ENGINEERING STANDARD

FOR

HAZARDOUS AREA

SECOND EDITION

JANUARY 2016

FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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GENERAL DEFINITIONS

Throughout this Standard the following definitions shall apply.

COMPANY:

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery and Distribution Company.

PURCHASER:

Means the “Company” where this standard is a part of direct purchaser order by the “Company”, and the “Contractor” where this Standard is a part of contract document.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR:

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR:

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

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0. INTRODUCTION

This standard specifies the requirement of Electrical Area Classification in Part 1 and Outlines the Method of Safeguarding of Electrical Installation in Part 2.

Part 1: ELECTRICAL AREA CLASSIFICATION AND EXTENT

In plants where flammable gases, vapors, liquids or dusts are present, a flammable atmosphere may be formed if they are released.

The flammable atmosphere may also exist inside plant equipment if air or oxygen is present together with a flammable material.

The primary step in recognition of danger is the classification of plant into zones in which the probability of the existence of a flammable atmosphere is broadly assessed. This procedure known as area classification is dealt with in Part 1.

Part 2: METHOD OF SAFEGUARDING OF ELECTRICAL INSTALLATIONS

Electrical apparatus, including electrically operated process instruments, shall not be installed in a hazardous area when it is practical and economic to site it elsewhere.

Electrical installations in hazardous areas involve high initial capital expenditure on methods of safeguarding and continuing high inspection and maintenance costs relative to comparable installations in non hazardous areas.

Where the installation of electrical apparatus in hazardous areas is unavoidable special methods of safeguarding must be adopted to avoid danger.

Part 2 elaborate on method of safeguarding of electrical apparatus in classified hazardous areas.

PART 1

ELECTRICAL AREA CLASSIFICATION

AND

EXTENT

1. SCOPE

The hazardous area classification and restricted area drawings shall be prepared by the Safety discipline in accompany with the other disciplines.

This Standard provides guidance on the classification of areas where flammable gas or vapor risks may arise in order to permit the proper selection of electrical apparatus for use in such areas.

By using the following procedure an area classification map could be sketched for each plant (see Note 1). It is intended to be applied in oil industries, where there may be a risk due to presence of flammable gas or vapor, mixed with air under normal atmospheric conditions (see Note 2) and covers the following areas:

- Petroleum refineries;
- Petroleum and gas pipeline transportation facilities;
- Natural gas liquid processing plants;
- Drilling rigs, production facilities on land and marine fixed or mobile platforms;
- Chemical process areas.

It does not apply to:

- Mining;
- Processing and manufacture of explosives;
- Areas where risks may arise due to the presence of ignitable dusts or fibers;
- Catastrophic failures, which are beyond the concept of abnormality dealt with this standard (see Note 3);
- Ignition sources other than those associated with electrical apparatus (see Note 4).

This standard does not take into account the effects of consequential damages. Definitions and explanations of terms are given together with the main principles and procedures relating to area classification.

However this standard is applicable for new plants, previous procedures will be retained temporarily as a reference guide for the many existing plants installed according to the earlier code or standard.

Note 1:

This is a revised version of this standard, which is issued as revision (2)-2016. Revision (1)-2012 of the said standard specification is withdrawn.

Notes:

1) For the purpose of this standard an area is a three dimensional region or space.

2) Normal atmospheric conditions include variations above and below reference levels of 101.3 kPa. (1013 m bar) and 20°C provided the variations have a negligible effect on the explosion properties of the flammable materials.

3) Catastrophic failure in this context is applied for example to rupture of a process vessel or pipeline.

4) In any plant installation irrespective of size, there may be numerous sources of ignition apart from those associated with electrical apparatus. Additional precautions may be necessary to ensure safety in this aspect but these are outside the scope of this part, however some reference is made to them in Part 2.

2. REFERENCE CODES AND STANDARD

IEC (INTERNATIONAL ELECTROTECHNICAL COMMITTEE)

IEC-60079-0	"Explosive Atmospheres – Part 0: Equipment – General Requirements"
IEC-60079-1	"Explosive atmospheres- Part 1, Equipment protection by flameproof enclosures "d""
IEC-60079-2	"Explosive atmospheres- Part 2, Equipment protection by pressurized enclosure "p""
IEC-60079-5	"Explosive atmospheres- Part 5, Equipment protection by powder filling "q""
IEC-60079-6	"Explosive atmospheres- Part 6, Equipment protection by oil immersion "o""
IEC-60079-7	"Explosive atmospheres- Part 7, Equipment protection by increased safety "e""
IEC-60079-10-1	"Explosive atmospheres- Part 10-1, Classification of Areas- Explosive Gas Atmospheres"
IEC-60079-10-2	"Explosive atmospheres- Part 10-2: Classification of areas – Combustible dust atmospheres"
IEC-60079-11	"Explosive atmospheres- Part 11, Equipment protection by intrinsic safety "i""
IEC-60079-14	"Explosive atmospheres- Part 14, Electrical installations design, selection and erection"
IEC-60079-15	"Explosive atmospheres – Part 15: Equipment protection by type of protection "n""
IEC-60079-18	"Explosive atmospheres – Part 18: Equipment protection by encapsulation "m""
IEC-60079-20-1	"IEC 60079-20-1: Explosive atmospheres – Part 20-1: Material characteristics for gas and vapour classification – Test methods and data"
IEC 60529	"Degrees of Protection Provided by Enclosures (IP Code)"
IEC 60034-5	"Rotating electrical machines- Part 5, Degrees of protection provided by the integral design of rotating electrical machines (IP Code)- Classification"
CENELEC	"Comite Europieen de Normalisation Electrotechnique / European Committee for Electrotechnical Standardization" (2006)
IEC 60947-1	"Low-Voltage Switchgear and Controlgear – Part 1: General Rules"

API (AMERICAN PETROLEUM INSTITUTE)

API RP 505	"Recommended Practice for Classification of Location for Electrical Installation at Petroleum Facilities Classified as Class I, Zone 0, Zone 1 and Zone 2"
API RP 500	"Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2"

BSI (BRITISH STANDARD INSTITUTION)

BS EN 50272-1	"Safety requirements for secondary batteries and battery installations Part 1: General safety information"

NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)

NFPA 30	"Flammable and Combustible Liquids Code"
NFPA 70	"National Electrical Code"
NFPA 497	"Recommended Practice for the classification of Flammable Liquids, Gases or Vapors and of Hazardous (Classified) Location of Electrical Installation in Chemical Process Areas"

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-SF-100	"Engineering Standard for Classification of Fires and Fire Hazard Properties"
IPS-I-EL-215	"Inspection Standard for Potentially Explosive Atmospheres (Hazardous Area)"

3. DEFINITIONS AND TERMINOLOGY

3.1 Explosive Atmosphere

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

3.2 Explosive Gas Atmosphere

A mixture with air under atmospheric conditions, of flammable materials in the form of gas, vapor or mist, in which, after ignition, combustion spreads throughout the unconsumed mixture.

Notes:

1) Although a mixture which has a concentration above the upper explosive limit (UEL) is not an explosive gas atmosphere, it can readily become so and, in certain cases for area classification purposes, it is advisable to consider it as an explosive gas atmosphere.

2) There are some gases which are explosive with the concentration of 100%.

3.3 Hazardous Area

An area in which an explosive gas atmosphere is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of equipment.

3.4 Non Hazardous Area

An area in which an explosive gas atmosphere is not expected to be present in quantities such as to require special precautions for the construction, installation and use of equipment.

3.5 Zones

Hazardous areas are classified in zones based upon the frequency of the appearance and the duration of an explosive gas atmosphere as follows:

3.5.1 Zone 0

An area in which an explosive gas atmosphere is present continuously or is present for long periods or frequently.

3.5.2 Zone 1

An area in which an explosive gas atmosphere is likely to occur in normal operation occasionally.

3.5.3 Zone 2

An area in which an explosive gas atmosphere is not likely to occur in normal operation and if does occur it will exist for a short period only.

Note:

Indications of the frequency of the occurrence and duration may be taken from codes relating to specific industries or applications.

Although there is no firm rule relating the time that flammable mixtures occur with Zone 0, Zone 1, Zone 2, and unclassified locations, many use the rule-of-thumb shown in Table 1.

TABLE 1 - SHOWING THE TYPICAL RELATIONSHIP BETWEEN ZONE CLASSIFICATION AND THE PRESENCE OF FLAMMABLE MIXTURES

Zone	Flammable Mixture Present
0	1000 or more hours/year (10%)
1	10 < hours/year < 1000 (0.1% - 10%)
2	1 < hour/year < 10 (0.01% - 0.1%)
unclassified	Less than 1 hour/year (0.01%)

3.6 Source of Release

A point or location from which a gas, vapor, mist or liquid may be released into the atmosphere so that an explosive gas atmosphere could be formed.

3.7 Grades of Release

There are three basic grades of release, as listed below in order of decreasing frequency and likelihood of the explosive gas atmosphere being present:

- Continuous grade
- Primary grade
- Secondary grade

A source of release may give rise to any one of these grades of release, or to a combination of more than one.

3.7.1 Continuous grade of release

Release which is continuous or is expected to occur frequently or for long periods.

3.7.2 Primary grade of release

Release which can be expected to occur periodically or occasionally during normal operation.

3.7.3 Secondary grade of release

Release which is not expected to occur in normal operation and, if it does occur, is likely to do so only infrequently and for short periods.

3.7.4 Multigrade source of release

A source of release which is a combination of two or three of the above mentioned grades; which:

a) Is basically graded continuous or primary, and;

b) Gives rise to a release under different conditions which create a larger zone but less frequently and/or for a shorter duration than as determined for the basic grade.

See also sub clause 3.8.

Note:

Different conditions mean, for example, different release rate of flammable material but under the same ventilation conditions.

A source of release which is basically graded continuous may in addition be graded primary if the rate of release of flammable material, for the primary grade frequency and/or duration, exceeds that for the continuous grade.

It may, additionally or alternatively to the primary grade, also be graded secondary if the rate of release of flammable material, for the secondary grade frequency and/or duration, exceeds that for continuous and, if applicable, the primary grade.

Similarly a source of release which is basically graded primary may in addition be graded secondary if the rate of release of flammable material for the secondary grade frequency and/or duration exceeds that for the primary grade.

3.8 Normal Operation

The situation when the plant equipment is operating within its design parameters.

Minor releases of flammable material may be part of normal operation. For example, releases from seals which rely on wetting by the fluid being pumped are considered to be minor releases.

Failures (such as the breakdown of pump seals, flange gaskets or spillages caused by accidents) which involve repair or shut down are not considered to be part of normal operation.

Note:

Normal operation includes start-up and shut-down conditions.

3.9 Ventilation

3.9.1 Natural ventilation

Movement of air and its replacement with fresh air due to the effects of wind and/or temperature gradients.

3.9.2 General artificial ventilation

Movement of air and its replacement with fresh air by artificial means (e.g., fans) and applied to a general area.

3.9.3 Local artificial ventilation

Movement of air and its replacement with fresh air by artificial means (usually extraction) applied to a particular source of release or local area.

