Hazardous Location Certification For Electrical Equipment

Installing electrical equipment in plant locations where the potential for fire or explosion exists requires specially certified equipment. Equipment that is designed to operate in hazardous locations is certified and labeled as such by certifying agencies. The user must be certain that the equipment is safe for the environment in which it is operating. Hazardous locations are classified by the authority having jurisdiction. Classifications are made according to the properties of the flammable vapors, liquids, gases, combustible dusts or fibers that may be present, and the likelihood that a combustible concentration or quantity is present.

This bulletin provides general information pertaining to classifications of equipment, hazardous locations, and to the other national and international classification methods used throughout the world. Some common names of these equipment classifications include: intrinsically safe, explosion-proof, flame-proof, IP (Ingress Protection), NEMA and non-incendive.

Hazardous Locations

North America

In North America, the National Electric Code (developed by the National Fire Protection Assocation) defines a hazardous location as "where fire or explosion hazards may exist due to flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings."

When dealing with hazardous locations the objective is to eliminate the chance of an explosive condition. In order for an explosive condition to be present, three elements of the combustion or ignition triangle (oxidizer, fuel and ignition source) must exist at the same time and in the necessary proportions. (See Figure 24-1)

In a hazardous location, both the oxidizer and fuel exist making it necessary to control the ignition source. Various methods exist to control the ignition source in a hazardous location; these methods are discussed in the "Protection Methods" section.

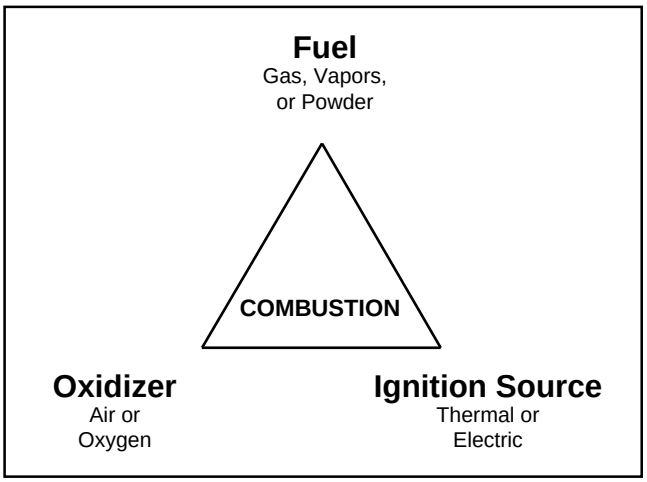


Figure 24-1: Ignition Triangle

Area Classifications

In the United States, a system of classifying hazardous locations and materials has been developed. This system incorporates three areas of concern (See Figure 24-2):

1. Class
2. Division
3. Group

Classes

The different types of hazardous materials are classified into one of three different classes. These three classes are areas in which the danger of explosion exists due to the presence of:

Class I Flammable gases or vapors

Class II Combustible dusts

Class III Easily ignitable fibers or flyings (particles suspended in air)

Divisions

Hazardous locations are separated into two different divisions depending on the likelihood that an explosive condition is present. Divisions are distinguished by the probability that an explosive mixture is present under:

Division 1 Normal operating conditions

Division 2 Abnormal operating conditions

Groups

Hazardous materials are placed into a specific group based on their characteristics and level of explosive hazard. Hazardous gases or vapors fall into four groups, designated A, B, C, and D. **Group A contains the most ignitable** materials, and **Group D contains the least ignitable** materials. Figure 24-2 lists the different groups and examples of the gases and dusts found within them.

International Area Classification

Outside of North America, a different classification system exists. This system was developed by the International Electrotechnical Commission (IEC). Unlike the system used in North America in which the designations of Class, Division, and Group are used, the IEC system defines area classifications in terms of Zones, and Groups (See Table 24-I).

Zones

Three types of IEC Zone classifications define areas where an explosive mixture is present:

Zone 0 Continuously present or will be present for long periods of time.

Zone 1 Present under normal operating conditions. (Similar to the US and Canada Division 1 location.)

