

HAZARDOUS AREA STANDARDS AND APPROVALS

There are different standards used for hazardous areas and electrical equipment designed for use in those environments, depending upon where in the world they are to be used. In Europe EN standards are used to check compliance with the ATEX directive. In the USA the standard is NEC (National Electric Code), with a variant called CEC (Canadian Electric Code) used in Canada. In addition some countries have their own approval standards (e.g. GOST for Russia and the former Soviet States, TISI for Thailand, etc), however these are often based on EN standards.

To simplify matters an attempt is being made to harmonise all major standards for use in the IEC Ex scheme. The aim of the IECEx Scheme is to facilitate international trade in electrical equipment intended for use in explosive atmospheres (Ex equipment) by eliminating the need for multiple national certification while preserving an appropriate level of safety.

Whilst the standards used in Europe and America are intended to achieve the safe installation and operation of electrical equipment in hazardous areas, they are different in principles, classification and approach.

The purpose of the following guide is to detail some of the differences in the two approaches and to use a step-by-step process to select the correct type of luminaire or other electrical, equipment for use in a hazardous area.

THE CLASSIFICATION OF HAZARDOUS AREAS INTO ZONES IS GIVEN FOR GAS MIXTURES, IN IEC OR EN 60079-10 AND SELECTION IN IEC OR EN 60079-14.

FOR COMBUSTIBLE DUST HAZARDS THE EUROPEAN STANDARDS ARE EN 61241-10 AND EN 61241-14.

THE INFORMATION FOLLOWING IS GIVEN AS BACKGROUND TO THE USE OF THE ABOVE STANDARDS.

THE APPLICATION OF THE STANDARDS AND ANY LOCAL REGULATION IS THE RESPONSIBILITY OF THE USER.

EUROPEAN HAZARDOUS AREA EQUIPMENT DIRECTIVE, STANDARDS AND APPROVALS

ATEX DIRECTIVE

The ATEX Directive 94/9/EC is a directive adopted by the European Union (EU) to facilitate free trade in the EU by aligning the technical and legal requirements in the Member States for products intended for use in potentially explosive atmospheres.

The Directive covers electrical and mechanical equipment and protective systems, which may be used in potentially explosive atmospheres (flammable gases, vapours or dusts.) It became mandatory at the end of June 2003 for Europe.

One of the significant changes that was introduced in the ATEX directive was the move away from defining types of equipment by their protection concept and using categories instead. These are in effect levels of safety. They are linked to the protection concept by the wording in the individual harmonised European standards. In fact the definition of the categories aligns the protection concept with it's traditional area of use. The directive for use is 99/92/EC.

The table below shows the relationship between the category and the expected zone of use.

It is very important to emphasise that the ATEX categories are levels of safety. The various types of protection are put into these categories of safety as shown in the EN equipment standards. The hazardous area classification into zones is entirely separate.

However, because the types of protection have been designed for use in particular hazardous areas and the application/installation standards give the basic suitability of types of protection for different zones, the ATEX categories align with the zone of use for practical purposes. This is provided that other attributes of the equipment or zone do not conflict and that the risk assessment for the zone does not dictate differently.

Category 1 - Zone 0

Category 2 - Zone 1

Category 3 - Zone 2

| Category | Degree of Safety | Design Requirement | Application | Expected Zone of Use |
|----------|---------------------------|--|---|---------------------------------|
| 1 | Very high level of Safety | Two independent means of protection or safe with two independent faults | Where explosive atmospheres are present continuously or for lengthy periods | Zone 0 (gas) and Zone 20 (dust) |
| 2 | High level of Safety | Safe with frequently occurring disturbances or with a normal operating fault | Where explosive atmospheres are likely to occur | Zone 1 (gas) and Zone 21 (dust) |
| 3 | Normal level of Safety | Safe in normal operation | Where explosive atmospheres are likely to occur infrequently and be of short duration | Zone 2 (gas) and Zone 22 (dust) |

Table 4 ATEX Categories and Applications

STEP BY STEP PRODUCT SELECTION GUIDE

STEP 1

Establish if the hazardous area is due to the presence of an explosive gas or an explosive dust.

EXPLOSIVE GASES

Using the table FIG. 1.0 below, ascertain first if the gas present is a group I or group II gas.

