HAWKE International

TECHNICAL SECTION

Hawke Cable Glands & Accessories

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Harsh & Hazardous

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A wide variety of factors influence which product should be selected for an application, as well as how it should be installed.

This section has been designed to identify the most important of these factors and help make the selection and installation of explosion protected electrical equipment easier.

Our technical section introduces the different regulations, codes, guidelines and standards that inform the design, installation and maintenance of electrical and non-electrical systems for use in potentially explosive atmospheres.

It also covers how the type of operational facility, geographic location, operator practice and national legislation authority, influences not only design but the installation rules that might apply. For example, products used on an offshore floating petroleum facility might not be designed or classified in the same way as an onshore petrochemical facility.

Questions?

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1.0 Potentially Explosive Atmospheres

An explosive atmosphere is defined as:

A mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapour, or dust which, after ignition, permits self-sustaining propagation.

2.0 Area Classification (Classification of Locations)

An area classification is a three-dimensional analysis to identify if there is a potential for an atmosphere containing flammable vapours, liquids, gases, mists or combustible dusts to form during the normal operation of a facility. Areas are further classified based on the likelihood the flammable or combustible could present in sufficient quantities for an explosion to occur.

An area classification facilitates the identification of acceptable electrical and non-electrical equipment for the specific locations, as well as the installation practices that must be followed.

The primary objective is to protect persons and property by minimizing the risk that a flammable atmosphere and an ignition source occur at the same time.

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3.0 IEC

3.1 Area Classification

Area classification is a three-dimensional analysis of a facility that identifies both hazardous areas and non hazardous areas and further subdivides the hazardous area into Zones.

Hazardous areas are sub-divided into three Zones, as shown below:-

Flammable Gases and Vapours	
Zone 0	An area in which an explosive atmosphere is constantly present, or present for long periods.
Zone 1	An area in which an explosive atmosphere is likely to occur in normal operation. (Typical Industry Guideline: 10 hours or more per year but less than 1,000 hours per year)
Zone 2	An area in which an explosive atmosphere is not likely to occur in normal operation and if it occurs it will exist only for a short time. (Typical Industry Guideline: Less than 10 hours per year)

Combustible Dusts	
Zone 20	An area in which combustible dust, as a cloud, is present continuously or frequently during normal operation in sufficient quantity to be capable of producing an explosive concentration of combustible dust in a mixture with air.
Zone 21	An area in which combustible dust, as a cloud, is occasionally present during normal operation in a sufficient quantity to be capable of producing an explosive concentration of combustible dust in a mixture with air.
Zone 22	An area in which combustible dust, as a cloud, may occur infrequently and persist for only a short period, or in which accumulations of layers of combustible dust may give rise to an explosive concentration of combustible dust in a mixture with air.

For further information on the classification of hazardous areas, please refer to the following publications:-

IEC/EN 60079-10-1	Explosive atmospheres. Classification of areas. Explosive gas atmospheres.
IEC/EN 60079-10-2	Explosive atmospheres. Classification of areas. Explosive dust atmospheres.
Energy Institute *(Formerly Institute of petroleum)*	Model code of safe practise in the petroleum industry. EI15 Area Classification Code for Petroleum installations.

3.2 Classification Society

A Classification Society may also enforce requirements for the design of installations of facilities. These requirements, which are in addition to statutory requirements, may influence the design and installation of the electrical systems. Classification Societies include ABS, DNV and Lloyds Register.

3.3 Design and Installation of Electrical Systems for Hazardous (Classified) Areas

There are numerous regulation codes, guidelines and standards for the design, selection and installation of electrical equipment in potentially explosive atmospheres. These requirements are in addition to the requirements for installations in non-hazardous areas.

There are several types of protection, i.e. construction techniques, available for electrical apparatus in hazardous areas. The type of protection permitted will depend upon the applicable installation codes and rules to be adopted.

The selection of electrical apparatus should be in accordance with the following: -

- Classification of the hazardous area.
- Temperature class or ignition temperature of the gas, liquid, vapours, mist, dust or fibre.
- Where applicable, the gas, vapour or dust classification in relation to the group or sub-group of the electrical apparatus.
- External influences and ambient temperature.

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3.4 Apparatus Selection According to Zones

3.4.1 Apparatus for use in Zone 0

- Intrinsic safety 'ia'
- Flameproof 'da'.
- Encapsulation 'ma'.
- Optical Radiation 'op is'.
- Equipment protection by special protection 's' Ex sa.

3.4.2 Apparatus for use in Zone 1

- Electrical apparatus permitted for use in Zone 0, or
- Flameproof enclosure 'd' or 'db'.
- Pressurised apparatus.
- Powder filling 'q'.
- Oil immersion "o" or 'ob'.
- Increased safety 'e' or 'eb'.
- Intrinsic safety 'ib'.
- Encapsulation 'mb'.

3.4.3 Apparatus for use in Zone 2

- Electrical apparatus permitted for use in Zone 0 and Zone 1, or
- Electrical apparatus designed specifically for Zone 2 (e.g. type of protection 'n') or
- Flameproof 'dc'
- Increased safety 'ec'
- Intrinsic safety 'ic'
- Encapsulation 'mc'
- Non-sparking 'nA'
- Protected sparking 'nC'
- Restricted breathing 'nR'
- Liquid immersion 'oc'
- Pressurization 'pzc'
- Special protection 'sc'

3.4.4 Apparatus for use in Zones 20, 21 and 22

- IEC/EN 60079-31 – Explosive atmospheres.
  Equipment dust ignition protection by enclosure "t".

3.5 Apparatus selection according to the ignition temperature of the gas or vapour

The equipment must be selected so that its maximum surface temperature will not reach the ignition temperature of any gas or vapour that may be present.

If the marking of the electrical apparatus does not include an ambient temperature range, the apparatus is only for use within an ambient temperature range from -20°C to +40°C.

Temperature Class Of Electrical Apparatus	Maximum Surface Temperature Of Electrical Apparatus	Ignition Temperature Of Gas Or Vapour
T1	450°C	>450°C
T2	300°C	>300°C
T3	200°C	>200°C
T4	135°C	>135°C
T5	100°C	>100°C
T6	85°C	>85°C

3.6 Apparatus selection according to apparatus grouping

The grouping of gases and vapours are classified into Group I and Group II categories. Group I is relevant to atmospheres containing firedamp (a mixture of gases, composed mostly of methane, typically found underground in mines).

Group II is intended for use in all other places with potentially explosive atmospheres. Group II electrical apparatus with types of protection 'd' and 'i' are further sub-divided into apparatus group IIA, IIB or IIC. Electrical apparatus with type of protection 'n' may also be sub-divided if it contains certain devices or components.

Gas / Vapour Sub-division	Apparatus Sub-group Permitted
IIA (typical gas propane)	IIA, IIB or IIC
IIB (typical gas ethylene)	IIB or IIC
IIC (typical gases acetylene and hydrogen)	IIC

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3.7 Apparatus Construction Standards

IEC/EN 60079-0 - General Requirements

IEC/EN 60079-1 - Flameproof Enclosure 'd'

IEC/EN 60079-2 - Pressurisation 'p'

IEC/EN 60079-5 - Powder Filling 'q'

IEC/EN 60079-6 - Oil Immersion 'o'

IEC/EN 60079-7 - Increased Safety 'e'

IEC/EN 60079-11 - Intrinsic Safety 'I'

IEC/EN 60079-15 - Electrical Apparatus type 'n'

IEC/EN 60079-18 - Encapsulation 'm'

IEC/EN 60079-28 - Protection of equipment and transmission systems using optical radiation

IEC/EN 60079-31 - Dust protection by enclosure 't'

3.8 Installation Standards and Codes

There are numerous different regulations, codes, guidelines and standards for the design, installation and maintenance of electrical and non-electrical systems for use in potentially explosive atmospheres. The type of operational facility, geographic location, operator practice, local and national legislation, authority having jurisdiction etc. will determine many of the design and installation rules permitted.

For further information on the design, selection and installation of equipment for use in hazardous areas see: -

IEC/EN 60079-14	Explosive atmospheres.
	Electrical installations design, selection and erection.
IEC/EN 61892-7	Mobile and fixed off shore units.
	Electrical installations.
	Hazardous areas.

3.9 Inspection and Maintenance Standards and Codes

For information regarding the installation and maintenance of equipment for use in hazardous areas, see:-

IEC/EN 60079-17	Explosive atmospheres.
	Electrical installations inspection and maintenance.
IEC/EN 60079-19	Explosive Atmospheres.
	Equipment repair, overhaul and reclamation

4.0 ATEX 2014/34/EU Directive

ATEX is the term used when referring to the European Union's (EU) Directive 2014/34/EU.

The ATEX Directive main objectives are to guarantee the free circulation of goods within the European Union by aligning the technical and legal requirements of the Member States.

'ATEX' is derived from the French 'Atmosphères Explosibles'.

The Directive is named: - "Approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres".

The Directive covers electrical and non-electrical equipment and protective systems intended for use in potentially explosive atmospheres in mining and surface industries.

The Directive covers:-

- Equipment and products that have potential ignition sources.
- Protective systems – products that control the effects of incipient explosions.
- Safety Devices – products that may be outside a potentially explosive atmosphere but that have an explosion safety function.
- Components – products that are intended to form parts of equipment or protective systems.

To ensure compliance with the Directive, equipment must meet with the essential requirements specified in the Directive and be marked with the CE marking.

The process of ensuring that equipment complies with the Directive, conformity assessment procedure(s) must be complied with. These procedures may involve a Notified Body. A Notified body is a body that is independent of the product manufacturer and assesses conformity of the products and the manufacturer with the Directive. The Notified Body has to be approved and appointed by its government.

