

# Explosion Protection Guide

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## Hazardous areas definitions

Hazardous locations are defined as those areas where fire or explosion hazards may exist due to the presence of flammable gases or vapors, flammable liquids or combustible dusts. Two different hazardous areas electrical standards coexist throughout the world. In North America, the "Class, Division" System is the basis for area classification of hazardous locations. According to this system, hazardous locations are divided into three Classes, and two Divisions. The Classes are based on the type of hazard and the explosive characteristics of the material while the Divisions are based on the occurrence or risk of fire or explosion that the material presents. In other parts of the world, areas containing potentially explosive atmospheres are dealt with a "Zone System". (ATEX, IECEx). In the Zone system the level of hazard probability is divided into three Zones as oppose to North America's two Divisions.

ATEX group	ATEX category and environment type	Zone classification ATEX / IECEx	Required equipment protection level	Class / Zone / classification US / Canada	Class / Division classification US / Canada
I	M1	N/A	Ma	N/A	Mining
	M2		Mb		
II	1G	Zone 0	Ga	Class I, Zone 0	Class I, Division 1
	2G	Zone 1	Gb	Class I, Zone 1	
	3G	Zone 2	Gc	Class I, Zone 2	Class I, Division 2
	1D	Zone 20	Da	Class II, Zone 20	Class II, Division 1
	2D	Zone 21	Db	Class II, Zone 21	
	3D	Zone 22	Dc	Class II, Zone 22	Class II, Division 2, Class III

## Hazardous areas according to ATEX and IECEx zones

ATEX Directive considers the following groups:

**Group I** Products designed for use in mines and in their surface plants.

**Group II** Products designed for use on surface sites in the presence of explosive atmospheres.

These products are then subdivided within the Groups as following:

### Group I

*Category M1* Equipment ensuring a very high level of protection; they must be powered if an explosive atmosphere is present.

*Category M2* Equipment ensuring a high level of protection; they must be disconnected if an explosive atmosphere is present.

### Group II

*Category 1* Equipment ensuring a very high level of protection; they are installed in those places in which there is always an explosive atmosphere or in which there is an explosive atmosphere for long periods.

*Category 2* Equipment ensuring a high level of protection; they are installed in those places in which an explosive atmosphere will probably develop.

*Category 3* Equipment ensuring a normal level of protection; they are installed in those places in which there is a small probability that an explosive atmosphere will develop.

Hazardous areas are then classified in zones according to the frequency and duration of an explosive atmosphere consisting of combustible gas or dusts.

**Zones:** define the type of explosive atmosphere as well as the likelihood of an explosive atmosphere being present

**Zone 0** A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously or for long periods.

**Zone 1** A place in which an explosive atmosphere consisting of a mixture with air or flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally.

**Zone 2** A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

**Zone 20** A place in which an explosive dust atmosphere is present continuously, or for long periods.

**Zone 21** A place in which an explosive dust atmosphere is likely to occur in normal operation.

**Zone 22** A place in which an explosive dust atmosphere is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

# Hazardous areas definitions

## Hazardous locations according to North American classes and divisions

In North America, hazardous locations have traditionally been defined by a combination of classes and divisions.

**Classes:** define the type of explosive atmosphere:

**Class I** A location made hazardous by the presence of flammable gases or vapors that may be present in the air in quantities sufficient to produce an explosive or ignitable mixture

**Class II** A location made hazardous by the presence of combustible or electrically conductive dust

**Class III** A location made hazardous by the presence of easily ignitable fibers or flyings in the air, but not likely to be in suspension in quantities sufficient to produce ignitable mixture

**Divisions:** define the likelihood of an explosive atmosphere being present

**Division 1** A location where a classified hazard exists or is likely to exist under normal conditions

**Division 2** A location where a classified hazard does not normally exist but is possible to appear under abnormal conditions

Recently the U.S. and Canada have revised their installation codes to recognize the international 3-Zone area classification system (ATEX / IECEx system) for equipment used in hazardous locations.

**Zone 0** An area in which an explosive gas atmosphere is continuously present for a long period of time

**Zone 1** An area in which an explosive atmosphere is likely to occur in normal operation

**Zone 2** An area in which an explosive gas atmosphere does not normally exist.

In Canada, all new installations must use the 3-Zone system. Existing installations may continue to use the 2-Division system or opt to re-classify using the 3-Zone system.

In the U.S., all installations (both new and existing) can either continue using the 2-Division system or re-classify their product using the 3-Zone system.

