CHAPTER 5
TESTING AND APPROVALS

The CEC and Article 501-1 of the NEC allow the use of Zone 0, 1, and 2 equipment in Division 2 locations.

5.1 HAZARDOUS AREA ELECTRICAL EQUIPMENT STANDARDS

Changes in electrical codes are similar to changes in tax codes. Most times the goal of simplification is lost as new rules are crafted in the hope of leveling the playing field. To clarify matters, insertions are made in the text to explain the others. Trying the meld the old and new codes together becomes inexplicable to the lay person. To resolve this the Canadian Code adopted the IEC standards in Section 18 and moved previous classification methods such as Divisions to Appendix J. The U.S., on the other hand, is building upon Article 505 to allow Hazardous Locations to be classified as either Zones or Divisions. Given the choice most U.S. users to date have elected to remain with their current method of classifications, namely Divisions. However, the CEC and Article 501-1 of the NEC now allows the use of Zone 0, 1 & 2 equipment in Division 2 locations. While both of these codes have made great strides in giving users a wider choice of products, the third-party approval process remains the main challenge and hurdle to installing and using new equipment. This section will sort out some of the complexities of the approval and marking of equipment.

5.1.1 NATIONAL STANDARDS & CODES OF PRACTICE

Many countries base their National Standards and Codes of Practice on IEC or nationally published standards. The U.S. adopted IEC equipment and classification standards with technical differences to U.S. standards included in the Annex of each document. Canada adopted the IEC 79 series of standards. CENELEC is the European Committee for Electrotechnical Standardization. It has been officially recognized as the standard organization for the European Union to produce a single set of requirements for all 19 countries. CENELEC publishes standards for the European market which are referred to as EN (European Standards). (See Table 5.1.) The CENELEC EN and IEC 79 standards are closely aligned. European countries have started to adopt the IEC standards without modifications directly as EU Standards. Example: IEC 60079-0 = EN 60079-0.

Table 5.1
Methods of Ex Protection Standards
Electrical equipment for gases, vapors and mists

	Code	CENELEC (EN)	IEC
General requirements		50014	60079-0
Oil immersion	o	50015	60079-6
Pressurized	p	50016	60079-2
Powder filled	q	50017	60079-5
Increased safety	e	50019	60079-7
Flameproof enclosure	d	50018	60079-1
Intrinsic safety	ia	50020	60079-11
Intrinsic Safety	ib	50020	60079-11
Encapsulated	m	50028	60079-18
Type of Protection “n”	n	50021	60079-15

The third-party approval process remains the major challenge and hurdle to installing and using new equipment.

5.2 CERTIFICATION OF Ex PROTECTED EQUIPMENT - APPROVALS VS. CERTIFICATIONS

The term “Approval” is no longer a preferred term because it suggests that the test authority approved the use of a particular product. The preferred term is “Certified.” The definition of certification is that a piece of electrical apparatus has been examined and tested by a recognized authority and found to comply with the requirements of an appropriate standard.

5.2.1 TEST AUTHORITIES

Nationally Recognized Test Labs (NRTLs) are organizations that can certify electrical equipment for compliance with a standard for use in potentially explosive atmospheres (Table 5.2). Most of these NRTLs have reciprocal agreements which allow other labs outside of their country to test and certify equipment to the countries standards. The most notable of these agreements is the cUL mark which signifies that UL has tested and certified the equipment to the Canadian standards.

There are three types of certificates for equipment; certificate of conformity, component certificates, and certification of Ex electrical apparatus. OEMs should pay close attention to teh certificate requirements when they ship products to European users.

Table 5.2
NRTLs of Various Countries

Country	Test Authority
USA	UL, FM, ETL
Brazil	CEPEL
Canada	CSA
UK	Baseefa2000, SIRA, EECS
Norway	NEMKO
Sweden	SEMKO
Denmark	DEMKO
Holland	KEMA
Germany	PTB, DMT, TUV
France	LCIE, CERCHAR
Spain	LOM
Italy	CESI
Australia	SAA
Japan	JIS
South Africa	SABS

OEMs who install additional equipment and wiring in flameproof enclosures must have the enclosures retested to obtain an Ex electrical apparatus certification.