- Group I gases are firedamp methane gas.
- Group II gases are all other explosive gases as listed opposite with relevant subdivisions A, B or C according to the nature of the chemical content.

| GROUP IIA | | | | GROUP IIB | GROUP IIC |
|--|---|--|--|---|---|
| <p>Hydrocarbons</p> <p>Alkanes: Methane Ethane Propane Butane Pentane Hexane Heptane Octane Nonane Decane Cyclobutane Cyclopentane Cyclohexane Cycloheptane Methylcyclobutane Methylcyclopentane Methylcyclohexane Ethylcyclobutane Ethylcyclopentane Ethylcyclohexane Decahydronaphthalene (decaline)</p> <p>Alkenes: Propene (propylene)</p> <p>Aromatic hydrocarbons: Styrene Methylstyrene</p> <p>Benzene and its derivatives: Benzene Toluene Xylene Ethylbenzene Trimethylbenzene Naphthalene Cumene Cymene</p> | <p>Mixtures of hydrocarbons: Industrial methane Turpentine Petroleum naphtha Oil naphtha Petroleum (including petroleum spirits) Dry cleaning solvents Fuel oil Kerosene Gas-oil Benzole for cars</p> <p>Compounds containing oxygen:</p> <p>Oxides: (including ethers): Carbon monoxide Dipropyl ether</p> <p>Alcohols and phenols: Methanol Ethanol Propanol Butanol Pentanol Hexanol Heptanol Octanol Nonanol Cyclohexanol Methylcyclohexanol Phenol Cresol Diacetone-alcohol</p> <p>Aldehydes: Acetaldehyde Methaldehyde</p> | <p>Ketones: Acetone Ethyl-methyl ketone Propyl-methyl ketone Butyl-methyl ketone Amyl-methyl ketone 2,4-Pentanedione (acetylacetone) Cyclohexanone</p> <p>Esters: Methyl formate Ethyl formate Methyl acetate Ethyl acetate Propyl acetate Butyl acetate Amyl acetate Methyl methacrylate Ethyl methacrylate Vinyl acetate Ethyl acetylacetate</p> <p>Acids: Acetic acid</p> <p>Compounds containing halogens</p> <p>Compounds with no Oxygen: Chloromethane Chlorethane Bromoethane Chloropropane Chlorobutane Bromobutane Dichlorethane Dichloropropane Chlorobenzene Benzyl chloride Dichlorobenzene Allyl chloride Dichloroethylene</p> | <p>Chloroethylene (vinyl chloride) Benzyl trifluoride Methylene chloride</p> <p>Compounds containing Oxygen: Acetyl chloride Chloroethanol</p> <p>Compounds containing Sulphur: Ethyl mercaptan Propyl mercaptan Thiophene Tetrahydrothiophene</p> <p>Compounds containing Nitrogen: Ammonia Acetonitrile Nitromethane Nitroethane</p> <p>Amines: Methylamine Dimethylamine Trimethylamine Diethylamine Propylamine Butylamine Cyclohexylamine Monoethanolamine Diaminoethane Aniline Dimethylaniline Amphetamine Toluidine Pyridine</p> | <p>Hydrocarbons Allylene (Propyn) Ethylene Cyclopropane Butadine</p> <p>Compounds containing Nitrogen: Acrylonitrile Isopropyl nitrate Hydrocyanic acid</p> <p>Compounds containing Oxygen: Methyl ether Ethylmethyl ether Ethyl ether Butyl ether Ethylene oxide (epoxyethane) Epoxy-propane Dioxian Dioxin Trioxin Butyl hydroxyacetate Tetrahydrofurfuryl Methyl acrylate Ethyl acrylate Furane Crotonaldehyde Acrolien Tetrahydrofuran</p> <p>Mixtures: Gas from a coke furnace</p> <p>Compounds containing Halogens: Tetrafluoroethylene Propane, 1 chloro. 2,3 epoxy (epichlorohydrin)</p> | <p>Hydrogen Acetylene Carbon disulphide</p> |

FIG 1.0

COMBUSTIBLE DUSTS

If an area is classed as hazardous due to the presence of combustible dust, it is important to establish if it is a metallic or non metallic dust. The latest series of standards for electrical apparatus in the presence of combustible dust that will provide protection concepts, installation and selection requirements will be the EN/IEC 61241 series.

The most commonly used part of the EN 61241 series applicable to luminaires will be EN 61241-1: Protection by enclosures with marking "tD". It should be noted that this standard outlines to two techniques that provide equivalence in safety but different requirements in terms of selection and installation.

The two techniques are "Practice A" and "Practice B", practice B is principally a prescriptive based technique where practice A is performance based. Practice A is the most commonly used technique, where dust may form in layers up to 5mm thick and where a temperature difference of 75K is specified between the maximum surface temperature and the ignition temperature of the dust; the method of determining dust ingress is according to IEC 60529 the IP code. Practice A and Practice B apply to Zones 21 and 22. For clarity the zones for dust can be described as follows:

ZONE 21

Where a combustible dust, as a cloud, is likely to occur during normal operation in sufficient quantity to be capable of producing an explosive concentration of combustible or ignitable dust in mixture with air.

