Can you identify the differences in how these areas should be classified and the differences in wiring practices? If not, then this digest is a must read for you.

The purpose of this document is to explain the concepts of hazardous areas, the differences between Zones and Divisions, the different explosion protection techniques and how electrical equipment is installed in hazardous locations around the world. For more detailed information on the equipment available and the installation methods used, ask your Cooper Crouse-Hinds® representative for a copy of the *Electrical Code Digest* or contact the author at Paul.Babiarz@crouse-hinds.com

Area 1

Area 2

1. Which location should be classified as Zone 1 and which should be classified Zone 2?
2. What clues lead you to these conclusions?
3. What forms of explosion protection can you identify in the Zone 1 photo?
4. Describe the wiring practices used in these photos?
5. Are seals required?

Answers

1. Area 1 is Zone 1; Area 2 is Zone 2
2. Area 1 is adjacent to a process area. Area 2 is outside of a laboratory.
3. In Area 1 the phone handset and meters at the top of the panel are intrinsically safe - Ex-ia; the GHG 273 light switch (bottom left) is flameproof and increased safety - Ex-de.
4. The wiring practices use flexible cables through an open conduit system that protects vertical runs of cable.
5. Explosionproof seals are not required because the switches and other are factory sealed and conduit is not used.

CHAPTER 1
THE ELECTRICAL CODE EVOLVES

The first electrical equipment used in the mines were motors to drive the elevators, ventilators and mining equipment.

1.1 THE FIRST HAZARDOUS AREAS

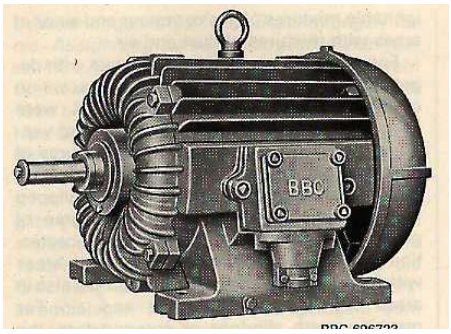
The first hazardous areas are reputed to have been recognized in coal mines. Methane gas, which is absorbed by coal, later escapes from the coal once it is mined. The methane gas, which is lighter than air, would occasionally be ignited by the miner's candles. This resulted in a double jeopardy of the ignition of methane gas and subsequent ignition of the coal dust itself. The first solution was to hire miners to ignite the gases each day with a very long pole with a burning ember at the end. This list of volunteers soon ran short so convicts from local prisons were recruited. Criminals yes, but fools they were not. Eventually, ponies were enlisted and outfitted with special saddles that carried a lighted candle. The ponies were doused with water and sent running through the mine shafts in hopes of creating only very small explosions.

Igniting small pockets of methane gas was one of the original methods to prevent ignition in coal mines

Later in 1815 Sir Humphrey Davy invented the Davy lamp, which was a kerosene lantern with a fine brass mesh surrounding the burning wick. The mesh emitted some light but was fine enough to not let the flame propagate through the screen. Later, mechanical ventilation was introduced into the mines, which dispersed the methane to the point where there was not sufficient fuel left to ignite. The method of providing adequate ventilation is still in use today in reducing hazards.

One of the first explosion-protected mining lanterns manufactured by Cooper Crouse-Hinds CEAG in Germany.

The first electrical equipment used in the mines were motors to drive the elevators, ventilators and mining equipment. After the sparking motors resulted in some mine mishaps, they were totally enclosed, which contained the explosions. This marked the beginning of the metallic explosionproof enclosures with tight-fitting joints later called flame paths.



Motors used in mines were the first electrical equipment to use explosionproof construction.

Reference: M Toney et. al., A History of Electrical Area Classification in the United States. In IEEE PCIC Conference Record 2000, pp. 273-279.

1.2 ELECTRICAL CODE EVOLUTION

In the early 1900s, when contractors were busy electrifying industrial buildings, electrical wires were run through existing gas pipes, resulting in today's conduit system of wiring. This was the basis for future North American codes and wiring practices. At the same time, the International Electrotechnical Commission (IEC) was founded in Switzerland. The IEC is the United Nations of the electrical industry. Its ultimate goal is to unify worldwide electrical codes and standards. Few IEC practices were incorporated into the National Electrical Code® (NEC) or Canadian Electrical Code® (CEC), mainly because North America operated on different voltages and frequencies than most of the rest of the world.