Conformity assessment procedures include, but are not limited by:-

- EU Type Examination – including testing and inspection of a product design, where appropriate.
- Production Quality Assurance – including the assessment, periodic auditing, testing and inspection of production samples, where appropriate, and of the manufacturers quality system.
- Product Verification – the inspection and/or testing of each production item for conformity with the type that was subjected to EU Type Examination.
- Internal Control of Production – the verification by the manufacturer that the product design and each production item conform to either harmonized European Standards or the essential requirements or a combination of the two.

ATEX Directive 2014/34/EU came into force on 20th April 2016, immediately replacing the previous Directive 94/9/EC without a transition period, all products within its scope have to comply before being placed on the market or put into service.

To ensure compliance with the Directive, equipment must meet with the essential requirements specified in the Directive and be marked with the CE marking.

The Directive classifies equipment into eight categories depending on the equipment's area of use:-

Category	Description
M1	Equipment intended for mining use and required to remain functional in the presence of an explosive atmosphere.
M2	Equipment intended for mining use, but is intended to be de-energised in the event of an explosive atmosphere.
1G	Non-mining equipment for use in Zone 0.
2G	Non-mining equipment for use in Zone 1.
3G	Non-mining equipment for use in Zone 2.
3G	Non-mining equipment for use in Zone 2.
2D	Non-mining equipment for use in Zone 21.
3D	Non-mining equipment for use in Zone 22.

4.1 ATEX 137 Directive 99/92/EC

The Directive covers the use of equipment in potentially explosive atmospheres and its aim is to establish minimum requirements for improving the safety and health of workers.

Article 137 of Directive 89/391/EC was published in the official journal of the EC on 28th January 2000 as Directive 99/92/EC, it is the 15th individual Directive of the framework Directive 89/391/EEC.

The article defines the: -

- Obligations of the employees re. the prevention and protection against explosions
- Assessment obligations regarding the assessment of explosion risks
- General obligations re. the safety and health of worker
- Requirements for explosion protection documents

In places where potentially explosive atmospheres may occur in such quantities as to endanger the health and safety of workers, the point of entry must be marked with the sign shown in accordance with Section II, Article 7 of the Directive.

5.0 Wiring Systems

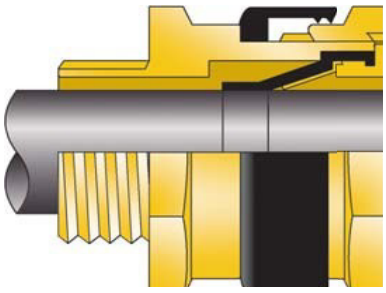
Cable systems and accessories should be installed in positions that prevent them from being subject to mechanical damage, corrosion, chemical attack, heat and other detrimental environmental conditions. Selection of the wiring system and cable type must consider these influences and where exposure to such conditions are unavoidable, protective measures such as minimising the risk of mechanical damage by the use of appropriate armoured cable types should be considered.

The connection of cables and conduits to the electrical apparatus must be in accordance with the requirements of the relevant type of protection and installation rules.

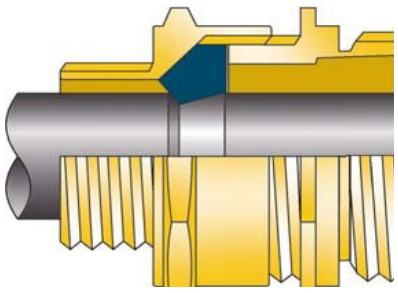
5.1 IEC Wiring Methods

With the introduction of cables incorporating new construction materials and especially cables with fire retardant or fire resistant properties such as cables complying with IEC 60331 and IEC 60332, cables may exhibit 'cold flow' characteristics. 'Cold flow' is a term used for thermoplastic materials that flow when subjected to pressure at ambient temperature. These 'cold flow' characteristics could have adverse effects on the protection of the apparatus. A suitable cable gland should be used that does not incorporate displacement/compression seals that act upon the part(s) of the cable having cold flow characteristics.

To overcome this problem, Hawke has developed cable glands that incorporate diaphragm seals that act upon the 'cold flow' cable sheath without compressing or damaging the cable. A typical cable gland incorporating displacement/compression seals and a Hawke 501/453/UNIV cable gland incorporating a diaphragm seal are shown below:-



No cable damage due to Hawke 501/453 Universal diaphragm seal cable gland design.



Cable damage as found with cable gland deisgns incorporating compression / displacements seals

The IEC installation standard IEC/EN 60079-14 addresses 'cold flow' in clause 10.2.

5.2 (A)Extract from IEC 60079-14 :2014

Installations in Hazardous Areas

9.3.2 Cables for fixed installations

Cables used for fixed installations in hazardous areas shall be appropriate for the ambient conditions in service. Cables shall be sheathed with termoplastic, thermosetting or elastomeric material. They shall be circular and compact. Any bedding or sheath shall be extruded. Fillers, if any, shall be non-hygroscopic.

10.2 Selection of cable glands

The cable gland shall be selected to match the cable diameter. The use of sealing tape, heat shrink tube or other materials is not permitted to make the cable fit to the cable gland. Cable glands and/or cables shall be selected to reduce the effects of the "coldflow characteristic" of the cable.

Note 1: *Cables employ materials which may exhibit "coldflow" characteristics. "Coldflow" in cables can be described as the movement of the cable sheath under the compressive forces created by the displacement of seals in cable glands where the compressive force applied by the seal is greater than the resistance of the cable sheath to deformation. Low smoke and/or fire resistant cables usually exhibit significant cold flow characteristics. Cold flow could give rise to a reduction in the insulation resistance of the cable and, where reasonably practical, efforts should be made to prevent this by selection of suitable cable glands.*

Cable glands shall be in accordance with IEC 60079-0 and shall be selected to maintain the requirements of the protection technique according to Table 10.

To meet the ingress protection requirement it may also be necessary to seal between the cable glands, adaptors and blanking elements and the enclosure (for example by means of a sealing washer or thread sealant).

Note 2: *In order to meet the minimum requirement of IP54, threaded cable entry devices into threaded cable entry plates or enclosures of 6 mm or greater thickness need no additional sealing between the cable entry device and the entry plate or enclosure providing the axis of the cable entry device is perpendicular to the external surface of the cable entry plate or enclosure*

Table 10

Selection of cable glands, adaptors and blanking elements type of protection according to the enclosure type of protection

Protection technique for the equipment	Glands, Adaptors and Blanking Element Protection Technique			
	Ex 'd' (See 10.6)	**Ex 'e'** (See 10.4)	**Ex 'e'** (See 10.4)	**Ex 't'** (See 10.7)
Ex **'d'**	X			
Ex **'e'**	X	X		
Ex **'i'** and Ex **'nL'** – Group II	X	X	X – See 16.6	
Ex **'i'** – Group IIa				X – See 16.6
Ex **'m'**	**Ex 'm'** would not normally be applied to wiring connections. The protection technique for connections shall suit the wiring system used.			
Ex **'n'** and Ex **'nL'** For Ex **'nR'** see also 10.8	X	X	X	
Ex **'o'**	**Ex 'o'** would not normally be applied to wiring connections. The protection technique for connections shall suit the wiring system used.			
Ex **'p'** – all types	X	X		
Ex **'pD'**			X	
Ex **'q'**	**Ex 'q'** would not normally be applied to wiring connections. The protection technique for connections shall suit the wiring system used.			
Ex **'s'**	Only as allowed by the conditions of the certificate.			
Ex **'t'**			X	

X denotes permitted use.

a) if only one intrinsicaly safe circuit is applied, then there are no specified requirements for cable glands.

b) only permitted for Gc installations.

10.3 Connections of cables to equipment

If additional clamping is required to prevent pulling and twisting of the cable transmitting the forces to the conductor terminations inside the enclosure, a clamp shall be provided, as close as practicable to the gland along the cable.

Note 1: *Cable clamps within 300mm of the end of the cable gland are preferred.*

Cables shall be routed straight from the cable gland to avoid laterial tension that may compomise the seal around the cable.

10.4 Additional requirements for entries other than Ex "d", Ex "t" or Ex "nR"

If additional cable entry holes for other than Ex "d", Ex "t" or Ex "nR" are required they may be made under the following conditions: • permitted by the manufacturer's documentation with area, size of holes and quantity of holes; • entry holes either plain or threaded shall meet the tolerances given by the manufacturer. Threaded holes in plastic enclosures should be at right angles to the face of the enclosure (due to the possible moulding methods for plastic enclosures, the wall of the enclosure may have draw angles). Surfaces with angles do not allow the gland and associated fittings inserted in the hole to fit square to the face, resulting in ineffective sealing. Taper threaded holes in plastic enclosures are not recommended because the high stresses created during sealing of these threads may fracture the enclosure wall.

10.5 Unused openings

With the exception of enclosures containing only one inrinsically safe circuit, unused entries in the enclosure shall be sealed by blanking elements in accordance with Table 10 and that maintain the degree of ingress protection IP 54 or that required by the locatin, whichever is the higher. Blanking elements shall e a type that can only be removed with the use of a tool. For flameproof enclosures, adaptors shall not be used together with blanking elements.

10.6 Additional requirements for type of protection 'd' – Flameproof Enclosures

10.6.1 General

If an Ex "d" gland clamping by the sealing ring (compression) is used with braided or armoured cable, it shall be of the type where the braid or armour is terminated in the gland and compression takes place on inner cable sheath. For fine braided cable, where the braid is less than 0.15 mm diameter and has coverage of at least 70 % compression only on the outer sheath is accepted.