3.9.4 No ventilation

No ventilation exists where no arrangements have been made to cause air replacement with fresh air.

3.10 Explosive Limits

3.10.1 Lower explosive limit (LEL)

The concentration of flammable gas, vapor or mist in air, below which an explosive gas atmosphere will not be formed.

3.10.2 Upper explosive limit (UEL)

The concentration of flammable gas, vapor or mist in air, above which an explosive gas atmosphere will not be formed.

3.11 Relative Density of a Gas or a Vapor

The density of a gas or a vapor relative to the density of air at the same pressure and at the same temperature. (Air is equal to 1.0)

3.12 Flammable Material (flammable substance)

Material which is flammable of itself, or is capable of producing a flammable gas, vapor or mist.

3.13 Flammable Gas or Vapor

Gas or vapor which, when mixed with air in certain proportions, will form an explosive gas atmosphere.

3.14 Flammable Liquid

Liquid capable of producing a flammable vapor under any foreseeable operating conditions.

Note:
An example of a foreseeable operating condition is one in which the flammable liquid is handled at temperatures close to or above its flash point.

3.15 Flammable Mist

Droplets of flammable liquid, dispersed in air, so as to form an explosive atmosphere.

3.16 Flash Point

The lowest liquid temperature at which, under certain standardized conditions, a liquid gives off vapors in quantity such as to be capable of forming an ignitable vapor/air mixture.

3.17 Boiling Point

The temperature of a liquid boiling at an ambient pressure of 101.3 kPa (1013 mbar).

Note:

For mixtures the initial boiling point should be used.

"Initial boiling point" is used for liquid mixtures to indicate the lowest value of the boiling point for the range of liquids present.

3.18 Vapor Pressure

Pressure exerted when a solid or liquid is in equilibrium with its own vapor. It is a function of the substance and of the temperature.

3.19 Ignition Temperature of an Explosive Gas Atmosphere

Lowest temperature of a heated surface which, under specified conditions according to IEC 60079-4, will ignite a flammable substance in the form of a gas or vapor mixture with air.

3.20 Extent of Zone

Distance in any direction from the source of release to the point where the gas/air mixture has been diluted by air to a value below the lower explosive limit.

3.21 Liquefied Flammable Gas

Flammable material which is stored or handled as a liquid and which at ambient temperature and atmospheric pressure is a flammable gas.

4. GENERAL

4.1 Safety Principles

Installations in which flammable substances are handled or stored should be designed, constructed, operated and maintained so that any releases of flammable substance, and consequently the extent of hazardous areas, are kept to a minimum, whether in normal or abnormal operation, with regard to frequency, duration and quantity of a release.

It is important to examine those parts of process equipment and systems from which a release of flammable substance may arise and to consider modifying the design to minimize the likelihood and frequency of such releases and the quantity and rate of release of substance.

These fundamental considerations should be examined at an early stage of the design development of any process plant and should also receive prime attention in carrying out the area classification study.

In the case of activities other than those of normal operation, e.g. commissioning or nonroutine maintenance, the area classification may not be valid. It is expected that the activities other than those of normal operation would be dealt with by a safe system of work. The area classification should take into account any routine maintenance.

In a situation in which there may be an explosive gas atmosphere, the following steps should be taken:

a) Eliminate the likelihood of an explosive gas atmosphere occurring around the source of ignition, or

b) Eliminate the source of ignition.

Where this is not possible, protective measures, process equipment, systems and procedures should be selected and prepared so the likelihood of the coincidence of a) and b) is so small as to be accepted as low as reasonably practicable. Such measures may be used individually, if they are recognized as being highly reliable or in combination to achieve the required level of safety.

4.2 Area Classification Objectives

Area classification is a method of analysing and classifying the environment where explosive gas atmospheres may occur, so as to facilitate the proper selection, installation and operation of equipment to be used safely in that environment. The classification also takes into account the ignition characteristics of the gas or vapour such as ignition energy and ignition temperature. Area classification has two main objectives, the determination of the type of any hazardous zone, and the extent of the zone (see 7 and 8).

Note:

Selected characteristics may be designated for equipment e.g. ignition energy and temperature ratings, see IEC 60079-20-1.

In most practical situations where flammable substances are used, it is difficult to ensure that an explosive gas atmosphere will never occur. It may also be difficult to ensure that equipment will never give rise to a source of ignition. Therefore, in situations where an explosive gas atmosphere has a high likelihood of occurring, reliance is placed on using equipment which has a low likelihood of creating a source of ignition. Conversely, where the likelihood of an explosive gas atmosphere occurring is reduced, equipment constructed with less rigorous requirements may be used.

In particular, zone 0 or zone 1 areas should be minimized in number and extent by design or suitable operating procedures. In other words, plants and installations should be mainly zone 2 or non-hazardous. Where release of a flammable substance is unavoidable, process equipment items should be limited to those which give secondary grade releases or, failing this (that is where primary or continuous grade releases are unavoidable), the releases should be of very limited quantity and rate. In carrying out plant design, these principles should receive prime consideration. Where necessary, the design, operation and location of process equipment should ensure that, even when it is operating abnormally, the amount of flammable substance released into the atmosphere is minimized, so as to reduce the extent of the hazardous area.

Once a plant has been classified and all necessary records prepared, it is important that no modification to equipment or operating procedures is made without reference to those responsible for the area classification. The classification should be updated for any plant or operational changes. Reviews should be carried out during the life of the plant.

4.3 Explosion Risk Assessment

Subsequent to the completion of the area classification, a risk assessment may be carried out to assess whether the consequences of ignition of an explosive atmosphere requires the use of equipment of a higher equipment protection level (EPL) or may justify the use of equipment with a lower equipment protection level than normally required.

In some cases a zone of negligible extent (NE) may arise and may be treated as non hazardous. Such a zone implies that an explosion, if it takes place, will have negligible consequences. The zone NE concept can be applied irrespective of any other adjustments for risk assessment to determine EPL.

Note 1:

An example of Zone NE is a natural gas cloud with an average concentration that is 50 % by volume of the *LFL* and that is less than 0,1 m3 or 1,0 % of the enclosed space concerned (whichever is smaller).

The EPL requirements may be recorded, as appropriate, on the area classification documents and drawings to allow proper selection of equipment.

Note 2:

IEC 60079-0 describes EPLs and IEC 60079-14 defines the application of EPLs to an installation.

4.4 Competence of Personnel

The area classification should be carried out by those who understand the relevance and significance of the properties of the flammable substances, principles of gas/vapour dispersion and those who are familiar with the process and the equipment. It may be beneficial for other engineering disciplines, e.g. electrical and mechanical engineers, and personnel with specific responsibility for safety to be part of and have an input to the area classification process. The competency of the person shall be relevant to the nature of the plant and methodology used for carrying out the area classification. Appropriate continuing education or training should be undertaken by personnel on a regular basis where required.

Note:

Competency can be demonstrated in accordance with a training and assessment framework relevant to national regulations or standards or user requirements.

5. AREA CLASSIFICATION METHODOLOGY

5.1 General

It is rarely possible by a simple examination of a plant or plant design to decide which parts of the plant can be equated to the three zonal definitions (zones 0, 1 and 2). A more detailed approach is therefore necessary and this involves the analysis of the basic possibility of an explosive gas atmosphere occurring.

In determining where a release of flammable gas or vapour may occur, the likelihood and duration of the release should be assessed in accordance with the definitions of continuous, primary and secondary grades of release. Once the grade of release, the release rate, concentration, velocity, ventilation and other factors are assessed there is then a firm basis on which to assess the likely presence of an explosive gas atmosphere in the surrounding areas and determine the type and/or extent of the hazardous zones.

This approach therefore requires detailed consideration to be given to each item of process equipment which contains a substance flammable by itself or due to process conditions, and which could therefore be a source of release.

The procedure of determination of Area Classification is considered in IPS-E-SF-100 in accompany with the other disciplines.

PART 2

METHOD OF SAFEGUARDING

OF

ELECTRIC INSTALLATION

1. SCOPE

This Recommendation deals with the special precautions necessary to ensure the safe use of electricity in oil, gas, and petrochemical industries where flammable materials are manufactured, processed, handled, or stored. It does not deal with the dangers in Explosive factories nor does it deal with risk arising from static electricity or lightning.

It is concerned mainly with sources of ignition arising from the use of current electricity that is to say electric arcs, sparks, and heating effects.

The hazardous area classification and restricted area drawings shall be prepared by the Process and Safety discipline but never by the electrical discipline.

2. METHODS OF SAFEGUARDING

2.1 Segregation

2.1.1 Definition

Segregation is method of safeguarding where fire resistant impermeable barriers are used to create a lower risk zone or a non hazardous area in which electrical apparatus appropriate to the lowered classification should be used.

2.1.2 Examples of segregation

A switch room containing industrial type switchgear has fire resistant and impermeable walls adjoining the hazardous area and is so arranged that the distances from the sources of hazard to the doors and other openings in the switch room comply with the requirements of the classification of the hazardous area.

2.2 Explosion Protected Equipment

For installation of electrical equipment in hazardous area, appropriate explosion protected equipment according to hazardous area classification shall be used as follows:

2.2.1 Flameproof enclosures (Exd)

2.2.1.1 Definition

2.2.1.1.1 A flameproof enclosure is defined in IEC 60079-1 as:

An enclosure for electrical apparatus that will withstand an internal explosion of the flammable gas or vapor which may enter it without suffering damage and without communicating the internal flame to the external flammable gas or vapor for which it is designed, through any joints or structural openings in the enclosure.

A flameproof enclosure is designed to withstand the pressure of an internal explosion; it is not necessary therefore to provide openings for pressure relief. Where there is a joint, however, or where a spindle or shaft passes through the enclosure, the products of the explosion can escape. Any path which these may take needs to be of sufficient length and constriction to cool the products of the explosion so as to prevent ignition of a flammable atmosphere external to the enclosure. The dimensions of these flame paths are critical and are specified in IEC 60079.1.

Flameproof enclosures cannot yet be certified independently of their contents but this situation may change for small enclosures as a result of current work.

Alteration to the disposition of the internal components is not permitted because conditions may be created inadvertently which will lead to pressure piling (a condition resulting from the ignition of

precompressed gases in compartments or subdivisions other than those in which ignition was initiated, and which may lead to higher maximum pressure than would otherwise be expected). No modification, addition or deletion to the enclosure or its internal components shall be made without the written permission of the certifying authority (such permission shall be obtained through the manufacturer of the apparatus) unless it can be verified that such change does not invalidate the certification.

It should be noted that a flameproof enclosure is not tested for its ability to withstand the effects of an internal electrical fault.

2.2.1.1.2 Level of protection (equipment protection level, EPL)

Electrical equipment with flameproof enclosure “d” shall be one of the following:

– Level of protection “da” (EPL “Ma” or “Ga”);

– Level of protection “db” (EPL “Mb” or “Gb”); or

– Level of protection “dc” (EPL “Gc”).

Level of protection “da” is only applicable to catalytic sensors of portable combustible gas detectors.

