

# THE OUTLOOK FOR GLOBAL UNITY FOR HAZARDOUS AREA EQUIPMENT

Copyright Material IEEE  
Paper No. PCIC-98-12

Paul S. Babiarz - Crouse-Hinds  
Member, IEEE  
Crouse-Hinds  
P.O. Box 4999  
Syracuse, NY 13221

Gerhard Schwarz  
CEAG Sicherheitstechnik GmbH  
Neuer Weg 47  
D-69412 Eberbach  
Germany

Dr.-Ing. Hans Wehinger  
Physikalisch - Technische Bundesanstalt (PTB)  
Postfach 3345  
38023 Braunschweig  
Germany

## **Abstract:**

Modifications to the National Electrical Code (NEC®) and Canadian Electrical Code (CEC) have created changes and complications in the marking and approvals of new explosion-protected products. Instead of making the practice of consolidating approvals for globalized products simpler, Canada and the US have gone in different directions. This, in turn, which will confuse all those who manufacture, specify, install and inspect explosion protected equipment. Europe has recently adopted the ATEX Directive, which creates a new method of approving explosion-protected equipment for Europe. Previously, equipment and materials had to pass equipment and construction standards which limited new ideas and techniques. Now, due to the ATEX Directive, manufacturers have the opportunity to build and test explosion protected equipment to the new Directive 94-9, which is based on performance testing. This new system may revolutionize the hazardous area industry as well as trade throughout Europe by freeing up manufacturers to use new inventive types of equipment and construction standards.

## **Findings:**

The Zone classification system in North America was adopted as a step toward global harmonization of hazardous area equipment. There are still many obstacles in the way before globally harmonized products are available. These differences include:

- Continued disagreement between the Division and Zone classification systems,
- Differences in ordinary location requirement testing,
- Differences in markings,
- Differences in wiring & installation methods (i.e. cable terminations vs. twist on connectors)

There are some relatively, simple steps that can be taken in the short term to accelerate the wider acceptance of the zone concept as well as new products and installation practices.

- The first step toward globalization will be for the US & Canada to determine one North American marking system common to both countries. Between the US and Canada the Zone concept has created four separate methods for marking products. This is a drastic departure from one common marking which existed before the codes were revised.

- The CENELEC and IEC countries must also agree on common standards and marks.
- Plan on one mark for North America and one for the IEC. The requirements for ordinary location testing for an individual country are too complicated to resolve easily. The best that can be hoped for in the near term is one common marking for each system.
- Under the North American IEC type-marking system, equipment should be identified with the appropriate classified area. (i.e. Zone 1 or Division 2) The concept of explosion protected equipment designed for certain classified areas is ingrained within the petrochemical industry. Shifting to the IEC marking system, which identifies the explosion protection technique without the area suitability, is too sudden of a departure for this industry.
- End users must be more flexible in accepting other third party testing labs. Specifying an approval lab only prevents competition. If the standards are written correctly and testing labs are certified, manufacturers must be free to shop for competing rates and time schedules.
- Don't count on having ready access to European markets if your products have North American IEC type approvals. Obtaining IEC approvals to North American standards does not mean that EC countries or end users will accept these products. There are additional requirements and barriers such as the CE mark which manufacturers must plan for.
- Do not rely on having many IEC Zone 2 products just yet. The Zone 2 equipment standards, which are still being developed, indicate there may not be many differences between Zone 1 and Zone 2 products.
- Look for products to have the same exteriors with different internal components to meet local requirements of the country. Most existing products cannot meet both North American ordinary location and IEC Zone 1 requirements.
- Simplify the testing requirements, markings and third party test acceptances. The other quasi-technical/cultural differences, such as how areas are classified and equipment is wired and installed, may never reach total agreement.
- Keep abreast of the ATEX Directive. This will bring changes to the European community in the way products are approved and brought to market. Working in parallel with the Directive will speed up and simplify the globalization process.