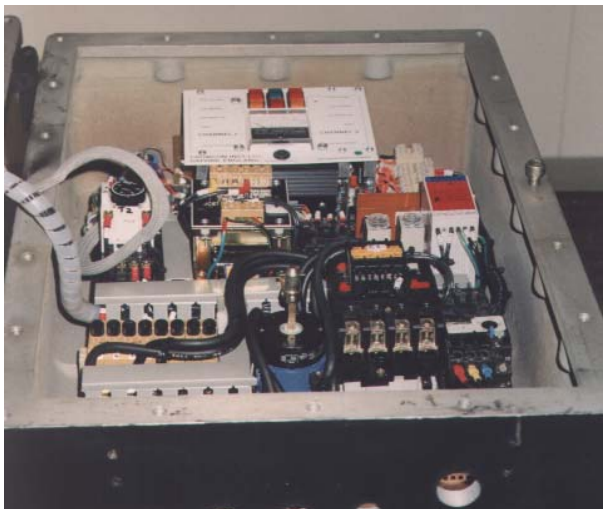
5.2.2 CERTIFICATES OF CONFORMITY

A Certificate of Conformity confirms that assembled Ex certified components of electrical equipment meet all the design and test requirements of an appropriate standard and has been manufactured with good engineering practice. Explosion Protected electrical equipment with a Certificate of Conformity can be installed in a designated hazardous area without further verification by the test authority. Certificates of conformity will include the suffix X after the unique certificate number to indicate that there are installation conditions of use to maintain the safety features.

5.2.3 COMPONENT CERTIFICATES

Recognized test authorities can also certify individual components for compliance with a particular standard. These certified components will normally have “Conditions of Use” specified in the certification document and denoted by the suffix U following the certificate number. These conditions must be observed to maintain the Ex safety design features. Typically the conditions will include creepage and clearance distances, voltage and current ratings and circuit protection. Certified components are normally 100% inspected after manufacture, and where practical, marked to indicate the voltage and current ratings.

Many times component certificates apply to flameproof enclosures (see 5.7). OEMs who install additional equipment and wiring inside must then have the enclosure tested to obtain an Ex electrical apparatus approval.



Flameproof enclosures normally have a component certificate.

5.2.4 CERTIFICATION OF Ex EQUIPMENT (APPARATUS)

See Appedix 5 for more details

A recognized test authority can verify that equipment designed and tested to an appropriate standard complies with all the construction and component test procedures. The manufacturer is then allowed to mark the products with the certificate dates. To maintain a high level of compliance and quality control, the manufacturer will be open to surveillance and audits by the test authority to ensure that the original product design specification is maintained during mass production.

5.3 NEMA VS IP RATINGS

Enclosures are designed to protect components mounted inside from the outside environment. When these enclosures contain electrical equipment, the degree of protection is critical to shield the components from moisture and dusts that could contaminate and damage the equipment. The North American Electrical Manufacturers Association (NEMA) have designated numbers to describe the protection that the enclosure will render. Likewise the IEC Standard IEC 60529 provides a means of classifying the degree of protection from touch, dust, water and impact.

The IEC designation of the ratings is known as *Ingress Protection* or IP. The IP classification should not be construed as indicating corrosion resistance. The IP is followed by 2 numbers with the first number providing the degree of protection against solid objects and dust, and the second number the degree of protection against water. See Table 5.3 below.

Non-metallic products from the SpecOne product lines, such as the D2Z Distribution Panels, are designed for use on offshore oil rigs and are rated as IP 66 and NEMA 4X, thus providing a high degree of protection.

Table 5.3 - Ingress Protection (IP) Classification

FIRST NUMERAL - Protecting against solid bodies

- **0** - No Protection
- **1** - Objects equal to or greater than 50 mm
- **2** - Objects equal to or greater than 12.5 mm
- **3** - Objects equal to or greater than 2.5 mm
- **4** - Objects equal to or greater than 1.0 mm
- **5** - Dust Protected
- **6** - Dust-tight

SECOND NUMERAL - Protecting against liquid

- **0** - No Protection
- **1** - Vertically Dripping Water
- **2** - 75º to 105º-Angled Dripping Water
- **3** - Spraying Water
- **4** - Splashing Water
- **5** - Water Jets
- **6** - Heavy Seas, Powerful Water Jets
- **7** - Effects of Immersion
- **8** - Indefinite Immersion

5.3.1 CONVERSION OF NEMA ENCLOSURE TYPE NUMBERS TO IP CLASSIFICATION

A commonly asked question is what IP number is equivalent to NEMA 4X. While there may be differences in the intricacies of the testing program such as nozzle size and water velocity, Table 5.4 provides conversion of the NEMA type numbers to IP ratings.