The requirements for level of protection “dc” are applicable to electrical equipment and Ex components with electrical switching contacts.

Other than specific requirements for level of protection “da” and “dc”, all other requirements of this standard shall apply to level of protection “db”.

For details of EPL refer to IEC 60079-1.

For definition of “Ma” , “Mb” , “Ga” , “Gb” , “Gc” refer to IEC 60079-0 and IEC 60079-14.

2.2.1.2 Enclosure grouping and temperature classification

Flameproof enclosures are grouped according to specified maximum permissible dimensions for gaps between joint surfaces and the surfaces of other openings in the enclosure. IEC 60079.1 quote the maximum permissible dimensions of gaps for the various enclosure groups but, in practice, joints shall be fitted as close as possible and on no account shall the maximum permissible dimensions be exceeded.

All enclosures are marked with the appropriate Standard group reference. For industrial gases the enclosure groups are IIA, IIB and IIC in IEC 60079.1.

Enclosures certified for a particular group may be used with gases and vapors appropriate to an enclosure group having larger permissible maximum gap dimensions. For example a group IIB enclosure may be used in place of group IIA enclosure but not vice versa.

Enclosures to IEC 60079.1 are marked with a temperature class (T1-T6 in accordance with IEC 60079.0) and shall not be installed where flammable materials are used which have ignition temperatures below the maximum for that class.

2.2.1.3 Cable entries

It is necessary, at the time of ordering, to specify the number and size of cable entries to a flameproof enclosure. These have to be machine cut by the manufacturer and this operation shall not be carried out on site.

2.2.1.4 Conditions of use

Flameproof enclosures are primarily intended for use in Zone 1 gas and vapor risks. When used in Zone 2 gas and vapor risks no relaxation of the application, installation or maintenance requirements shall be permitted. Flameproof enclosures must not be used in Zone 0.

Where a flameproof enclosure is exposed to the weather or installed in wet conditions an enclosure which is specifically designed as flameproof/weatherproof shall be used where available. Weatherproofing is usually achieved in this type of enclosure by gasketed joints which are additional to and separate from the flame paths. The weatherproofing of other flameproof enclosures may be achieved by the use of suitable grease in the flame path (see Clause 2.2.1.6) provided that these are not adversely affected by chemicals with which they may come into contact.

Where a flameproof enclosure is exposed to corrosive conditions its safety features may be impaired by corrosion of the enclosure. It shall therefore, be suitably protected by, for example, painting external surfaces and the greasing of flanges (see Clause 2.2.1.6). Consideration shall also be given to increasing the frequency of maintenance.

Type Exd protection is applicable to virtually all types of electrical apparatus.

In this type, equipment is housed in an enclosure into which gas can gain access; the gas can be ignited within the enclosure without the explosion damaging the enclosure or being transmitted to any flammable atmosphere external to the enclosure.

The enclosure must be sturdy enough to withstand the explosion and to have closely machined flanges of specified minimum lengths on all covers, spigots, shafts and bearings etc., which provides access paths through all its walls or covers.

Assessment of suitability of a specific enclosure involves comparison with closely specified constructional features along with actual explosion and ignition transmission tests under prescribed conditions.

2.2.1.5 The effect of tape and obstacles on flame paths

The tape wrapping of flanged joint and other opening or the presence of obstacles near the edges of flanges joints and other openings may impair the protection afforded by a flameproof enclosure. To compensate for these effects the rules set out below which are applicable in both zone 1 and zone 2 shall be observed:

2.2.1.5.1 Tape (usually a grease impregnated linen tape)

I) Group IIC enclosures

Tape shall not be applied to any flanged Joint or spindle or shaft gap.

II) Group IIB and IIA enclosures

a) Tape shall not be applied to spindle or shaft gaps.

b) Irrespective of the flange width. The tape shall be restricted to one layer enclosing all parts of the flange with a short overlap and new tape shall be applied when existing tape is disturbed.

2.2.1.5.2 Obstacles (such as external covers, guards, supports, pipes, structural steel work etc.).

Where the obstacle is more than 40 mm away from the edge of flanged joint or other opening no special precautions are necessary.

I) Group IIC enclosures

There shall be no obstacle within 40 mm of flanged joint or spindle or shaft gap.

II) Group IIB and IIA enclosures

a) There shall be no obstacle within 6 mm of flanged joint or within 40 mm of a spindle or shaft gap.

b) Where an obstacle is between 6 mm and 40 mm of a flanged joint the gap shall not exceed 0.1 mm irrespective of the flange width.

2.2.1.5.3 Integral obstacles

Many flameproof enclosures have obstacles external to and integral with the enclosure but since they have been tested and certified in this condition no special rules or precautions are necessary.

2.2.1.6 The effect of grease, other sealants and paint on flanged joints

Experience has shown that the presence in a flanged joint of grease or non setting jointing compound has caused no deterioration in the flameproof qualities of the joints, the same results has been obtained where the exterior of the flanges has been painted, even if the paint has filled and bridged the gap. Therefore no special precautions are necessary when these materials are applied, except that aluminum paint should not be used because of the potential danger from a combination of aluminum and rust.

2.2.1.7 Aluminum flameproof enclosures and cables with aluminum conductors

The risks can arise when aluminum is used as a flameproof enclosure material and when aluminum conductors are used inside flameproof enclosures. Until further information is available the following precautions, shall be applied.

Because aluminum flameproof enclosures can eject hot aluminum particles under fault conditions, and because of the danger of arcs burning through the enclosure, the use of such enclosures is restricted to circuits protected by a 15 ampere or smaller fuse.

Cables with aluminum conductors shall not be used in flameproof enclosures unless the possibility of ejecting hot aluminum particles from the enclosures has been minimized by either:

a) Using cable terminating enclosures whose joints are threaded or spigoted, or

b) Using fully insulated conductors, and using terminals which are designed or reduce the likelihood of faults and are shrouded by insulation. The compound filling of boxes is one method of meeting this requirement.

2.2.2 Intrinsically Safe System (Exi)

An intrinsically safe is defined in IEC 60079-11 as follows:

Type of protection based on the restriction of electrical energy within equipment and of interconnecting wiring exposed to the explosive atmosphere to a level below that which can cause ignition by either sparking or heating effects.
Intrinsically safe apparatus and intrinsically safe parts of associated apparatus shall be placed in Levels of Protection "ia", "ib" or “ic”.

2.2.2.1 Principle

I) In an intrinsically safe system the energy release in those parts of the system intended for use in the hazardous area is limited under both normal and specified fault conditions, to well below the minimum energy which can cause ignition.

II) An intrinsically safe system is defined as a system comprising apparatus and interconnecting wiring in which any spark or thermal effect in any part of the system intended for use in the hazardous area is incapable under prescribed conditions, of causing ignition of a given gas or vapor.

Because the minimum ignition energy is very small usually below one millijoule, this method of safeguarding can be applied only to light current application such as:

Instrument, communication and data transmission.

III) No modification, addition or deletion shall be made to an intrinsically safe system, until a certificate of intrinsic safety has been obtained for the proposed change or until it has been established that the change is permitted by the original certificate issuing authority.

IV) All intrinsically safe systems posses power sources, and precautions needs to be taken to ensure that these can not release, unsafe amount of energy in the hazardous area. Intrinsically safe system also require to be protected against invasion from all other circuits and systems, whether these are intrinsically safe or not, thus there are requirements for clearance and creepage distances, insulation values, earthing, screens etc., to prevent invasion of an intrinsically safe system either directly or by induction.

V) The two most common forms of intrinsically safe systems are:

i. Those which have parts in the hazardous area and a power supply in the non hazardous area, such a power supply often being an integral part of the associated safe area apparatus see diagram 1.

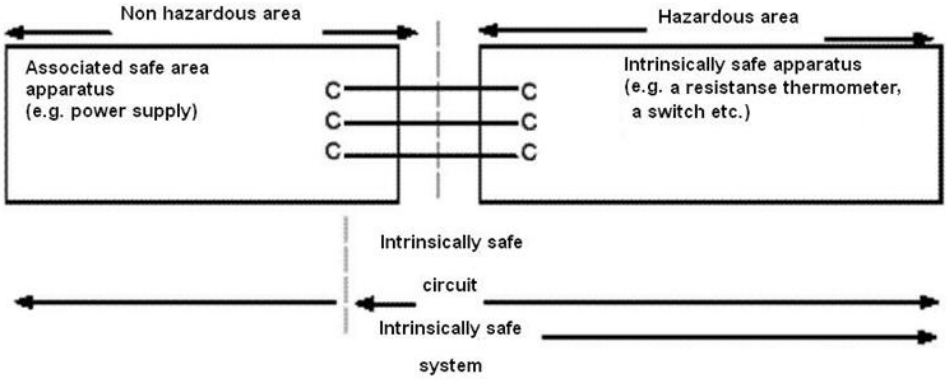

Diagram 1

Note:

The associated safe area apparatus and the intrinsically safe apparatus may have individual certificates but the interconnection of such items of apparatus does not necessarily constitute an intrinsically safe system, because an item of apparatus has input and output parameters (e.g., inductance, capacitance, voltage, and current which may not match those of the apparatus in the system). A certificate of intrinsic safety shall therefore be obtained for the complete intrinsically safe system.

In these cases in order to prevent dangerous amount of energy being fed to the hazardous area, the power supply is of special design, and energy limiting components are where necessary installed in the circuit to the hazardous area.

Normally barrier units are used to effectively limit both voltages and current in the hazardous area, provided that the associated safe area apparatus complies with the requirements of the certificate of intrinsic safety. Circuit connected to the hazardous area terminals of a barrier unit need to be certified for use with the barrier unit.

ii. Those which have all parts in the hazardous area and are battery or self powered (see diagrams 2 and 3).

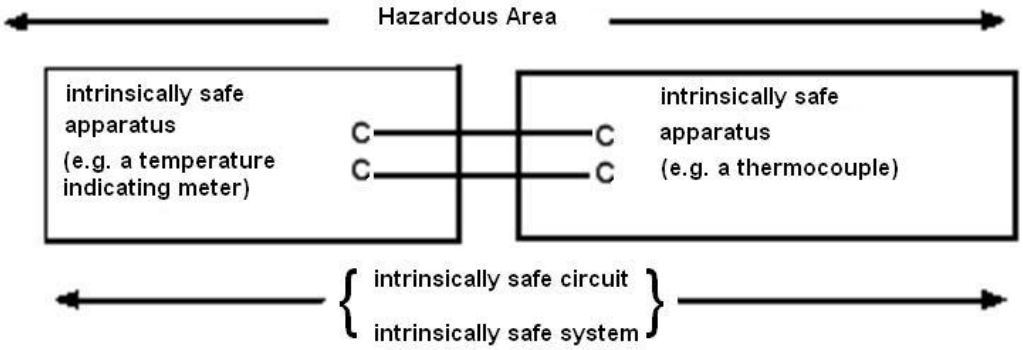

Diagram 2

Note 1:

The items of intrinsically safe apparatus may have individual certificates of intrinsic safety, but the interconnection of such items of apparatus does not necessarily constitute an intrinsically safe system because an item of apparatus has input and output parameters (e.g., inductance; resistance, voltage, and current) which may not match those of the other apparatus in the system. A certificate of intrinsic safety shall therefore be obtained for the complete intrinsically safe system.

