Potentially Explosive Atmospheres Requirements

*Understand the differences between European and North American rules*
Overview

The Explosive Atmospheres market is both lucrative and expanding, but the level of certification requirements and the level of checking (both by the buyer and by the regulatory authorities) are increasing. In order to access this market it is imperative that equipment manufacturers understand the design, manufacture and certification requirements on both discrete apparatus and assemblies (rigs and skids) to ensure that the products are designed without adding unnecessary costs and that the products are certified on time and correctly. To facilitate this, Intertek can help with design advice, training and complete global certification at multiple locations worldwide.

Introduction

What is Potentially Explosive Atmosphere Certification and why might you need it?

Any industry that processes, uses or manufactures materials that may give rise to a flammable atmosphere (gas, mist, liquid, dusts or even small fibres) may have a potentially explosive atmosphere. Such industries/processes include:

- Oil and Gas Drilling
- Petrochemical Refining and Processing
- Fuel Storage
- Chemical manufacturing
- Car Manufacturing
- Water Treatment
- Power Generation
- Pharmaceutical
- Distilleries
- Food manufacturers
- Aviation
- Military
Where fuel and oxygen (normally the oxygen in air) are present in the workplace, potential ignition sources must be rendered safe to an acceptable level for the risk.

Industries that generate potentially explosive atmospheres classify the dangerous areas based on the likelihood and duration of the explosive atmospheres presence. This is referred to as a ‘Zone’ (Europe and NEC505) or ‘Division’ (NEC500).

When a Zone or Division has been established, special precautions must be taken by the manufacturer to reduce the likelihood of an ignition being present to an acceptable level (and possibly to use mitigation measures to lower the consequence of an explosion).

Given the onerous nature of an explosion, special certification schemes have been set up to control the design and certification of equipment for potentially explosive atmospheres. Although the schemes differ globally (some are mandatory under law, some are simply procurement specifications), the bases for design and certification is similar, and the schemes normally rely on empirical testing, constructional assessment and production control by a recognised Certification Body.

Manufacturers of electrical equipment (and non-electrical for Europe) must be aware that if they sell to industries that have potentially explosive atmospheres (the vast majority of industries) they may be asked for ‘certification’, and that often the equipment will need to be certified by a Notified or NRTL Body such as Intertek.
Part 1: Zones & Divisions

**What are the differences between the Zone and Division systems in hazardous (classified) locations? What do the terms Zone and Division mean and what are their similarities and differences?**

The aim of both is to achieve safety by identifying areas where ignition sources should be eliminated or ensuring that the ignition source is non-effective. Until the advent of ATEX in July 2003, the most prevalent ignition sources were those associated with electrical equipment e.g. electrical arcing or electrically heated surfaces. Both systems work with the same natural laws of physics and chemistry, such as gas ignition temperatures and combustible percentages of volatile gases.

In 1947, the NEC first recognized different levels of risk exist in hazardous locations. Consequently, it established Division 1 and Division 2, to provide a means to treat the issue. This permitted installation methods to be specified, based upon what was considered to be an acceptable level of risk.

The IEC recognized the NEC divisions were based more on whether the hazard was present under either normal or abnormal conditions, instead of on the duration of the hazard. Therefore, the IEC established three divisions, or Zones, that are based on how often the hazard is present rather than upon normal versus abnormal conditions. The three zones break the NEC's Division 1 into two distinct zones, one of which (Zone 0) is for those locations that are the most hazardous because they remain hazardous for a long time. Separating Zone 0 from the remainder of what is Division 1 in the NEC system permits a more refined treatment of the hazards of the two zones. It restricts methods of protection in Zone 0 while permitting more relaxed method of protection in Zone 1 locations.

The NEC Committee rewrote Article 505 because the Division Classification system and IEC system are too different to merge. The IEC and NEC Group classifications for the different gases in ascending order of "More Easily Ignitable." Note that the group denoted with an "A" in the IEC area is the least ignitable, while the group denoted with an "A" in the NEC group is the most ignitable. Also, the IEC system uses three sub-groups for the representative gases while the NEC system uses four. To further confuse the two systems, the IEC and NEC do not use the same terminology, and neither have the same number of categories [1] (zones) to identify the likelihood of the hazard being present.