Table 5.4
NEMA vs. IP Ratings

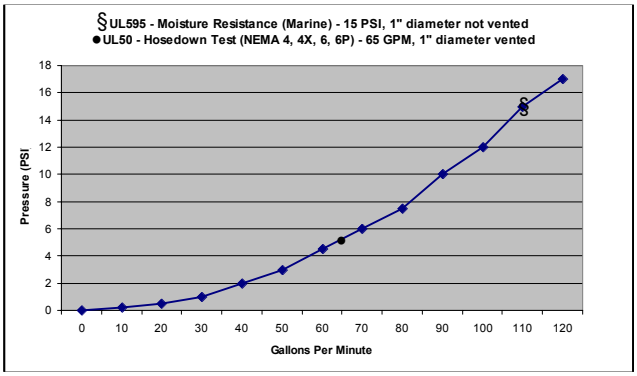
Type Number	IP Designation
1	IP10
2	IP11
3	IP54
3R	IP14
3S	IP54
4 and 4X	IP56
5	IP52
6 and 6P	IP67
12 and 12K	IP52
13	IP54

**Note: Table cannot be used to convert "IP" Codes to "NEMA" Types. See NEMA 250 for additional details.*

5.3.2 ENVIRONMENTAL RATINGS USED FOR LIGHT FIXTURES - MARINE GRADE

This is commonly referred to as UL595 Marine certification. This covers electrical fixtures of installation aboard ships and is considered more stringent that the NEMA 4, 4X, 6 and 6P ratings. The differences in the tests are not immediately discerned since the requirements for the two tests use different units of measure. For UL595, the critical measurement for the water sprayed is measured in PSI (pounds per square inch). The UL 50 (NEMA) unit of measure is in GPM (gallons per minute). When these two measurements are converted and plotted in Figure 5.3.4a, the significant difference becomes apparent. The hose test under UL 50 is 5 PSI and the marine grade test is 15 PSI.

Figure 5.5
Hose Test Data Flow (UL 50 vs. UL 595).



The most common application of marine grade light fixtures are the FMV and F2MV floodlights which are also suitable for Division 2.

5.3.3 SHELL DELUGE TEST:

This test originated with the Shell UK Exploration and Production LTD and was designed to simulate emergency deluge testing for electrical equipment in offshore locations. The objective of the test is to ensure that exposure of equipment to severe conditions will not lead to water ingress in quantities that could cause equipment to become a potential source of ignition when exposed to a flammable atmosphere. It covers fluorescent luminaries, floodlights, terminal boxes and motors. After the fixtures reach normal operating temperatures, they are subjected to cold salt-water spray. The fixtures must have less than 5 ml of water present inside and continue to meet prescribed insulation tests. (See Appendix 5 for the test requirements.)

Marine ratings undergo extreme hose and deluge tests.

The SpecOne eLLK fluorescent luminaries meet the Shell Deluge test.

To simplify markings, CENELEC should drop the E in EEx while the U.S. drops the requirement for A in AEx. The NRTL logo should indicate to users that the product meets the national standards.