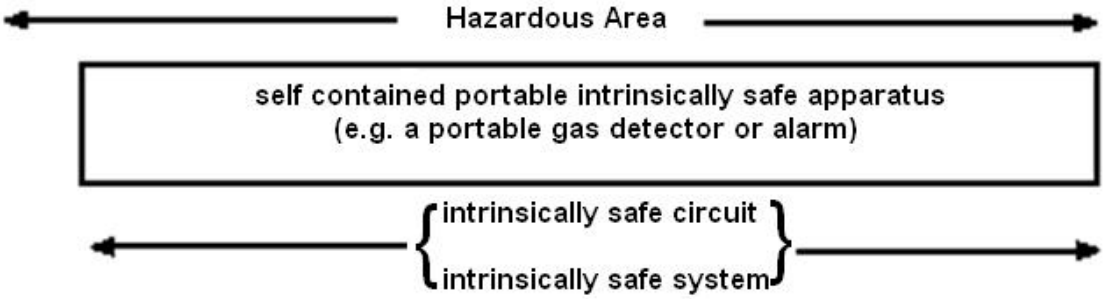

Diagram 3

Note 2:

This type of apparatus is considered to be intrinsically safe system for the purpose of this part.

Apart from the consideration given to power sources detailed in Notes 1 and 2 above, account has to be taken in all cases of any sources of energy generation or storage which may exist either in the non-hazardous area or the hazardous area. Example of such sources are:

- Capacitance and inductance.
- Thermoelectric.
- Electrochemical devices.
- Motors and tachogenerators.

Values of capacitance or inductance which normally would be considered (e.g., 20 picofarads or 100 microhenries) are significant in some circuits and care shall always be exercised to ensure that excessive values are not introduced by the use of long cables of an inappropriate type.

2.2.2.2 Certification

Intrinsically safe apparatus, circuits and systems shall be certified.

A certificate of intrinsic safety certifies that a specified system or apparatus is intrinsically safe in accordance with the requirements of IEC 60079-11.

The certificate is valid only when the system or apparatus is installed in accordance with the requirements stated in the certificate.

Because of misuse and misunderstanding of the term intrinsically safe a check should always be made to ensure that a certificate of intrinsic safety exists and that it applies to the system concerned. A certificate of intrinsic safety for apparatus is not necessarily proof that the system which contains it is safe except in the case of self contained intrinsically safe apparatus which is considered to be an intrinsically safe system for the purpose of this volume (see also the notes to the diagrams in Clause 2.2.2.1). It is therefore necessary to examine carefully the scope of particular certificate of intrinsic safety and to ensure that all parts of the system both within and

outside the hazardous area are fully covered by the certificate or by the series of complementary and cross referenced certificates.

For the minimum required Ex. Certificates refer to clause 5 of this standard.

2.2.2.3 Categories

There are three categories of intrinsic safety "ia, ib and ic". The difference relates to the fault consideration of the apparatus or circuit and defines the safety factor under these conditions. Essentially the definitions are as follows:

Level of protection "ia"

With *U*m and *U*i applied, the intrinsically safe circuits in electrical apparatus of level of protection "ia" shall not be capable of causing ignition in each of the following circumstances:

a) in normal operation and with the application of those non-countable faults which give the most onerous condition;

b) in normal operation and with the application of one countable fault plus those non-countable faults which give the most onerous condition;

c) in normal operation and with the application of two countable faults plus those non-countable faults which give the most onerous condition.

The non-countable faults applied may differ in each of the above circumstances.

In testing or assessing the circuits for spark ignition, the following safety factors shall be applied in accordance with “safety factor” clause of IEC 60079-11:

– for both a) and b) 1.5

– for c) 1.0

The safety factor applied to voltage or current for determination of surface temperature classification shall be 1.0 in all cases.

If only one countable fault can occur, the requirements of a) and b) shall be considered to give a level of protection of "ia" if the test requirements for "ia" can then be satisfied. If no countable faults can occur the requirements of a) shall be considered to give a level of protection of "ia" if the test requirements for "ia" can then be satisfied.

Level of protection "ib"

With *U*m and *U*i applied, the intrinsically safe circuits in electrical apparatus of level of protection "ib" shall not be capable of causing ignition in each of the following circumstances:

a) in normal operation and with the application of those non-countable faults which give the most onerous condition;

b) in normal operation and with the application of one countable fault plus the application of those non-countable faults which give the most onerous condition.

The non-countable faults applied may differ in each of the above circumstances.

In testing or assessing the circuits for spark ignition, a safety factor of 1.5 shall be applied in accordance with “safety factor” clause of IEC 60079-11. The safety factor applied to the voltage or current for the determination of surface temperature classification shall be 1.0 in all cases.

If no countable fault can occur the requirements of a) shall be considered to give a level of protection of "ib" if the test requirements for "ib" can be satisfied.

Level of protection "ic"

With *U*m and *U*i applied, the intrinsically safe circuits in electrical apparatus of level of protection "ic" shall not be capable of causing ignition in normal operation and under the conditions specified in IEC 60079-11.

In testing or assessing the circuits for spark ignition, a safety factor of 1.0 shall be applied in accordance with “safety factor” clause of IEC 60079-11. The safety factor applied to the voltage or current for the determination of surface temperature classification shall be 1.0.

Category "ia" is suitable for zone 0, 1 and 2, while category "ib" shall not be used in zone 0, and is only suitable for zones 1 and 2. Category “ic” is only suitable for zone 2 and shall not be used in zone 0 and 1.

Notes:

1) The concept of countable faults does not apply to this level of protection. Infallible components and assemblies, as in Clause 8, are not applicable. For level of protection “ic”, the term ‘infallible’ should be read as ‘meeting the requirements of 7.1’.

2) Ui: Maximum input voltage

Maximum voltage (peak a.c. or d.c.) that can be applied to the connection facilities of apparatus without invalidating the type of protection.

3) *U*m: Maximum r.m.s. of a.c. or d.c. voltage

Maximum voltage that can be applied to the non intrinsically safe connection facilities of associated apparatus without invalidating the type of protection

4) This additionally applies to the maximum voltage that can be applied to non-intrinsically safe connection facilities of intrinsically safe apparatus (for example, charging connections on battery operated apparatus, where charging is only done in the non-hazardous area).

5) The value of Um may be different at different sets of connection facilities, and may be different for a.c. and d.c. voltages.

6) Safety factor is the amount of load above the normal operating rating that a device can handle without failure.

7) Opening, shorting or grounding of field installed wiring is considered to be a part of normal operation.

2.2.2.4 Groups and classes

Intrinsically safe systems are grouped or classified according to the gas used for testing and/or assessment prior to certification. Lists of gases and vapors associated with particular groups/classes are given in IEC 60079-11 related tables.

When choosing system for use in a particular flammable atmosphere the system chosen shall be certified for use in the group/class associated with that atmosphere or in a group/class of lower ignition energy. Thus system certified for gas group IIB may be used in flammable atmospheres associated with gas groups IIA or IIB but shall not be used in flammable atmospheres associated with gas group IIC.

2.2.2.5 Temperature classification

Intrinsically safe systems now have also a designated temperature class (T1-T6 in accordance with IEC 60079-0) and shall not be installed where flammable materials are used which have ignition temperatures below the maximum for that class.

Note:

The presence of dust layers may impair normal heat dissipation and result in elevated temperatures of both apparatus and dust.

2.2.3 Apparatus with Type of Protection "s"

("s" stands for special protection):

2.2.3.1 Definition

Special protection “s” is defined in IEC 60079-33 as:

Special protection “s” allows for the design of a product that cannot comply in full with recognized types of protection or where the standards for the recognized types of protection do not cover the required operating conditions such as:

- outside normal atmospheric pressure given in the IEC 60079 series;
- above normal oxygen content;
- outside the temperature ranges given in IEC 60079 series;
- hybrid mixtures (gas and dust).

Note: Additional consideration and additional testing related specifically to the intended conditions of use could be necessary. This is particularly important when the types of protection “d” (flameproof enclosure – IEC 60079-1) and “i” (intrinsic safety – IEC 60079-11) are applied. Such conditions might include hypobaric, hyperbaric and oxygen enriched atmospheres.

2.2.3.2 Equipment group and temperature classification

The equipment grouping and temperature classification defined in IEC 60079-0 for the use of equipment in explosive gas atmospheres apply to special protection ”s” equipment. The subdivisions A, B and C for equipment of Group II and Group III also apply.

For temperature classification, the limiting parameters, including external influences, shall be specified such that the maximum permissible temperature is not exceeded taking into account the relevant level of protection “sa”, “sb” or “sc” as required by Clause “Application of EPL” of IEC 60079-33.

Equipment that comprises special protection “s” parts combined with parts with different protection techniques should generally be designed, tested and marked for the equipment grouping, temperature classification and EPL appropriate to the other techniques.

2.2.3.3 Level of protection (equipment protection level (EPL))

Electrical equipment with special protection “s” shall be either

- level of protection “sa” (EPL “Ma, Ga, Da”), or
- level of protection “sb” (EPL “Mb, Gb, Db”), or
- level of protection “sc” (EPL “Gc, Dc”).

The requirements of this standard shall apply to all levels of special protection “s” (EPLs) unless otherwise stated.

Notes:

1) Apparatus with type of protection "s" shall not be used in any flammable atmosphere for which has not been certified.

2) No modification addition or deletion to such apparatus shall be made without the written permission of the approving or certifying authority (such permission shall be obtained through the manufacturer of the apparatus).

2.2.4 Electrical apparatus with increased safety type of protection Exe.

2.2.4.1 Type of protection Exe is defined in IEC 60079-7 as follows:

I) The type of protection Exe is the method of protection by 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 in apparatus which does not produce arcs or sparks in normal service.

II) Type "e" protection is used for equipment which in normal use produces neither sparks arcs nor dangerous temperature. It is necessary only to increase the safety means of additional mechanical electrical and, thermal protection method so that danger from ignition is not expected even during fault conditions.

2.2.4.2 Condition of use

Whilst type of protection "e" has features in common with type of protection "n" it is, in many respects, more stringent (e.g., in the case of motors lower temperature rises are specified and special overload protection is required to avoid excessive temperatures under all conditions including stalling).

Apparatus with type of protection "e" may be used in Zone 2 gas and vapor risks with any type of enclosure which is suitable for the environment provided it is permitted in the above Standards. Apparatus with type of protection "e" may also be used in Zone 1 gas and vapor risks provided that:

I) The enclosures of live bare parts and insulated parts are to degrees of protection IP54 respectively as a minimum, except that where there is a likelihood of harmful gases and vapors entering the enclosure in quantities likely to cause deterioration of the insulation, the enclosure of insulated parts shall also be to IP54 as a minimum.

II) In the case of motors the methods of control of the rotor and stator winding temperatures are strictly in accordance with the above Standards. The devices used for temperature control, whether of the current dependent or temperature detector type shall be high quality and shall be regularly tested.