Note: *Flame propagation of flame may occur through the interstices between the strands of standard stranded conductors, or between individual cores of a cable. Specialcable construction can be employed as means of reducing and preventing flame propagation. Examples include compacted strands, sealing of the individual strands, and extruded bedding. Further information is given in Annex E.*

Flameproof cable glands, adapters or blanking elements, having parallel threads may be fitted with a sealing washer between the entry device and the flameproof enclosure provided that, after the washer has been fitted, the applicable thread engagement is still achieved. Thread engagement shall be at least five full threads. Suitable grease may be used provided it is nonsetting, non-metallic and non-combustible and any earthing between the two is maintained. Where taper threads are used, the connection shall be made wrench tight.

10.6.2 Selection of cable glands

The cable entry system shall comply with one of the following:

a) barrier cable glands in compliance with IEC 60079-1 and certified as equipment;

b) cable glands in compliance with IEC 60079-1, certified as an equipment and combined with the cables complying with 9.3.2(a) and with a minimum length of the connected cable of 3 m.

Note 1 : *The minimum length is required to minimize the negative effects of gas migration through the cable (see also Annex E).indirect cable entry using combination of flameproof enclosure with bushing and increased safety terminal box.*

c) mineral-insulated metal-sheathed cable with or without plastic outer covering with appropriate flameproof cable gland complying with IEC 60079-1;

d) flameproof sealing device (for example a sealing chamber) specified in the equipment documentation or complying with IEC 60079-1 and employing a cable gland appropriate to the cables used. The sealing device shall incorporate compound or other appropriate seals which permit stopping around individual cores. The sealing device shall be fitted at the point of entry of cables to the equipment.

Note 2 : *Compliance to 10.6.2 is not necessary if the cable gland and actual cable are certifi ed as a part of the equipment (enclosures).*

Annex E (Informative)

Restricted migration of gas through cables

E.1 Migration test for cables

A piece of cable with a length of 0,5 m should be type tested when installed into a sealed enclosure of 5 l (+/– 0.2 l), under constant temperature conditions. The cable is considered acceptable if the time interval required for an internal overpressure of at least 0,3 kPa (30 mm water gauge) to drop by 0,15 kPa (15 mm water gauge) is not less than 5 s. The enclosure must be completely tight to avoid pressure loss through the enclosure gaps.

10.7 Additional requirements for type of protection 't' – Protection by enclosure

The IP protection shall be as given in Table 11.

Table 11 – Level of protection, equipment group and ingress protection relationship

Level Of Protection	Group IIIC	Group IIIB	Group IIIA
'ta'	IP6X	IP6X	IP6X
'tb'	IP6X	IP6X	IP5X
'tc'	IP6X	IP6X	IP5X

Ex "t" glands, adapters or blanking elements, having parallel threads may be fitted with a sealing washer between the entry device and the "t" enclosure. If no washer is used the thread engagement shall be at least five full threads. Tapered threaded joints without an additional seal or gasket shall engage no less than 3-1/2 threads.

Annex NA 1 Introduction

During the revision of IEC 60079-14 to create Edition 5, the UK committee expressed concerns about the proposed changes to the requirements relating to the selection of cable glands into Ex'd' (flameproof) enclosures. The UK committee voted against the revision of IEC 60079-14 to create Edition 5 at both CDV and FDIS stages. IEC 60079-14:1996 Edition 2 included a selection chart which was taken directly from BS 5345-3:1989. Subsequent editions of IEC 60079-14, up to and including Edition 4 in 2007, retained the selection chart. In Edition 5, which was published in November 2013, the chart was replaced with different criteria.

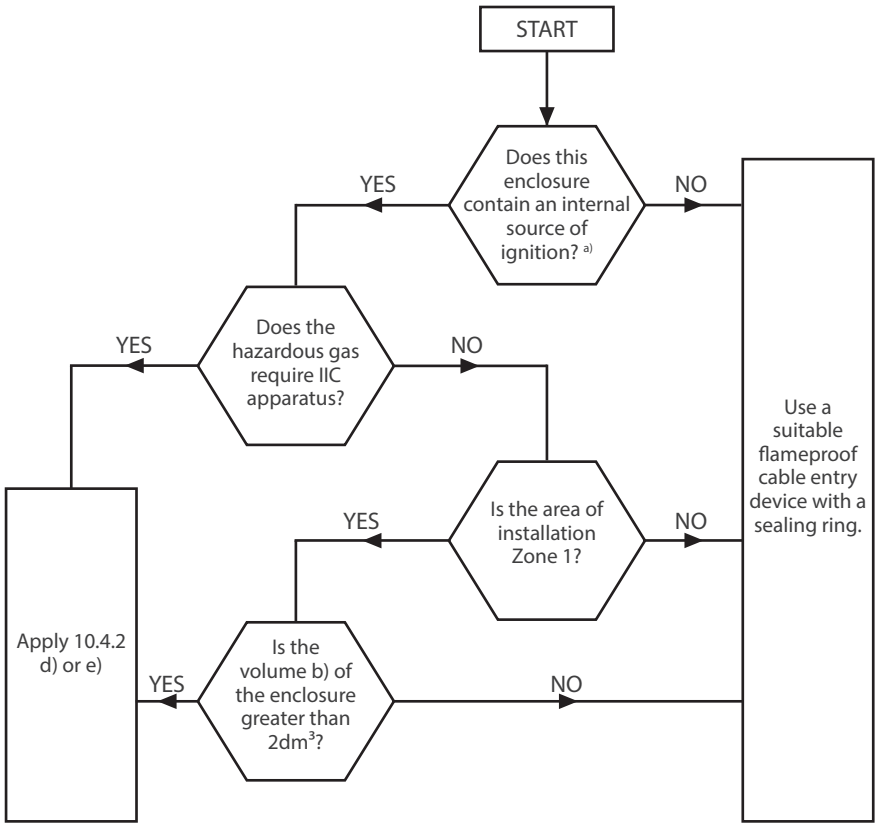


Figure 2 – Selection chart for cable entry devices into flameproof enclosures for cable complying with item b) of 10.4.2

10.6.2 Selection of cable glands

a. Internal sources of ignition include sparks or equipment temperatures occurring in normal operation which can cause ignition. An enclosure containing terminals only or an indirect entry enclosure (see 10.4.1) is considered not to constitute an internal source of ignition.

b. The term 'volume' is defined in IEC 60079-1)

c. Mineral-insulated metal-sheathed cable with or without plastic outer covering with appropriate flameproof cable gland complying with IEC 60079;

d. Flameproof sealing device (for example a sealing chamber) specified in the equipment documentation or copying with IEC 60079-1 and employing a cable gland appropriate to the cables use. The sealing device shall incorporate compound or other appropriate seals which permit stopping around individual cores. The sealing device shall be fitted at the point of entry of cables to the equipment;

e. Flameproof cable gland, specified in the equipment documentation or complying with IEC 60079-1, incorporating compound filled seals or elastomeric seals that seal around the individual cores or other equivalent sealing arrangements.

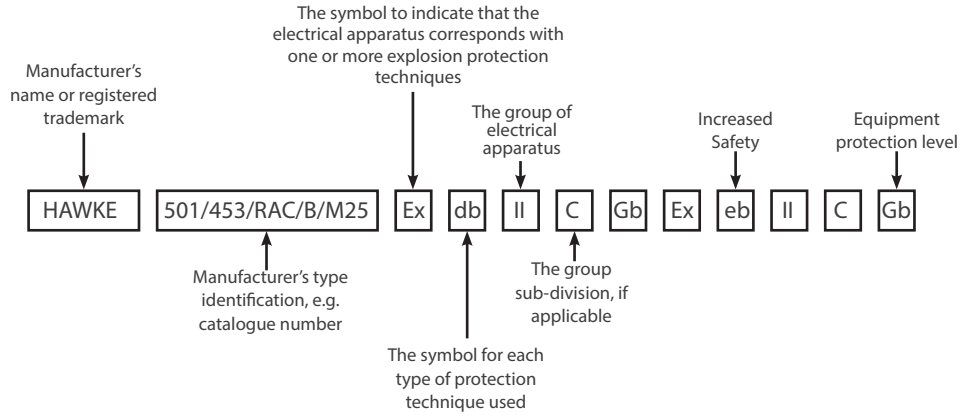
5.3 Wiring Methods for Type of Protection 'e' – Increased Safety

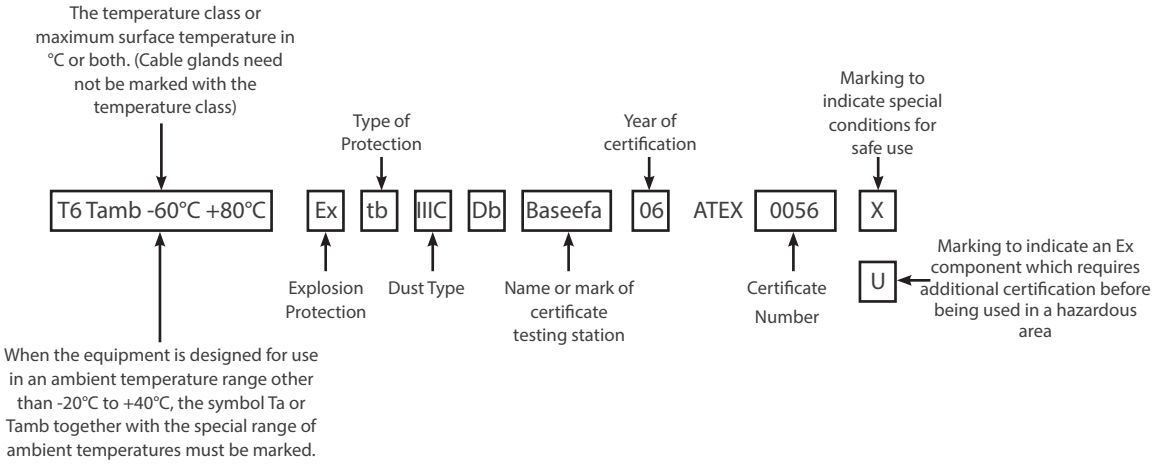
The cable entry device, e.g. cable gland, must comply with all the requirements referred to in the appropriate standard, be appropriate to the cable type and maintain the type 'e' integrity of the equipment.

