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Process Industry Instruments Approvals And Certifications

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Process Industry Instruments

Approvals and Certifications

1. HAZARDOUS AREA APPROVALS

When designing a new product, manufacturers decide on the appropriate standards to follow and design the new product to comply. The manufacturer's product approvals group works with the product designers to ensure that all applicable requirements are met. In addition, compliance engineers and designers work with the approval agency during the design phase. Once the design is complete, prototype samples of the product are tested.

After testing, the manufacturer submits the product's documentation and hardware to the approval agency for their review. If approval is granted, the approval agency sends certification documents to the manufacturer, who can then label and sell the product as approved.

Safety in hazardous areas

A hazardous area is an area in which explosive atmospheres are present, or may be expected to be present, in quantities such as to require special precaution for the construction and use of electrical equipment

The hazardous conditions may be either man-made (as in petrochemical plants) or naturally occurring (as with coal mining). It is important to ensure that all electrical equipment installed in a hazardous area cannot form a spark or hot surface that would ignite flammable atmospheres. To ensure safety in hazardous areas, all equipment is examined and tested by a recognized testing authority before it is used in a hazardous area.

The fire triangle

Three components must be present for fire or explosion to occur (i.e., for an area to be classified as hazardous):

- Explosive material in sufficient quantities (e.g., petrol, hydrogen, vapors from a flammable liquid, combustible dusts)
- Ignition source of sufficient energy to ignite the explosive material (e.g., flames, welding, hot surfaces, spontaneous heating)
- Oxygen

These three components comprise the fire triangle. An explosion will not occur if any one of the three components is missing.

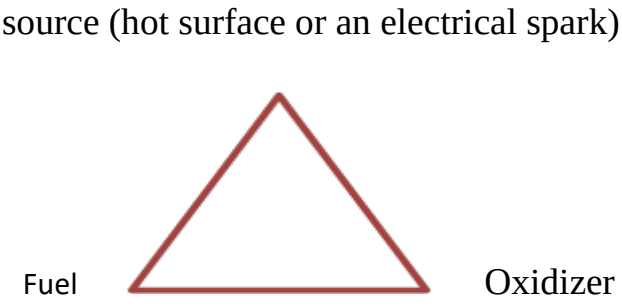


Figure 1.1: The fire triangle

Advantages of using certified equipment

By using certified products in hazardous areas, users can ensure that people and property will be protected from the risks associated with the use of electrical equipment in hazardous locations. Certification ensures expert conformity with standards and provides evidence of compliance with legal obligations such as safety regulations. In addition, certification markings provide ready identification of products that are fit for a purpose.

2. APPROVAL AGENCIES AND MARKINGS APPROVAL AGENCIES

Several approval agencies located throughout the world act as testing authorities in the design, manufacture, and operation of process control instruments. You need to be conversant about the requirements of agencies in your geographic area in particular, but you should also be somewhat familiar with agencies in other parts of the world.

The most common standards used in the process control industry are:

- International Electrotechnical Commission (IEC)
- European Standards (EN)
- Canadian Standards Association (CSA) in Canada
- Factory Mutual (FM) in the United States

Approval agencies around the world certify process control instruments to meet these standards. The approval agencies with which you should be familiar include:

- British Approval Services for Electrical Equipment in Flammable Atmosphere (BASEEFA) in the United Kingdom
- BVS and PTB in Germany
- FM in the United States
- CSA in Canada
- TIIS in Japan
- NEPSI in China
- CERCHAR and LCIE in France
- CESI in Italy
- DEMKO in Denmark
- ISSeP in Belgium

- DEKRA in the Netherlands
- SEV in Switzerland
- SIRA in England

European ATEX directive

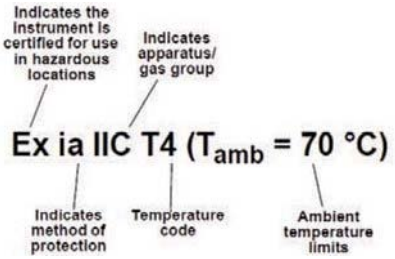
ATEX is the European Union's directive 2014/34/EU that applies to equipment and protective systems intended for use in potentially explosive atmospheres. ATEX is mandatory for the CE marking and putting on market in countries within EU and EFTA. The purpose of the directive is to facilitate trade within the European Union by aligning the laws of the member states regarding the safety requirements for hazardous area products.

3. APPROVAL AGENCY APPROVAL MARKINGS

Each approval agency uses a specific format to indicate which certifications it has granted to a particular instrument.