Apparatus with type of protection ’e’ is marked with a temperature class T1-T6 in accordance with IEC 60079-0 and shall not be installed where flammable materials are used which have ignition temperatures below the maximum for that class.

Although apparatus with type of protection ’e’ is suitable for use in all gases and vapors, provided account is taken of surface temperature considerations, it is sometimes used in combination with parts which have some other form of protection (e.g., switches which are flameproof), in which case attention shall be paid to any gas or vapor grouping of the parts with the other form of protection.

No modification, addition or deletion shall be made to apparatus with type of protection ’e’ without the written permission of the certifying authority (such permission shall be obtained through the manufacturer of the apparatus) unless it can be verified that such change does not invalidate the certification.

When selecting apparatus special care shall be taken to ensure that the apparatus and its component parts are constructed so as to guard against electrical and mechanical failure in the intended conditions of use.

Particular attention shall be given to the need for weatherproofing and protection against corrosion.

In case of using “Exe” Motors for high inertia loads, specific care shall be taken into account for comparing starting time and “t_E”.

In such cases, where starting time is higher than “t_E”, additional protections such as speed sensors, impedance relays, rate-of-rise sensors, etc. along with associated safety devices may also be used to limit the rotor temperature.

2.2.5 Electrical apparatus with type of protection "n" IEC concept code symbol Exn.

("n" stands for Non incendive protection)

2.2.5.1 Definition

Type of protection applied to electrical equipment such that, in normal operation and in certain specified regular expected occurrences, it is not capable of igniting a surrounding explosive gas atmosphere

Note 1:
Additionally, the requirements of this standard are intended to ensure that a malfunction capable of causing ignition is not likely to occur.

Note 2:

An example of a specified regular expected occurrence is a luminaire with failed lamp.

2.2.5.1.1 Non-sparking device “nA”

Device constructed to minimize the risk of occurrence of arcs or sparks capable of creating an ignition hazard during conditions of normal operation.

Note:

For the purposes of this standard normal operation is considered to exclude the removal or insertion of components with the circuit energized.

2.2.5.1.2 Devices and components “nC”

2.2.5.1.2.1 Enclosed-break device “nC”

Device incorporating electrical contacts that are made and broken and that will withstand an internal explosion of the flammable gas or vapour which may enter it without suffering damage and without communicating the internal explosion to the external flammable gas or vapour.

Note:

The principle difference between enclosed break devices “nC” and flameproof “d” are that the dimensions are not controlled and that safety factors have not been added.

2.2.5.1.2.2 Hermetically-sealed device “nC”

Device which is so constructed that the external atmosphere cannot gain access to the interior and in which the seal is made by fusion, for example by soldering, brazing, welding or the fusion of glass to metal.

2.2.5.1.2.3 Non-incendive component “nC”

Components having contacts for making or breaking a specified ignition capable circuit but in which the contacting mechanism is designed and constructed so that the component is not capable of causing ignition of the specified explosive gas atmosphere.

Note:

The enclosure of the non-incendive component is not intended to either exclude the explosive gas atmosphere or contain an explosion. This is usually applied to specially constructed switch contacts that are mechanically designed to quench any arc or spark so that they are not a source of ignition.

2.2.5.1.2.4 Sealed device “nC”

Device which is so constructed that it cannot be opened during normal service and is sealed effectively to prevent entry of an external atmosphere.

2.2.5.1.3 Restricted-breathing enclosure “nR”

Enclosure that is designed to restrict the entry of gases, vapours and mists.

The general requirements of such apparatus are that it shall not in normal operation.

I) Produce an arc or spark unless:

a) The operational arc or spark occurs in an enclosed break device; or,

b) The operational arc or spark has insufficient energy to cause ignition of a flammable atmosphere; or,

c) The operational arc or spark occurs in a hermetically sealed device.

II) Develop a surface temperature or hot spot capable of causing ignition of an external flammable atmosphere.

Note:

This requirement applies to the temperature of internal and external surfaces to which a surrounding atmosphere has access, except internal surfaces within enclosed break devices, hermetically sealed devices or restricted breathing enclosures.

2.2.5.2 Condition of use

I) Apparatus with type of protection "n" is only suitable for Zone 2 and safe areas. Ex n type motors shall not be used in zone 2 area. For other apparatus using of type EX n shall be subject to company engineer approval, and shall not be used in Zone 1 classified hazardous areas.

II) Suitability of apparatus for use in all gases and vapors including hydrogen and acetylene when mixed with air shall be tested and certified with due consideration to surface temperature.

III) Temperature classification of this type of apparatus shall comply with requirements of IEC 60079-15 for maximum surface temperature.

IV) Ingress protection (IP) of apparatus shall be in compliance with the requirements of relevant IEC standards according to location of installation. Minimum degree of protection shall be IP 54.

V) No modification addition or deletion shall be made to apparatus with type of protection "n" without the written permission of the certifying authority (such permission shall be obtained through the manufacturer of the apparatus)

VI) When selecting apparatus special care shall be taken to ensure that the apparatus and its component parts are constructed so as to guard against electrical and mechanical failure in the intended conditions of use.

VII) Particular attention shall be given to the need for weather proofing and protection against corrosion.

Note:

For more details about electrical apparatus with type of protection "n", reference shall be made to IEC 60079-15.

2.2.6 Oil Immersed Apparatus Type of Protection "o" IEC Concept Code Symbol Ex o.

2.2.6.1 This type of protection is one in which immersed in non volatile oil such that an explosive atmosphere which may occur above the oil level or outside of the enclosure cannot be ignited, e.g. switchgear, motor starters and transformers.

2.2.6.2 Level of protection

Electrical equipment with liquid immersion “o” shall be either:

a) Level of Protection “ob” (EPL Gb or Mb); or

b) Level of Protection “oc” (EPL Gc).

The requirements of this standard shall apply to all levels of protection unless otherwise stated.

2.2.6.2.1 Requirements for level of protection “ob”

Electrical circuits and components, when liquid immersed in accordance with this standard, are considered to be not ignition capable in normal operation and during expected malfunctions, and shall be assigned a Level of Protection “ob” (EPL Gb or Mb).

A liquid level indication according to clause 4.7 of IEC 60079-6 (2015) is required.

Switching devices protected by liquid immersion level of protection “ob” shall comply with the following additional requirements:

a) When a sealed enclosure is employed, the enclosure shall comply with the overpressure test using four times the prescribed pressure according to IEC 60079-6.

b) Electrical equipment containing switching devices operated in the protective liquid, rated at 2 kVA per contact or less, are permitted without further test. Where the switching device is rated above 2 kVA per contact, neither pressure increases nor excessive decomposition products shall invalidate the type of protection as demonstrated by tests in accordance with clause 6.1.5 of IEC 60079-6 (2015).

c) The equipment shall be suitable for a prospective short circuit current of 32 kA unless marked with a lower value.

Disconnectors and manual tap selectors, above 1,000 V, shall be lockable and provided with a warning according to clause “7 i)” of IEC 60079-6 (2015). In addition, information on their use shall be included in the instructions.

2.2.6.2.2 Requirements for level of protection “oc”

Electrical circuits and components, when liquid immersed in accordance with this standard, are considered to be not ignition capable in normal operation or in the case of regular expected occurrences, and shall be assigned a Level of Protection “oc” (EPL Gc).

Ex Equipment containing switching devices operated in the protective liquid, rated at 10 kVA per contact or less, are permitted without further test. For switching devices rated above 10 kVA per contact, neither pressure increases nor excessive decomposition products shall invalidate the type of protection as demonstrated by tests in accordance with clause 6.1.5 of IEC 60079-6 (2015).

2.2.6.3 This type of apparatus is acceptable for zone 2 of hazardous classified areas.

2.2.6.4 Type Ex o apparatus relies solely on keeping sparking contacts below a minimum depth of oil which is decided from type test.

2.2.6.5 For details of general requirements and tests of type Ex o apparatus reference shall be made to IEC 60079-6.

2.2.6.6 Temperature limitations

2.2.6.6.1 General

The maximum permissible temperature for equipment or parts of equipment shall be equal to the lower of the two temperatures determined by 2.2.6.6.2 or 2.2.6.6.3.

2.2.6.6.2 Maximum surface temperature

The temperature at the free surface of the protective liquid or at any point on the surface of the electrical equipment to which an explosive gas atmosphere has access shall not exceed the limit for the assigned temperature class or assigned maximum surface temperature. In no case shall the limit exceed 200°C.

2.2.6.6.3 Flashpoint of the protective liquid

The stated minimum flash-point (closed cup) for the protective liquid used shall be at least 25 K greater than the temperature at the free surface of the protective liquid and the temperature of the internal components immersed in the liquid.

2.2.6.6.4 If the maximum ambient temperature is not specified it shall be taken to be 40°C.

2.2.6.6.5 For apparatus which may have to carry short time current (short circuit current lasting a specified time) special attention to be paid to the behavior of the equipment in relation to its surface temperature. In any case the permissible temperature as stated above must not be exceeded.

2.2.6.6.6 The maximum temperature of the oil at any point in the equipment shall in no case exceed 115°C. This limit is fixed so as to avoid excessive deterioration of the oil.

2.2.7 Encapsulated electrical apparatus type of protection (Exm)

2.2.7.1 Specification is prepared for this type of protection by IEC 60079-18, and can be described as an apparatus which is embedded in mass of fire resistant solid insulating materials, the material should withstand against fracture under internal fault condition.

2.2.7.2 In this type of protection parts that could ignite an explosive atmosphere by either sparking or heating are enclosed in a compound in such a way that this explosive atmosphere can not be ignited.

2.2.7.3 Level of protection (equipment protection level (EPL))

Electrical equipment with encapsulation “m” shall be either:

a) Level of protection “ma” (EPL “Ma, Ga, Da”),

b) Level of protection “mb” (EPL “Mb, Gb, Db”), or

c) Level of protection “mc” (EPL “Gc, Dc”).

The requirements of this standard apply to all levels of protection for encapsulation “m” unless otherwise stated.

2.2.7.3.1 Additional requirements for levels of protection “ma” and “mb”

Components without additional protection shall be used only if they cannot damage the encapsulation mechanically or thermally in the case of any fault conditions specified in this standard.

Alternatively, where a fault of an internal component may lead to failure of encapsulation “m” due to increasing temperature, the requirements of clause 7.9 of IEC 60079-18 (2014) shall apply.

2.2.7.3.2 Additional requirements for level of protection “ma”

The working voltage at any point in the circuit shall not exceed 1 kV.

2.2.7.4 This type of protection is permitted for use in Zone 0 with approval of Company’s representative.

2.2.8 Equipment protection by pressurized enclosure “p”

Protection by pressurization is subdivided into three Levels of Protection (“pxb”, “pyb” and “pzc”) which are selected based upon the Equipment Protection Level required (Mb, Gb, Db, Gc or Dc), whether there is the potential for an internal release, and whether the equipment within the pressurized enclosure is ignition-capable; see Table 1 of IEC 60079-2 (2014). The Level of Protection then defines design criteria for the pressurized enclosure and the pressurization system; see Table 2 of IEC 60079-2 (2014).