A minimum ingress protection rating of IP54 is required for increased safety equipment. To meet with this requirement it may be necessary to provide a seal between the cable gland and the equipment, for example, by the use of a sealing washer or thread sealant. Where cable glands are fitted into non-metallic enclosures, metallic enclosures with a painted type finish or enclosures with non-threaded clearance holes, additional ingress and earthing / bonding considerations may be necessary. Please refer to the sealing washer, earthtag, serrated washer and locknut accessories shown in the catalogue.

6.0 Apparatus Marking - IEC (Group II)

6.1 ATEX Marking (Glands)





6.2 ATEX Marking (Enclosures)

- The name and address of the manufacturer.
- Type, serial number and the year in which the equipment was constructed.
- The specific marking of explosion protection followed by the symbol of the equipment group and the category.
- IEC/EN 60079-0, IEC/EN 60079-7 and IEC/EN 60079-31 (Optional)

  - 'Exeb IIC',

  - Temperature Classification,

  - IP Rating,

  - Certification Name and Number,

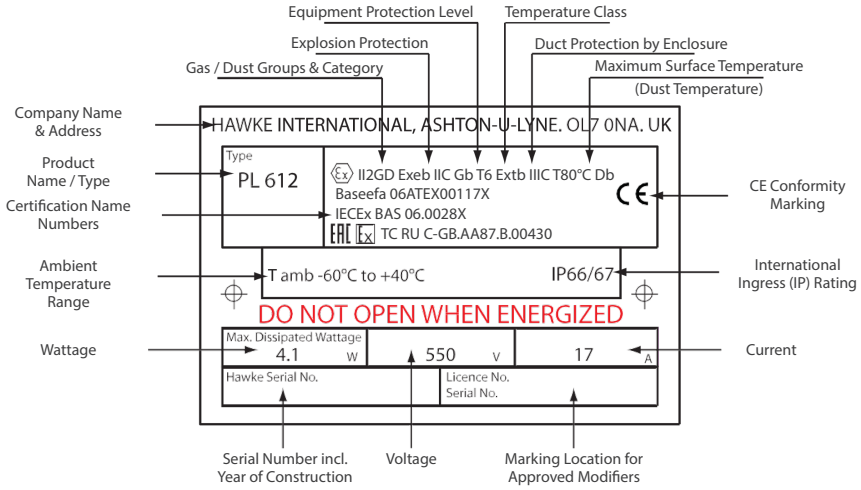
  - 'DO NOT OPEN WHEN ENERGIZED',

  - Maximum Dissipated Power (Watts), Volts and Amps.

Note: If the temperature range is outside the normal range of -20°C to +40°C, it must be marked on the label.

For equipment Group II:-

The letter 'G' where explosive atmospheres caused by gases, vapour or mists are concerned and/ or the letter 'D' where explosive atmospheres caused by dusts are concerned.



6.3 Additional CE Marking

The CE conformity marking must consist of the initials and be followed by the identification number of the notified body responsible for production control.

6.4 EPL's (Explosion Protection Levels)

The introduction of the EPL's and changes in the IEC/EN 60079 and IEC/EN 60079-31 series standards has introduced new marking requirements.

6.4.1 Gas (Surface)

The gas group that was previously (II) for Increased safety in surface applications is now IIA, IIB or IIC, depending upon the certification.

6.4.2 Dust

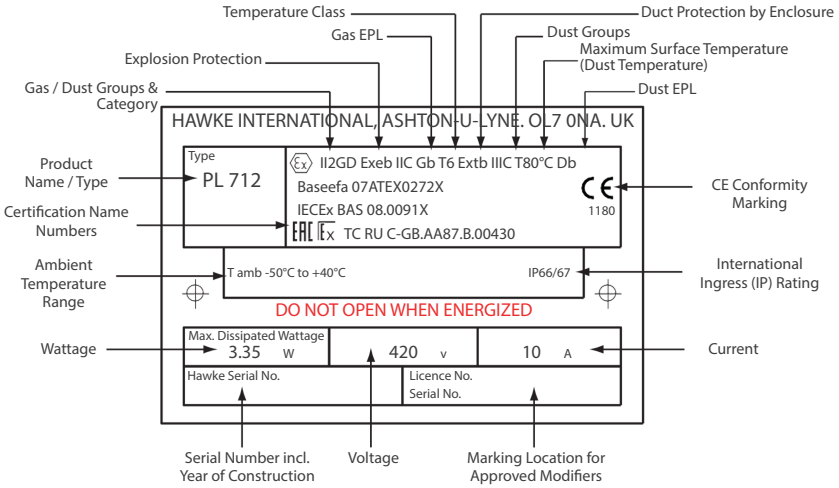
Grouping has also been applied to dusts where the marking is differentiated from gases by the addition of another I i.e. IIIA, IIIB or IIIC.

6.4.3 Explosion Protection Levels

The explosion protection levels are identified by their lettering:-

Gases	Typical Zone	Dusts	Typical Zone
Ga	0	Da	20
Gb	1	Db	21
Gc	2	Dc	22

The PL7 Series of boxes are approved to the latest standards and are marked as follows:-



7.0 CE Marking

The CE Marking is intended to facilitate the free movement of products within the European Union. By affixing CE marking to products, the manufacturer is making a legal declaration that the product meets with the appropriate requirements of all relevant European Directives. CE marking only applies to products within the scope of the Directives. It should not be applied to products if they are outside the scope of the Directives.

7.1 EMC, Electromagnetic Compatibility Directive

Most electrical and electronic products made or sold in the EU must:

- Be constructed so they do not cause excessive electromagnetic interference and are not unduly affected by electromagnetic interference;
- In the case of certain radio-transmitting equipment, be subject to EU type examination by anotified body; and
  - Carry CE marking
    Cable glands are not considered to come within the scope of the Directive, however Hawke International have carried out independent third-party testing on the EMC shielding effectiveness of armoured type cable glands fitted onto single wire armoured and braided type cables. The electromagnetic ingress between the cable sample (perfect connection) and that of the cable sample fitted with the cable gland was of such a small magnitude that it could be regarded as within acceptable uncertainty of measurement. As such, it can be concluded that the shielding effectiveness of single wire armoured or braided cable is maintained when fitted with an appropriate Hawke armoured type cable gland.

7.2 Low Voltage Directive

The Low Voltage Directive 2014/35/EU embodies a number of principles: -

- Only electrical equipment that does not jeopardise the safety of people, domestic animals and property, is permitted on the market.
- Only electrical equipment, that satisfies the CE marking requirements of the LVD, is in compliance.
- Electrical equipment is not required to be tested or marked for approval by an independent third party.
- Enforcement is the responsibility of each member state within its national jurisdiction.
- The regulations apply to all electrical equipment, except where extensions apply, that is designed for use between 50 and 1000 volts AC or 75 and 1500 volts DC.
- Only components, which are in themselves "electrical equipment", need satisfy the Low Voltage Directive.

Cable glands are not in themselves "electrical equipment" and therefore do not fall within the scope of the LVD.

8.0 Certification/Listing/Approvals

Electrical equipment for use in potentially explosive atmospheres is usually certified, listed or approved by a recognised Certification Body or Test House. In Europe, there are numerous Certification Bodies such as Baseefa and CSA (SIRA) in the UK.

In North America, there are many recognised Certification Bodies and testing laboratories such as UL, FM and the CSA. The definition of "Approved" by the NEC is "Acceptable to the authority having jurisdiction". The NEC requires certain products to be "Listed" or "Identified". Listed (or Certified) means products are tested to a range of Standards for a specific category of equipment and and limited field modifications permitted.

Identified means there is evidence, such as investigation by a laboratory, manufacturer's self-evaluation the product complies with the applicable standards. All approvals must be acceptable to the Authority Having Jurisdiction AHJ over an installation.

Further information is given in the NEC.

9.0 CENELEC and IEC Degree of Protection, IP Code

The standard IEC/EN 60529 describes a system for classifying the degrees of protection provided by the enclosures of electrical equipment as follows:-

First Number		
0	Non-protected	Protection of persons against access to hazardous parts inside the enclosure and against solid foreign objects
1 	Protected against objects of 50mm diameter and greater	An object probe, sphere of 50mm diameter, shall not fully penetrate
2 	Protected against solid foreign objects of 12.5mm diameter and greater	An object probe, sphere of 12.5mm diameter, shall not fully penetrate
3 	Protected against solid foreign objects of 2.5mm diameter and greater	An object probe, sphere of 2.5mm diameter, shall not penetrate at all
4 	Protected against solid foreign objects of 1.0mm diameter and greater	An object probe, sphere of 1.0mm diameter, shall not penetrate at all
5 	Dust-protected	Ingress of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of apparatus or to impair safety
6 	Dust-tight	No ingress of dust

Second Number		
0	Non-protected	Protection of the equipment inside the enclosure against harmful effects due to the ingress of water
1 	Protected against vertically falling water drops	Vertically falling drops shall have no harmful effects
2 	Protected against vertically falling water drops when enclosure tilted up to 15°	Vertically falling drops shall have no harmful effects when the enclosure is tilted at any angle up to 15° on either side of the vertical
3 	Protected against spraying water	Water sprayed at an angle up to 60° on either side of the vertical shall have no harmful effects
4 	Protected against splashing water	Water splashed against the enclosure from any direction shall have no harmful effects
5 	Protected against water jets	Water projected in jets against the enclosure from any direction shall have no harmful effects
6 	Protected against powered water jets	Water projects in powerful jets against the enclosure from any direction shall have no harmful effects
7 	Protected against the effects of temporary immersion in water for 30 mins	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water under standardised conditions of pressure and time
8 	Protected against the effects of continuous immersion in water	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is continuously immersed in water under conditions which shall be agreed between manufacturer and user but which are more seevere than for point 7 above

Typical Designation : IP66

The protection of the enclosure and the equipment inside against external influences or conditions, such as: mechanical impacts, corrosion, corrosive solvents, solar radiation, icing moisture (e.g. produced by condensation), and explosive atmospheres, are matters that should be dealt with by the relevant product Standard.