IEC approval markings

Transmitters that are certified to comply with IEC standard, are marked as follows:



Indicates the type of protection. Indicates hazard severity Temperature code

Intrinsically safe for: Class I, Div. 1, Groups ABCD T4

Indicates the material class Gas groups

Figure 3.1: Example of North American approval markings

ATEX approval marking

Transmitters that are certified to comply with ATEX Directive 94/9/EC are marked with the following prior to the IEC marking:

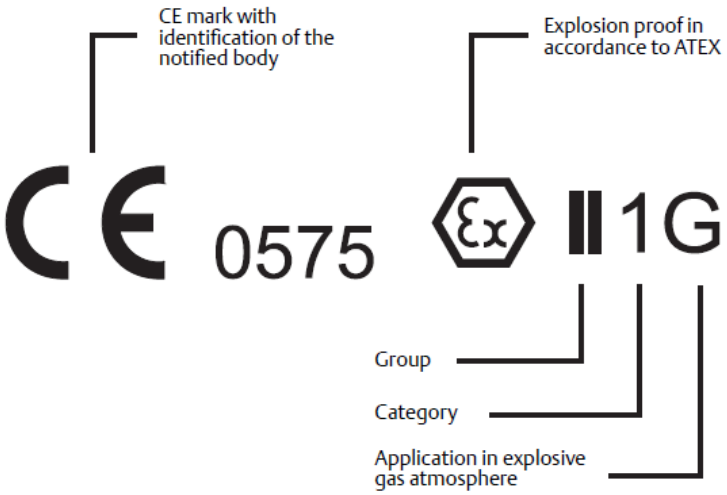


Figure 3.2: Example of ATEX approval marking

4. METHOD OF PROTECTION

Many methods of protection in hazardous areas work by eliminating one of the three components of the fire triangle. Methods of protection include:

- Exclusion
- Containment
- Energy limitation
- Dilution
- Avoidance

The most common methods of protection used in the process control industry are containment, energy limitation, and avoidance, which are described below.

Containment

Users can use the containment method so that if an explosion occurs, it is contained within the equipment enclosure. Thus, sparks or flames will not leak into the hazardous atmosphere and cause another fire or explosion. Containment is often used with spark-producing parts, such as switch gears, control boards, or transformers.

Explosion-proof enclosures (Ex db)

Explosion-proof (or flameproof) enclosures are used to surround equipment parts that could ignite an explosive atmosphere (e.g., by sparking). Explosion- proof enclosures must meet the following conditions:

- All enclosure joints leading to the outside environment must be flameproof
- The enclosure must have sufficient strength to withstand an internal explosion without rupture or permanent deformation

- The enclosure's surface temperature must never exceed the ignition temperature of the ambient gas-air mixture When selecting an explosion- proof material, users should consider the material's thickness, corrosion resistance, impact strength, and porosity

- The design must also prevent explosions by removing sufficient energy from escaping gases so that energy levels are below the minimum ignition energy levels of any flammable gases and combustible dusts in the ambient atmosphere. If energy levels are maintained below these levels, an explosion will not occur.

Intrinsic safety (Ex i)

Intrinsically safe (I.S.) equipment and wiring prevents explosion by limiting the electrical energy to ignite explosive gases in the atmosphere under normal or defined fault conditions. The energy allowed into the hazardous location is limited by an external mounted I.S. barrier (provided by the installer). Advantages of I.S. approaches include:

- Less operator action required to maintain a safe system
- Easier to maintain and repair the equipment

I.S. devices are assigned maximum voltage, current, capacitance, inductance and power supply limits. The magnitude of these parameters determines the level of energy storage allowed in the I.S. circuit.

Avoidance

Users may also prevent explosions by using equipment or parts of equipment that do not arc or spark in normal service, thus preventing the ignition source from ever occurring.

Increased safety (Ex e)

Increased safety is perhaps the most widely used method of protection. The design and manufacture of increased safety equipment excludes normally sparking components.

Manufacturers design other components to reduce substantially the likelihood of the occurrence of fault conditions that could cause ignition by:

- Reducing and controlling working temperatures
- Ensuring reliable electrical connections
- Increasing insulation effectiveness
- Reducing the probability of contamination by dirt and moisture ingress (entry)

Common increased safety applications include terminal and connection boxes, control boxes, and light fittings.

Non-sparking equipment (Ex n)

Non-sparking equipment is equipment with which special precautions are taken with connections and wiring to increase reliability. The equipment does not produce arcs, sparks, or hot surfaces in normal operation. Non-sparking equipment is commonly used with three-phase induction motors in hazardous areas.

