with electrical equipment inside, an explosion could occur. With the enclosure cover properly installed and tight tolerances maintained, the flame will be unable to propagate to the outside atmosphere.	Advantages Can be used with high power electrical devices such as contactors, transformers and motors. Disadvantages 1. Power must be disconnected before cover can be removed. 2. All bolts must be installed & threaded cover must be tight. 3. Size & Weight are restrictive. 4. Explosion proof conduit & appropriate seals must be installed. 5. Not certified for use in all hazardous area groups
Pressurization (Purged Enclosure) This concept keeps the enclosure filled with a positive pressure of air or inert gas. Therefore, as long as the pressure, the explosive gases cannot enter the enclosure.	Advantages Can be used with high power electrical devices such as contactors & transformers. Disadvantages 1. The air/ gas supply must be capable of compensating for leakage through the enclosure. 2. Mechanical/ Intrinsic interlocking must be utilized when opening & closing enclosure doors. 3. Separate air/ gas supply is necessary.
Intrinsic Safety This method of protection limits the energy to the hazardous area. The energy limitation is provided by the use of safety barriers which are mounted in the safe area. Due to the energy limitation of the barrier, regardless of the fault in the hazardous area, sufficient energy can not be released o ignite the explosive atmosphere.	Advantages 1. Explosion proof enclosure & conduit are not necessary. 2. Failure to replace enclosure covers or bolts will not degrade protection. 3. Field instruments can be maintained & calibrated with power applied. 4. Intrinsic safety is approved for all hazardous areas. Disadvantages 1. Since intrinsic safety operates with low power, only low power instruments may be utilized in the hazardous area.

IEC 615008- SAFETY SYSTEMS

		IS/IEC Ex	USA
Zone 20	• Enclosure, "ta" (Da) • Intrinsic safety, "ia" (Da) • Encapsulation, "ma" (Da)	IS/IEC 60079-31 IS/IEC 60079-11 IS/IEC 60079-18	ISA 60079-31 UL 60079-11 UL 60079-18
Zone 21	• Enclosure, "tb" (Db) • Pressurization, "p" (Db) • Intrinsic safety, "ib" (Db) • Encapsulation, "mb" (Db)	IS/IEC 60079-31 IS/IEC 61241-4 IS/IEC 60079-11 IS/IEC 60079-18	ISA 60079-31 ISA 61241-2 UL 60079-11 UL 60079-18
Zone 22	• Enclosure, "tc" (Dc) • Pressurization, "pc" (Dc) • Intrinsic safety, "ic" (Dc) • Encapsulation, "mc" (Dc)	IS/IEC 60079-31 IS/IEC 61241-4 IS/IEC 60079-11 IS/IEC 60079-18	ISA 60079-31 ISA 61241-2 UL 60079-11 UL 60079-18

Note : Zone 20, 21 & 22 General Requirements Are Contained In UL 60079- 0 Or ISA 61241-0 (USA), & IEC 60079-0 (IECEx)

EXPLOSION GROUPS

Equipment Protection Level	IS/IEC/ EU/ US
Ga	Group IIC
Gb	(Group IIB + H ²)
Gc	Group IIB
Da	Group IIA
Db	Group I
Dc	None
Ma	None
Mb	None

G = Gas, D = Dust, M = Mining
* In Presence Explosive Atmosphere

IEC 615008- SAFETY SYSTEMS

IEC/En 61508 is the international standard for electrical, electronic & programmable electronic safety related systems. It sets out the requirements for ensuring that systems are designed, implemented operated & maintained to provide the required safety integrity level (SIL). Four SILs are defined according to the risk involved in the system application, with SIL4 being used to protected against the highest risks. IEC 61508 is becoming increasingly relevant in the assessment of ATEX Safety Related Devices.

The standard is in seven parts :
IEC 61508-1 General requirements
IEC 61508-2 Requirements for E/E/PE safety-related systems
IEC 61508-3 Software requirements.
IEC 61508-4 Definitions and abbreviations
IEC 61508-5 Examples & methods for determination of safety integrity level
IEC 61508-6 Guidelines on the application IEC 61508-2 & IEC 61508-3
IEC 61508-7 Overview of techniques & measures

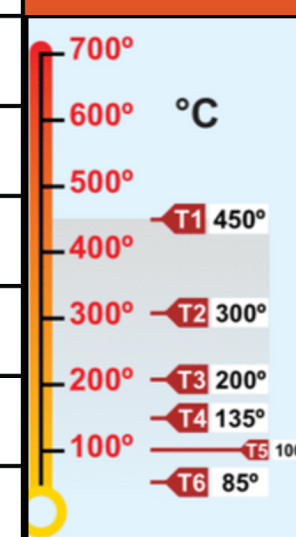
NEMA V/S IP ENCLOSURE

NEMA Type	3, 3S, 13	4 & 4X	6 & 6P
Equivalent IP	IP 54	IP 55	IP 67

TEMPERATURE CLASS

Classification of maximum surface temperature for Group II Electronic Equipment (Temperature Class)

T Class	°F	°C
T1	842°F	450°C
T2	572°F	300°C
T3	392°F	200°C
T4	275°F	135°C
T5	212°F	100°C
T6	185°F	85°C



See IEC 60079/EN50014/NEC 500 For Full Classification Of Temperature Class

EXPLOSION GROUPS

Typical Gas/ Dust/ Fiber	IS/IEC/ EU/ US
Acetylene	Group IIC
Hydrogen	(Group IIB + H ²)
Ethylene	Group IIB
Propane	Group IIA
Methane	Group I
Metal Dust	None
Coal Dust	None
Grain Dust/ Fibers	None

EXPLOSION GROUPS

Gas Group	Representative Test Gas
IIIA	Combustible flyings
IIIB	Non-conductive dust
IIIC	Conductive dust

INGRESS PROTECTION IP CODES

Hazardous area equipment typically requires a minimum IP rating of IP 54 may be assessed and tested to the high rating below.

FIRST NUMBER	SECOND NUMBER
Protection Against Solid Bodies	Protection Against Liquid
No Protection	No Protection
Objects greater than 50 mm	Vertical (90°) Dripping Water
Objects greater than 12 mm	(70° To (90°) Dripping Water
Objects greater than 2.5 mm	Sprayed Water
Objects greater than 1 mm	Splashed Water
Dust Protected	Water Jets
Dust Tight	Heavy Seas
	Effects Of Immersion
	Indefinite Immersion

See IEC 60529 for full definition of IP rating