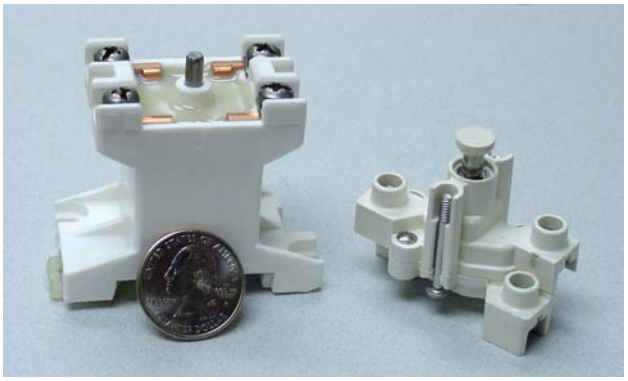
5.4 APPROVAL MARKINGS

Many industrial end users and manufacturers wanted a harmonized international standard so a new plant built offshore would have the same equipment and installation standards as one built domestically. This would allow them to take advantage of a single sourcing of materials and less expensive alternatives not always available elsewhere. Manufacturers will develop products that can be sold into any market with little if any modifications. End users will use one design team with one set of suppliers working to meet one global standard. Despite the common goal to standardize electrical codes, the present course of actions for the NEC and CEC, have made this impractical. For example, the U.S., Canada, ATEX and CENELEC each have different nomenclature and requirements. A typical label designating that the hazardous area equipment meets North American, IEC, and CENELEC approvals would contain the information shown in Table 5.5.

Table 5.5
Marking Requirements

Country Requirement	Marks
U.S. Division system	CL I, Gr B-D, Div. 2, T4A
U.S. Zone system	CL I Zone 1 AEx de IIC T4
IEC Zone System Canadian Zone System	Ex de IIC T4
CENELEC zone system	EEx de IIC T4
ATEX Markings	Ex II 2G
North American Enclosure Type Protection	NEMA 4X
IEC degree of Protection of Enclosures	IP 65
Various Third Party Approval Agencies	UL, CSA, FM, PTB, CEPEL
IEC or CENELEC requirement	Certificate numbers
European marks	CE

How will this fit onto a label of an explosion protected component such as a contact block used in control stations to disconnect power? Two such blocks are shown below along with a U.S. quarter to show their size.

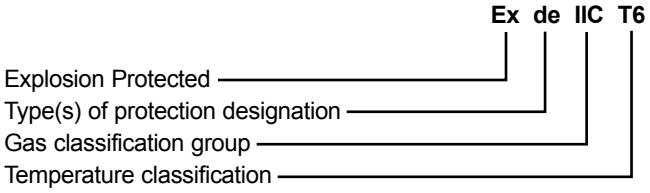


Many new explosion protected products are compact, leaving less room for markings.

For these contact blocks to be commercially successful, they must be approved for all hazardous areas and small enough to be mounted in control station enclosures. On small devices (e.g., switches, terminal blocks, and control stations), there may not be enough room for all the information required by all the systems. On larger pieces of equipment, the labels will be very crowded with all the additional information. One compromise on markings would be for CENELEC to drop the E in EEx while the U.S. drops the requirement for A in AEx. The NRTLS logo should indicate to users that the product meets the national standards. The IEC Ex-Scheme (see 5.8) was developed to solve these inconsistencies.

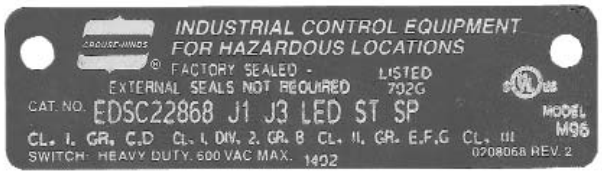
5.4.1 NORTH AMERICAN MARKINGS — CEC

The CEC has adopted the IEC method of markings:



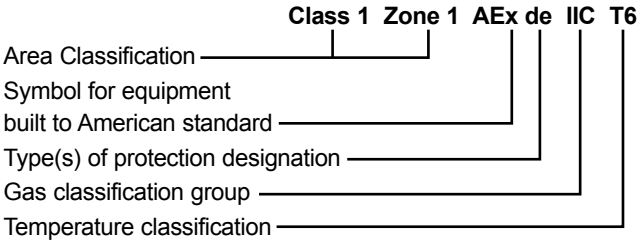
5.4.2 NORTH AMERICAN MARKINGS — NEC

The standard North American markings under the Division classification system identifies the location where the products can be located and installed.



Typical nameplate for Class I, Division 2, Groups C-D.