Type of protection	Marking
Explosion-proof enclosures in Zone 1	Ex db
Intrinsic safety in Zone 0	Ex ia
Intrinsic safety in Zone 1	Ex ib
Increased safety in Zone 1	Ex eb
Non-sparking equipment in Zone 2	Ex n

Table 4.1: Examples of suitable protection types for different zones

5. EXPLOSIVE MATERIAL CLASSFICATIONS / GROUPS

North American approval agencies such as FM and CSA designate a material class in their certifications. The material classes are:

- Class I: Gases and vapors
- Class II: Dust
- Class III: Fibers and flyings

Explosive substances groups

Explosion substances codes differ between IEC/ATEX and North American markings.

Representative substance	North American explosive substances group	IEC explosive substances group
Acetylene	Class I, Group A	IIC
Hydrogen	Class I, Group B	IIC
Ethylene	Class I, Group C	IIB
Propane	Class I, Group D	IIA
Methane	Class I, Group D	I
Conductive metals	Class II, Group E	N/A
Carbonaceous	Class II, Group F	N/A
Grain	Class II, Group G	N/A
Fibers/flyings	Class III	N/A

Table 5.1: Gas groups

Temperature class

Temperature class defines the maximum surface temperature exposed to the Hazardous location. It shall be selected to be lower than the applicable auto ignition temperature of the hazardous substance. Similar temperature classification is used in both IEC/ ATEX and North American markings.

Temp. group	Max. surface temp. °C (°F)	Examples of gases and vapors against which protection is afforded
T1	450 (842)	Hydrogen, ammonia
T2	300 (572)	Acetone, ethanol, propane
T3	200 (392)	Petrol, crude oil
T4	135 (275)	n-heptane, ethyl ether
T5	100 (212)	None specified yet
T6	85 (185)	Carbon disulfide

Table 5.2: Temperature group codes

Examples of material Ex coding:

- Model code I1:

Ex ia IIC T4 Ga (Tamb = –50 °C to 70 °C) is a ATEX marking that indicates that the instrument may be used with gases in

Group IIC at temperatures within the range associated with group T4 and in ambient temperatures between –50 °C and 70 °C. This protection type is intrinsically safe level ia, and equipment protection level Ga (suitable for installation in Zone 0, 1 and 2).

- Model code I7:

Ex ia IIC T4 Ga (-50 °C _< Tamb _< 70 °C) is a IECEx marking that indicates that the intrinsic safety instrument may be used with gases in Group IIC at temperatures within the range associated with group T4 and in ambient temperatures between -50 °C and 70 °C. This protection type is intrinsically safe level ia, and equipment protection level Ga (suitable for installation in Zone 0, 1 and 2)

- Model code E5:

Explosion Proof for Class I, Division 1, Groups B, C, and D is an FM marking that indicates the instrument may be safely used with gases in gas groups B, C, and D

- Model code I6:

Intrinsically Safe for Class I, Division 1, Groups A, B, C, and D; Temperature Code T4 is a CSA marking that indicates that the instrument may be safely used with gases in gas groups A, B, C, and D at temperatures within the range associated with group T4

6. HAZARDOUS AREA CLASSFICATIONS

Approval agencies have designated hazardous area zone and division classifications that describe the degrees of risk in different types of hazardous areas. The classifications also specify which types of equipment protection are allowed in each zone or division. For example, sand filling is allowed in Division 2 and in Zones 1 and 2. Explosion-proof equipment is allowed in Zones 1 and 2. FM and CSA indicate the hazardous area division in their certification markings. IEC/ATEX indicate the hazardous area zone in their certification markings.

The following two examples show how hazardous area classifications are designated in product specifications:

- E5 Explosion Proof for Class I, Division 1, Groups B, C, and D indicates the instrument may be safely used in hazardous areas with ignitable concentrations of gases or vapors (Class I) present most of the time or for short periods of time under normal conditions
- I5 non-incendive for Class II, Division 2, Groups A, B, C, and D indicates the instrument may be safely used in hazardous areas with ignitable concentrations of dust (Class II) present only under fault conditions

North American	IEC	Definition
Division 1	Zone 0	Ignitable concentrations present most of the time under normal conditions
	Zone 1	Ignitable concentrations present under normal conditions for short periods
Division 2	Zone 2	Ignitable concentrations present only under fault conditions

7. INSTALLATION PRACTICES

Users must follow local installation standards, depending on their geographic location. Two examples are:

- North America—National Electrical Code (NEC) NFPA 70
- Europe (ATEX) - EN60079-14

These are standards for installations in hazardous areas, including explosion-proof, I.S., and sealing installations. The NEC specifies hazardous areas in which certain procedures must be followed.