**Standards**
The American Petroleum Institute (API) RP 500, Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities
Classified as Class I Division I and Division 2, defines the extent of classified areas in refineries operating under the Division system.

The National Fire Protection Association (NFPA) published NFPA Codes 497 recommended practice for the classification of flammable liquids, gases, or vapors and of hazardous (classified) locations for electrical installations in chemical process areas. And NFPA Code 499 is recommend practice for classification of combustible dusts and of hazardous (classified) locations for electrical installations in chemical process areas.

IEC 60079-10 provides rules and standards about how to define and develop the extent of a Zone-classified area. Appendix C of IEC 60079 contains examples demonstrating the results of the applications of the rules found in the body of the IEC 60079 document.

**Comparison**

Both Division and Zone classification systems begin with defining what the hazard is and the probability the hazard will be present.

**Comparison of how the hazards are defined**

The NEC Division system uses Classes and Groups to identify the hazard. The classes are used to represent gases, types of dusts, or fibres.

- Class I represents flammable gases and vapours
- Class II represents combustible dusts,
- Class III represents ignitable fibres

Groups further define the hazard in Class I and II locations. For Class I, Groups A (acetylene and similar gases), B (hydrogen and similar gases), C (ethylene and similar gases), and D (propane and similar gases) represent flammable gases.

The IEC Zone system identifies the hazard by two main Groups: Group I for mining (underground locations) and Group II for surface (not underground) industries. [Note: NEC doesn't cover underground mining installations which are covered by the Mine Safety and Health Administration (MSHA)].

Group II is divided into three subgroups arranged in order of hazard due to threat of ignition: A (the most difficult to ignite, such as propane); B (gases such as ethylene); and C (the easiest to ignite, such as acetylene/hydrogen).
**Divisions**

A Class I Division 1 location is where:

- Concentrations (refer to NFPA 497) for the percentage volumes of gases that will burn, since too little (too lean) or too much (too rich) gas won't burn of flammable gases or vapours that would be ignitable under normal operating conditions,
- Hazardous gas mixture(s) may exist frequently because of repair or maintenance operations or leakage, or
- The breakdown of equipment simultaneously releases hazardous gas and causes failure of electrical equipment.

A Class I Division 2 location is where:

- Volatile flammable liquids are handled or stored, but they are normally confined within closed containers from which they can escape through container rupture, or
- Positive ventilation normally prevents ignitable concentrations of vapours (that is, the quantity of clean air continually brought into the atmosphere prevents the hazardous gas concentration from reaching its lower explosive limit percentage), or
- The area is adjacent to a Class I Division 1 location from which hazardous concentrations of gas may occasionally be transported.

**IEC/CENELEC**

The IEC/CENELEC approach uses three Zones instead of two Divisions. The Zones are based on how often (frequency and duration) the hazard is present instead of whether the hazard is present "normally."

IEC 60079-10, Electrical Apparatus for Explosive Gas Atmospheres, Classification of Hazardous Areas. The definitions of zones are as follows:

- Zone 0 location is "...an area in which an explosive gas atmosphere is present continuously or for long periods."
- Zone 1 location is "...an area in which an explosive gas atmosphere is likely to occur in normal operation."
- Zone 2 location is "...an area in which an explosive gas atmosphere is not likely to occur in normal operation, and if it does occur, is likely to do so only infrequently and will exist for a short period only."

The zone system makes extensive use of the Lower Explosive Limit (LEL) concept. That is, if the amount of flammable gas in the atmosphere mixture is below the LEL for the gas, then the mixture is too lean and won't burn. However,
the "...likely frequency of release, the release rate, the concentration, the velocity, the ventilation, and other factors all affect the Zone classification."

The concept of Zone 0 is a big difference. Zone 1 locations are roughly equivalent to Division 1 locations and Zone 2 locations roughly equivalent to Division 2 locations.