## Gas and dust groups

ATEX - IECEx and US / Canada zones system		US / Canada class / division system	
Gas / dust group	Typical substances	Gas / dust group	Typical substances
IIC	Acetylene	Class I, Group A	Acetylene
IIB + H <sub>2</sub>	Hydrogen	Class I, Group B	Hydrogen
IIB	Ethylene	Class I, Group C	Ethylene
IIA	Propane	Class I, Group D	Propane
IIIC	Conductive Dust	Class II, Group E	Combustible Metal Dust
IIIB	Non-conductive Dust	Class II, Group F	Combustible carbonaceous dust
		Class II, Group G	Combustible dusts not in group E or F
IIIA	Combustible Flyings	Class III	Combustible fibres and flyings

## Temperature classification

ATEX / IECEx		NEC / CEC	
Maximum Surface Temp	T Class	Maximum Surface Temp.	T Class
450°C (842°F)	T1	450°C (842°F)	T1
300°C (572°F)	T2	300°C (572°F)	T2
		280°C (536°F)	T2A
		260°C (500°F)	T2B
		230°C (446°F)	T2C
		215°C (419°F)	T2D
200°C (392°F)	T3	200°C (392°F)	T3
		180°C (365°F)	T3A
		165°C (329°F)	T3B
		160°C (320°F)	T3C
135°C (275°F)	T4	135°C (275°F)	T4
		120°C (248°F)	T4A
100°C (212°F)	T5	100°C (212°F)	T5
85°C (185°F)	T6	85°C (185°F)	T6

Ignition temperature is the minimum temperature of a surface at which an explosive atmosphere ignites. Flammable vapors and gases can be classified into temperature classes according to their ignition temperature. The maximum temperature of a piece of equipment must always be lower than the ignition temperature of the gas - air mixture or vapor - air mixture in which it is placed.

# ATEX and IECEx protection concepts

Symbol	Type of protection	Suitable for zone							Typical EPL				EN/IEC standard	
		0	1	2	20	21	22	Ga	Gb	Gc	Da	Db		Dc
e	Increased safety		•	•					•					60079-7
n	Type 'n' (non sparking)			•						•				60079-15
	Type 'n' (closed-break)			•						•				
	Type 'n' (sealed and hermetically sealed)			•						•				
	Type 'n' (restricted breathing)			•						•				
d	Flameproof		•	•					•					60079-1
q	Powder filled		•	•					•					60079-5
ia	Intrinsic safety	•	•	•	•	•	•	•			•			60079-11
ib			•	•		•	•		•			•		
ic				•			•			•			•	
px	Pressurised enclosure		•	•					•					60079-2
py			•	•					•					
pz				•						•				
ma	Encapsulation	•	•	•	•	•	•	•			•			60079-18
mb			•	•		•	•		•			•		
mc				•			•			•			•	
o	Oil immersion		•	•					•					60079-6
op pr	Optical radiation		•	•					•					60079-28
op sh		•	•	•				•						
po is		•	•	•				•						
ta	Dust ignition protection by enclosure				•	•	•				•			60079-31
tb						•	•					•		
tc							•						•	
pd	Pressurised enclosure				•	•					•			61241-4
							•						•	

## UL protection concepts (for gas, vapor...)

US code	CAN code	Type of protection	Class I Div			Class I Zone		US Standard	CA Standard
			1	2	0	1	2		
AEx e	Ex e	Increased safety				•	•	ISA 60079-7	CSA E60079-7
(NI)	(NI)	Non-incendive		•				ISA 12.12.01 / FM 3611	C22.2 No.213
AEx nA	Ex nA	Non-sparking		•				ISA 60079-15	CSA E60079-15
(XP)	(XP)	Explosion proof	•	•				UL 1203 / FM 3615	C22.2 No.30
AEx d	Ex d	Flame proof				•	•	ISA 60079-1 / UL 1203 / FM 3615	CSA 60079-1
AEx q	Ex q	Powder filled				•	•	ISA 60079-5	CSA E60079-5
AEx nC	Ex nC	Enclosed break					•	ISA 60079-15	CSA E 60079-15
(IS)	(IS)	Intrinsic safety	•	•				UL 913 / FM 3610	C22.2 No. 157
AEx ia	Ex ia				•	•	•	ISA 60079-11 / FM 3616	CSA E60079-11
AEx ib	Ex ib					•	•		
AEx nL	Ex nL	Limited energy					•	ISA 60079-15	CSA E60079-15
Type X	Type X	Pressurised	•	•				NFPA 496 (FM 3620)	NFPA 496
Type Y	Type Y		•	•					
Type Z	Type Z		•						
AEx px	Ex px					•	•	ISA 60079-2	CSA E60079-2
AEx py	Ex py					•	•		
AEx pz	Ex pz						•		
AEx nR	Ex nR	Restricted breathing					•	ISA 60079-15	CSA E60079-15
AEx m	Ex m	Encapsulated				•	•	ISA 60079-18	CSA E60079-18
AEx ma	N/A				•	•	•		
AEx mb						•	•		
AEx o	Ex o	Oil immersion				•	•	ISA 60079-6	CSA E 60079-6