TABLE 1  
Marking Requirements

Country Requirement	Marks
US Division system	CL I, Gr B-D, Div. 2, T4A
US Zone system	AEx CL I Zone 1 de IIC T4
Canadian Zone System (alternate)	Ex CLI de IIC T4
IEC Zone System	
Canadian Zone System (preferred)	Ex de IIC T4
IEC or CENELEC zone system	EEx de IIC T4
ATEX Markings (1)	Ⓔ II 2G
ATEX Marking	CE (CE)
North American Enclosure Type Protection	NEMA 4x
IEC degree of Protection of Enclosures	IP 65
Various Third Party Approval Agencies	UL, CSA, FM, PTB, BASEEFA
IEC or CENELEC requirement	Certificate numbers

### What Path Are We On?

Changes in electrical codes are similar to changes in tax codes. Most times the goal of simplification is lost as new rules are inserted in the hope of leveling the playing field. To clarify matters, insertions are made in the text to explain the others. Trying to meld the old and new codes together becomes inexplicable. Has North America now invented another world standard for classified areas that is a combination of US, Canadian and IEC standards that can't be used anywhere else in the world? The answer seems to be yes, at least for the time being. Does a North American approval to IEC standards allow easier access to European markets? Probably not.

The same path was followed in the instrumentation industry when the 4 to 20 mA analog signals were agreed upon in the 1950's and as recently as 1994 when the Fieldbus Foundation was developed. Prior to 1994 the Interoperable Systems Project (ISP) and WorldFIP were pursuing the same goal of a universal Fieldbus protocol. In August 1994, they finally reached agreement on a common protocol and established the Fieldbus Foundation. The same problems existed in those industries that now exist in the hazardous area industry as far as achieving agreement between North American and Europe. The differences in the current method of marking the products are indicative of the confusion that now reigns in the industry. These issues must be addressed immediately before we move much further.

### 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 US, Canada, ATEX and European Committee for Electrotechnical Standardization (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 at least the information shown in Table 1.

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 in Figure 1 along with a US quarter to show their size.

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 is simply not 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. The only viable solution is to continue the harmonization efforts on both sides of the ocean to develop universal and abbreviated explosion-protected nomenclature. Because of ordinary location testing there will likely be a minimum of two marks; one to

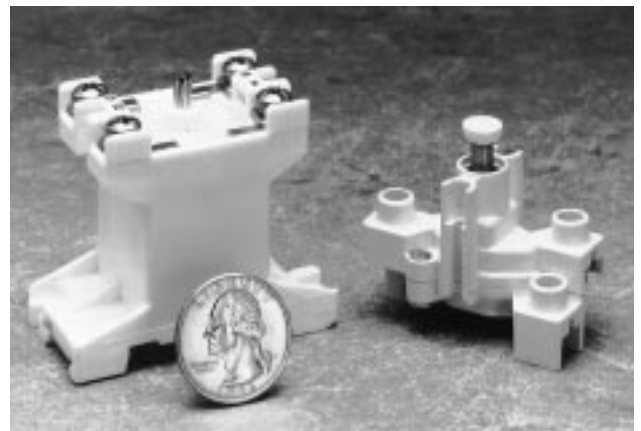


FIGURE 1  
Contact Blocks

designate approvals in North America and one for Europe. A good first step would be to consolidate the U.S. and Canadian markings as well as the CENELEC and IEC markings. An even easier solution would be to adopt the IEC markings and have faith that the approval agency tested the products for the country's ordinary location requirements.

Although not subjects of this paper the next questions that beg to be answered are; will anyone be able to read these marks, and who will interpret them? For now manufacturers may be forced to apply different labels for the individual markets. However, as new global products come on the market, simplifying the markings and labeling requirements will become a major issue.

### **The Next big Hurdle - Differences in Ordinary Location Testing**

What does it mean to have a piece of apparatus approved to ordinary location requirements? For products to comply with North American (i.e., NEC or CEC) zone requirements, they must meet the IEC tests for zone classification in addition to ordinary location testing for either the U.S. or Canada. Ordinary location requirements involve rigorous flame, material, shock, and other electrical tests. Having to perform this additional testing precludes immediate third party approvals for European equipment under the North American zone classification system. For example, nonmetallic boxes approved for use under the IEC zone system must not hold a static charge to prevent sparking. Therefore, carbon is added to the material. The carbon increases the flammability of the plastic - not a consideration under the IEC concept - so it cannot meet North American flammability tests. Thus, in North America, the carbon must be removed, making it noncompliant with the IEC. Most materials cannot meet both North American ordinary location and Zone 1 IEC requirements.