**Explosion Protection Concepts**

One of the major problems in designing for both European and North American systems are protection concepts availability, applicable standards, standards harmonization and preferences. In North America allowable protection concepts are defined in the National Electric Code (NEC) and Canadian Electric Code (CEC). Under Article 500 of the NEC, the allowable protection techniques are: Explosion proof (Flameproof in Europe), Dust Ignition proof, Dust tight, Intrinsic Safety, Purged and Pressurized, Nonincendive, Oil Immersion, Hermetically Sealed and Combustible Gas Detection System are allowed concepts for Division 1 and/or 2 locations. While the NEC does recognize the Zone system under Articles 505 and 506, a majority of the existing area classifications throughout North America are classified under the Class and Division system. The NEC does allow, on a limited basis, the use of Zone certified equipment to be installed in Class and Division classified areas.

In Europe and in many other countries, commonly used concepts in addition to the ones suitable for North America such as Increased Safety Ex ‘e’ (primarily used for AC Motors, junction boxes and luminaries) and Encapsulation are widely used, along with the lesser used concepts such as Oil Filled or Powder Filled.

In addition, ATEX Certification requires that ‘all’ potential ignition sources are addressed, including non-electrical sources such as friction, impact, static and RF. Many additional protection concepts such as ‘c’, constructional safety or ‘b’, control of ignition sources, adding additional complexity to skid or assembly approvals.

The division system uses "explosion proof[2]" flame path cooling in Division 1 and Division 2 locations; but, in the Zone system does not allow this "flameproof" methodology in Zone 0.

For all practical purposes, the T-ratings for both systems are identical. The zone system allows intrinsic safety with two fault conditions applied (ia), as the division system permits, and a lesser form of intrinsic safety that is only safe with one fault applied (ib).
In both the division and zone system, purging and pressurizing is permitted in all locations. The use of "increased safety" (Ex e) protection isn't recognized by the Division system; but the Zone system permits its use in all but Zone 0 locations.

Encapsulation (Ex ma and Ex mb) isn't a recognized protection method in the Division system; but the Zone system uses it frequently.

"Special Protection" (Ex s) is not recognized within the division system; but, the Zone system allows a mechanism whereby apparatus and equipment can be certified to be safe and workable in a given location, though it does not comply with the other recognized forms of protection.

Equipment certified for use in a Zone 0 can also be installed in a Zone 1 or 2; likewise equipment certified for use in Class I Div 1 can also be installed in Class I Division 2 locations.

**North America**

In North America-Division, Class, and Group Categories:

Division I - There is a high probability of an explosive atmosphere in normal operation. This can be for part of the time, up to all the time.

Division 2 - There is a low probability of an explosive atmosphere being present during normal operation.

The North American class designations are:

Class I - Contains flammable gases or vapours in quantities large enough to produce an explosion.
Class II - Is hazardous due to the presence of combustible dust in the air.
Class III - Contains easily ignitable fibres or flyings in the air. However, the quantities of fibres and flyings suspended in the air are not likely to be large enough to cause an explosion.

Group designations further define the types of gases, and dusts

Example of an American certification would be:

Class 1, Div I, Groups A, B and C; Div 2, Groups F and G
Hazardous locations: EU & NA requirements

**NEC System**

- **Class I: Gases**
  - Div I: Group A: Acetylene
  - Div 2: Group B: Hydrogen
  - Group C: Ethylene
  - Group D: Propane

- **Class II: Dusts**
  - Div I: Group A
  - Div 2: Group B
  - Group C
  - Group D

- **Class III: Combustible Flammable**
  - Note: Group E Div 1 only
  - Group F
  - Group G

[www.intertek-hazloc.com](http://www.intertek-hazloc.com)
**IEC Zone System**

![IEC Zone System Diagram]

**Dust Zones**

For identifying dust areas in Europe, zones 20, 21 and 22 have been introduced, the definition of dust zones is similar to that for gas zone i.e. 0, 1 and 2.