Under 505-10(b) (1-2) of the NEC equipment must be marked with the appropriate Class, Zone, symbol “AEx,” protection techniques, applicable gas classification and temperature classification. For example:



All current equipment approved for Class I Division 1 and Zones 0, 1 & 2 can be used in Class I Division 2. The AEx marking is applied to equipment which is certified to IEC standards. For example, all of the SpecOne equipment such as D2Z panels, eLLK, control stations, restricted breathing light fixtures and terminal boxes have the AEx marking.

The directive 94/9/IEC, also known as the ATEX directive, allows performance testing which should encourage new protection techniques. It leaves the construction details up to the manufacturer.

5.5 ATEX—THE NEW EUROPEAN APPROVAL PROCESS

See Appendix 6 for a detailed summary.

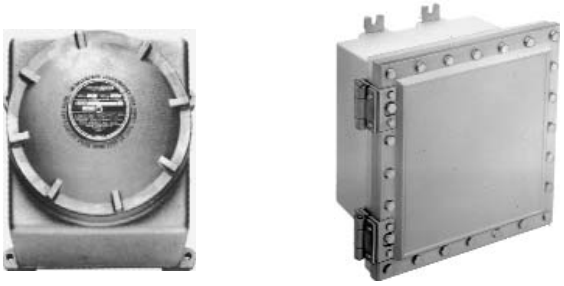
Before 1978 each European country had its own standard for Hazardous Location equipment, or it accepted one or more of the standards from another country. In 1978, the first set of European standards for electrical products for use in hazardous areas (based on the first EC directive) were issued based on a collective work of all prior standards for use in all listed European Community (EC) countries. Only equipment designed and certified by the authorized bodies to these standards could be used within the community, regardless of where the equipment was made.

The last directive, 94/9/EC "Explosive Atmospheres Directive (ATEX)" covers all equipment that is intended for use in potentially explosive atmospheres. All Hazardous Location equipment installed and used in the EC must fulfill the essential health and safety requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres. The manufacturer fof the equipment may assume that this is the case if it is designed and certified to harmonize with European Standards or Norms (EN). This directive became applicable in 1996 and has a transition period ending June 30, 2003. After this date all products used in the EC must conform to the requirements of the ATEX directive.

There are other European directives that must be met. The EMC (Electromagnetic Compatibility) directive applies to Hazardous Location equipment as well as similar industrial equipment (There are also safety directives for toys). Any product or consumer good sold or used within the EC must meet the directives relevant for that product. Confirmation is shown by the "CE" symbol on the product label which is the manufacturers or importers self-certification. *Note: The CE is not an approval mark and has no relevance outside of the EC.*

In order to obtain CENELEC certification to the ATEX directive, the manufacturing facility must first have an ISO certified, quality system. The facility must undergo a quality system audit to verify the facility is continually adhering to the ISO quality procedures, including the special quality requirements which belong to explosion protection. ATEX defines the basic technical requirements of equipment and the protection methods with which the apparatus is brought to market. The safety levels or requirements are not limited to the existing European Standards. Electrical apparatus which does not comply with the European Standards but which provides an equal level of safety can now be "certified" by a test lab.

ATEX was intended to encourage new products with explosion protection techniques outside the boundaries of the EN standards, and to avoid the lengthy approval process ending in a so-called inspection certificate. It leaves the construction details up to the manufacturer. This places responsibility of documenting and certifying the equipment on the manufacturer, thereby eliminating the usual *Certificate of Conformity or Inspection Certificate.*



The Cooper Crouse Hinds GUB and EJB products are certified by PTB to the ATEX directive. The products have an external ground, a cover locking mechanism on threaded covers and additional nameplate markings.

The CE mark is a manufacturer's self declaration that the products meet a standard. It is not an approval and is only required in the European market.

5.5.1 THE CE MARK—NEW MARKINGS, CERTIFICATIONS AND DOCUMENTATION

In 1985, the European Council settled on a new mark, CE, which declares that the apparatus in question meets all relevant EC directives including essential safety requirements. Under ATEX the certificate of conformity is replaced by an EC type examination certificate. Electrical products intended for Zone 0 and Zone 1 installations still require testing by a third party and a documented quality system by the manufacturer. This implies that Zone 2 material does not have to undergo third party testing and approvals, but can be self-certified by the manufacturer. However, it remains to be seen whether the marketplace will require third party testing and approval. The deadline is June 30, 2003 when all apparatus must follow the ATEX directive and have a quality system in place. The CE mark is a manufacturers self declaration that the products meet a standard. It is not an approval and is only required in the European market.