Table 24-I: Area Classification

	Continuous Hazard	Intermittent Hazard	Hazard under Abnormal Conditions
Europe	Zone 0	Zone 1	Zone 2
North America	Division 1		Division 2

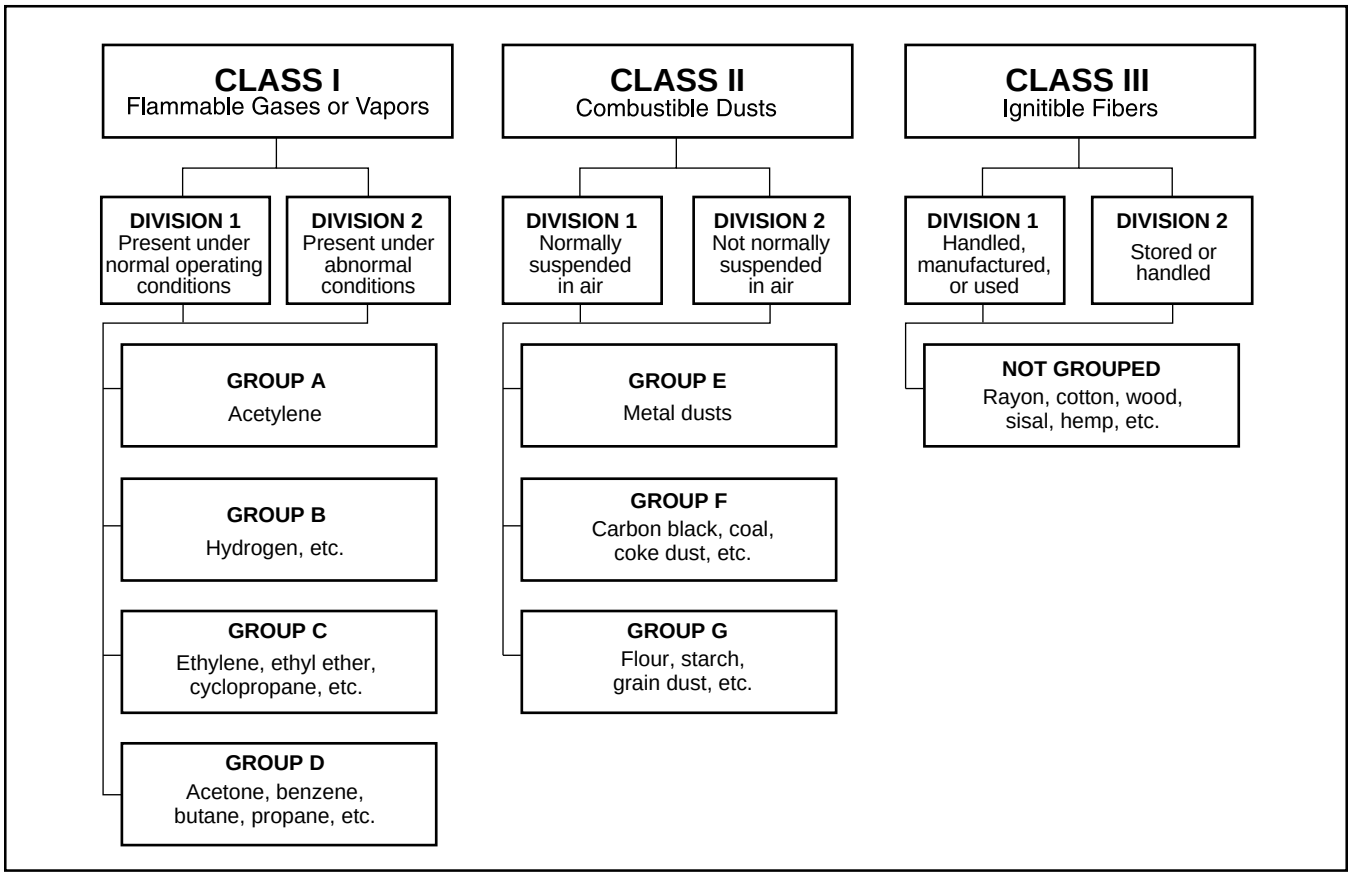


Figure 24-2: International Hazardous Locations / Materials

Zone 2 Only present for short periods of time, and is not likely to occur except under abnormal conditions. (Similar to the US and Canada Division 2 location.)

Groups

The IEC area classification system places each gas into one of three groups depending on its properties, such as Auto-Ignition Temperature (AIT), Minimum Igniting Current (MIC), etc. These Groups (and sample gases) are:

Group IIC Acetylene, Hydrogen (exclusive to group)

Group IIB Ethylene, Ethyl Ether, Butadiene, Cyclopropane

Group IIA Propane, Ethane, Butane, Benzene, Ethyl Alcohol, Methyl Ethyl Keytone

Temperature Codes

North America and Europe Product Classifications

In North America, Australia, Europe, and throughout other parts of the world, devices that are intended for use in hazardous locations are required to be labeled with the surface temperature that the device could reach under fault conditions. A temperature code (Table 24-II) is given to each device based on that temperature.