1. Categories not to be confused with categories used in the ATEX Directive 94/9/EC
2. The North American terminology “Explosion proof” is known as flameproof in Europe and rest of the world

**Part 2: Ingress protection and Enclosure ratings**

**Ingress protection (IP) is commonly required for most protection concepts in Europe, while in North America considers enclosure type ratings (NEMA or Type) as well as IP ratings. In addition, Hazardous Area equipment that may be located outdoors often requires a higher rating than the protection concept specifies. When certifying a product for both Europe and North America, it is important to understand the ‘highest’ specification that will be required and work to that design.**

The division system maintains a listing of types of enclosures, such as Type 4, or 7, 12, while in the Zone system this is known as the Ingress Protection (IP) system. The IP system designates, by means of a number, the degree of protection provided by an enclosure against solid objects. It also has a second

[www.intertek-hazloc.com](http://www.intertek-hazloc.com)
number to designate the degree of protection provided by the enclosure against water ingress. For example, an IP number of 54 would eliminate the possible ingress of dust and protect against splashing water from any direction.

**What are IP ratings?**

IEC (International Electro technical Commission) Publication 60529 Classification of Degrees of Protection Provided by Enclosures provides a system for specifying the enclosures of electrical equipment on the basis of the degree of protection provided by the enclosure. IEC 60529 does not specify degrees of protection against mechanical damage of equipment, risk of explosions, or conditions such as moisture (produced for example by condensation), corrosive vapours, fungus, or vermin. The European standard is based on IEC529 which in Europe is EN 60529. This standard was originally used for electrical enclosures, however under ATEX 94/9/EC which is implemented in the UK as the Equipment and Protective System Regulations 1996, this now equally applies to non-electrical equipment. Refer to the chapter on equipment marking for further details.

The Ingress Protection (IP) ratings are developed by the European Committee for Electro Technical Standardization (CENELEC) and specify the environmental protection an enclosure provides. The IP rating normally has two (or three) numbers:

1. Protection from solid objects or materials
2. Protection from liquids
3. Protection against mechanical impacts (commonly omitted)

The rating refers to the equipment's ability to permit solids and liquids to penetrate the equipment enclosure. Electrical equipment's IP rating is expressed as a two-digit number. The first number designates protection from solids, while the second number designates protection from liquids. It is important that manufacturers have their equipment certified by an outside laboratory to verify the product's IP rating. Epsilon is one such organisation which can verify the equipments IP rating; there are other companies that provide this service. The important thing is that the product is certified by an outside organization. If IP ratings are specified on a product's data sheet, then an approval certification number should also be included.

An "x" is used for one of the digits if there is only one class of protection; i.e. IPX4 which addresses liquids only.
**First Digit**

The first digit of the IP code indicates the degree that persons are protected against contact with moving parts (other than smooth rotating shafts, etc.) and the degree that equipment is protected against solid foreign bodies (dusts) intruding into an equipment.

<table>
<thead>
<tr>
<th>IP</th>
<th>Test</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td><img src="image1.png" alt="Image" /></td>
<td>No protection</td>
</tr>
<tr>
<td>1</td>
<td><img src="image2.png" alt="Image" /></td>
<td>Protected against solid bodies greater than 50mm diameter. (e.g. accidental contact with the hand)</td>
</tr>
<tr>
<td>2</td>
<td><img src="image3.png" alt="Image" /></td>
<td>Protected against solid bodies greater than 12.5mm diameter. (e.g. finger)</td>
</tr>
<tr>
<td>3</td>
<td><img src="image4.png" alt="Image" /></td>
<td>Protected against solid bodies greater than 2.5mm diameter (e.g. tools, wires)</td>
</tr>
<tr>
<td>4</td>
<td><img src="image5.png" alt="Image" /></td>
<td>Protected against solid bodies greater than 1.0mm diameter (e.g. thin tools and fine wire).</td>
</tr>
</tbody>
</table>
| 5  | ![Image](image6.png) | Protected against dust (no harmful deposit)  
Dust Proof |
| 6  | ![Image](image7.png) | Completely protected against dusts  
Dust Tight |

[www.intertek-hazloc.com](http://www.intertek-hazloc.com)
The table below shows the particle size used in the first digit of the IP rating, the table is an accurate representation.

*Table 1: Size chart*

<table>
<thead>
<tr>
<th>IP1X=50mm</th>
<th>IP2X=12.5mm</th>
<th>IP3X=2.5mm</th>
<th>IP4X=1mm</th>
<th>IP5=Dust</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
<td><img src="image4.png" alt="Diagram" /></td>
<td><img src="image5.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>
**Second Digit**

The second digit indicates the degree of protection of the equipment inside the enclosure against the harmful entry of water or moisture (e.g. dripping, spraying, submersion, etc.)