Explosion-proof installation

Figure 7.1 shows the NEC requirements for an explosion-proof installation. Note that rigid metal conduits (or another approved conduit) must be used to enclose electrical wiring in hazardous areas. In addition, conduit seals should be placed along the electrical conduit line. In Europe, most explosion- proof installations use cable glands. Both methods are acceptable.

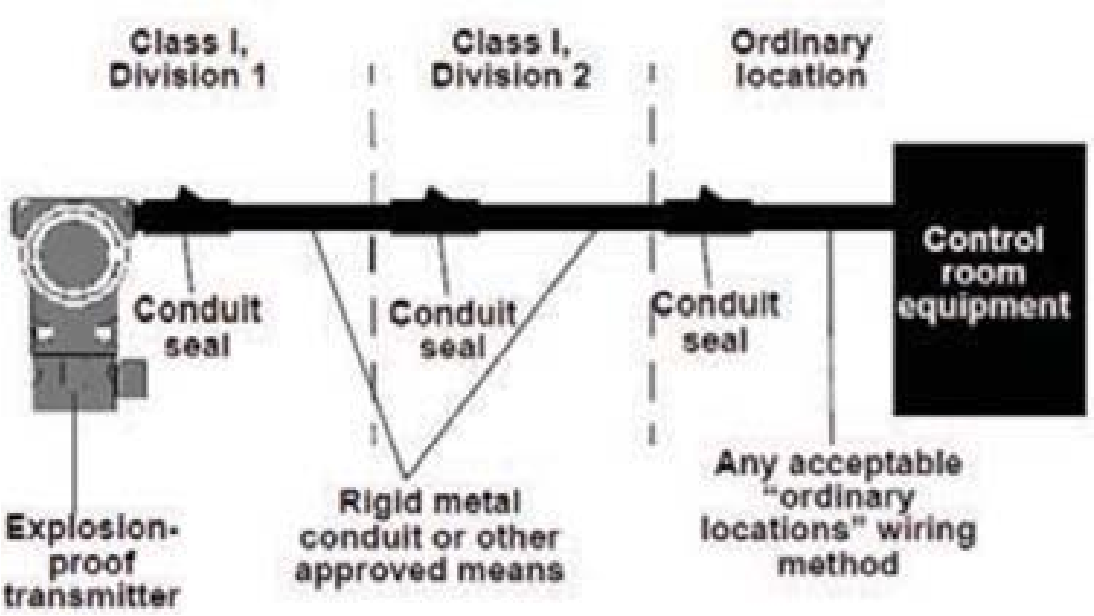


Figure 7.1 : NEC explosion-proof installation

Intrinsic safety installation

Figure 7.1 shows the NEC requirements for an I.S. installation. Users should consider functional issues such as communications and temperature effect when performing an I.S. installation. The I.S. barrier must be located outside the hazardous area.

Specific conditions for safe use

In many cases, an Ex certificate has associated unique installation or maintenance requirements, often called Specific Conditions for Safe use. For ATEX, IECEx (and some other) certificates, this is indicated by the letter "X" at the end of the certificate number. These requirements are listed in the certificate, and also in the Product Certifications document and/or Control drawing or Installation manual.

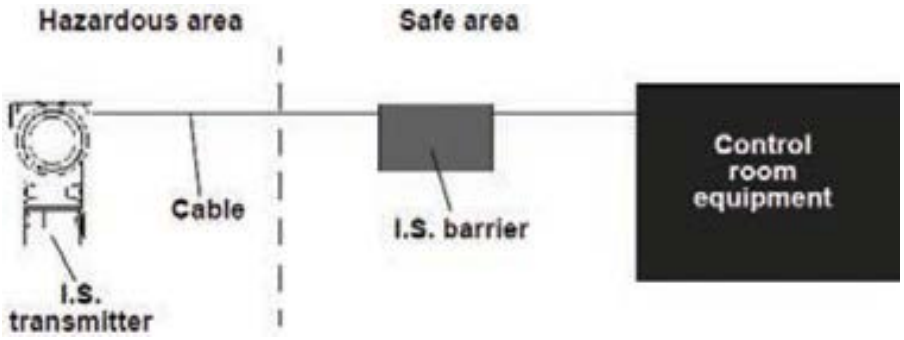


Figure 7.2 : Intrinsic safety installation

Sealing installation

The NEC requires that electrical enclosures be sealed if:

- The equipment marking requires sealing
- The equipment contains a source of electrical or thermal ignition
- The equipment has a provision for process connection but does not incorporate dual independent sealing of process fluids