ZONE 22

In this zone, combustible dust clouds may occur infrequently, and persist for only a short time, or in which accumulation or layers of combustible dust may be present under abnormal conditions and give rise to ignitable mixtures of dust in air. Where following an abnormal condition, the removal of dust accumulations or layers cannot be assured, then the area shall be classified as zone 21.

INTERNATIONAL REFERENCE GUIDE TO HAZARDOUS AREAS

STEP 2

Now having established which gas or dusts are present, the next thing to establish is the hazardous area category. FIG 1.1 below sets out the zone definitions to classify your area.

| ZONE | TYPE OF PROTECTION ASSIGNED TO APPARATUS |
|--------|--|
| Zone 0 | An area in which an explosive atmosphere is continuously present or for long periods or frequently |
| Zone 1 | An area in which an explosive atmosphere is likely to occur in normal operation occasionally |
| 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. (Zone 2 is often described as the 'remotely hazardous area'.) |

TABLE 2 HAZARDOUS AREA CLASSIFICATION

FIG 1.1

Using the guide in FIG 1.1 you can now classify the hazardous area into a zone. If you are unsure as to which zone an area should be classified as, please refer to your local health and safety officer or your fire brigade for guidance. Victor Lighting or any other manufacturer of hazardous area equipment is not able to offer any advice in this respect.

STEP 3

Having now identified the zone and gas/dust present in the hazardous area, the ignition temperature of the gas/dust needs to be ascertained. For atmospheres containing explosive dust, the ignition temperature of the dust needs to be established both when it is in a cloud and when it is in a layer. This information can be found from the table in FIG 1.2 below.

EXPLOSIVE GASES

| GAS | IGNITION TEMP °C | GAS | IGNITION TEMP °C | GAS | IGNITION TEMP °C |
|-------------------------------------|------------------|--|------------------|------------------------|------------------|
| Acetic acid (glacial) | 464 | Isopropyl ether | 443 | Vinyl chloride | 472 |
| Acetone | 465 | Mesityl oxide | 344 | Xylenes (o-xylene) | 463 |
| Acrylonitrile | 481 | Methane (natural gas) | 537 | Acrolein (inhibited) | 220 |
| Ammonia | 651 | Methanol (methyl alcohol) | 385 | Arsine | NA |
| Benzene | 498 | 3-methyl-1-butanol (isoamyl alcohol) | 350 | Butadiene | 420 |
| Butane | 287 | Methyl ethyl ketone | 404 | Ethylene oxide | 429 |
| 1-butanol (butyl alcohol) | 343 | Methyl isobutyl ketone | 448 | Hydrogen | 500 |
| 2-butanol (secondary butyl alcohol) | 405 | 2-methyl-1-propanol (isobutyl alcohol) | 415 | Propylene oxide | 449 |
| N-butyl acetate | 425 | 2-methyl-1-propanol (tertiary butyl) | 478 | Propyl nitrate | 175 |
| Isobutyl acetate | 421 | Petroleum naphta | 288 | Ethylene | 450 |
| Sec-butyl alcohol | 343 | Pyridine | 482 | Ethylamine | 320 |
| Di-isoutylene | 391 | Octanes | 206 | Ethyl mercaptan | 300 |
| Ethane | 472 | Pentanes | 260 | Ethyl sulfide | NA |
| Ethanol (ethyl alcohol) | 363 | 1-pentanol (amyl alcohol) | 300 | Hydrogen cyanide | 538 |
| Ethyl acetate | 426 | Propane | 432 | Hydrogen sulfide | 260 |
| Ethylene diamine (anhydrous) | 385 | 1-propanol (propyl alcohol) | 412 | Morpholine | 310 |
| Ethylene dichloride | 413 | 2-propanol (isopropyl alcohol) | 399 | 2-nitropropane | 428 |
| Gasoline (56-60 octane) | 280 | Propylene | 455 | Tetrahydrofuran | 321 |
| Hexanes | 223 | Styrene | 490 | Unsymmetrical dimethyl | |
| Heptanes | 204 | Toluene | 480 | hydrazine (udmh 1. 1- | 249 |
| Isoprene | 395 | Vinyl acetate | 402 | dimethyl hydrazine | |

EXPLOSIVE DUSTS METALLIC

| MATERIAL | CLOUD | LAYER |
|-----------|-------|-------|
| Aluminum | 650 | 760 |
| Magnesium | 620 | 490 |
| Titanium | 330 | 510 |
| Zinc | 630 | 430 |
| Bronze | 370 | 190 |
| Chromium | 580 | 400 |
| Tin | 630 | 430 |
| Cadmium | 570 | 250 |

EXPLOSIVE FIBRES

| MATERIAL | CLOUD | LAYER |
|-------------|-------|-------|
| Cotton lint | 520 | - |
| Flax | 430 | 230 |
| Rayon | 520 | 250 |