There will probably not be significant construction differences between Zone 1 & 2 equipment.

5.5.2 ZONE 2 STANDARDS

Over 90% of the hazardous areas in North America are classified as Division 2. As Canada and the U.S. move toward the Zone concept of classifying areas, these Division 2 areas would logically be classified as Zone 2 areas. The trend to Zone 2 will also accelerate in the CENELEC countries where most hazardous areas are now classified as Zone 1. However, there is a scarcity of Zone 2 apparatus available in the European markets.

Recognizing that Zone 2 is an area in further need of development, in 1990 CENELEC started to write a harmonized standard for Zone 2 construction requirements basing the requirements on IEC 79-15, BS 5000 and VDE 0165. The first standard was completed in 1997 and then presented to IEC as the new edition of IEC 79-15. The main points of the standard and the differences between Zone 1 and 2 construction requirements are shown in Table 5.6.

Most of the differences will be in reduced testing requirements for Zone 2 products. The major difference is that manufacturers following IEC guidelines will not be mandated to have the Zone 2 products certified by third parties. This is not likely to be the case for North America where endusers generally require proof of product certification for Hazardous Locations.

5.5.3 ARE IEC PRODUCTS CERTIFIED FOR ZONE 2 ACCEPTABLE IN NORTH AMERICA?

With the U.S. and Canada now testing to IEC standards, what is the likelihood that products certified to these standards will be commercially viable in the CENELEC countries? The answer is probably not much of a chance for the short term since:

1. Zone 2 equipment in Europe can be self certified by the manufacturer while in North America Zone 2 or Division 2 equipment will have to be certified by a third party in order for it to be commercially viable.
2. The company that imports the material is responsible for ensuring that the material has the CE mark. This self-declaration from the manufacturer confirms that the products meet the relevant directives such as EMC Electromagnetic compatibility and for the explosion protection.
3. There are still many differences in markings which remain a moving target, and
4. Ordinary testing requirements differ greatly between countries. This remains a large hurdle.

Table 5.6
Construction Differences between Zones 1 & 2

Description	Zone 1	Zone 2
Equipment grouping & surface temperatures	EN 50014 & IEC 79-0	No difference
Mechanical Strength	7 joules/4 joules	50% of values in Zone 1*
Aging Procedure	E.g. 80°C, 90% relative humidity; 4 weeks followed by -25° C, 24 hr.	Same figures but only 2 weeks instead of 4 weeks
Mechanical properties of plastics	T1—20 K	T1—10 K
Third party certificate	Required	Not required

* Identical level for Zone 1 and Zone 2 is under consideration.

5.6 NEW ATEX MARKING REQUIREMENTS IN CLASS II—DUSTS & ZONES 20, 21, 22

Each piece of equipment must be marked with the following minimum data: (see Tabe 5.8 page 32)

- Manufacturers name and address
- CE marking
- Series and model number
- Year of construction
- The letter “G” for group II for explosive areas containing gases
- The letter “D” for areas where an explosive atmosphere can occur from dusts.
- The Ex symbol showing the equipment is explosion protected.
- Other details which are required for safety of operation.

Under past requirements the equipment was marked with the form of protection leaving the user with the responsibility to interpret where the apparatus could be installed. This differs from the North American practice of identifying on the label the actual areas that the equipment can be installed in, i.e., Class I, Division 2. Under the new ATEX directive all equipment must have current markings by July 1, 2003 which are a condition for marketing the products in the European Union.

5.6.1 ATEX CONCEPT CATEGORIES

See 5.6.1 of Appendix 5

In the ATEX Directive (94/9/EC) categories distinguish between safety of equipment and locations of use. The relationship between categories and zones as contained in Table 5.7 are as follows:

- Category 1 – Zone 0
- Category 2 – Zone 1
- Category 3 – Zone 2

In addition, the new directive will also cover explosion-protected equipment for dusts (similar to Class II) as well as gases, vapors & mists (similar to Class I).