Neither does having North American approvals to meet the IEC standards mean that North American products can be sold immediately into European or CENELEC countries. The products would have to meet local construction requirements and have the CE mark. This mark shows that the manufacturer declares compliance with and fulfills all relevant EC directives for the mentioned product. More on this later.

As of this writing there are still disagreements within North America on equipment standards. The UL standards on zone protection techniques are American National Standards (ANSI). ISA, which claims to represent the user market, is also developing ANSI standards that may or may not differ from the UL standards. CSA adopted IEC standards for hazardous areas and also reaffirmed that equipment must also pass ordinary location tests. It is not likely that these three standards or the testing and marking requirements for equipment will be exactly alike. However, for the sake of harmonization, they must be

Although these differences are costing time money and aggravation to manufacturers and end users, solutions will eventually be wrangled out in codes and standard committees. There are, however, some interesting

parallels between the current consolidation of codes in North America and the European Union. Perhaps it is time to step back and examine how the same system evolved in the CENELEC countries to take advantage of opportunities, to avoid pitfalls and to simplify the North American codes and standards.

### **European Markets:**

Although explosion protection methods were developed at the turn of the century, it was not until 1935 that the first regulations for installing electrical equipment in hazardous areas were published in Germany. The first construction requirements, known as VDE regulations, were published in 1943 and revised again in 1961. Soon thereafter, the European community was founded with the major goal of establishing a free trade zone in Europe. To promote standardization within the electrical community the CENELEC was established to write uniform standards, testing procedures and markings. In 1972 the IEC established the Zone Classification system of Zones 0, 1 and 2 for the potential hazards due to gases, vapors and mists which became known as IEC 79-10. It was not until 1976 that Germany adopted the zone concept for classifying hazardous. The IEC revised the 79-10 standard in 1995 into the document, *IEC 79-10:1995* to classify hazardous areas.

### **Approval Process in Germany before 1978:**

Prior to 1978 the Federal Republic of Germany required that all electrical apparatus for use in potentially explosive atmospheres be certified by the State. The document was named "BAUARTZULASSUNG" which means type approval. This testing program was similar to the US, in that it required that products undergo sample and performance testing by PTB, which is a physical technical government institute. The PTB approval was limited to only Germany and any products exported required another certificate from each country.

### **Approval process in Germany and Europe after 1978:**

On December 18, 1975 in accordance with article 100 of the Rome treaties the council of the European Community issued the "*Directive on the Approximation of the Laws of the Member States Concerning Electrical Apparatus for Use in Potentially Explosive Atmospheres*". The primary aim of this directive was to eliminate obstacles for trading within the European community. It was supplemented in 1978 by the "*Directive on the Approximation of the Laws of the Member States Concerning Electrical Apparatus for Use in Potentially Explosive Atmospheres Employing Certain Types of Protection*." These directives stipulated that the sale and trade of electrical equipment couldn't be forbidden by the member states for reasons of safety if it complied with the harmonized standards. These standards published by CENELEC are called European Norms or Euronorms (EN). Third party certification agencies exist in each member country, which approve products to EN standards throughout Europe. However, a manufacturer can choose any agency or testing station to certify the equipment.

Euro — Norms	
EN 50014	General Requirements
EN 50015	Oil Immersion
EN 50016	Pressurized Apparatus
EN 50017	Powder filling
EN 50018	Flameproof enclosures
EN 50019	Increased Safety
EN 50020	Intrinsic Safety
EN 50028	Encapsulation


Once a certificate of conformity is issued, the apparatus is marked with a symbol:



There may be situations where the electrical equipment does not comply with the EN, but which may provide an equal level of safety. The equipment could then be tested and issued an Inspection Certificate. This process proved to be very time consuming. The manufacturer must show the test lab that the equipment met or exceeded the relevant standard. This draft certificate would then be submitted to all test labs in the EC for comments before it could be issued. The comment period lasts four months and a member country could require additional tests, starting the process again.