EXPLOSIVE DUSTS NON METALLIC

| MATERIAL | CLOUD | LAYER |
|-------------------------|-------|-------|
| Alfalfa | 460 | 200 |
| Cocoa | 420 | 200 |
| Coffee | 410 | 220 |
| Corn | 400 | 250 |
| Cornstarch | 380 | 200 |
| Malt | 400 | 250 |
| Skim milk | 490 | 200 |
| Rice | 440 | 220 |
| Sugar | 350 | 400 |
| Wheat | 480 | 220 |
| Coal (pittsburgh seam) | 610 | 180 |
| Wheat flour | 380 | 360 |
| Cellulose acetate | 450 | 390 |
| Ethyl acetate | 450 | 390 |
| Nylon | 500 | 430 |
| Polyethylene | 450 | 380 |
| Polystyrene | 560 | - |
| Epoxy | 540 | - |
| Polyurethane | 550 | 390 |
| Cork | 490 | 280 |
| Wood flour (white pine) | 470 | 260 |

FIG 1.2

STEP 4

Knowing the ignition temperature of the explosive atmosphere, the zone and the gas grouping or dust type we are better able to decide upon the appropriate type of electrical apparatus required. It is important therefore to understand the certified protection concepts recognised for safe operation as used for an ATEX category and/or within a zone.

The category in ATEX links to types of protection listed below. If the ATEX categories are used as a cross reference to zones then the protection concepts listed apply

ATEX CATEGORY PROTECTION TYPE - STANDARDS AND PROTECTION METHODS

| CATEGORY | PROTECTION TYPE | STANDARDS | PROTECTION METHOD |
|----------|--|------------|---|
| 1 | Ex 'ia' Intrinsic Safety. | EN 50020 | Where the design limits the ignition spark energy to below that which will ignite the explosive gas. Safe even with two simultaneous faults. |
| | Special protection for Category 1 [and Zone 1] | EN60079-26 | Special construction normally based on the use of two independent types of protection both individually suitable for Category 1. |
| 2 | Ex 'ia' Intrinsic Safety | EN 60079-7 | All protection methods described above for Category 1 are also suitable for Category 2. |
| | Ex 'e' Increased Safety | | Design prevents any ignition from occurring by ensuring no normally sparking components are used and other components reduce the risk of causing a fault that may cause an ignition. This is achieved by strictly controlling and limiting the temperature of components, ensuring adequate insulation is used, all electrical connections are true and the IP rating offers adequate protection against contamination. |
| | Ex 'd' Flameproof | EN60079-1 | The components may produce sparks that could cause ignition of the explosive gas but which are housed in an explosive proof enclosure. The design of the enclosure may allow the gas to enter, but any explosion is contained within the enclosure. |

| CATEGORY | PROTECTION TYPE | STANDARDS | PROTECTION METHOD |
|----------|------------------------------|-------------|--|
| | Ex 'ib' Intrinsic Safety | As Ex ia | As Ex ia but allows for the occurrence of only one component fault. |
| | Ex 'tD' | EN 61241-1 | Design ensures dust ingress protection and surface temperature limitation to avoid ignition of dust layer or cloud. |
| | Ex 'm' Encapsulation | EN 60079-18 | Integral components which can potentially ignite an explosive gas are encapsulated allowing the isolation of these components from the explosive atmosphere surrounding them. This allows the strict control of surface temperatures under normal and fault conditions. |
| | Ex 'p' Pressurised Apparatus | EN 60079-2 | One type of pressurisation maintains a positive static pressure inside the apparatus to prevent entry of gas and another maintains a continuous flow of air or inert gas to neutralise or carry away any explosive mixture entering or being formed within the enclosure. Essential to these methods are continuous monitoring systems to ensure their reliability and purging schedules on installation and following opening. |
| | Ex 's' Special Protection | | As special protection, Ex 's' is not subject to any formal standard as such. It is used where equipment does not comply exactly with standards but where its method of operation is proven to be safe in a hazardous area environment. |
| | Ex 'q' Powder filling | EN 50017 | This technique involves the mounting of potentially incandive components in an enclosure filled with sand or similar inert powder. The sand prevents explosive ignition. It was originally developed to protect heavy duty traction batteries. It is now primarily of use where the incandive action is the abnormal release of electrical energy by the rupture of fuses or failure of components used in electronic apparatus. The likelihood of possible incandive failure of the components is assessed and precautions taken to minimise it. Usually Ex q is used for discrete sub-assemblies and components inside Ex e apparatus. |
| 3 | Ex 'n' non sparking | EN 60079-15 | All protection methods described above for Category 1 & Category 2 are suitable for use in Category 3 This is a method very similar to Ex 'e' increased safety although not as stringent. The components are designed so as not to produce any sparks or dangerous temperatures in operation. |
| | Ex 'nA' and Ex 'nR' | EN 60079-15 | The Ex non sparking 'nR' denotes the use of a restricted breathing enclosure. This technique is used where internal components run hotter than the required T rating. The T rating is achieved by mounting the offending components in a sealed enclosure to prevent the explosive atmosphere contacting them. This technique by virtue incorporates high IP ratings of minimum IP65. |
| | Ex 'o' Oil Immersion | EN 50015 | Ex 'o', involves the immersion of the sparking components in oil with controlled venting. |