The new ATEX directives will cover class II, dust areas. These will be designated as Zone 20, 21, or 22 on the nameplate.

From the area beyond the seal outward from the enclosure, all of the wiring methods and fittings are considered installation materials and not subject to any ATEX standard, certificate or approval.

5.7 ATEX APPROVALS ON OEM EQUIPMENT

Installation and wiring practices using conduit are not common in Europe. This can create challenges for North American OEMs who are using conduit and need certifications to the ATEX directive for products shipped into Europe.

Although, conduit is not widely used in Europe, this technique is included in the CENELEC standard and the IEC standards as one of the entry methods into flameproof enclosures. The design and testing requirements are contained in the CENELEC standard 50018 and IEC Standard IEC 60079-1. Either tapered (NPT) or parallel (straight or metric) threads are acceptable. The conditions are:

- The Ex-d enclosure must be certified.
- Only the manufacturer can make the drilled and tapped entries into the Ex-d enclosure.
- All conduits or cable glands entering the enclosure must be sealed by an approved method.

From the area beyond the enclosure seal, all of the wiring methods and fittings are considered installation materials and not subject to any certificate or approval. *Thus, getting fittings certified to the ATEX directive would not be a common practice.* The correct use of conduit installation is spelled out in the installation standard EN 60079-14 and IEC 60079-14.

Table 5.7
Marking Examples

Mark	Group II	Zone	Apparatus	Explosive Material
Ex	II 1G	Group II Category 1	Zone 0 apparatus	G = gases, vapors, mists
Ex	II 2G	Group II Category 2	Zone 1 apparatus	G = gases, vapors, mists
Ex	II 3G	Group II Category 3	Zone 2 apparatus	G = gases, vapors, mists
Ex	II 1D	Group II Category 1	Zone 20 apparatus	D = dust
Ex	II 2D	Group II Category 1	Zone 21 apparatus	D = dust
Ex	II 3D	Group IICategory 1	Zone 22 apparatus	D = dust

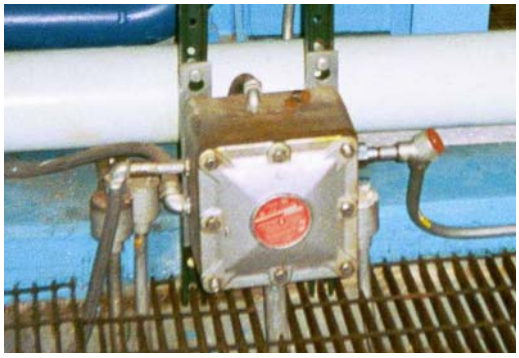
Conduit, cabling, and fittings beyond the sealing fittings are considered installation materials and not subject to ATEX standards.

After OEM's install components inside of an Ex-d enclosure, it is the OEM's responsibility to obtain approval on the enclosure as an electrical apparatus.

5.7.1 ATEX APPROVALS FOR OEMS

The challenge of obtaining an ATEX certificate becomes the responsibility of the OEM. The manufacturer of the flameproof enclosure can only obtain a component certificate for the empty Ex-d enclosure, which is designated by a "U" on the certificate. A component certificate means the enclosure meets the basic flameproof requirements but does not have a T-number assigned to it. After the OEM installs products inside of the Ex-d enclosure, it is the OEM's responsibility to obtain an approval on the enclosure as an electrical apparatus. This requires additional testing to obtain a T-number for the product and sometimes a retesting of the flameproof enclosure. The OEM then applies their own product label on the completely assembled apparatus.

The only way for OEMs to avoid the additional testing for ATEX certificates is to allow the enclosure manufacturer to wire, install and drill the Ex-d enclosures. This is different from the North American method where manufacturers obtain a UL Classification on explosion proof enclosures by testing them under worst case conditions for flame propagation and explosion pressures. OEMs are then able to install equipment inside of and field drill conduit entries in explosion proof enclosures without undergoing additional tests and approvals.



