INTRINSICALLY SAFE PRESSURE SENSING IN HAZARDOUS APPLICATIONS

Part of the Suco Group

1. INTRODUCTION

In industrial applications, pressure sensors play a critical role in monitoring and controlling processes across various sectors, including oil and gas, chemical manufacturing, pharmaceuticals, and mining. Many of these environments present significant risks due to the presence of flammable gases, vapours, dusts, or fibres, which can ignite under certain conditions. In such hazardous locations, the principle of intrinsic safety (IS) becomes vital for ensuring the safe operation of electronic equipment, mitigating the risk of explosions, and protecting both personnel and assets.

We will explore the concept of intrinsic safety, with a focus on the use of pressure sensors in hazardous environments, looking at ATEX classifications for hazardous locations, the principles underlying intrinsically safe design, and the key considerations for implementing intrinsically safe pressure sensing solutions.

2. INTRINSIC SAFETY IN HAZARDOUS ENVIRONMENTS

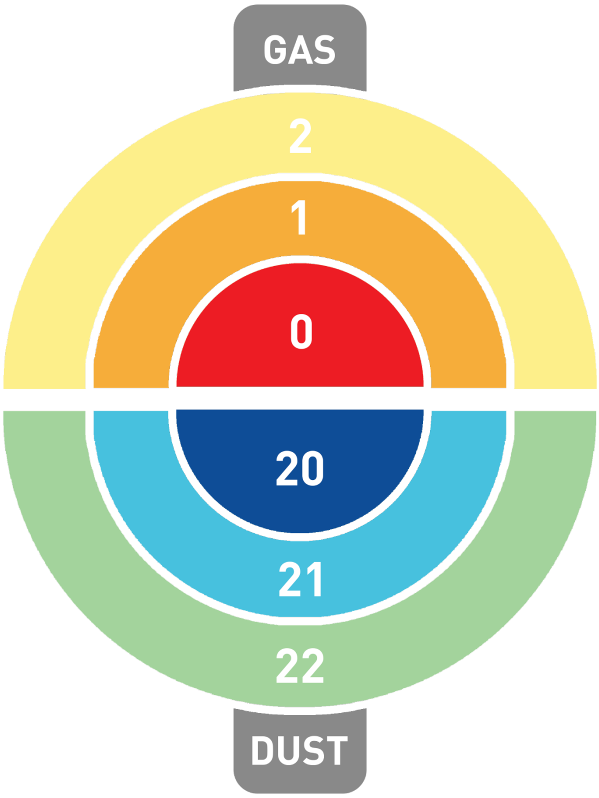
Intrinsic safety is a protection technique that ensures electrical and electronic equipment can operate safely in explosive atmospheres. It achieves this by limiting the energy available in the system to levels below those required to ignite the surrounding hazardous substances.

The core principles of intrinsic safety include energy limitation, circuit isolation, and temperature control. Devices are designed to operate with limited electrical energy, preventing sparks or heat from reaching ignition levels. Circuit isolation, often achieved through galvanic isolation or Zener barriers, further reduces the risk by restricting excess energy from reaching the hazardous area. Additionally, equipment is engineered to ensure surface temperatures remain below the auto-ignition temperature of the hazardous substances.

Intrinsic safety standards are governed by regulatory frameworks, with ATEX (derived from the French "Atmosphères Explosibles") being the primary standard in Europe.

2. ATEX CLASSIFICATIONS OF HAZARDOUS LOCATIONS

ATEX provides a systematic classification of hazardous locations based on the type and frequency of explosive atmospheres, in compliance with the ATEX directive 2014/34/EU, UK Regulations 2016 (UKSI 2016 No. 1107), and the relevant type approval standards EN IEC 60079-0 and EN 60079-11.



GAS ATMOSPHERES

Zone 0 refers to areas where an explosive gas atmosphere is present continuously or for long periods.

Zone 1 covers areas where such atmospheres are likely to occur during normal operations.

Zone 2 refers to areas where explosive gas atmospheres are unlikely to occur, but, if they do, will persist for a short period.

DUST ATMOSPHERES

Zone 20 includes areas where combustible dust is present continuously or for long periods.

Zone 21 applies to areas where such dust is likely to occur during normal operations.

Zone 22 pertains to areas where combustible dust is unlikely but can persist briefly if it does occur.

Equipment classifications are further divided into **Group I**, for underground mining applications involving methane and coal dust, and **Group II**, for surface industries.

Group II equipment is subdivided into three categories:

Category 1, suitable for the highest risk areas (Zone 0 and Zone 20).

Category 2, designed for intermediate risk areas (Zone 1 and Zone 21).

Category 3, intended for lower risk zones (Zone 2 and Zone 22).

ATEX also defines temperature classes, ranging from T1 to T6, which indicate the maximum surface temperature of equipment. For example, T1 devices must not exceed 450°C, whereas T6 devices are limited to 85°C.

4. IECEX CERTIFICATION

The IECEx (International Electrotechnical Commission System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres) is an international certification system that provides a global framework for ensuring the safety of equipment used in explosive atmospheres. It harmonises standards across countries, facilitating international trade and simplifying compliance for manufacturers.

IECEx certification confirms that equipment meets stringent safety requirements, including limiting energy and controlling surface temperatures to prevent ignition in hazardous environments. The system includes testing, quality assessment, and certification for equipment, personnel competence, and repair facilities, ensuring consistency and reliability worldwide. Its global reach complements regional standards like ATEX, making IECEx crucial for industries operating across international markets.

5. PRESSURE SENSORS IN HAZARDOUS APPLICATIONS

Pressure sensors are indispensable in monitoring system parameters such as fluid or gas pressure, ensuring the safe and efficient operation of industrial processes. In hazardous environments, they must meet stringent requirements to prevent ignition. These sensors find applications in oil and gas for monitoring wellhead pressures, pipeline integrity, and gas storage. In the chemical and pharmaceutical industries, they ensure correct pressure levels in reactors, distillation columns, and storage tanks. In mining, pressure sensors monitor hydraulic pressures and ventilation systems, while in the food and beverage industry, they measure pressure in production lines handling volatile or flammable substances.

The design of intrinsically safe pressure sensors involves careful material selection, such as using non-sparking materials and corrosion-resistant alloys for sensor housings. Compliance with ingress protection (IP) ratings ensures that dust or moisture does not compromise the device. Energy limitation is achieved through low-power electronics and energy-limiting circuits, while thermal management ensures that surface temperatures remain below ATEX limits. Electrical isolation, through techniques like galvanic isolators or Zener barriers, is critical to prevent high-energy faults. Compliance with ATEX and IECEx standards and verification by notified bodies ensures adherence to IS requirements.

6. BENEFITS OF INTRINSICALLY SAFE PRESSURE SENSORS

The use of intrinsically safe pressure sensors offers enhanced safety by minimising the risk of ignition in explosive atmospheres. They ensure regulatory compliance by meeting international standards for hazardous area equipment, provide reliable performance even in challenging conditions, and offer cost-effective solutions with simplified installation and maintenance compared to explosion-proof equipment.

7. CONCLUSION

Intrinsically safe sensing is a cornerstone of safety in hazardous environments, enabling the use of electronic pressure sensors without compromising safety.

By adhering to ATEX classifications, leveraging robust design principles, and prioritising certification, industries can ensure reliable and safe operation in explosive atmospheres.

As industrial processes become increasingly automated, the role of intrinsically safe pressure sensors will continue to grow, underscoring their importance in achieving both safety and operational excellence.

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