There are additional and supplementary optional letters to the above coding; these designators are A, B, C & D and H, M, S & W, and further information can be found in the relevant Standard(s).

9.1 Deluge Ingress Protection

On off shore facilities, equipment may be located in areas subject to emergency deluge systems. Equipment that has been evaluated as certified for use in hazardous areas may not be suitable for use in these locations. A testing method for electrical equipment to be installed in areas subject to deluge systems, DTS01, has been prepared by the Explosion and Fire Hazards Group of ERA Technology (now known as ITS) in collaboration with Shell UK Exploration and Production Ltd.

Testing includes: -

- Energising the equipment (where appropriate) for 60 minutes prior to the deluge test, then interrupting the electrical power at the start of the deluge test and resuming after 60 minutes until the completion of the deluge test.
- Carrying out insulation resistance testing before and after pre-conditioning and after the deluge test, where applicable.
- Carrying out pre-conditioning by exposure to vibration and thermal ageing at 90% relative humidity and at a temperature 20k above the equipments maximum service temperature and/or at least 80°C of any appropriate seals.
- Carrying out deluge test using a deluge chamber fitted with deluge nozzles that apply a salt water solution deluge pressure within the range of 3.5 bar to 4.5 bar at a water temperature in the range of 5°C to 10°C for 3-hours.

10.0 IECEx Scheme

The objective of the IECEx Scheme is to facilitate international trade in electrical equipment intended for use in potentially explosive atmospheres by eliminating the need for multiple national certification. The IECEx Scheme provides a means for manufacturers to obtain Certificates of Conformity that will be accepted at national level in all participating countries. A Certificate of Conformity may be obtained from any certification body accepted into the scheme. The objective of the IECEx Scheme is world-wide acceptance of one standard, one certificate, and one mark.

For the IEC scheme to achieve its objective, every applicable national standard will need to be identical to the corresponding IEC standard. A transition period will be necessary to allow time for participating IECEx Scheme countries to align their national standards with the IEC standards and work towards national acceptance of IECEx Certificates of Conformity and the IECEx mark.

11.0 North American Hazardous (Classified) Locations

11.1 Area Classification

Area Classification is a "Risk Assessment" that analyzes a facility and identifies any environments where explosive materials may be present which facilitates the design, installation and maintenance of systems. The intent is to prevent the ignition of any explosive atmospheres that may be present by minimizing to an acceptable risk level that a flammable atmosphere may form and that any ignition sources may exist.

Area Classification is a three-dimensions evaluation that identifies both hazardous and non-hazardous locations. In North America, hazardous locations are classified using either the "Division" or "Zone" System that are further sub-divided in to areas of risk based on the probability that an explosive atmosphere may develop.

In the United States of America (USA) users have the option of using either the "Class, Division" system or the "Class, Zone" System. The basic requirements are contained in the National Electrical Code (NEC) Article 500, with the basic requirements for Division in Articles 501 and 502 and those for the Zone System in Articles 505 and 506. The NEC defines areas as "hazardous (classified) locations" and the requirements are contained in Articles 500 through 517.

In Canada, use of the "Zone" system is mandatory for all new construction and the rules for installations are contained in the Canadian Electrical Code – Part 1 (CE Code) Sections 18 and 20. The Class, Division System may be used in existing facilities (built prior to 1998 for gases and prior to 2015 for dusts) and the rules for installations are contained in the CE Code Part 1, Annex J18 and J20. Canada does not use the term "Class" when referring to the Zone System.

In the USA, the types of protection associated with the Zone System are prefaced by "A" (i.e. AEx) in Canada, and internationally, those types of protection are identified as "Ex".

Area Classification		
CLASS I: FLAMMABLE GASES, VAPOURS OR LIQUIDS	**Division 1**	**Zone 0**
	Where ignitable concentrations of flammable gases, vapours or liquids can exist all or some of the time or some time under normal operating conditions	Where ignitable concentrations of flammable gases, vapours or liquids can exist all of the time or for long periods at a time under normal operating conditions.
		Zone 1
		Where ignitable concentrations of flammable gases, vapours or liquids can exist all of the time or for long periods at a time under normal operating conditions
	Division 2	**Zone 2**
	Where ignitable concentrations of flammable gases, vapours or liquids are not likely to exist under normal operating conditions	Where ignitable concentrations of flammable gases, vapours or liquids are not likely to exist under normal operating conditions
CLASS II: COMBUSTIBLE DUSTS	**Division 1**	**Zone 20**
	Where ignitable concentrations of combustible dusts can exist all or some of the time under normal operating conditions	A location in which an Explosive Atmosphere in the form of combustible dust in air is present continuously, frequently, or for long periods.
		Zone 21
		A location in which an Explosive Atmosphete in the form of combustible dust in air is likely to occur under normal operation occasionally.
	Division 2	**Zone 22**
	Where ignitable concentrations of combustible dusts are not likely to exist under normal operating conditions	A location in which an Explosive Atmosphere in the form of combustible dust in air is not likely to occur under normal operation, but if it does occur, it will persist only for a short period of time.
CLASS III: IGNITABLE FIBRES AND FLYINGS	**Division 1**	**Zone 20**
	Where ignitable concentrations of fibres and flyings can exist all or some of the time under normal operating conditions	A location in which an Explosive Atmosphere in the form of combustible dust in air is present continuously, frequently, or for long periods.
		Zone 21
		A location in which an Explosive Atmosphete in the form of combustible dust in air is likely to occur under normal operation occasionally.
	Division 2	**Zone 22**
	Where ignitable concentrations of fibres and flyings are not likely to exist under normal operating conditions	A location in which an Explosive Atmosphere in the form of combustible dust in air is not likely to occur under normal operation, but if it does occur, it will persist only for a short period of time.

For further information on the classification of hazardous (classified) locations, see:-

- NFPA 70 National Electric Code (NEC)
- CEC Part 1 Canadian Electrical Code (CEC)

Apparatus for use in Class I, Division 1	Apparatus for use in Class I, Zone 0
• Explosion-proof • Intrinsically Safe • Purged / Pressurised (Type X or Y)	• Intrinsic Safety AEx ia / Ex ia • Class I, Division 1 Intrinsically Safe
Apparatus for use in Class I, Division 2	**Apparatus for use in Class I, Zone 1**
• Class I, Division 1 equipment • Non-incendive • Non-sparking Device • Purged / Pressurised (Type Z) • Hermetically Sealed • Oil Immersion • other non-arcing or heat producing equipment - (e.g. terminal blocks, non-sparking motors, transformers)	• Class I, Zone 0 equipment • Class I, Division 1 equipment • Flameproof AEx d / Ex d • Increased Safety AEx e / Ex e • Intrinsic Safety AEx ib Ex ib • Purged / Pressurized AEx p / Ex p • Powder Filling AEx q / Ex q • Oil Immersion AEx o / Ex o • Encapsulation AEx m / Ex m
	Apparatus for use in Class I, Zone 2
	• Class I, Zone 0 equipment • Class I, Division 1 or Division 2 equipment • Type of Protection AEx n / Ex n / AEx nR, nC / Ex nR, nC • Increased Safety AEx ec / Ex ebc • Intrinsic Safety AEx ic / Ex ic

11.2 Apparatus Selection According to Class I

Intrinsically safe equipment approved for use in Class I, Division 1 locations for the same gas, is permitted to be used in (Class I,) Zone 0 locations.

Equipment approved for use in Class I, Division 1, or listed for use in (Class I,) Zone 0 locations for the same gas, is permitted to be used in (Class I,) Zone 1 locations.

Equipment approved for use in Class I, Division 1 or Division 2 locations for the same gas, is permitted to be used in Class I, Zone 2 locations.

Equipment approved for use in Class I locations may not necessarily be acceptable for Class II locations as it may not be dust-tight or operate at a safe temperature with a dust covering.

11.3 Apparatus Selection According to the Ignition Temperature of the Gas or Vapour

The equipment must be selected so that its maximum surface temperature will not reach the ignition temperature of any gas or vapour that may be present.

Temperature Class of Electrical Apparatus	Maximum Surface Temperature of Electrical Apparatus	Ignition Temperature of Gas or Vapour
T1	450°C	> 450°C
T2	300°C	> 300°C
T2A	280°C	> 280°C
T2B	260°C	> 260°C
T2C	230°C	> 230°C
T2D	215°C	> 215°C
T3	200°C	> 200°C
T3A	180°C	> 180°C
T3B	165°C	> 165°C
T3C	160°C	> 160°C
T4	135°C	> 135°C
T4A	120°C	> 120°C
T5	100°C	> 100°C
T6	85°C	> 85°C

Low ambient conditions may require special consideration. Product standards in the USA and Canada are different in their approach to low temperature approval, In the USA hazardous location Division equipment is rated at a low ambient temperature of -25°C (-13°F) unless they are identified for low temperature service. In Canada, hazardous location Division equipment is rated at a low ambient temperature of -45°C (-40°F). In both countries, Zone equipment is rated at -20°C (-4°F) unless otherwise stated. The upper ambient suitability in all cases is +40°C (+104°F).