FIG 1.3

STEP 5

Now that you have clarified the gases/dusts present, their ignition temperature, the zone and applicable protection methods, the certified temperature codings must be understood for choosing the correct luminaire. Failure to understand the relationships could result in selecting an inappropriate luminaire for the zone and atmosphere. If the luminaires T rating code signifies the surface temperature of the equipment is greater than the ignition temperature of the gas/dust present, the luminaire will ignite the surrounding atmosphere causing an explosion.

Below FIG 1.4 shows the temperature codes related to surface temperatures. Using this table check the ignition temperature of the gas/dust present, as shown in FIG 1.2. This will then indicate the suitability of the equipment you have selected, or the temperature rating of the equipment you need to select.

| TEMPERATURE CLASSIFICATION | MAXIMUM SURFACE TEMPERATURE OF EQUIPMENT (°C) |
|----------------------------|---|
| T1 | 450 |
| T2 | 300 |
| T3 | 200 |
| T4 | 135 |
| T5 | 100 |
| T6 | 85 |

FIG 1.4

STEP 6

The environment that the equipment will operate in is also important. Many environments are arduous and may involve the equipment being subject to the following:

| TYPES OF ENVIRONMENT | EXAMPLES |
|--|---|
| Extreme high or low temperatures Arduous weather conditions Immersion in water Subject to dusty atmospheres | Middle east/Norway Offshore/Marine Dry docks Clean rooms/Grain silos |

FIG 1.5

In order to ensure that the equipment selected will perform in the environment for which it is intended, the following factors of equipment performance need to be considered.

- Ambient temperature - Does the equipment have certification to operate within the minimum and maximum temperatures of the environment?
- How much dust/liquid etc will the equipment be subjected to and for how long?
- Will the equipment be subject to any likely impact during its service life?
- Are there any chemicals/vapours present that could attack luminaires with plastic enclosures?

When selecting equipment, the product information will state the certified operating temperature such as the example below. If in selecting equipment the product information contains no statement or reference to ambient temperature be very sceptical and do not assume. Always check and obtain written confirmation from the manufacturer.

**Example Floodlight VL65A
-50°C to +55°C**



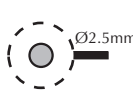
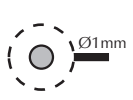


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Always check that the ambient temperature certification is applicable to your relevant choice of product as maximum ambient performances are often quoted and may only be applicable to certain product variants.

If the environment will subject the equipment to any dust/fibres/liquids, ensure it is certified to an appropriate level of ingress protection. This can be done using the table below.

INDEX OF PROTECTION (IP XX)

IP** degree of protection of enclosures of electrical equipment in accordance with standards IEC 529, EN 60529 and NFC 20-010

| 1st figure: Protection against solid bodies | | | | | | | |
|---|---------------|---|---|--|---|---|---|
| IP | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| TESTS | |  Ø50mm |  Ø12.5mm |  Ø2.5mm |  Ø1mm |  |  |
| | No Protection | Protected against solid bodies of 50 mm and greater (e.g. accidental contact with the hand) | Protected against solid bodies of 12.5 mm and greater (e.g. finger) | Protected against solid bodies of 2.5mm and greater (e.g. tools, wires) | Protected against solid bodies larger than 1 mm (e.g. thin tools and fine wires) | Protected against dust (no harmful deposit) | Completely protected against dust |





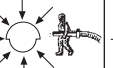
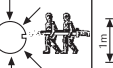
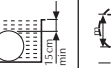

| 2nd figure: Protection against liquids | | | | | | | | | |
|--|---------------|---|---|---|---|---|---|---|---|
| IP | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| TESTS | |  |  |  |  |  |  |  |  |
| | No Protection | Protected against vertically falling drops of water (condensation) | Protected against drops of water falling up to 15° from the vertical | Protected against drops of water falling up to 60° from the vertical | Protected against splashing water from all directions | Protected against jets of water from all directions | Protected against powerful jets of water from all directions | Protected against the effects of temporary immersion in water | Protected against the continuous effects of immersion in water having regard to specific conditions |

FIG 1.6

Example Floodlight VL65A Ingress protection to IP66 and IP67

STEP 7... FINALLY

Having covered all the rules and safety considerations of the operation of electrical equipment in a hazardous area it is now possible to select a safe and appropriate product.