## UL protection concepts (for combustible dust)

US code	CAN code	Type of protection	Class II		Class III	Class II Zone			US Standard	CA Standard
			Div	Div		0	20	21		
(DIP)	(DIP)	Dust ignition proof	•	•	•				UL 1203 / FM 3616	CSA C22.2 No. 25
(NI)	(NI)	Dust protected		•	•				ISA 12.12.01 / FM 3611	CSA C22.2 No.25
AEx ta	Ex ta	Protection by enclosure					•	•	ISA 60079-31	CSA C22.2 No. 60079-31
AEx tb	Ex tb						•	•		
AEx tc	Ex tc							•		
N/A	N/A	Fiber & Flying protection			•				UL 1203 / ISA 12.12.01	CSA C22.2 No. 25
AEx maD	N/A	Encapsulation					•	•	ISA 60079-18	N/A
AEx mbD								•		
(PX)	(PX)	Pressurisation	•	•	•				NFPA 496 (FM 3620)	NFPA 496
(PY)	(PY)		•	•	•					
(PZ)	(PZ)			•	•					
AEx pD	N/A						•		ISA 61241-2	N/A
(IS)	(IS)	Intrinsic safety	•	•	•				UL 913 / FM 3610	CSA C22.2 No. 157
AEx iaD	N/A						•	•	ISA 60079-11	N/A
AEx ibD								•		

## IP Ratings and NEMA enclosure types

ATEX and IECEx standards define a two-digit IP code. The first number relates to protection from solids; the second number relates to protection from liquids. NEMA enclosure types follow a different system and can not be directly converted; NEMA enclosure types can approximately converted to IP rating, but IP rating can not be converted to NEMA enclosure types. In this case, equipment may carry several NEMA ratings.

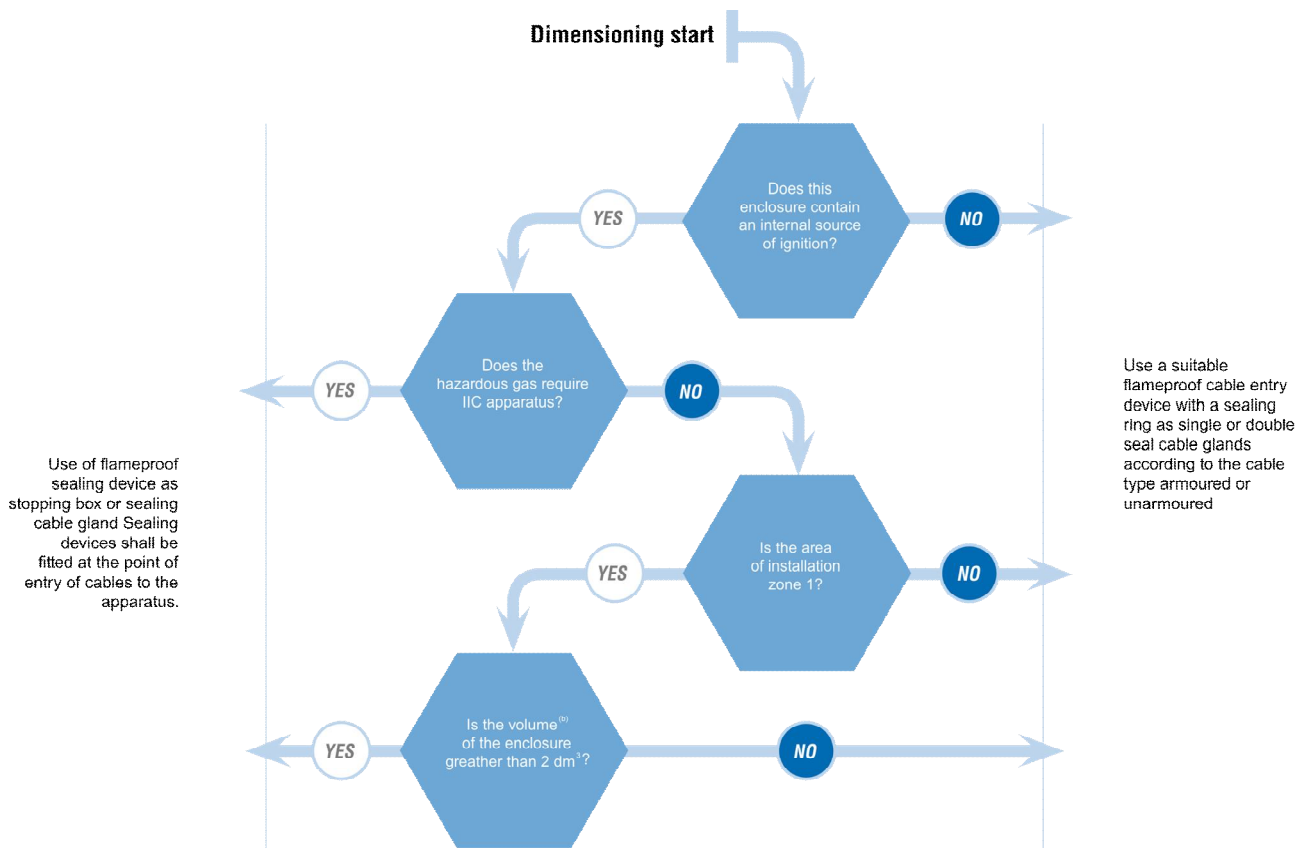
IP ratings according to EN / IEC 60529			
First number	Protection	Second number	Protection
0	No special protection	0	No special protection
1	Objects > 50 mm diameter	1	Vertically dripping water
2	Objects > 12.5 mm diameter	2	Vertically dripping water when enclosure tilted by 15°
3	Objects > 2.5 mm diameter	3	Sprayed water up to 60°
4	Objects > 1.0 mm diameter	4	Sprayed water from all directions
5	Dust protected	5	Water jets
6	Dust-tight	6	Powerful water jets
		7	Temporary submersion to a depth of 1m
		8	extended submersion to a depth of > 1m