Equipment that is approved for Class I and Class II should be marked with the maximum safe operating temperature.

For information regarding data for flammable gases and vapours, see NFPA 497 and NFPA 325.

11.4 Apparatus Selection According to the Ignition Temperature of the Dust

The equipment must be selected so that its maximum surface temperature will be less than the ignition temperature of the specific dust.

11.5 Apparatus Selection According to Material Group

All equipment used in Class III locations is limited to a maximum surface temperature of 165°C (329°F)

For information regarding data for dusts, see NFPA 499.

The grouping of Class I gases and vapours are classified into Groups A, B, C, & D	
Gas / Vapour Group	**Typical Gas**
A	Acetylene
B	Hydrogen
C	Ethylene
D	Propane

The grouping of Class II dusts are classified into Groups E, F & G	
Dust Group	**Typical Atmospheres Containing**
E	Combustible Metal Dusts
F	Coal Dusts
G	Grain Dusts

11.6 Apparatus Construction Standards

Divisions

- ANSI/UL 1203 C22.2 No.30 — Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.
- ANSI/ISA-12.12.01-2015 — Nonincendive Electrical Equipment for Use in Class I and II,
- CAN/CSA C22.2 No. 213-15 — Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations
- ANSI/NFPA 496 — Standard for Purged and Pressurised Enclosures for Electrical Equipment.
- • ANSI / UL 913 CAN/IEC 60079-11 — Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II and III, Division 1, Hazardous (Classified) Locations.
- ANSI/UL 2225 C22.2 No.174 — Cables and Cable-Fitting for use in Hazardous (Classified) Locations.

Zones

- ANSI/UL 60079-0 — Explosive Atmospheres - Part 0: Equipment - General Requirements
- ANSI/ UL 60079-1 CAN / CSA No. 60079-1 — Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures 'd'.
- ANSI/ UL 60079-7 CAN / CSA No. 60079-7 — Explosive Atmospheres – Part 7: Equipment Protection by Increased Safety 'e'.
- ANSI/ UL 60079-31 CAN / CSA No. 60079-31 — Explosive Atmospheres – Part 31: Equipment Dust Ignition Protection by "t".

11.7 Installation Standards and Codes

• NFPA 70	National Electrical Code (NEC)
• CECode Part 1	Canadian Electrical Code (CEC)
• USCG 46 CFR	Parts 110 – 113 - Shipping, Sub-Chapter J, Electrical Engineering
• API RP 14F	Recommended Practice for Design and Installation of Electrical Systems for Fixed and Floating Off shore Petroleum Facilities for Unclassified and Class I, Division 1 and 2 Locations.
• API RP 14RZ	Recommended Practice for Design and Installation of Electrical Systems for Fixed and Floating Off shore Petroleum Facilities for Unclassified and Class I, Zone 0, 1 and 2 Locations.

12.0 Wiring Systems

Cable systems and accessories should be installed in positions that prevent them from being subject to mechanical damage, corrosion, chemical attack, heat and other detrimental environmental conditions. Selection of the wiring system and cable type must consider these influences and where exposure to such conditions are avoidable, protective measures such as minimising the risk of mechanical damage by the use of appropriate armoured cable types should be considered.

The connection of cables and conduits to the electrical apparatus must be in accordance with the requirements of the relevant type of protection and installation rules.

12.1 National Electrical Code (NEC) Wiring Methods

In Class 1, Division 1 and Class I, Zone 1 locations, the NEC permits the following wiring methods:

Treaded Rigid Conduit or Intermediate Metal Conduit

PVC, RTRC or HDPE conduit encased in concrete with specific installation rules

Type Mineral Insulated (MI) Cable

Optical fiber cable

HL Listed Metal Clad (MC) Cable or Instrumentation Tray Cable (ITC) Cable

In Areas with Restricted Access

Under the supervision of Qualified Maintenance Personnel

Where Flexibility is required (with Restrictions)

Type TC-ER-HL cable and Flexible Cord

Flexible Couplings

Using fittings approved for the application, for example

for HL Cable installations, the use of Hawke type 711 cable gland/connector.

For conduit installations, the use of Killark conduit fittings

In Class 1, Division 2 and Class I, Zone 2 locations, the NEC permits the following wiring methods:

Threaded Rigid Metal Conduit

Intermediate Metal Conduit (IMC)

Flexible Metal Conduit

Liquid-tight Flexible Metal & Nonmetallic Conduit

Cables installed in Cable trays, Raceways, or Directly Burial (if Listed) or using TC-ER following the rules for Exposed Run (ER) cables and include a grounding conductor

Type MI, MC, MV, or TC

Power Limited Tray Cable (PLTC), Medium-voltage (MV), Tray Cable (TC, TC-ER), ITC,

Optical Fiber Cables

Extra-hard Usage Cord with Approved Fittings

Using fittings approved for the application, for example

Hawke offers several gland options for these cables including the Hawke type 711 cable gland/connector

For conduit and liquid-tight Flexible Metal conduit installations, Killark offers a variety of fittings.

12.2 Cable Seals, Class 1, Division 1

Cables must be sealed at the termination. The sealing fitting, e.g. a barrier type cable gland, must provide a seal against the passage of gas or vapours through the fitting. Type MC cables with multi-conductors, a gas / vapour tight continuous corrugated aluminium sheath and an overall jacket with a suitable polymeric material must be sealed with an appropriate fitting, e.g. Hawke type 711, after removing the cables jacket and all other coverings so that the sealing compound surrounds each individual insulated conductor. Cables with twisted pairs and shielded cables require the removal of the shielded material or separation of the twisted pairs unless the fitting, e.g. cable gland, is an approved means which minimises the entrance of gases or vapours and prevents propagation of flame into the cable core. If the fitting complies with this requirement, there will be information provided in the fittings installation instructions detailing the means to achieve the seal. Additional testing may be required on the fitting and the style and type of cable to show compliance with the sealing requirements.

A NRTL approved cable sealing fitting e.g. barrier type cable gland, must be fitted onto cables that enter explosion-proof enclosures. Further guidance is given in Section 501.5(d) of the NEC.

12.3 Canadian Electrical Code (CE Code) Wiring Methods

In Zone 1 and Class 1, Division 1 and Class I, Zone 1 locations, the CE Code permits the following wiring methods:

Threaded rigid metal conduit

Hazardous location cables including TECK, MCHL with approved fittings

Type Mineral Insulated (MI) Cable

Where flexibility is required;

Extra-hard Usage Cord with Approved Fittings

Installations for "ia", "ib", or intrinsically safe are exempt from the above requirements

In Zone 2 and Class 1, Division 2 and Class I, Zone 1 locations, the CE Code permits the following wiring methods:

Same as above but includes

Power Limited Tray Cable (PLTC), Tray Cable (TC, TC-ER), ITC, Medium-voltage (MV),

Other armoured cables such as ACWU

12.4 United States Coast Guard Wiring Methods

Electrical installations in hazardous (classified) locations must comply with the general requirements of Section 43 of the IEEE standard 45 and either the NEC Articles 500 - 505 or IEC 60079 series publications.

In hazardous (classified) locations, the USCG 46 CFR Sub-Chapter J, permits the following wiring methods: -

- Marine shipboard cables that are permitted for use, must meet all the requirements of either IEEE standard 45, IEC 60092-3 and the applicable flammability requirements. Cables constructed to IEC 60092-3 must meet with the flammability requirements of IEC 60332-3, Category A.
- Metal-clad (type MC) cables that are permitted for use, must have a continuous corrugated gas tight, vapour-tight, and water-tight sheath of aluminium or other suitable metal that is close fitting around the conductors and with fillers. The MC cable must have an overall jacket of an impervious PVC or thermoset material and be certified or listed to UL 1569.

For information on other wiring methods permitted and further information, refer to Subpart 111-60 of the USCG 46 CFR.

Each cable entry into explosion-protected equipment must be made with an appropriate fitting or cable gland that maintains the integrity of the equipment.

Note: The USGC permits equipment with an IECEx CoC from a list of Certification Bodies without additional domestic approval or testing.

12.4.1 Cables with multi-conductors that enter explosion-proof enclosures, must be sealed with an appropriate fitting, e.g. barrier type cable gland, after removing the cables jacket and all other coverings so that the sealing compound surrounds each individual insulated conductor. Cables with twisted pairs and shielded cables require the removal of the shielded material or separation of the twisted pairs unless the fitting, e.g. barrier type cable gland, is an approved means which minimises the entrance of gases or vapours and prevents propagation of flame into the cable core. If the fitting complies with this requirement, there will be information provided in the fittings installation instructions detailing the means to achieve the seal. Additional testing may be required on the fitting, and the style and type of cable to show compliance with the sealing requirements.

The equipment grounding path should be carefully considered when using Shipboard Cables or type TC cables, as these may not inherently provide a grounding means. The armour of Shipboard Cables should be grounded but can not be used as the grounding conductor. An appropriate sized grounding conductor should be included in each cable.

12.5 American Petroleum Institute Wiring Methods

12.5.1 Class 1, Division 1

The API RP 14F Recommended Practice for the design and installation of electrical systems for fixed and floating off shore petroleum facilities recommends the following wiring methods for hazardous (classified) locations.