1.3 DIVISION 1 IS BORN

The advent of automobiles and airplanes in the early 1920s created a need to refine fuels. Because volatile vapors from gasoline and electrical sparks did not safely mix, the first Hazardous Area classification, called "Extra Hazardous Location," later referred to as Division 1, was inserted into the NEC. Division 1 described areas that were normally hazardous. Thus, a new industry with the goal of protecting electrical equipment in hazardous areas was born. Explosionproof enclosures, oil immersion, and wire gauzed (meshed) enclosures for mining lanterns were the first types of protections developed.

Cooper Crouse-Hinds has manufactured electrical and explosion-protected equipment since 1897.

In 1931 Class I for gases and vapors, Class II for dusts, and Class III for fibers were defined. The Class I areas were further subdivided in 1935 into the Groups A, B, C, & D (refer to section 2.4) based on the gases' main characteristics of:

- explosive pressure
- flame transmission
- ignition temperature

1.4 DIVISION 2 BEGINS

In 1956 the concept of intrinsic safety appeared in the North American Codes. About the same time, North American industries determined that hazardous area classifications needed to be expanded. A Division 2 was needed to describe locations that were not normally hazardous to allow use of less expensive equipment and less restrictive wiring methods.

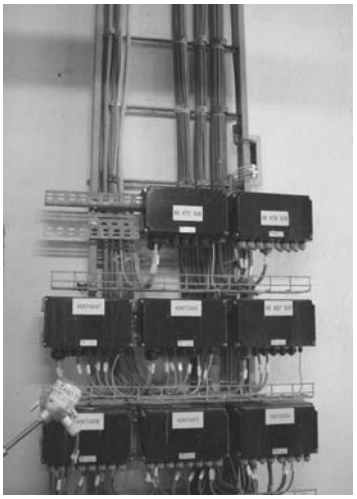
1.4.1 EXPLOSION PROTECTION CONCEPTS IN GERMANY / EUROPE

The first German standards, "Protection of Electrical Installations in Hazardous Areas", were published in 1935 as guidelines for the installation of electrical equipment in hazardous areas. With this came a fundamental change in 1938 by dividing the installation requirements (VDE 0165) and product design requirements (VDE 0170/0171). The product design standards included the basic types of explosion protection such as flameproof enclosures, oil immersion and increased safety. The components were designed to be explosion protected and housed in industrial type enclosures that were weatherproof. This lead to the development of flameproof components mounted inside of increased safety enclosures. Apparatus designed according to this standard were marked with the symbol (Ex). See Chapter 4, Methods of Protection and 5.3 for IP ratings.

In the 1960s, the European community was founded to establish a free trade zone in Europe. To reach this goal, technical standards needed to be harmonized. As a result the European Organization for Electrotechnical Standardization (CENELEC) was established. This new set of European standards (EN 50014 - EN 50020), published in 1972, was based on the Zone classification system as IEC 60079-10. European standards replacing the different national standards and guidelines for Zone 0 and Zone 2 applications were published much later as EN 50284 (requirements for apparatus used in Zone 0) and EN 50021 (requirements for apparatus used in Zone 2).

In 1975 the first EU directive for apparatus used in hazardous areas, the so-called "Explosion Protection Directive", was published. In 1978 the first edition of the European standards was published by CENELEC which covered installation techniques

- *Conduit techniques*
  (used mainly in the southern part of Europe)
- *Direct cable entry in flameproof enclosures*
  (used mainly in UK and France)
- *Indirect cable entry technique*
  (used in Germany)



Cabling is becoming more prevalent in Hazardous Locations.

By adopting the Zone method of classifying hazardous areas, North American users now have the ability to use the European (IEC) equipment in addition to the existing North American products.

1.5 WHY CODES CHANGED IN NORTH AMERICA

North American industry has grown accustomed to the Division classification system. Plants in the U.S. and Canada are safe and operating efficiently. So why change to a new classification system? The business world continues to shrink and most companies are thinking globally. 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 source of materials and less expensive alternatives not always available elsewhere.

The U.S. and Canada debated the merits of classifying hazardous areas as Zones instead of Divisions for over 20 years. By adopting the Zone method of hazardous areas, users now had the ability to use European (IEC) equipment in addition to the existing North American products. Many users concluded that the best system of area classification to allow the use of both IEC and North American equipment was in fact the three-Zone method.

This led to many options and alternatives for materials and installation methods, all centered around different methods of protection.

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