INTERNATIONAL STANDARDS AND APPROVALS

IECEX International Certification Scheme

“The aim of the IECEX Scheme is to facilitate international trade in electrical equipment intended for use in explosive atmosphere (Ex equipment) by eliminating the need for multiple national certification while preserving an appropriate level of safety.”

“The final objective of the IECEX Scheme is worldwide acceptance of one standard, one certificate and one mark.”

GOST-R (Russia)

Gosstandart of Russia is responsible for:

- establishment of the general rules and recommendations for certification of products, services (works) and systems of quality and production harmonised with international norms and rules;
- carrying out the State registration of the mandatory and voluntary certification systems and of the conformity marks.

Russia participates in the following international certification systems:

- System of the International Electrotechnical Commission (IEC) for tests of electrical equipment on conformity to the safety standards.

GGTN

Gosgortekhnadzor (GGTN) is the Federal Mining and Industrial Safety Supervisory Authority of Russia, and is responsible for the issue of permits and licenses for a broad range of machinery and equipment. As a separate entity to Gosstandart, GGTN requires product types that fall under its jurisdiction to undergo a further certification process.

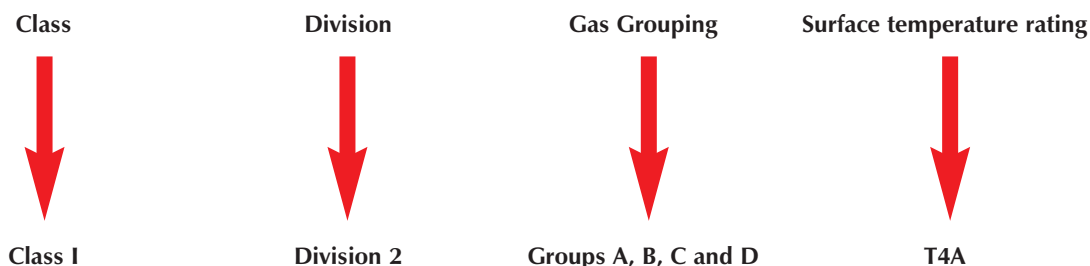
All potentially hazardous machinery and equipment, such as pressure vessels, boilers, burners, lifts and cranes is subject to GGTN approval, even if it has already obtained a GOST-R Coc.

In addition, any machinery to be used in hazardous or potentially explosive environments, such as oil or gas fields, refineries or chemical plants also require a separate GGTN permit. This applies even where the equipment itself would not normally require GOST-R approval.

NORTH AMERICAN STANDARDS AND APPROVALS

PRODUCT CODING

As in the European section, products are coded according to their certification for use in particular types of environments.



STEP 1

As detailed in the European section in STEP 1 the gas/dust/fibre present in the hazardous area needs to be identified and classified under the CEC\NEC (North American) classifications detailed in FIG 1.9 below.

CLASS I (EXPLOSIVE GASES)

| GROUP A ATMOSPHERE | | GROUP D ATMOSPHERE | |
|---|-----|--|-----|
| Acetylene | 305 | Acetic acid (glacial) | 464 |
| GROUP B ATMOSPHERE | | Acetone | 465 |
| Acrolein (inhibited) | 220 | Acrylonitrile | 481 |
| Arsine | NA | Ammonia | 651 |
| Butadiene | 420 | Benzene | 498 |
| Ethylene oxide | 429 | Butane | 287 |
| Hydrogen | 500 | 1-butanol (butyl alcohol) | 343 |
| Propylene oxide | 449 | 2-butanol (secondary butyl alcohol) | 405 |
| Propylnitrate | 175 | N-butyl acetate | 425 |
| GROUP C ATMOSPHERE | | Isobutyl acetate | 421 |
| Ethylene | 450 | Sec-butyl alcohol | 343 |
| Ethylenimine | 320 | Di-isoutylene | 391 |
| Ethyl mercaptan | 300 | Ethane | 472 |
| Ethyl sulfide | NA | Ethanol (ethyl alcohol) | 363 |
| Hydrogen cyanide | 538 | Ethyl acetate | 426 |
| Hydrogen sulfide | 260 | Ethylene diamine (anhydrous) | 385 |
| Morpholine | 310 | Ethylene dichloride | 413 |
| 2-nitropropane | 428 | Gasoline (56-60 octane) | 280 |
| Tetrahydrofuran | 321 | Hexanes | 223 |
| Unsymmetrical dimethyl hydrazine (udmh 1. 1-dimethyl hydrazine) | 249 | Heptanes | 204 |
| | | Isoprene | 395 |
| | | Isopropyl ether | 443 |
| | | Mesityl oxide | 344 |
| | | Methane (natural gas) | 537 |
| | | Methanol (methyl alcohol) | 385 |
| | | 3-methyl-1-butanol (isoamyl alcohol) | 350 |
| | | Methyl ethyl ketone | 404 |
| | | Methyl isobutyl ketone | 448 |
| | | 2-methyl-1-propanol (isobutyl alcohol) | 415 |
| | | 2-methyl-1-propanol (tertiary butyl) | 478 |
| | | Petroleum naphta | 288 |
| | | Pyridine | 482 |
| | | Octanes | 206 |
| | | Pentanes | 260 |
| | | 1-pentanol (amyl alcohol) | 300 |
| | | Propane | 432 |
| | | 1-propanol (propyl alcohol) | 412 |
| | | 2-propanol (isopropyl alcohol) | 399 |
| | | Propylene | 455 |
| | | Styrene | 490 |
| | | Toluene | 480 |
| | | Vinyl acetate | 402 |
| | | Vinyl chloride | 472 |
| | | Xylenes (o-xylene) | 463 |