Each type of gas, vapor, and dust has an auto ignition temperature at which it will spontaneously ignite without any other source of ignition. Therefore, depending on the type of gas, vapor, or dust present, the temperature code can limit the use of a particular device. For example, a gas that has an auto ignition temperature of 392° F, will required a temperature code (or T rating) of T3 for equipment being used in that area. Per Table 24-II any device used in that location must not exceed a surface temperature of 392° F and must have a rating of T3 through T6. You will notice that the higher the T-rating, the lower the allowable surface temperature.

Protection Methods

Various protection methods are available which enable electrical equipment to operate safely in a hazardous area. The two most common methods are intrinsically safe, and explosion-proof.

Intrinsically Safe

An intrinsically safe device and associated wiring are designed such that the electrical equipment is not capable of releasing sufficient electrical and/or thermal energy under normal or abnormal conditions to cause ignition of a specific flammable or combustible mixture in its most ignitable concentration.

With an intrinsically safe system, a safety barrier must be used. A safety barrier is an assembly located outside of the hazardous area, which limits the current and voltage being supplied to the device during normal and abnormal operating conditions. (Intrinsically safe systems are more common in Europe.)

Table 24-II: Temperature Classification

Classification		Maximum Surface Temperature	
Europe	**USA/Canada**	**°F**	**°C**
T1	T1	842	450
T2	T2	572	300
	T2A	536	280
	T2B	500	260
	T2C	446	230
	T2D	420	215
T3	T3	392	200
	T3A	356	180
	T3B	329	165
	T3C	320	160
T4	T4	275	135
	T4A	248	120
T5	T5	212	100
T6	T6	185	85

Explosion-proof (Flame-proof in Europe)

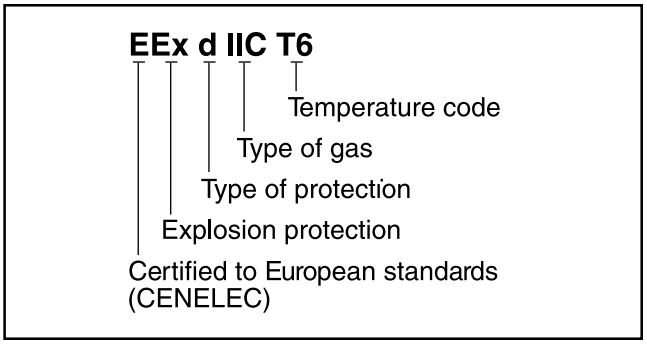
An explosion-proof device is contained in an enclosure that is capable of withstanding an internal explosion of a specified gas or vapor. The enclosure must also prevent the ignition of the specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within. The device must operate at an external temperature such that a surrounding flammable atmosphere will not ignite.

Non-Incendive

Non-incendive equipment is only allowed in a Division 2, or Zone 2 area, based on the premise that the device does not spark or become hot during normal operation and is constructed to a minimum standard of reliability.

European Product Classifications

The European Committee for Electrotechnical Standardization (CENELEC) has developed a classification system, which is used throughout the world (except for North America) for equipment going into hazardous areas. This system uses a series of codes to identify the certification type, protection type, gas group designation, and temperature classification.



Certification Type: EEx or Ex Symbol

The Ex symbol designates that the equipment was tested to a national standard only for the type of protection listed.

The EEx symbol designates that the equipment was tested to one of the European Harmonized standards of CENELEC and can bear the distinctive community mark ⟨Ex⟩ and is accepted by all EU (European Union) members.

In the previous example of EEx d IIC T6, the equipment meets the CENELEC requirements for flame-proof, for use in an acetylene or hydrogen area with an external temperature that will not exceed 185° F (85° C).

Table 24-III: CENELEC Designations

Type of Protection:

o	Oil immersion
p	Pressurization
q	Powder filling
d	Flame-proof
e	Increased safety
i	Intrinsic safety ia - Zone 0, Zone 1, and Zone 2 ib - Zone 1 and Zone 2
m	Encapsulation
n	Non-incendive (Zone 2 only)

Gas Group Designation

IIC	Acetylene, hydrogen
IIB	Ethylene
IIA	Propane

IP (Ingress Protection) Codes

The International Electrotechnical Commission (IEC) has a system to classify the degree of protection provided by an enclosure against the ingress of solids and liquids. This system is outlined in IEC Standard 529 and consists of the letters “IP” followed by a two digit number.

Example: IP 65

The first digit represents the degree of protection against the ingress of dust-type particles. The second digit represents the degree of protection against the penetration of water. (See Table 24-IV)

NEMA Enclosures

The National Electrical Manufacturers Association (NEMA) system advises manufacturers of the type of protection a housing will provide against a specific environmental condition. The NEMA ratings are described in Table 24-VI.