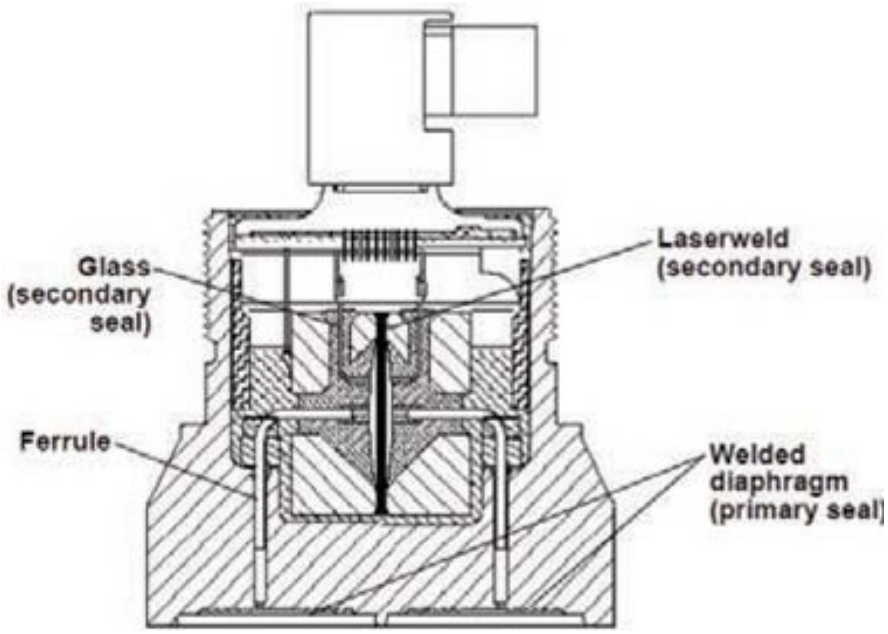


Figure 7.3 : Example of a sealed enclosure

8. ENCLOSURE RATINGS

Two standards govern the ingress (entry) protection (IP) of enclosures. These standards use rating systems to identify an enclosure's ability to resist external environmental influences. The two standards are:

- IEC
- National Electrical Manufacturer's Association (NEMA)

IEC ratings are based on performance criteria similar to NEMA, with different interpretations of enclosure performance.

13.2.1IEC ingress protection codes

IEC uses the codes in table 8.1 to designate an enclosure's ability to protect against different types of solids and liquids. The first number indicates

the degree of protection against solid foreign particles. The second number indicates the degree of protection against harmful entry of water. If either the first or second number is indicated with an X or a zero, then no protection is provided in that category. Examples of IEC IP codes include:

- IPX4 indicates protection against splashing water only
- IP2X indicates protection against solid foreign particles only
- IP56 indicates protection against dust and heavy seas or powerful water jets

1st no.	Description	2nd no.	Description
0 or X	No protection	0 or X	No protection
1	Objects ≥ 50 mm	1	Vertically dripping water
2	Objects ≥ 12.5 mm	2	75–105° angled dripping water
3	Objects ≥ 2.5 mm	3	Spraying water
4	Objects ≥1.0 mm	4	Splashing water
5	Dust- protected	5	Water jets
6	Dust-tight	6	Heavy seas, powerful water jets
		7	Effects of immersion
		8	Indefinite immersion

Table 8.1

NEMA indicates an enclosure's degree of protection against various materials using the numbers 1–13. The numbers cover liquid, solid, and hazardous area requirements.

NEMA ingress protection ratings

NEMA rating	Description
1	General purpose enclosure
2	Drip-tight enclosure
3	Weather proof
4	Water-tight
4X	Water-tight and corrosion resistant
5	Dust-tight
6	Submersible
7	Hazardous locations (Class I, Groups C and D)
8	Hazardous locations (Class I, oil- immersed)
9	Hazardous locations (Class II, Groups E, F, and G)
10	Explosion-proof (Bureau of Mines 0)
11	Acid and fume resistant, oil- immersed, used indoors
12	Industrial use
13	Dust proof

Table 8.2: NEMA enclosure protection codes

Comparing NEMA enclosure types with IEC classifications

IEC does not specify degrees of protection against risk of explosions or conditions such as moisture or corrosive vapors; NEMA does. Because of this reason and because tests and evaluations for other characteristics are not identical, IEC enclosure classification designations cannot be exactly

equated with NEMA enclosure type numbers. Table 8.3 shows general comparisons between NEMA enclosure types and IEC enclosure classifications that are similar but not exact.

NEMA rating	IEC code
3	IP54
4	IP56
4x	IP56
5	IP52
6	IP67
12	IP52

Table 8.3: Comparing NEMA with /EC designations

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Engineering Solutions and Training

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