CLASS II (EXPLOSIVE DUSTS)

| GROUP E | | | | | | | | |
|-----------|-------|-------|------------|-------|-------|-------------------------|-------|-------|
| MATERIAL | CLOUD | LAYER | MATERIAL | CLOUD | LAYER | MATERIAL | CLOUD | LAYER |
| Aluminum | 650 | 760 | Alfalfa | 460 | 200 | Wheat flour | 380 | 360 |
| Magnesium | 620 | 490 | Cocoa | 420 | 200 | Cellulose acetate | 450 | 390 |
| Titanium | 330 | 510 | Coffee | 410 | 220 | Ethyl acetate | 450 | 390 |
| Zinc | 630 | 430 | Corn | 400 | 250 | Nylon | 500 | 430 |
| Bronze | 370 | 190 | Cornstarch | 380 | 200 | Polyethylene | 450 | 380 |
| Chromium | 580 | 400 | Malt | 400 | 250 | Polystyrene | 560 | - |
| Tin | 630 | 430 | Skim milk | 490 | 200 | Epoxy | 540 | - |
| Cadmium | 570 | 250 | Rice | 440 | 220 | Polyurethane | 550 | 390 |
| | | | Sugar | 350 | 400 | Cork | 490 | 280 |
| | | | Wheat | 480 | 220 | Wood flour (white pine) | 470 | 260 |

| GROUP F | | |
|------------------------|-------|-------|
| MATERIAL | CLOUD | LAYER |
| Coal (Pittsburgh Seam) | 610 | 180 |

CLASS III (EXPLOSIVE FIBRES)

| MATERIAL | CLOUD | LAYER |
|-------------|-------|-------|
| Cotton lint | 520 | - |
| Flax | 430 | 230 |
| Rayon | 520 | 250 |

FIG 1.9

Using FIG 1.9 we can also ascertain the ignition temperatures of the identified gas/dust/fibre present.

STEP 2

Select the Gas/Dust/Fibre type present from FIG 1.9 and note:

- Material classification
 - I = Gas
 - II = Dust
 - III = Fibre
- The material group
- If the material present is a dust or fibre and whether it forms a cloud or a layer on surfaces
- The ignition temperature of the material

STEP 3

Assess the hazardous area as in STEP 2 of the european section with regard to the potential frequency and longevity of an explosive atmosphere. This can be done using the classifications below.

| DIVISION | CLASSIFICATION CRITERIA |
|----------|---|
| 1 | Gas/dust/fibres normally present in explosive amounts during operation. |
| 2 | Gas/dust/fibres not normally present in explosive amounts during operation. |

STEP 4

Now having defined the explosive gas/dust/fibres present, the nature of their presence, their ignition temperature and the classification of the hazardous area we, need to determine the temperature classifications to ensure the selection of equipment which will be safe in operation.

The classifications, which are similar to Europe, are further subdivided as follows

NORTH AMERICAN TEMPERATURE CLASSIFICATIONS

| Temperature in Fahrenheit | Temperature in Celsius | North American Temperature code |
|---------------------------|------------------------|---------------------------------|
| 842 | 450 | T1 |
| 572 | 300 | T2 |
| 536 | 280 | T2A |
| 500 | 260 | T2B |
| 446 | 230 | T2C |
| 419 | 215 | T2D |
| 392 | 200 | T3 |
| 356 | 180 | T3A |
| 329 | 165 | T3B |
| 320 | 160 | T3C |
| 275 | 135 | T4 |
| 248 | 120 | T4A |
| 212 | 100 | T5 |
| 185 | 85 | T6 |

FIG 2.0







Product markings will often show the actual rated temperature in brackets next to the temperature code to make judgement and selection easier.

STEP 5

Finally we need to take cognisance of the environment in which the equipment will be operating with respect to the concentration of liquids/gas/dust/fibres and ambient temperature.