2.2.9 Equipment protection by powder filling “q”

2.2.9.1 Electrical equipment and Ex components protected by powder filling “q” may contain electronic circuits, transformers, protection fuses, relays, intrinsically safe electrical apparatus, associated electrical apparatus, switches, etc.

2.2.9.2 Type of protection powder filling “q” provides equipment protection level (EPL) Gb. For further information, see IEC 60079-5.

2.3 Special Cases

2.3.1 Battery operated lift truck

Since this type of mobile and similar electrical vehicle may be moved in hazardous areas they shall

be considered as source of ignition or heat, and a type of protection appropriate to zone shall be considered for them.

2.3.2 Battery rooms

In addition to hazards of explosive gases or vapors which may enter into the battery rooms in oil gas and petrochemical plants and installations, the charging of electrical cells or batteries will contribute to the creation of hydrogen from which many explosions have been reported.

Therefore the following actions are required.

I) Adequate ventilation

Ventilation of battery room shall be so designed that the concentration of hydrogen does not exceed 1% of free air volume of battery room.

II) Electrical apparatus for Zone 1 with appropriate apparatus subgroup and temperature class for hydrogen ie IIC, T1 shall be considered. Depending on specific conditions and probability of penetration of other gases, other temperature classes could be assigned. However, because of uniformity, temperature class of T3 is recommended.

Note:

For further information regarding precaution in battery rooms see BS EN 50272-1 (2010) Safety requirements for secondary batteries and battery installations Part 1: General safety information.

III) It is necessary to exercise the same precautions where lift trucks and electrical vehicles are charged in non open buildings.

2.3.3 Portable and transportable apparatus

Portable and transportable electrical apparatus, including certified types shall be used in hazardous areas only when other alternatives (e.g. fixed electrical apparatus or pneumatically operated apparatus) are impracticable.

Standard industrial portable and transportable electrical apparatus may be used only when a certificate is issued guaranteeing the absence of flammable atmosphere for the period of use in the area concerned.

The danger shall be recognized of certified apparatus being taken into, or used in a flammable atmosphere for which it has not been certified or approved.

For the precautions necessary for portable and transportable apparatus with light metal enclosures reference shall be made to Clause (2.3.4).

Because of the likelihood of damage which may destroy its safety features portable and transportable apparatus shall be subject to frequent periodic inspection and its issue and return shall be carefully controlled.

2.3.4 Risks with light metals and their alloys

I) It has been clearly established that incendive frictional sparking from light metals and their alloys can occur when suitable conditions of contact arise particularly when the other material in contact is an oxygen carrier such as rust. Suitable safeguards shall therefore be taken to prevent occurrence of such frictional contact when a flammable atmosphere is present, as the simultaneous occurrence of the two sets of circumstances could lead to ignition.

II) For rigidly mounted electrical apparatus with light metal enclosures, and also for aluminum armored or sheathed cable, sited in Zone 2 the frictional sparking risk may be

disregarded. This also applies in Zone 1 unless the impact risk is high. In Zone 0 the use of such apparatus and cables shall be avoided.

III) Portable and transportable apparatus with unprotected light metal enclosures shall not be taken into hazardous areas unless suitably protected against frictional sparking by for example, coating the apparatus with a suitable abrasion resistant material.

When such coatings are used they shall be subject to regular and careful inspection. These precautions shall be adopted even for apparatus for use in Zone 2 since it may be difficult in practice to prevent the transfer of unprotected portable apparatus to an area of greater risk.

IV) Provided the protecting cowls are designed so that they are not readily deformed light metal fans (e.g., on motors) may be used in Zone 1 and Zone 2 since other failures (e.g. bearing failure) are more likely to create a source of ignition (If plastic fans or cowls are used as alternatives they shall be of antistatic material).

V) The precautions relating to the use of aluminum conductors in flameproof enclosures are given in Clause 2.2.1.7.

Note:

The term 'light metal' refers to such materials as aluminum, magnesium and titanium which are characterized by their ability when finely divided to react exothermically with atmospheric oxygen and as a result, to ignite a flammable atmosphere. The term 'light alloy' refers to an alloy containing at least 50% of the light metal by atomic proportions.

2.3.5 Personal electrical apparatus

Items of personal apparatus which are battery operated example radios, walkie talkies, key ring torches, etc., are sometimes carried by personnel and might be taken inadvertently into a hazardous area. These items can constitute a potential source of ignition and following measures shall be taken:

I) Personal communication apparatus, like, radios, walkie talkies, bleepers torches shall not be taken into a hazardous areas unless they have been certified or approved for the purpose.

II) Uncertified items like mobiles, radios, cameras with electronic light meters with flash attachments, ohm meters, meggers, calculators and similar apparatus shall not be taken into a hazardous area, unless, the work permit or certificate guaranteeing the absence of a flammable atmosphere has been issued.

2.3.6 Avoidance of physical damage to electrical apparatus and cables

The design and layout of electrical apparatus and its system should take account of possible damage which could occur as a result of unplanned events such as careless movements of a vehicle, flying debris following a well blow out, operation of cranes or dropping of tools or loads.

Therefore all cables should be provided with adequate support and protection including trough or tubs, and to be protected against corrosive fluids or organic chemical that could weaken plastic sheathing.

Due consideration should also be given to the vulnerability of cables to fire.

2.3.7 Avoidance of hazards from electrical sources of ignition

Sparks and hot surfaces obviously present the main hazard but the following as example posses a number of less self evident incendive properties the danger of which shall not be overlooked:

I) Incandescent particles emitted through the gaps in flameproof equipment if not properly designed.

II) Circulating currents in the frames of induction motors.

III) Static charges on plastic enclosures and covers.

IV) Inductive and capacitive pick up particularly on unused cable cores.

V) Earth currents.

VI) Chemical ignition from discarded sodium vapor lamps.

VII) High voltage and radio frequency discharge etc. Many of these dangers can be greatly reduced by suitable design, good installation practice and by skilled operation and maintenance.

The apparatus design is subject to the requirements of the standard for the apparatus concerned and also the standard for the ignition protection concept to which reference is made in this standard.

2.3.8 Avoidance of hazards from non electrical sources of ignition

Although the primary objective of area classification is the selection and location of electrical apparatus; non electrical sources of ignition should be considered in process of area classification.

The following are examples of non electrical sources of ignition which may cause explosion in hazardous areas:

I) Mobile sources.

II) Gas detection equipment.

III) Hot surfaces (vessels pipes etc.).

IV) High pressure hydraulic oil system.

V) Fired heaters.

VI) Combustion engines including diesel engines and gas turbines.

VII) Air intakes etc.

VIII) Road and rail traffic.

IX) Electrostatic hazard.

X) Frictional contact with a light metal or alloy.

XI) Pyrophoric scale and deposit hazard.

Notes:

1) Fire fighting and other emergency service vehicles of standard type and design can present a source of ignition.

2) Where they may have to enter plant, storage and distribution areas etc., under normal, emergency or exercise other than fire, their entry should be strictly controlled.

3) Where for contingency measures such vehicles are part of facilities, they should be located in a central non hazardous area remote from possible sources of major hydrocarbon release but with good immediate access.

2.4 Enclosure Protection (Degree of Protection Provided by Enclosures, IP Code)

2.4.1 In addition to protection against explosion, measures are required to be applied for a degree of protection for enclosure to safeguard:

I) Persons against contact with internal live or rotating parts inside the enclosure, and to the apparatus against ingress of solid objects dusts etc.

II) The apparatus against the ingress of water spray, jets, heavy seas and even total immersion.

2.4.2 IP classification has been systemized internationally and described in IEC 60947-1, IEC 60529 and IEC 60034-5.

Ingress protection is denoted by "IP" followed by two characteristic numerical.

I) The first characteristic numeral indicates the degree of protection provided by the enclosure with respect to persons also to the equipment inside the enclosure.

II) The second characteristic numerical indicates the degree of protection provided by the enclosure with respect to harmful ingress of water.

Tables 1a, 1b and 1c give degrees of protection of enclosures (as defined in IEC 60529).

Notes:

1) A third characterizing letter may also be added to indicate protection of persons (Optional). (See Table 1c)

2) A forth characterizing letter may also be added as supplementary information as following (Optional):

H: High voltage apparatus

M: Motion during water test

S: Stationary during water test

W: Weather conditions

TABLE "1a" - DEGREES OF PROTECTION INDICATED BY THE FIRST CHARACTERISTIC NUMERAL

First Characteristic Numeral	Degree of Protection		Test Conditions, See
	Brief Description	Definition	
0	Non- protected	--	--
1	Protected against solid Objects of 50 mm Ø and greater	The object probe, sphere of 50 mm Ø, shall not fully penetrate	13.2
2	Protected against solid Objects 12.5 mm Ø and greater	The object probe, sphere of 12.5 mm Ø, shall not fully penetrate	13.2
3	Protected against solid foreign objects 2.5 mm Ø and greater	The object probe, sphere of 2.5 mm Ø, shall not penetrate at all	13.2
4	Protected against solid foreign objects 1.0 mm Ø and greater	The object probe, sphere of 1.0 mm Ø, shall not penetrate at all	13.2
5	Dust – protected	Ingress of dust is not totally prevented but dust does not penetrate In a quantity to interfere with satisfactory operation of the apparatus or to impair safety.	13.4 13.5
6	Dust – tight	No ingress of dust.	13.4 and 13.6

TABLE "1b" - DEGREES OF PROTECTION INDICATED BY THE SECOND CHARACTERISTIC NUMERAL

First Characteristic Numeral	Degree of Protection		Test Conditions, See
	Short Description	Definition	
0	Non-protected	--	--
1	Protected against vertically falling water drops	Vertically falling drops shall have no harmful effects	14.2.1
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	14.2.2
3	Protected against spraying water	Water sprayed at an angle up to 60° on either side of the vertical shall have no harmful effects	14.2.3
4	Protected against splashing water	Water splashed against the enclosure from any direction shall have no harmful effects	14.2.4
5	Protected against water jets	Water projected in jets against the enclosure from any direction shall have no harmful effects	14.2.5
6	Protected against powerful water jets	Water projected in powerful jets against the enclosure from any direction shall have no harmful effects	14.2.6
7	Protected against the effects of temporary immersion in water	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water under standardized conditions of pressure and time	14.2.7
8	Protected against effects of conditions 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 severe than for numeral 7	14.2.8
9	Protected against high pressure and temperature water jets	Water projected at high pressure and high temperature against the enclosure from any direction shall not have harmful effects	14.2.9

TABLE "1c" – DEGREES OF PROTECTION AGAINST ACCESS TO HAZARDOUS PARTS INDICATED BY THE ADDITIONAL LETTER

Additional letter	Degree of Protection		Test Conditions, See
	Short Description	Definition	
A	Protected against access with the back of the hand	The access probe, sphere of 50 mm Ø, shall have adequate clearance from hazardous parts	15.2
B	Protected against access with a finger	The jointed test finger of 12 mm Ø, 80 mm length, shall have adequate clearance from hazardous parts	15.2
C	Protected against access with a tool	The access probe of 2.5 mm Ø, 100 mm length, shall have adequate clearance from hazardous parts	15.2
D	Protected against access with a wire	The access probe of 1.0 mm Ø, 100 mm length, shall have adequate clearance from hazardous parts	15.2

3. TEMPERATURE CLASS AND GAS IGNITION TEMPERATURE

3.1 Since flammable gas or vapor can be ignited by contact with a hot surface, for all type of protection apparatus, it is necessary to specify an appropriate temperature (T) class such that the maximum accessible surface temperature internally or externally will not exceed the ignitions temperature of the gases and vapors to which it may become exposed, this is achieved by consideration of the following factors:

3.1.1 The maximum surface temperature rating of the apparatus

This is defined under test by an appropriate certifying body as:

The highest temperature which is attained (but within the tolerances) by any part of surface of an electrical apparatus which would be able to produce an ignition of the surrounding atmosphere.