Table 24-V: Certified Testing Agencies

FM	Factory Mutual Research (USA)
UL	Underwriters Laboratories (USA)
CSA	Canadian Standards Association
SCS	Sira Certification Service (England)
PTB	Physikalisch-Technische Bundesanstalt (Germany)
BASEEFA	Health and Safety Executive (England)
SAA	Standards Association Australia

Table 24-IV: IP Codes

First Digit	Dust-type Protection	Second Digit	Water Protection
0	None	0	None
1	Objects 50 mm or larger	1	Vertically falling water drops
2	Objects 12.5 mm or larger	2	Vertically falling water drops with enclosure tilted up 15 degrees
3	Objects 2.5 mm or larger	3	Spraying water
4	Objects 1.0 mm or larger	4	Splashing water
5	Dust protected	5	Water jets
6	Dust tight	6	Powerful water jets
		7	Effects of temporary immersion in water
		8	Effects of continuous immersion in water

Table 24-VI: NEMA Enclosure Ratings

Rating NEMA	Environment	Protection Against
Type 1	Indoor	Contact with the enclosed equipment.
Type 2	Indoor	Limited amounts of falling water and dirt.
Type 3	Outdoor	Windblown dust, rain, and sleet; and to remain undamaged by the formation of ice on the enclosure.
Type 3R	Outdoor	Falling rain and sleet, and to remain undamaged by the formation of ice on the enclosure.
Type 4	Outdoor	Windblown dust, rain, splashing water, and hose directed water; also to remain undamaged by the formation of ice on the enclosure.
Type 4X	Outdoor	Same as Type 4, but will also be corrosion resistant.
Type 5	Indoor	Settling airborne dust, falling dirt, and dripping non-corrosive liquids.
Type 6	Indoor/outdoor	Entry of water during occasional temporary submersion at a limited depth.
Type 6P	Indoor/outdoor	Entry of water during prolonged submersion at a limited depth.
Type 11	Indoor	By oil immersion, enclosed equipment against the corrosive effects of liquids and gases.
Type 12	Indoor	Dust, falling dirt, and dripping noncorrosive liquids.
Type 12K	Indoor	Enclosures with knockouts used to provide protection against dust, falling dirt, and dripping non-corrosive liquids other than at knockouts.
Type 13	Indoor	Dust, spraying of water, oil, and noncorrosice coolant.

NEMA Hazardous Location Types

Type 7	Indoor	Locations classified as Class I; Groups A, B, C, or D; as defined in the National Electrical Code.
Type 8	Indoor/outdoor	Locations classified as Class I; Groups A, B, C, or D; as defined in the National Electrical Code.
Type 9	Indoor	Locations classified as Class II; Groups E, F, or G; as defined in the National Electrical Code.
Type 10	N/A	Enclosures are constructed to meet the applicable requirements of the Mine Safety and Health Administration.

PRODUCT CERTIFICATIONS

Valtek Products And Certification Types	NORTH AMERICA									EUROPE								AUSTRALIA							
	CLASS I									EEx			Ex					Ex							
	Division 1, Group				Division 2, Group				Other	i							Other	i							Other
	A	B	C	D	A	B	C	D		ia	ib	d	n	Gas Group	IP Rating	Temp Code		ia	ib	d	n	Gas Group	IP Rating	Temp Code	
Explosion-proof																									
IP-2000		FM CSA	FM CSA	FM CSA		FM CSA	FM CSA	FM CSA	NEMA 4x TYPE 4x											SAA		IIB+H_2	IP65	T6	
Postion Pac																									
TX			UL CSA	UL CSA			UL CSA	UL CSA	NEMA 4 TYPE 4																
TA2			UL CSA	UL CSA			UL CSA	UL CSA	NEMA 4 TYPE 4																
H2TS		UL	UL	UL		UL	UL	UL	NEMA 4																
A2TS		UL	UL	UL		UL	UL	UL	NEMA 4																
StarPac		FM	FM	FM		FM	FM	FM	NEMA 4x																
Intrinsically Safe																									
IP-2000	FM CSA	FM CSA	FM CSA	FM CSA	FM CSA	FM CSA	FM CSA	FM CSA	NEMA 4x TYPE 4x	SCS	SCS			IIC	IP66	T4		SAA	SAA			IIC	IP65	T5	
Non-Incendive																									
StarPac					FM CSA	FM CSA	FM CSA	FM CSA					SCS	IIC	IP54	T6					SAA	IIC	IP66	T6	
IP-2000					FM CSA	FM CSA	FM CSA	FM CSA					SCS	IIC	IP66	T6					SAA	IIC	IP65	T6	

FM = Factory Mutual Research
CSA = Canadian Standards Association
UL = Underwriters Labratories
SAA = Standards Association Australia
SCS = SIRA Certification Services (CENELEC Approved Testing Agency)