<table>
<thead>
<tr>
<th>IP</th>
<th>Test</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td><img src="image" alt="Diagram" /></td>
<td>No protection</td>
</tr>
<tr>
<td>1</td>
<td><img src="image" alt="Diagram" /></td>
<td>Protected against vertically falling drops of water (condensation)</td>
</tr>
<tr>
<td>2</td>
<td><img src="image" alt="Diagram" /></td>
<td>Protected against drops of water falling up to 15° from the vertical</td>
</tr>
<tr>
<td>3</td>
<td><img src="image" alt="Diagram" /></td>
<td>Protected against water sprayed up to 60° from the vertical</td>
</tr>
<tr>
<td>4</td>
<td><img src="image" alt="Diagram" /></td>
<td>Protected against splashing water from all directions</td>
</tr>
<tr>
<td>5</td>
<td><img src="image" alt="Diagram" /></td>
<td>Protected against jets of water from all directions</td>
</tr>
<tr>
<td>6</td>
<td><img src="image" alt="Diagram" /></td>
<td>Protected against powerful jets of water from all directions</td>
</tr>
<tr>
<td>7</td>
<td><img src="image" alt="Diagram" /></td>
<td>Protected against the effects of temporary immersion in water</td>
</tr>
<tr>
<td>8</td>
<td><img src="image" alt="Diagram" /></td>
<td>Protected against the continuous effects of immersion in water having regard to specific conditions</td>
</tr>
</tbody>
</table>
North American Enclosure Type Rating (NEMA)

The American form of Enclosure rating is known as NEMA or Type. NEMA is an acronym for National Electrical Manufacturers Association.

Standards covering environmental considerations for electrical enclosures are UL 50E, CSA C22.2 No. 94.2 and NEMA 250. NEMA Standard No. 250 provides the following information. NEMA Standards Publication 250 does test for environmental conditions such as corrosion, rust, icing, oil, and coolants. For this reason, and because the tests and evaluations for other characteristics are not identical, the IEC Enclosure Classification Designations cannot be exactly equated with NEMA Enclosure Type Numbers.

The definitions for each type of enclosure are given below:

Type 1: Enclosures are constructed for indoor use to provide a degree of protection to personnel against access to hazardous parts and to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt).

Type 2: Enclosures are constructed for indoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing).

Type 3: Enclosures are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow); and that will be undamaged by the external formation of ice on the enclosure.

Type 3R: Enclosures are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow); and that will be undamaged by the external formation of ice on the enclosure.

Type 3S: Enclosures are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to
provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow); and for which the external mechanism(s) remain operable when ice laden.

**Type 3X:** Enclosures are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow); that provides an additional level of protection against corrosion and that will be undamaged by the external formation of ice on the enclosure.

**Type 3RX:** Enclosures are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow); that will be undamaged by the external formation of ice on the enclosure that provides an additional level of protection against corrosion; and that will be undamaged by the external formation of ice on the enclosure.

**Type 3SX:** Enclosures are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow); that provides an additional level of protection against corrosion; and for which the external mechanism(s) remain operable when ice laden.

**Type 4:** Enclosures are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure.

**Type 4X:** Enclosures are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (windblown dust); to provide a degree of
protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); that provides an additional level of protection against corrosion; and that will be undamaged by the external formation of ice on the enclosure.

Type 5: Enclosures are constructed for indoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and settling airborne dust, lint, fibres, and flyings); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing).

Type 6: Enclosures are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (hose directed water and the entry of water during occasional temporary submersion at a limited depth); and that will be undamaged by the external formation of ice on the enclosure.

Type 6P: Enclosures are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (hose directed water and the entry of water during prolonged submersion at a limited depth); that provides an additional level of protection against corrosion and that will be undamaged by the external formation of ice on the enclosure.

Type 12: Enclosures are constructed (without knockouts) for indoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and circulating dust, lint, fibres, and flyings); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing).