#### ATEX Directive - Approval Process after 1995:

To encourage new products with explosion-protection techniques outside the boundaries of the EN standards and to avoid the lengthy approval process, a new directive 94/9/EC or "ATEX" was issued (2). ATEX defines the basic technical requirements and the protection methods of the equipment. The manufacturer is responsible for documenting and certifying the equipment thereby

which declares that the apparatus in question meets all relevant EC directives including essential safety requirements. Under ATEX the certificate of conformity and the  mark, which previously were legal "passports", and are no longer required on equipment. The CE mark and the manufacturer's declaration of conformity will replace these, putting more responsibility back on the manufacturer. However, products intended for Zone 0 and Zone 1 installations will still require testing by a third party and a documented quality system by the manufacturer. This implies that Zone 2 equipment does not have to undergo third party testing and approvals, but can be self-certified by the manufacturer. However, it is expected that the marketplace will require third party testing and approval. The deadline is June 30, 2003 when all apparatus must follow the ATEX Directive and manufacturers have a quality system in place.

#### Zone 2 Standards:

Over 90% of the hazardous areas in North America are classified as Division 2. As Canada and the US moves 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 classified as Zone 1. However, there is a scarcity of Zone 2 apparatus available in the European markets. (3).

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 draft was completed in 1997 and presented to IEC as the new edition of IEC 79-15. The main points of the draft standard and the differences between Zone 1 and 2 construction requirements are as follows:

Construction Differences Between Zones 1 & 2		
Description	Zone 1	Zone 2
Apparatus grouping & surface temperatures	EN 50014 & IEC 79-0	No differences
Mechanical Strength	7J/4J	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 certificate	T1- 20 K Required	T1- 10 K Not Required

eliminating the usual *Certificate of Conformity or Inspection Certificate*. The safety levels or requirements are not limited to the existing European Norms. Electrical apparatus which does not comply with the European Norms but which provides an equal level of safety can now be 'certified' by a test lab. ATEX allows performance testing of products, instead of testing production facilities and enforcing constructions standards, which should encourage new protection techniques and innovative products.

#### New Markings, Certifications and Documentation - The CE Mark

In 1985, the European Council settled on a new mark, CE,

Based on preliminary drafts, there will probably not be significant construction differences between Zone 1 & 2 equipment. Most of the differences will be in reduced testing requirements for Zone 2 products.

#### What about for non-EU countries like the US and Canada?

With the US and Canada now testing to IEC standards, what is the likelihood that products approved 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. The CENELEC and IEC standards are not yet fully harmonized.
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 could be the largest hurdle of them all.

### **Conclusions:**

Although North America has changed its codes and standards to harmonize with the Zone classification system, Canada and US have progressed in different directions. Each country requires different markings on equipment, which will confuse manufacturers, installers and owners. In addition, CENELEC standards still disagree with IEC requirements. The ATEX Directive could be the catalyst to meld all of this together in an understandable systematic approval and marking scheme. In the meantime time will best answer some of the following questions:

- Will CSA accept products tested to IEC standards by US third party agencies if they meet CSA ordinary locations?
- Will apparatus approved to the AEx US standards meet the new ATEX standards?
- Conversely, will apparatus approved to the new ATEX standards be able to meet the AEx standards?
- Are the new UL or ISA standards really a step toward global harmonization or just adding additional testing requirements for manufacturers?
- Can a global product for hazardous areas meet all of the different requirements and be labeled simply enough to be understood by installers and inspectors?
- Are there significant construction and cost differences between Zone 1 and 2 products?

### **References:**

1. Department of Trade and Industry Business in Europe, "Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres, Guidance Notes on UK Regulations" First edition, February 1998.
2. Physikalisch-Technische Bundesanstalt PTB, "Certification Procedure for Explosion-Protected Equipment I Compliance with Directive 94/9/EC" Memorandum (ATEX 100a) June 1997.
3. Paul S. Babiarz, Danny P. Liggett & Craig M. Wellman, P.E. "How Products Will be Adapted to the Dual Hazardous Area Classification System" IEEE Industry Applications Vol. 4, No. 2, March/April 1998.