- Type MC-HL metal clad cables as defined in UL 2225.
- Armoured marine shipboard cable with an overall impervious sheath over the armour, constructed in accordance with UL 1309, and listed as 'Shipboard Cable Marine' by a National Recognised Testing Laboratory (NRTL). This wiring method is a departure from the NEC.
- Type ITC cable that is NRTL - listed for use in Class I, Division 1 locations with a gas / vapour tight continuous corrugated aluminium sheath and with an overall PVC or other suitable polymeric jacket.
- Threaded rigid copper-free aluminium conduit.
- Threaded rigid steel, hot dipped galvanized conduit, coated with PVC, or other suitable material, and with the interior protected by an additional means.

An NRTL approved cable sealing fitting, e.g. barrier type cable gland complying with UL 2225, must be fitted onto cables where they enter explosion-proof enclosures.

For further information and other wiring methods acceptable for Division 1, refer to Clause 6.4.2.2 of the API RP14F.

For fitting requirements of cables with multi-conductors, twisted pairs or shielded conductors into explosion proof equipment. See clause 12.4.1.

12.5.2 Class 1, Division 2

- Wiring methods as recommended for use in Division 1.
- Type MC cable with a gas / vapour tight continuous corrugated aluminium sheath, an overall PVC or other suitable polymeric jacket, and grounding conductors in accordance with NEC 250-122.
- Non-armoured marine shipboard cable, with an overall impervious jacket in accordance with UL 1309 and listed as 'Shipboard Cable Marine' by a NRTL. This wiring method is a departure from the NEC.

Additional wiring methods acceptable for Division 2 include type PLTC, ITC, TC and MV cables. It is recommended that an overall PVC or other suitable polymeric material jacket is included for these cable types.

For additional information, refer to Clause 6.4.2.3 of API RP14F.

In Division I locations, all electrical equipment (except intrinsically safe systems and equipment inside purged enclosures) should be explosion-proof.

In Division 2 locations, the equipment does not need to be explosion-proof, except where necessary to maintain the integrity of the installation.

Further information on the use of equipment is given in Clause 6.4.7 of API RP14F.

An NRTL approved cable sealing fitting, e.g. barrier type cable gland complying with UL 2225, must be fitted onto cables where they enter explosion-proof enclosures.

For fitting requirements of cables with multi-conductors, twisted pairs or shielded conductors into explosion proof equipment. See clause 12.4.1.

12.5.3 Class 1, Zones 0, 1 and 2

The API RP 14 FZ, Recommended Practice for the design and installation of electrical systems for fixed and floating off shore petroleum facilities for unclassified and Class I, Zone 0, Zone 1 and Zone 2 locations, recommends the following wiring methods for hazardous (classified) locations.

12.5.4 Class 1, Zone 1

- Type MC-HL metal clad cables as defined in UL 2225.
- Armoured marine shipboard cable with an overall impervious sheath over the armour, constructed in accordance with UL 1309, and listed as "Shipboard Cable Marine" by a National Recognised Testing Laboratory (NRTL). This wiring method is a departure from the NEC.
- Type ITC cable that is NRTL - listed for use in Class 1, Division 1 locations with a gas/ vapour tight continuous corrugated aluminium sheath and with an overall PVC or other suitable polymeric jacket.
- Threaded rigid copper-free aluminium conduit.
- Threaded rigid steel, hot dipped galvanized conduit, coated with PVC, or other suitable material, and with the interior protected by an additional means.

Non-armoured marine shipboard cable, with an overall impervious jacket in accordance with UL 1309 and listed as 'Shipboard Cable Marine' by a NRTL. This wiring method is a departure from the NEC.

For further information and other wiring methods acceptable for Zone 1, refer to Clause 6.4.2.2 of the API RP14FZ.

For fitting requirements of cables with multi-conductors, twisted pairs or shielded conductors into explosion proof equipment. See clause 12.4.1.

12.5.5 Class 1, Zone 2

- Wiring methods as recommended for use in Zone 1.
- Type MC cable with a gas / vapour tight continuous corrugated aluminium sheath, an overall PVC or other suitable polymeric jacket, and grounding conductors in accordance with NEC 250-122.
- Non-armoured marine shipboard cable, with an overall impervious jacket in accordance with UL 1309 and listed as 'Shipboard Cable Marine' by a NRTL. This wiring method is a departure from the NEC.

Additional wiring methods acceptable for Zone 2 include type PLTC, ITC, TC and MV cables. It is recommended that an overall PVC or other suitable polymeric material jacket is included for these cable types.

For additional information, refer to Clause 6.4.2.3 of API RP14FZ.

Further information on the use of equipment is given in Clause 6.4.7 of API RP14FZ.

An NRTL approved cable sealing fitting, e.g. barrier type cable gland complying with UL 2225, must be fitted onto cables where they enter explosion-proof enclosures.

For fitting requirements of cables with multi-conductors, twisted pairs or shielded conductors into explosion proof equipment. See clause 12.4.1.

Where cables enter equipment which is permitted for use in Zone 2 or unclassified areas and that is not explosion-proof, a suitable cable fitting e.g. cable gland design, need not be explosion-proof, except when necessary to maintain the integrity of the enclosure and as required by the Recommended Practice.

In unclassified and Zone 2 locations, when the metallic sheath is approved as a grounding conductor, the continuous metal sheath of the MC cable or the combined metallic sheath and grounding conductors may be used as the grounding conductor when used with termination fittings that are NRTL listed to UL 514B.

12.6 National Electrical Code (NEC) Zone Equipment Marking

Equipment that is listed for use in Class I Zones, as permitted by the NEC, should be marked as follows:

- Class 1, Zone 0 or Class 1, Zone 1 or Class 1, Zone 2, Class 1, Zone 20 or Class 1, Zone 21 or Class 1, Zone 22
- Applicable gas classification group(s)
- Temperature Code

Area Classification	For equipment built to US Standards	Type(s) of Protection e.g.	Classification Groups	Temperature Code
Class 1, Zone 1	AEx	d	IIIC, IIIB, IIIA	T6, T5, T4, etc.
Class 1, Zone 21	AEx	tD	IIIC, IIIB, IIIA	T6, T5, T4, etc.

12.7 Canadian Electrical Code (CE Code) Zone Equipment Marking

Equipment that is listed for use in Zones, as permitted by the CE Code, should be marked as follows:

- Zone 0 or Zone 1 or Zone 2, Zone 20 or Zone 21 or Zone 22
- Applicable gas classification group(s)
- Temperature Code

Area Classification	For equipment built to Canadian Standards	Type(s) of Protection e.g.	Classification Groups	Temperature Code
Class 1, Zone 1	Ex	d	IIIC, IIIB, IIIA	T6, T5, T4, etc.
Class 1, Zone 2	Ex	tD	IIIC, IIIB, IIIA	T6, T5, T4, etc.

12.8 National Electrical Code (NEC) Division and Canadian Electrical Code (CE Code) Equipment Marking

Equipment that is approved for use in Class I, Class II or Class III, Division 1 or 2 must be marked as follows:

- Class I or Class II or Class III, or a combination where appropriate.
- Division 1 equipment not marked to indicate a Division or marked Division 1 is suitable for both Division 1 and 2 locations.
- Group Classification.
- Operating temperature or temperature range, as permitted by the applicable standards.

12.8.1 Non-Hazardous Locations

Nema Enclosure Type No.	Applications
1	Enclosures constructed for indoor use to provide a degree of protection to personnel against access to hazardous parts and to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt).
2	Enclosures constructed for indoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing).
3	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow); and that will be undamaged by the external formation of ice on the enclosure.
3R	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow); and that will be undamaged by the external formation of ice on the enclosure.
3S	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow); and for which the external mechanism(s) remain operable when ice laden.

Nema Enclosure Type No.	Applications
3X	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow); that provides an additional level of protection against corrosion and that will be undamaged by the external formation of ice on the enclosure.
3RX	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow); that will be undamaged by the external formation of ice on the enclosure that provides an additional level of protection against corrosion; and that will be undamaged by the external formation of ice on the enclosure.
3SX	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow); that provides an additional level of protection against corrosion; and for which the external mechanism(s) remain operable when ice laden.
4	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure.
4X	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); that provides an additional level of protection against corrosion; and that will be undamaged by the external formation of ice on the enclosure.
5	Enclosures constructed for indoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and settling airborne dust, lint, fibres, and flyings); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing).

Nema Enclosure Type No.	Applications
6	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (hose directed water and the entry of water during occasional temporary submersion at a limited depth); and that will be undamaged by the external formation of ice on the enclosure.
6P	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (hose directed water and the entry of water during prolonged submersion at a limited depth); that provides an additional level of protection against corrosion and that will be undamaged by the external formation of ice on the enclosure.
12	Enclosures constructed (without knockouts) for indoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and circulating dust, lint, fibres, and flyings); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing).
12K	Enclosures constructed (with knockouts) for indoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and circulating dust, lint, fibres, and flyings); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing).
13	Enclosures constructed for indoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and circulating dust, lint, fibres, and flyings); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing); and to provide a degree of protection against the spraying, splashing, and seepage of oil and non-corrosive coolants.

12.8.2 Hazardous Locations

The National Electrical Manufacturers Association Identifies Hazardous Location enclosures as follows.

Enclosure Type No.	Application
7	Enclosures constructed for indoor use in hazardous (classified) locations classified as Class I, Division 1, Groups A, B, C, or D as defined in NFPA 70.
8	Enclosures constructed for either indoor or outdoor use in hazardous (classified) locations classified as Class I, Division 1, Groups A, B, C, and D as defined in NFPA 70.
9	Enclosures constructed for indoor use in hazardous (classified) locations classified as Class II, Division 1, Groups E, F, or G as defined in NFPA 70.
10	Enclosures constructed to meet the requirements of the Mine Safety and Health Administration (MSHA)

Further information can be found in NEMA Standard Publication 250.

