Intrinsically Safe Circuit Protection for Hazardous Environments
Hazardous Locations

Gases, petroleum products, and airborne dusts tend, by their very nature, to be explosive if sources of sparks or excess heat are present.

Over the years, these hazards have led to some loss of life and property. In response to this hazardous potential, regulatory bodies around the world have worked to minimize the hazards associated with these working environments.

Intrinsic Safety protection methods have been developed to prevent hazardous substances from coming into contact with sources of ignition in two ways:

- Energy limitation - Limits the spark energy
- Temperature limitation - Limits the surface temperature
Limiting Energy and Temperature

• Under normal operation, fuses are used to limit the current under any abnormal condition to ensure that the circuit will not overheat due to excessive currents.

• To prevent the energy from the fuse from igniting the gases in its environment during operation, electronic equipment manufacturers have been forced to pot or coat the entire circuit board.

• This process is not only hard to control, but it adds production steps, material, and weight to the final product. All of these represent a considerable percentage of the final product cost.
Intrinsic Safety Certification

• Today, in order to safely operate electrical equipment in Hazardous Locations, third-party certifications are required (per NEC).

• UL LLC issued the first UL 913 standard back in 1971: Standard for Intrinsically Safe Electrical Equipment for use in Hazardous Locations.

• The most recent revision of this standard, the seventh edition, was published in 2012.
Hazardous environment Classes

• For Class I hazardous locations, flammable gases or vapors can be ignited by sparks caused by electronic switching, arcing or high surface temperature of the devices.

• For Class II and III hazardous locations, the greatest area of concern is the device’s surface temperature, which may trigger an explosion if the temperature is higher than the ignition point of the combustible dusts.

• Example: If the surface temperature of a device does not exceed 120°C (under normal operating conditions) and 165°C (under fault conditions), it is considered safe because it is not capable of causing ignition due to high surface temperature.

<table>
<thead>
<tr>
<th>Category of Hazard</th>
<th>Degree of Hazard</th>
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<tr>
<td>Class I: Location with flammable gases or vapors</td>
<td>Division 1: Ignitable concentration of flammable gases, vapors, or liquids can exist all the time or some of the time</td>
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<td>Class II: Location with combustible dusts</td>
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<td>Class III: Location with ignitable fibers or filings</td>
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Fault Condition: How a fuse would help

• Under normal operation, these types of devices can generate tiny internal sparks from components such as motor brushes, switch contacts, and connectors.

• To use these types of devices safely in a hazardous location, the energy of such sparks must be contained to avoid igniting explosive materials in the environment.

• An intrinsically safe certified fuse is necessary to prevent overcurrent conditions and it ensures that the circuit will open without generating a spark capable of causing ignition.

• Arcing can occur when the fuse opens, which must be contained within the fuse’s encapsulation.

• The surface temperature of the fuse also must be kept below the temperature that could ignite explosive gases or dust.

• By preventing over-current conditions, the fuse thus limits the current to the rest of the circuit, preventing the temperature of the circuit from reaching levels that may ignite the environment.
The first fuse in the industry to be certified under the new UL 913 standard, the PICO® 259-UL913 Series offers a range of encapsulated fuses approved for Intrinsically Safe Electrical Equipment.

Ideal for use in the oil, gas, mining, chemical, and pharmaceutical industries, the 259-UL913 Series fuse was designed to limit the energy and heat generated during its operation. Applications include: testing, measuring, sensing equipment.

In addition to UL 913, these fuses meet ATEX and IECEx requirements in IEC 60079-0 and IEC 60079-11.

Sealed to contain the energy and heat of the fuse and prevent dust intrusion.

Example of a Fuse used in an intrinsically safe application.
Features and Customer Benefits

**Features:**

- Sealed, encapsulated design
- Well suited for 125V applications
- Current rating options from 62mA to 5A
- Designed for operation in a range of hazardous environments
- RoHS compliant

**Benefits:**

- The fuse encapsulation prevents heat and sparks from being exposed to the hazardous gases in the environment
- Eliminates the need for an additional potting, epoxy, or encapsulation process for the fuse, thereby reducing total product cost
- Increases overall safety of the apparatus, which enhances protection of human life in hazardous operating environments