Type 12K: Enclosures are constructed (with knockouts) for indoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and circulating dust, lint, fibres, and flyings); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing).
**Type 13:** Enclosures are constructed for indoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and circulating dust, lint, fibres, and flyings); to provide a degree of protection against harmful effects on the equipment due to the ingress of water (dripping and light splashing); and to provide protection against spraying, splashing, and seepage of oil and non-corrosive coolants.

The following table provides a guide for converting from NEMA enclosure type numbers to IP rating. The NEMA Types meet or exceed the test requirements for the associated IEC Classifications; for this reason, the table should not be used to convert from IP rating to NEMA.

<table>
<thead>
<tr>
<th>NEMA</th>
<th>Application</th>
<th>Comment</th>
<th>IP Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Indoors</td>
<td>Protected against accidental contact, limited amount of dirt</td>
<td>IP20</td>
</tr>
<tr>
<td>2</td>
<td>Indoors</td>
<td>Intrusion of dripping water and dirt</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Outdoors</td>
<td>Protection against dust, rain. No damage when ice forms on housing</td>
<td>IP64</td>
</tr>
<tr>
<td>3R</td>
<td>Outdoors</td>
<td>Protection against rain. No damage when ice forms on the housing</td>
<td>IP22</td>
</tr>
<tr>
<td>3S</td>
<td>Outdoors</td>
<td>Protection against dust, rain and hail. No damage when ice forms on the housing</td>
<td>IP64</td>
</tr>
<tr>
<td>4</td>
<td>Indoors/Outdoors</td>
<td>Protection against splash water, dust, rain. No damage when ice forms on the housing</td>
<td>IP66</td>
</tr>
<tr>
<td>4X</td>
<td>Indoors/Outdoors</td>
<td>Protection against splash water, dust, rain. No damage when ice forms on the housing. Protected against corrosion</td>
<td>IP66</td>
</tr>
<tr>
<td>6</td>
<td>Indoors/Outdoors</td>
<td>Protection against dust, water jet and water during temporary submersion. No damage when ice forms on the housing</td>
<td>IP67</td>
</tr>
<tr>
<td>6P</td>
<td>Indoors/Outdoors</td>
<td>Protection against water during longer submersion. Protected against corrosion</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Indoors</td>
<td>Protection against dripping water. Protected against corrosion</td>
<td></td>
</tr>
<tr>
<td>12, 12K</td>
<td>Indoors</td>
<td>Protected against dust and dripping water</td>
<td>IP55</td>
</tr>
<tr>
<td>13</td>
<td>Indoors</td>
<td>Protected against dust and splash water, oil and non-corrosive liquids</td>
<td>IP65</td>
</tr>
</tbody>
</table>
For more information on Intertek’s services for hazardous location product testing, site assessment and technical training capabilities or to begin your project right away,

Call: 1-800-WORLDLAB
Email: icenter@intertek.com, info.uk@intertek.com
or visit: www.intertek-hazloc.com

Our Hazardous Location Credentials
Intertek has one of the largest and most experienced hazardous location teams available at multiple locations world-wide. Our expertise is backed by a number of accreditations and recognitions including:

- OSHA recognized Nationally Recognized Testing Laboratory (NRTL) for Hazardous Location Divisional Listing
- Standards Council of Canada accredited Certification Body (CB) and Testing Organization (TO)
- Notified Body and UKAS Accredited for the ATEX Directive, 94/9/EC.
- IECEx Certification Body (CB) and Test Laboratory (TL)
- Full Hazloc Training including an Accredited COMPEX Training Center
- Site Services (Risk Assessment, Area Classification and Inspection)

We certify products for compliance to National and International published standards which satisfy the applicable requirements of the National Electrical Code (NEC) in the U.S., the Canadian Electrical Code (CEC) in Canada, IECEx and the European Union's ATEX Directive. Some of the standards we test to include those of ANSI, UL, IEC, CSA, MIL Specs, FM, and CENELEC and CEN.

This publication is copyright © Intertek and may not be reproduced or transmitted in any form in whole or in part without the prior written permission of Intertek. While due care has been taken during the preparation of this document, Intertek cannot be held responsible for the accuracy of the information herein or for any consequence arising from it. Clients are encouraged to seek Intertek’s current advice on their specific needs before acting upon any of the content.

www.intertek-hazloc.com