Note:

The most adverse conditions include recognized overloads and any fault conditions specified in the standard for the type of protection concerned.

3.1.2 Where ambient temperatures are above 40°C. This shall be mentioned in apparatus specification and the normal de-rating shall apply to maintain the maximum internal and external surface temperatures for which the apparatus shall be designed and supplementary certification is required.

3.1.3 Where apparatus are coupled or assembled to form a system the effective system "T" class will be that of the lowest item in the system, i.e., that of the maximum surface temperature in the system.

3.2 Ignition Temperature

Ignition temperature of a gas known also as auto, self ignition or spontaneous ignition temperature is the lowest temperature at which when mixed with air at normal pressure and as a sequence of chemical reactions initiated on account of solely of temperature, the substance will ignite and burn in the absence of any initiating source of spark or flame.

3.3 Selection of "T" Class

3.3.1 There are six recognized international temperature class namely "T1" to "T6" which has been reflected in IEC 60079-0

3.3.2 Method of test of ignition temperature of a vapor or chemically pure gas in air at atmospheric pressure is given in IEC 60079-20-1.

3.3.3 In some standards like UL certain subdivision has been made to temperature classes T2, T3 and T4.

For details of temperature class see Table 2 of this standard.

3.3.4 The maximum surface temperature of any exposed electrical equipment should not exceed 80% of the ignition temperature of the specific gas or vapor in degrees centigrade.

TABLE 2 - RELATION BETWEEN "T" (TEMPERATURE) CLASS AND INTERNATIONAL STANDARDS

MAX. SURFACE TEMPERATURE IN DEGREE CENTIGRADE	IEC60079-0 PART "0"	CENELEC EN, 60079-0	UL 698
450	T1	T1	T1
300	T2	T2	T2
280	---	---	T2A
260	---	---	T2B
230	---	---	T2C
215	---	---	T2D
200	T3	T3	T3
180	---	---	T3A
165	---	---	T3B
160	---	---	T3C
135	T4	T4	T4
120	---	---	T4A
100	T5	T5	T5
85	T6	T6	T6

Note:

All temperatures are based on an ambient of 40°C.

Figures are for group II electrical apparatus (Refer to 4.1).

4. PROCEDURE FOR SELECTING ELECTRICAL APPARATUS INCLUDING APPARATUS GROUPING

4.1 Electrical Apparatus for Hazardous Areas is Divided into:

Group I Electrical apparatus for mines susceptible to firedamp (methane).

(Group I Apparatus is not considered in this standard).

Group II Electrical apparatus for places with a potentially flammable atmosphere, other than mines susceptible to firedamp.

Group III Electrical equipment of Group III is intended for use in places with an explosive dust atmosphere other than mines susceptible to firedamp.

4.2 Selection of Group II Apparatus

The electrical apparatus of group II is suitable for gases, vapors and liquids in surface application in the petroleum, petrochemical, oil and gas industries both onshore and offshore; according to the nature of the hazardous area for which it is intended and is subdivided to subgroups IIA, IIB, IIC, depending on its suitability for use with specific gas. Since ignition of a flammable atmosphere can occur by either arcs sparks or hot contact the following fundamental consideration shall be carefully scrutinized in selection of electrical apparatus for use in hazardous areas:

4.2.1 The type of protection of the apparatus in relation to the area classification of the hazardous area:

Table 3 of this standard gives guide for selection of apparatus according to zone gas and vapor risks.

4.2.2 For the temperature classification of the apparatus in relation to the ignition temperature of the gases and vapors involved, see: Table 2 of this standard

4.2.3 The apparatus gas subgroup (where applicable) in relation to the relevant properties of the gases and vapors involved; for detail see: Table 4a of this standard for grouping of electrical apparatus. (See also Table 4b).

4.2.4 The apparatus construction and enclosure in relation to the environmental conditions; refer to table 1 of this standard.

Note:

It should be noted that apparatus with type of protection flameproof Ex d are not necessarily weather proof.

TABLE 3 - SELECTION OF APPARATUS ACCORDING TO ZONE, GAS AND VAPOR RISKS

Zone 0	Zone 1	Zone2
Type of protection	**Type of protection**	**Type of protection**
Ex 'ia' Ex 'sa' (specifically certified for use in zone 0) Ex 'ma' (upon owner approval)	Any type of protection suitable for zone 0 and Ex 'da' and 'db' Ex 'e' (for Non-sparking parts) Ex 'ib' (only for other than mines) Ex 'mb' Ex 'ob' Ex 'q' Ex 'sb' Ex 'pxb' and 'pyb'	Any type of protection suitable for zone 0 or 1 and Ex 'nA', 'nC' and 'nR' (upon owner approval) Ex 'dc' Ex 'ic' Ex 'mc' Ex 'oc' Ex 'sc' Ex 'pzc'

Note 1:
In zone 1 area, type of protection Ex 'e' may be used for non-sparking equipment (i.e., junction boxes, luminaries, etc.)

Note 2:
In zone 2 area, using type of protection Ex 'n' for electric motors is not allowed and for other apparatus is subject to company representative approval.

Note 3:
Apparatus suitable for zone 1 can be used in zone 2 subject to the usual temperature and gas group classification restrictions where applicable.

Note 4:
The type of protection will also be designated 'EEx' where equipment is certified to the harmonized European standards.

TABLE 4a - GROUPING AND CLASSIFICATION OF ELECTRICAL APPARATUS IN DIFFERENT COUNTRIES

CENELEC IEC EN 60079	IEC 60079	USA NATIONAL ELECTRICAL CODE (Class 1) GROUP	TYPICAL GASES AND VAPORS
IIA	IIA	D	ETHANE,PROPANE, BUTANE,PENTANE, HEXANE, HEPTANE OCTANE,NONANE, DECANE,ACETIC ACID, ACETONE, METHANOL, TOLUENE, ETHYLACETATE
IIB	IIB	C	ETHYLENE,COKE OVEN GAS DIMETHYL ETHER, DIETHY-LETHER ETHYLENE OXIDE
IIC	IIC	B	HYDROGEN
			CARBON DISULPHIDE
		A	ACETYLENE
			ETHYL NITRATE

Note:

Groupings in different countries may slightly differ. The above table is for rough comparisons only and reference should be made to the relevant standard to ascertain the grouping for a particular gas (See also Table 4b).

TABLE 4b - U.S.A HAZARDOUS LOCATIONS CLASSIFICATION AND GROUPING CONCEPT

*** HAZARDOUS LOCATION CLASSIFICATIONS**

CLASS I	CLASS II	CLASS III
HIGHLY FLAMMABLE GASES OR VAPORS	COMBUSTIBLE DUSTS	COMBUSTIBLE FIBERS OR FLYINGS

Notes:

*** For pertinent definitions see API RP 505**

GROUPS:

A - Atmospheres containing acetylene

B - Atmospheres containing hydrogen or gases or vapors of equivalent hazard

C - Atmospheres containing ethylene, acetaldehyde, cyclopropane, diethyl ether and dimethyl hydrazine.

D - Atmospheres containing gasoline, hexane, naphtha, benzene, butane, propane, alcohol, acetone, benzol, or natural gas

E - Atmospheres containing metal dust, including aluminum, magnesium, & other metals of equally hazardous characteristics

F - Atmospheres containing carbon black, coke or coal dust.

G - Atmospheres containing flour starch, or grain dusts such as silos and wood factories.

TABLE 5 – DEFAULT RELATIONSHIP BETWEEN TYPES OF PROTECTION AND EPLs (according to IEC 60079-14)

EPL	Type of protection	Code	According to
"Ga"	Intrinsically safe	"ia"	IEC 60079-11
	Encapsulation	"ma"	IEC 60079-18
	Two independent types of protection each meeting EPL "Gb"		IEC 60079-26
	Protection of equipment and transmission systems using optical radiation	"op is"	IEC 60079-28
	Special protection	"sa"	IEC 60079-33
"Gb"	Flameproof enclosures	"d"	IEC 60079-1
	Increased safety	"e"	IEC 60079-7
	Intrinsically safe	"ib"	IEC 60079-11
	Encapsulation	"m" "mb"	IEC 60079-18
	Oil immersion	"o"	IEC 60079-6
	Pressurized enclosures	"p", "px", "py", "pxb" or "pyb"	IEC 60079-2
	Powder filling	"q"	IEC 60079-5
	Fieldbus intrinsically safe concept (FISCO)		IEC 60079-27
	Protection of equipment and transmission systems using optical radiation	"op is" "op sh" "op pr"	IEC 60079-28
	Special protection	"sb"	IEC 60079-33
"Gc"	Intrinsically safe	"ic"	IEC 60079-11
	Encapsulation	"mc"	IEC 60079-18
	Non-sparking	"n" or "nA"	IEC 60079-15
	Restricted breathing	"nR"	IEC 60079-15
	Energy limitation	"nL"	IEC 60079-15
	Sparking equipment	"nC"	IEC 60079-15
	Pressurized enclosures	"pz" or "pzc"	IEC 60079-2
	Protection of equipment and transmission systems using optical radiation	"op is" "op sh" "op pr"	IEC 60079-28
	Special protection	"sc"	IEC 60079-33
"Da"	Encapsulation	"ma"	IEC 60079-18
	Protection by enclosure	"ta"	IEC 60079-31
	Intrinsically safe	"ia" or "iaD"	IEC 60079-11 or IEC 61241-11
	Special protection	"sa"	IEC 60079-33
"Db"	Encapsulation	"mb"	IEC 60079-18
	Protection by enclosure	"tb" or "tD"	IEC 60079-31 IEC 61241-1
	Pressurized enclosures	"pD"	IEC 61241-4

EPL	Type of protection	Code	According to
	Intrinsically safe	"ib" or "ibD"	IEC 60079-11 or
	Special protection	"sb"	IEC 60079-33
"Dc"	Encapsulation	"mc"	IEC 60079-18
	Protection by enclosure	"tc" or "tD"	IEC 60079-31 IEC 61241-1
	Pressurized enclosures	"pD"	IEC 61241-4
	Intrinsically safe	"ic"	IEC 60079-11
	Special protection	"sc"	IEC 60079-33
New protection marking codes with identification of EPLs may be introduced in the future.			