# Enclosure types according to NEMA 250

		Type of enclosure																
		1	2	3	3X	3R	3RX	3S	3SX	4	4X	5	6	6P	12	12K	13	
Indoor use		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Outdoor use				•	•	•	•	•	•	•	•		•	•				
Protection against	Access to hazardous parts	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
	Ingrss to solid foreign objects (falling dirt)	•	•								•	•	•	•	•	•	•	
	Ingress of solid foreign objects (windblown dust, lint, fibres and flyings)			•	•			•	•	•	•		•	•				
	Ingress of water (dripping and light splashing)		•							•	•	•	•	•	•	•	•	
	Ingress of solid foreign objects (circulating dust, lint, fibres and flyings)									•	•		•	•	•	•	•	
	Ingress of solid forcing objects ( settling airborne dust, lint, fibres and flyings)									•	•	•	•	•	•	•	•	
	Ingress of water (hosedown and splashing water)									•	•		•	•				
	Oil and coolant seepage															•	•	•
	Oil or coolant spraying and splashing																	•
	Corrosive agents				•		•		•	•	•			•				
	Ingress of water (occasional temporary submersion)													•	•			
	Ingress of water (occasional prolonged submersion)														•			
	Ingrss of water ( rain, snow and sleet)			•	•	•	•	•	•	•	•	•	•	•	•			
External mechanisms operable when ice laden								•	•									
Approximate IP rating equivalent		2	22	55	55	24	24	55	55	6	66	5	6	68	54	54	54	