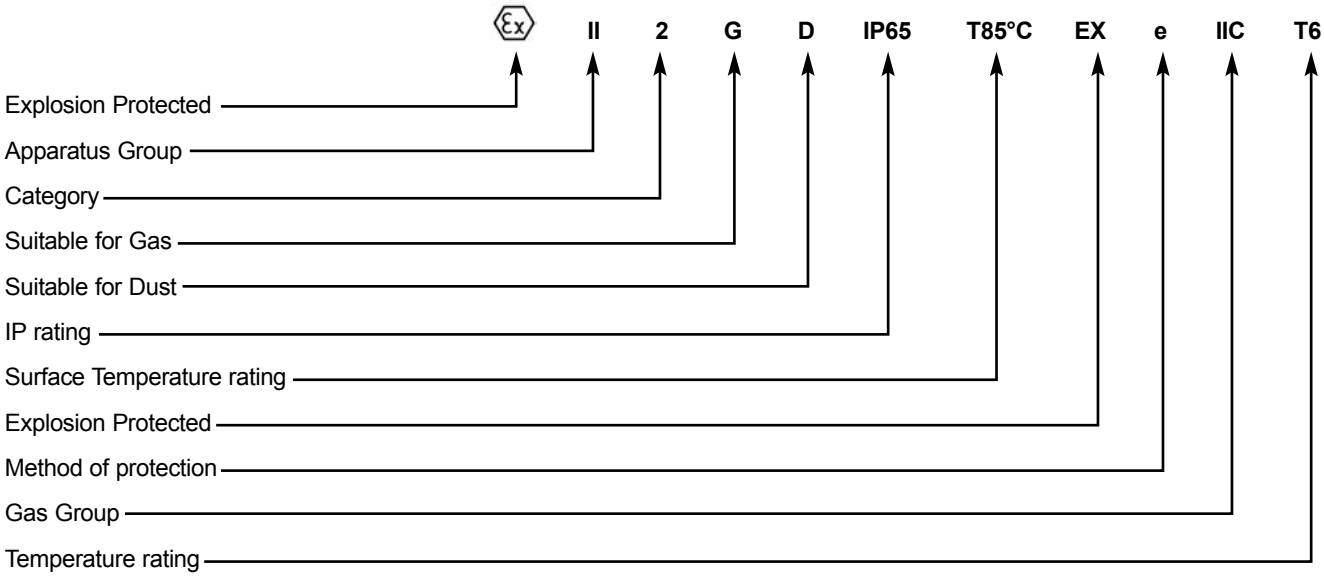
This explosionproof enclosure has 6 different conduit openings which can be field drilled. Drilling of the Ex-d enclosure must be performed by the manufacturer. The OEM for the electrical installation is responsible for obtaining the certification to a product standard on the Hazardous Location equipment. The manufacturer of the Ex-d enclosure can obtain the certificate if they perform the wiring and installation of apparatus in the Ex-d enclosure.

The IEC Ex-scheme was established to simplify markings and standards testing for hazardous area equipment.

5.8 THE IEC Ex SCHEME

The IEC Ex Scheme is a recent movement started by the IEC in 1991 to facilitate international trade by eliminating the need for duplication of testing and certifications. Presently, for a manufacturer to gain approval of equipment in various countries, the alternative to submitting equipment to each country's test laboratory is to apply to one laboratory. These labs have agreements with many others around the world resulting in a spider web arrangement. Each agreement requires periodic review of each other's capabilities which is expensive and time consuming. As seen in the examples of different marking requirements, one must be an expert to decipher the meanings of the multitude of marks and scriptures for Hazardous Location equipment. Currently there are 22 member countries with the USA joining in May 2001. The member countries are: Australia, Canada, Switzerland, China, Germany, Denmark, France, United Kingdom, Hungary, Italy, Korea, Netherlands, Norway, Romania, Russia, Sweden, Slovena, Yugoslavia, South Africa, USA & Finland. Each country has specific conflicts with universal standards and markings that are known as national differences. Examples of these differences are the flame-retardant tests or shock tests required by local fire codes in the U.S.. The U.S. has joined the IEC Ex scheme but allows for a 15-year adoption period while differences are resolved among the multitude of differences in local requirements.

Table 5.8
Example of New ATEX markings



For questions or comments, please contact the author at paul.babiarz@crouse-hinds.com