Enclosures are not actually certified to the NEMA Standard Publication 250. Enclosures are certified to UL 50 or CSA C22.2 No 94.1 and do not include the requirements for Hazardous Location enclosures.

The hazardous location requirements are contained in UL 1203, CSA C22.2 No. 25 and C22.2 No. 30.

The enclosures are designed to protect and to provide additional protection as stated in the table below:

UL/CSA ENCLOSURE TYPE IEC / EN 60529

The IEC and CENELEC 60529 Standards and UL/CSA Enclosure Types can not be compared as equivalent ratings. The NEMA Standard includes test for environmental conditions such as mechanical damage, corrosion, rusting, ice formation, etc.

The enclosures are designed to protect and to provide additional protection as stated in the table below:-

Nema Enclosure Type	IEC / EN 60529
1	IP20
2	IP22
3 and 3S	IP55
3R	IP24
4 and 4X	IP66
5	IP53
6	IP67
6P	IP68
12, 12K and 13	IP54

The IEC and CENELEC 60529 Standards and NEMA degrees of protection can not be compared as equivalent ratings. The NEMA Standard includes test for environmental conditions such as mechanical damage, corrosion, rusting, ice formation etc.

13.0 Abbreviations, Acronyms and Definitions

Enclosure Type No.	Applications
ABS	American Bureau of Shipping. ABS is a ship classification society involved with establishing and administering of standards and rules for marine vessels and structures.
AEx	A marking prefix for apparatus complying with one or more types of explosion protection techniques for installation in accordance with UL 60079 and as required by the NEC.
ANSI	American National Standards Institute.
API	American Petroleum Institute.
ATEX	EU Directive 94/9/EC and 2014/34/EU Equipment and protective systems intended for use in potentially explosive atmospheres. The term ATEX is derived from the French words ATmospheres EXplosible (Note: ATEX is not the same as certification by, for example, IECEx)
SGS Baseefa	An IECEx accredited Certification Body and an EU Nando accredited Notified Body that provides. a wide range of testing and certification services related to equipment and systems intended for use in potentially explosive atmospheres (this is often referred to as the CEC).
CEC	Canadian Electrical Code. Part 1, CSA Standard C22.1-09, is a safety standard for the installation and maintenance of electrical equipment.
CEN	European Committee for Standardisation.
CENELEC	The European Committee for Electrotechnical Standardization was created in 1973. CENELEC is a non-profit technical organization consisting of over 30 European countries, with an additional 10 neighbouring countries participating in CENELEC work with an Affiliate status.
CFR	USA Code of Federal Regulations.
CSA SIRA	CSA-SIRA Certification Service (UK). IECEx accredited Certification Body and an EU – Nando accredited Notified Body that provides. a wide range of testing and certification services related to equipment and systems intended for use in potentially explosive atmospheres.

Enclosure Type No.	Applications
Cold Flow	Certain types of cable employ materials that can exhibit 'cold flow' characteristics that could have adverse effects on the protection of the apparatus. Where such cable is used, a suitable cable entry device should be employed, for example cable entry devices not employing compression seals that act upon the part(s) of the cable having 'cold flow' characteristics. 'Cold flow' can be more fully described as thermoplastic materials that flow when subjected to pressure at ambient temperature.
CSA	Canadian Standards Association. A Standards Council of Canada accredited Certification Body, USA - OSHA Nationally Recognized Testing Laboratory, and an IECEx accredited Certification Body and an EU Nando accredited Notified Body that provides. a wide range of testing and certification services related to equipment and systems intended for use in potentially explosive atmospheres, as well as other unrelated services. CSA is also a key Canadian Standards Development Organization.
DNV	Det Norske Veritas.
EPL	Explosion Protection Level.
Ex	EA marking prefix for apparatus complying with one or more types of explosion protection techniques in accordance with IEC standards.
Explosion proof	A term used to describe equipment that is capable of withstanding an explosion of a specified gas or vapour that may occur within it and preventing the ignition of a specified gas or vapour surrounding it.
Flameproof	A type of protection of electrical apparatus in which the enclosure will withstand an internal explosion of a flammable mixture which has penetrated into the interior, without suffering damage and without causing ignition, through any joints or structural openings in the enclosure, of an external explosive atmosphere consisting of one or more of gases or vapours for which it is designed.
FM Global	Factory Mutual Research Corporation (USA). A USA – OSHA accredited Nationally Recognized Testing Laboratory, Standards Council of Canada accredited Certification Body and an IECEx accredited Certification Body and an EU – Nando accredited Notified Body that provides. a wide range of testing and certification services related to equipment and systems intended for use in potentially explosive atmospheres, as well as other unrelated services.
Hazardous Areas	Locations where fire or explosion hazards may exist due to the presence of flammable gases, vapours, mists, ignitable fibres or dusts.

Enclosure Type No.	Applications
IADC	International Association of Drilling Contractors.
IEC	International Electrotechnical Commission. Founded in 1906, the IEC is the world organisation that prepares international standards for all electrical, electronic and related technologies. The membership consists of more than 70 participating countries.
IECEx	The aim of the IECEx Scheme is to facilitate international trade in electrical equipment intended for use in potentially explosive atmospheres by eliminating the need for multiple national certificates.
Increased Safety	A type of protection applied to electrical apparatus that does not produce arcs or sparks in normal service and under specified abnormal conditions, in which additional measures are applied so as to give increased security against the possibility of excessive temperatures and of the occurrence of arcs and sparks.
IEx	A Associação IEx Certificações. In Brazil, all electrical or electronic equipment for use in potentially explosive atmospheres should be certified by a Brazilian certification body recognised by INMETRO. IEx is an accredited body that is able to issue relevant certification.
INMETRO	Nacional de Metrologia, Normalização e Qualidade Industrial (Brazil).
Intrinsically Safe Systems	An assembly of interconnected items of apparatus which may comprise of intrinsically safe apparatus, associated apparatus and other apparatus, and interconnecting cables in which the circuits within those parts of the system that may be exposed to explosive gas atmospheres are intrinsically safe circuits.
Impervious Sheathed Cable	Cable constructed with an impervious metallic or non-metallic overall covering that prevents the entrance of gases, moisture or vapours into the insulated conductor or cable.
IP	A system of rating levels of Ingress Protection provided by the apparatus.
ISA	The International Society for Measurement and Control, a global, nonprofit organization.
ISO	International Organizations for Standardization. Worldwide federation of national standard bodies from 162 countries. ISO's mission is to promote the development of standardization to facilitate international exchange of goods service.
ITS	Interteck Testing Services.

Enclosure Type No.	Applications
Marine Shipboard Cable	Impervious sheathed armoured or non-armoured cable constructed in accordance with UL 1209 / CSA C22.2 No. 245, except that an overall impervious sheath is required over the armoured construction, and listed as "Shipboard Cable, Marine" by a Nationally Recognised Testing Laboratory (NRTL).
Maximum Surface Temperature	The highest temperature of a surface accessible to a flammable mixture under conditions of operation and within the ratings of the equipment.
MC Cable	Metal-clad cable as defined by NEC Article 501.
MC-HL Cable	Metal-clad cable for hazardous locations as defined in UL 2225.
NEC	National Electric Code (ANSI / NFPA 70).
NEMA	National Electrical Manufacturer's Association.
NFPA	National Fire Protection Association.
NRTL	National Recognised Test Laboratories (US). Those recognised by the OSHA include CSA, FMRC and UL. The NRTL determines that the specific products meet the relevant standards of safety as required by the OSHA and that the products are safe for use in the U. S. workplace. For further information, refer to the OSHA website www.osha.gov
OSHA	Occupational Safety and Health Administration. Works with the U. S. Department of Labour National Recognised Test Laboratories (NRTL's) to ensure products safe for use in the U.S.
PLTC	Power limited tray cable as defined by NEC Article 725.
Potentially Explosive Atmosphere	A mixture with air, under atmospheric conditions, of flammable substances in the form of a gas, vapour, mist or dust in which after ignition, combustion spreads through the unconsumed mixture.
Restricted Breathing (ExnR)	Enclosure that is designed to restrict the entry of gases, vapours, dusts and mists.

Enclosure Type No.	Applications
SCC	Standards Council of Canada (Conseil canadien des normes)
SCS	SIRA Certification Service (UK). Provide a range of testing and certification services, and have agreements with other international approval authorities.
TC	Tray cable. There are multiple various defined in NEC Article 336.
TECK Cable	Interlocking corrugated armour for use in Class I, Division 1 and Zone 1 locations in Canada, or Class 1, Division, Zone 2 locations in the US.
UL LLC	Underwriters Laboratories Inc – USA.
ULC	Underwriters Laboratories Inc – Canada. A business unit of UL LLC.
USCG	United States Coast Guard.

Harsh & Hazardous

Hubbell Harsh & Hazardous

Extreme environments demand superior performance, which is why you will find Hubbell products and systems installed in some of the most arduous and safety critical locations worldwide.

The Hubbell Harsh & Hazardous group combines dedicated, market leading brands within the Hubbell portfolio to provide a complete package for companies operating in some of the toughest environments on the planet.

We are committed to providing quality products and services that will meet and exceed your expectations. Our principal activities include the design and manufacture of rugged and hard wearing products. These include telephones and communication products, lighting, control gear and electrical connection products, all designed to operate primarily in extreme outdoor, hazardous and corrosive areas.

Our Brands

All of our brands are long established and well respected businesses within each of their industries. Our primary industry sectors include: Oil & Gas, Petrochemical, Industrial, Marine, Military, Transport and Commercial.

Chalmit | Victor Lighting | Hawke International | Vantage Technology | Killark | RigPower

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