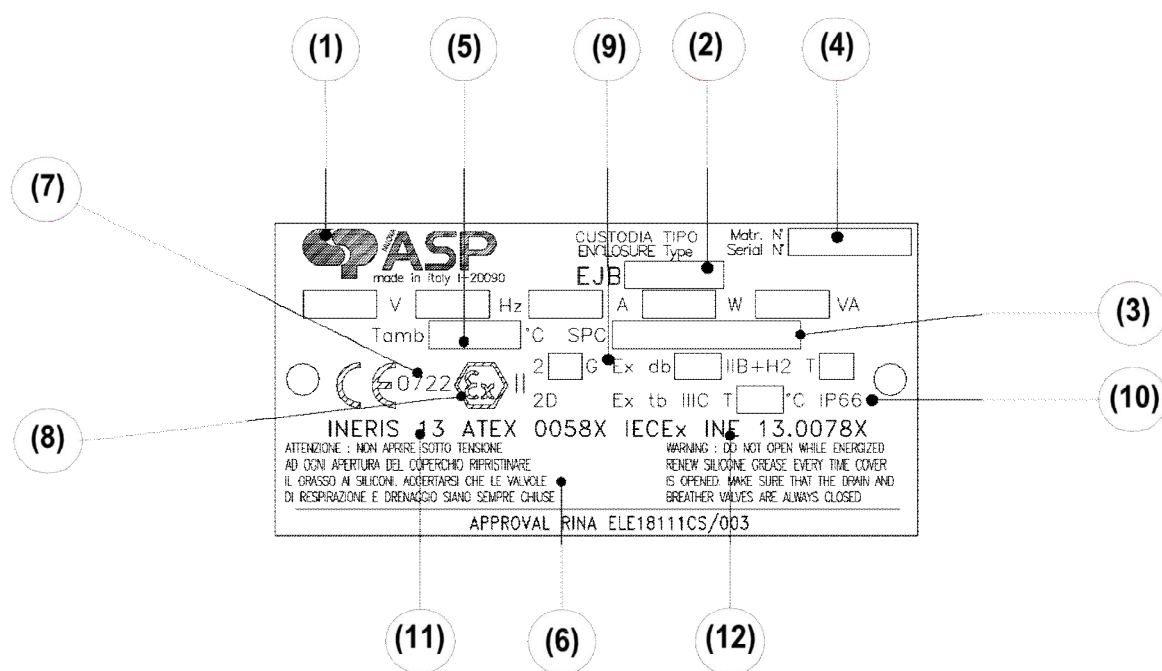


# Cable gland selection for Ex d equipment



# Typical marking

## ATEX / IECEx



- (1) brand, name and address of the manufacturer
- (2) equipment type designation given by manufacturer
- (3) specification number of customer (if request)
- (4) year of construction and serial number
- (5) Operating temperature range
- (6) warning used for all types of enclosure
- (7) identifying number of Notified Body responsible of production surveillance on "ATEX" equipment (only for ATEX)
- (8) distinctive community mark specific of explosion protection (only for ATEX)
- (9) ATEX marking only

II: group of apparatus - equipment suitable to be installed in surface places

2G: category – equipment suitable to be installed in places in which, during the normal activities, explosive atmosphere caused by gases, vapours, mists (G) are likely to occur (zone 1); suitable to be installed in zone 1 and in zone 2.

2D: category – equipment suitable to be installed in places in which, during the normal activities, explosive atmosphere caused by mixture of air and combustible dust are likely to occur (zone 21); suitable to be installed in zone 21 and in zone 22.

(10) IECEx marking – type of protection

Ex: protection against explosion

d: type of protection flameproof

IIB: equipment suitable to be installed in surface places for all types of combustible gas

Gb: equipment for explosive gas atmospheres, having a "high" level of protection, which is not a source of ignition in normal operation or during expected malfunctions

+H2 adapted for use in presence of hydrogen gas

tb: protection by enclosures, (for EPL Db)

IIIC: for use in places with an explosive dust atmosphere other than mines susceptible to firedamp; conductive dust

Db : equipment for explosive dust atmospheres, having a "high" level of protection, which is not a source of ignition in normal operation or during expected malfunctions



IP66 dust-tight (6); protected against powerful water jets (6)

(11) Identification of Notified Body that have issued the *EC-type examination certificate* and its relative number



(12) Identification of Notified Body that have issued the *IECEx certificate of conformity* and its relative number

# Typical marking

NEC 500

 I-20090	ENCLOSURE type <input type="text"/>	year s/n <input type="text"/>	Tamb. -20°C to +40°C
	ENCLOSURE FOR USE IN HAZARDOUS LOCATIONS AS TO EXPLOSION AND FIRE HAZARD ONLY Explosion-proof enclosures for use in Hazardous Locations, Class I, Division 1, Groups B, C and D; Class II, Groups E, F and G; Class III		
	WARNING: To reduce the risk of ignition of hazardous atmospheres, conduit runs must have a sealing fitting within 18 inches of enclosure. CAUTION: To Reduce The Risk Of Ignition Of Hazardous Atmospheres, Disconnect the Equipment From The Supply Circuit Before Opening Enclosures. Keep Tightly Closed When In Operation.		

NEC 505

 Made in Italy I-20090	EJB <input type="text"/>	Matr. N° <input type="text"/>	Serial N° <input type="text"/>
	E356725 <input type="text"/> W <input type="text"/> V <input type="text"/> Hz Tamb <input type="text"/> °C <input type="text"/> A		
<input type="text"/> Ah <input type="text"/> Vdc Entries <input type="text"/>		<input type="text"/>	
CNL Control Station Enclosures for use in Ex d IIB+H <sub>2</sub> T6 IP66; Hazardous Locations		USL Control Station Enclosures for use in Class I, Zone I, AEx d IIB+H <sub>2</sub> T6 IP66; Hazardous Locations	
Class I, Division 2, Groups A, B, C, and D			