TABLE 6 – EQUIPMENT PROTECTION LEVELS (EPLs) WHERE ONLY ZONES ARE ASSIGNED (according to IEC 60079-14)

Zone	Equipment protection levels (EPLs)
0	"Ga"
1	"Ga" or "Gb"
2	"Ga", "Gb" or "Gc"
20	"Da"
21	"Da" or "Db"
22	"Da", "Db" or "Dc"

5. CERTIFICATION AND MARKING

The general electrical items for use in hazardous areas shall be certified by recognized international certifying authorities who are among the following: Underwriters Laboratories Inc. (UL/FM) of USA, the Ex Certification Bodies of IEC or the Notified Bodies for ATEX certification. Certificate of conformity indicating the certifying authority shall be supplied by the vendors at quotation stage. The minimum required Ex. Certificates are as follows:

a) As per ATEX

I. EU Declaration of Conformity (Directive 2014/34/EU, ATEX)

For equipment of categories 1, 2 and 3, the MANUFACTURER shall deliver an EU Declaration of Conformity signed by the MANUFACTURER against an EU examination type certificate delivered by the Notified Body.

"Self certification" (by internal control of production) by the MANUFACTURER is not recognized by the COMPANY.

II. EU Type Examination Certification (Annex III of the Directive 2014/34/EU, ATEX).

The EU type Examination certificate shall be delivered to COMPANY for category of equipment (category 1 and 2).

A type examination certificate (or "Statements of Compliance") shall be delivered to COMPANY for equipment of category 3.

III. Quality Assurance Notification (directive 2014/34/EU, ATEX-QAN).

A production quality assurance notification shall be delivered by the MANUFACTURER to COMPANY for products of category 1 and 2 (Annex IV of the Directive 2014/34/EU,).

A product quality assurance notification shall be delivered by the MANUFACTURER to

COMPANY for products of category 3 (Annex VII of the Directive 2014/34/EU,).

These documents are delivered by the Notified Body to the MANUFACTURER upon successful quality audit.

Copies of all the EU Declarations of conformity and EU type examination certificates and type examination certificate (Statements of compliance) and valid quality assurance notifications shall be provided by ENGINEER/CONTRACTOR for COMPANY review and/or approval.

All these documents shall be in English language.

or

b) As per IECEx

I. EXTR (EX Test Report, IECEx)

II. QAR (Quality Assessment Report, IECEx)

III. CoC (Certificate of Conformity, IECEx)

5.1 Certification

A certificate is a document formally attesting a fact. Therefore certification is the exercise of producing a "Certificate".

5.1.1 In the contest of electrical equipment for use in potentially explosive atmospheres it can be said that the act of obtaining a certificate from an unbiased expert (third party) is an ideal way of ensuring that the risk of utilizing such equipment in such atmospheres produces the minimum of risk.

5.1.2 To secure the interest of users to this end, the following requirements shall be met:

I) User of apparatus needs confidence that a particular apparatus is suitable for use in the place intended for installation.

II) The types of protection, grouping, temperature classification etc. Which are awarded to the apparatus complies with the specific standard.

Note:

Purged or pressurized equipment shall be assessed on the basis of the actual site of use.

III) The certifying body and expert organization should be internationally well known, and documentation produced by them shall be recognized by Regulatory Bodies.

IV) Certificate conditions if any, shall be submitted by manufacturer to user.

5.1.3 The name of some of the recognized Certifying Authorities is given below:

- BRITISH APPROVAL SERVICES FOR ELECTRICAL EQUIPMENT IN FLAMMABLE ATMOSPHERES (BASEEFA).
- ASSOCIATION OF SHORT CIRCUIT TESTING AUTHORITIES (ASTA).
- UNDERWRITERS LABORATORIES (UL).
- EUROPEAN AUTHORITY FOR HARMONIZED STANDARD CERTIFICATION UNDER ECC "NOW EOTC" Which stands for European Organization for Testing and Certification.
- PHYSIKALISCH TECHNISCHE BUNDESANSTAIT (PTB).
- FM / UL (USA)
- KEMA (NL)
- SIRA (UK)
- TUV Nord (Germany)
- NEMKO (Norway)
- Intertek (UK)
- INERIS (FR)
- CSA (CA)
- EXAM (Germany)
- ISSeP (Belgium)

5.2 Marking

Part of the certification procedure is to ensure that the product is suitably indelibly marked with at least the following information:

5.2.1 Manufacturer's name or trade mark.

5.2.2 Manufacturer type designation for apparatus.

5.2.3 The indication of the testing station, and the Certification Number.

5.2.4 Zonal classification.

5.2.5 Identification of the type of protection(s).

5.2.6 The apparatus group or sub-group (as applicable).

5.2.7 The class of maximum surface temperature.

5.2.8 The standard number to which compliance has been certified, the pertinent part number and the date.

5.2.9 Maximum rating (kW., Volt, Frequency, etc.).

Any other relevant information.

Note:

Manufacturer should be asked to provide complete instructions for the installation and maintenance.

6. PRECAUTIONS IN INSTALLATION

6.1 Types of protection to which reference is made in this part relate not only to apparatus, but also to the whole system; and installation shall be carried out according to the detailed guidance given in standard No. IPS-C-EL-115 which shall cover but is not limited to the following items:

- Wiring
- Cabling and cable glands
- Cables with aluminum sheathing and armoring
- Trunking, ducts, pipes and trenches
- Plugging off of unused cable entries
- Means of effecting safe circuit isolation
- Earthing and bonding
- Etc.

7. INITIAL AND PERIODIC INSPECTIONS

7.1 Initial and periodic inspection is beyond the scope of this part and will be dealt within standard No. IPS-I-EL-215.

Complete safeguarding is not achieved unless proper operation, periodic inspection and maintenance is accomplished, after installation.

7.2 Safe operation and maintenance can only be carried out if there is effective documentation, and when the operation and maintenance personnel are fully trained and familiar with the hazard of gas and vapors, instruction manuals, and are made aware and informed of any changes which may affect the scope of hazard in potentially explosive gas/vapor atmospheres, and the precautions to be observed.

8. CHANGE IN EXISTING AREA CLASSIFICATION

8.1 When the areas that were formerly safe become hazardous because of development or other reasons the extension of zones can affect the mechanical ventilation of some enclosed area.

8.2 With the new zones and their extents some air intake could be in zone 2 which changes the ventilation condition and may affect the safety requirements criteria.

8.3 The ventilation systems in such cases shall be re-evaluated and modified to needs.

8.4 To maintain the required safeguard, new system might be installed, the associated fans may demand more power from the normal or emergency power system which might have also impact on power from the normal or emergency power system which might have also impact on power demand.

8.5 Electrical equipment especially motors could become unsuitable for their newly classified areas.

8.6 Emergency equipment and installations such as the fire water pump, control room and emergency power supply system may need relocation to safe areas.

8.7 When a zone changes or ventilation is reduced existing intrinsically safe circuits and systems shall be evaluated for new condition (zones) and to be redesigned and or modified to avoid any danger from them.

8.8 The enhancement as a consequence of change could be in the form of system relocation, increased mechanical ventilation, and incorporation of additional safety and control devices, including pertinent wiring and cabling.

Note 1:

Change in existing area classification shall be done under process safety supervision.

Note 2:

The existing and new electrical, Instrument and mechanical equipment in such modified area shall be evaluated by related departments.

APPENDICES

APPENDIX A

GLOSSARY

Abnormal Operation

Process-linked malfunctions that occur infrequently.

Associated Apparatus

Electrical apparatus which contains both energy-limited and non-energy-limited circuits and is constructed so that the non-energy-limited circuits cannot adversely affect the energy-limited circuits.

Note:

Associated apparatus may be either:

a) Electrical apparatus which has an alternative type of protection included in this standard for use in the appropriate explosive atmosphere;

b) Electrical apparatus not so protected and which therefore is not to be used within an explosive atmosphere, for example, a recorder which is not of itself in an explosive atmosphere but is connected to a thermocouple situated within an explosive atmosphere where only the recorder input circuit is energy limited.

Certification Authority (CA)

1) An authority trusted by one or more users to create and assign certificates. Optionally the certification authority may create the users' keys.

2) A trusted third party 'clearing house' that issues digital signatures and digital certificates.

3) An entity that issues digital certificates (especially X.509 certificates) and vouches for the binding between the data items in a certificate.

Electrical Hazard

Source of possible injury or damage to health in the presence of electrical energy from an electrical installation.

Enclosed Area

Any room or space within which, in the absence of artificial ventilation, the ventilation will be limited and any flammable atmosphere will not be dispersed naturally.

(to be continued)

APPENDIX A (continued)

Flammable Atmosphere

Mixture with air, under normal atmospheric conditions, of flammable materials in the form of gas, vapor or mist, in which, after ignition, combustion spreads throughout the unconsumed mixture

Notes:

a) This definition specifically excludes dusts and fibers in suspension in air. Mists, though included in the definition, are not covered by this standard.
b) Although a mixture which has a concentration above the upper explosive limit is not a flammable atmosphere, there is a risk of creating a flammable atmosphere by dilution.
c) Normal atmospheric conditions include variations above and below reference levels of 101.3 kPa (1013 mbar) and 20 °C provided the variations have negligible effect on the explosion properties of the flammable materials.
d) For the purposes of this standard, the terms "explosive", "combustible" and "flammable" are regarded as synonymous.

Flammable Gas or Vapor

Gas or vapor which, when mixed with air in certain proportions, will form an explosive gas atmosphere.

Flameproof

(Electro technical) class of methods used to prevent the ignition, caused by electrical equipment, of explosive atmospheres

Note 1 to entry: The term is deprecated in other applications.

Intrinsic Safety “i”

Type of protection based on the restriction of electrical energy within equipment and of interconnecting wiring exposed to the explosive atmosphere to a level below that which can cause ignition by either sparking or heating effects.

Intrinsically Safe Circuit

Circuit, in which any spark or any thermal effect produced in the conditions specified in this standard, which include normal operation and specified fault conditions, is not capable of causing ignition of a given explosive atmosphere.

Minimum Ignition Energy (MIE)

Minimum energy that can ignite a mixture of a specified flammable material with air or oxygen, measured by a standard procedure

Note 1 to entry: See ASTM E582-88 for gases and vapors, IEC 61241-2-3, ASTM E2019-03 and EN 13821 for dust clouds.

(to be continued)

APPENDIX A (continued)

Protective Barrier

Part providing protection against direct contact from any usual direction of access

Note:

Direct contact is defined in IEV 195-06-03.

Segregation

Physical separation and/or isolation for the purposes of safety, protection of damage to equipment or the prevention of electromagnetic noise from mains power cabling interfering with circuits operating on telecommunications cabling.

Ventilation

Movements of air and replacement with fresh air due to the effects of wind, temperature gradients or artificial means (for example fans or extractors).

The website http://std.iec.ch/glossary is referred for more phrases based on IEC 60050 series.