On establishing these operating conditions we can establish the desired ingress protection required of the equipment by using the table below.

INDEX OF INGRESS PROTECTION

| 1st figure: Protection against solid bodies | | | | | | | |
|---|---------------|---|---|--|--|---|---|
| IP | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| TESTS | |  Ø50mm |  Ø12.5mm |  Ø2.5mm |  Ø1mm |  |  |
| | No Protection | Protected against solid bodies of 50 mm and greater (e.g. accidental contact with the hand) | Protected against solid bodies of 12.5 mm and greater (e.g. finger) | Protected against solid bodies of 2.5mm and greater (e.g. tools, wires) | Protected against solid bodies larger than 1 mm (e.g. thin tools and fine wires) | Protected against dust (no harmful deposit) | Completely protected against dust |









| 2nd figure: Protection against liquids | | | | | | | | | |
|--|---------------|---|---|---|---|---|--|---|---|
| IP | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| TESTS | |  |  |  |  |  |  |  |  |
| | No Protection | Protected against vertically falling drops of water (condensation) | Protected against drops of water falling up to 15° from the vertical | Protected against drops of water falling up to 60° from the vertical | Protected against splashing water from all directions | Protected against jets of water from all directions | Protected against powerful jets of water from all directions | Protected against the effects of temporary immersion in water | Protected against the continuous effects of immersion in water having regard to specific conditions |

FIG 2.1

The ingress protection level is found by putting the first and second figure together e.g. IP67

A third figure is sometimes used in the index of protection. This relates to the degree of mechanical protection the equipment has been certified as having. This relates to the degree of impact energy the equipment will stand before its hazardous area and ingress protection certification is compromised. FIG 2.2 below details the levels of protection.

INDEX OF MECHANICAL PROTECTION

| IK CODE | IK00 | IK01 | IK02 | IK03 | IK04 | IK05 | IK06 | IK07 | IK08 | IK09 | IK10 |
|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|
| Impact energy Joule | a | 0.14 | 0.2 | 0.35 | 0.5 | 0.7 | 1 | 2 | 5 | 10 | 20 |
| a not protected to this standard | | | | | | | | | | | |

FIG 2.2

Many manufactures do not display this protection figure so if no information is provided please contact the manufacturer direct. This is a valuable form of protection measurement if the equipment may be subject to any significant impact either accidental or during normal operation.

The environment will also be subject to ambient temperature fluctuations for both seasonal and day and night time variations. It is therefore important to establish what ambient temperatures the equipment is certified for use in. Ambient temperature operation is usually stated as the maximum temperature the equipment is certified for use in.

INTERNATIONAL REFERENCE GUIDE TO HAZARDOUS AREAS

STEP 6 FINALLY

We have developed the methodology to select the correct hazardous area type approved equipment that suits an environment by establishing as follows:

- Class I, II or III (Gas, dust or fibre present)
- Division 1 or 2 (Level of hazardous area)
- Ignition temperature of gas/dust/fibre present
- Max operating space temperature of equipment (T code)
- Ingress protection level of equipment
- Min and max ambient operating temperature of equipment

EUROPEAN V NORTH AMERICAN HAZARDOUS AREA CLASSIFICATIONS

TEMPERATURE RATINGS

| Temperature in Fahrenheit | Temperature in Celsius | North American Temperature code | IEC Temperature code |
|---------------------------|------------------------|---------------------------------|----------------------|
| 842 | 450 | T1 | T1 |
| 572 | 300 | T2 | T2 |
| 536 | 280 | T2A | T2 |
| 500 | 260 | T2B | T2 |
| 446 | 230 | T2C | T2 |
| 419 | 215 | T2D | T2 |
| 392 | 200 | T3 | T3 |
| 356 | 180 | T3A | T3 |
| 329 | 165 | T3B | T3 |
| 320 | 160 | T3C | T3 |
| 275 | 135 | T4 | T4 |
| 248 | 120 | T4A | T4 |
| 212 | 100 | T5 | T5 |
| 185 | 185 | T6 | T6 |

Note Actual temperatures may be shown instead of T - codes in North America

HAZARDOUS AREA CLASSIFICATIONS

North American to IEC / CENELEC Zone method of protection usability chart.

(Use with caution: **most Category 1 products cannot be used in North American Class I Div. 1 Areas**)

| North American Approval | CENELEC/IEC equivalent Zone |
|-------------------------|-----------------------------|
| Class I, Division 1 | Zone 1 |
| Class I, Division 2 | Zone 2 |

| North American Gas & Vapour Groups | CENELEC/IEC Gas and Vapour classification |
|------------------------------------|---|
| Group A | IIC |
| Group B | IIC |
| Group C | IIB |
| Group D | IIA |

NOTES



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