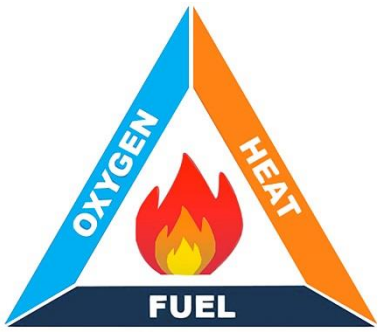
# UNDERSTANDING INTRINSIC SAFETY

APPLICATION NOTE EXPMN-017 (US)

Many industries generate, use, or store flammable materials that can create a hazardous atmosphere if conditions are not properly controlled. Portable equipment used in these environments could cause an explosion if internal circuits create a spark or enough heat to become a source of ignition when a flammable atmosphere is present. To prevent injuries due to fires and explosions, portable electronic equipment must be properly designed and certified for use in atmospheres that can potentially contain hazardous materials.

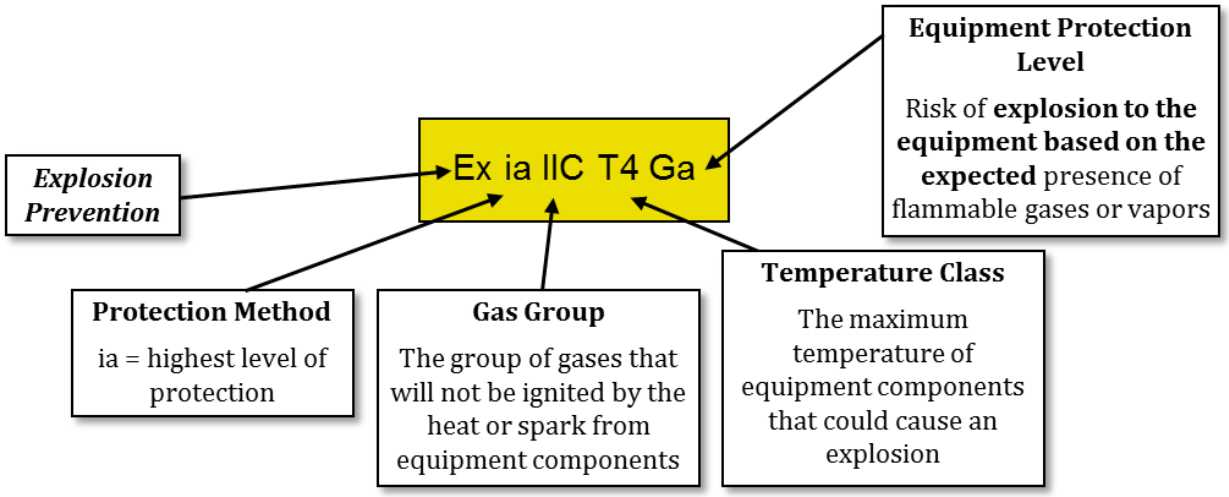
The essence of intrinsic safety design involves eliminating the potential source of ignition associated with equipment.

Intrinsic safety standards mandate design and testing criteria for equipment intended for use in hazardous atmospheres. The essence of intrinsic safety design involves eliminating the source of ignition associated with equipment function or failure. Engineers accomplish this by designing the equipment to limit the energy of a potential spark and the temperatures of any surfaces to less than the temperature or energy necessary to ignite gases or vapors present in the atmosphere.




A fire is prevented by "eliminating a side of the fire tetrahedron." Intrinsic Safety design prevents explosions by eliminating the source of ignition. All components are designed to ensure no heat or sparks above the rated temperature will occur that could ignite gases or vapors.

The Intrinsic Safety Rating marked on a product is a series of codes that explains what level of hazardous atmosphere the instrument has been tested to safely perform in. Here is an example.




## IEC Definitions

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|---|---|
| **IEC** | ***International Electrotechnical Commission***—this is the organization that established the testing standards that are recognized and adopted around the world. |
| **Ex** | This mark means the equipment is designed for use in potentially explosive atmospheres. |
| **ia** | ***Equipment Protection Level***—referring to the level of protection designed into protective components and circuits.<br>**"ia" "Very High" protection—safe after two consecutive malfunctions.**<br>"ib" "High" protection—safe after one malfunction<br>"ic" "Normal" protection—safe under normal operating conditions. |

| Type of Protection | Concept | Protection Method |
|---|---|---|
| Intrinsic safety | Limit Energy of sparks and surface temperature | **Ex ia**<br>Ex ib<br>Ex ic |

| | |
|---|---|
| **IIC** | ***Gas Group*—**Roman numeral IIC is the gas group for the most explosive gas, acetylene. Equipment rated for Group IIC can also be used in atmospheres with less explosive gases in Group I, IIA, and IIB. |

| Gas Group Classification | | |
|---|---|---|
| **IEC** | | **CSA – North America** |
| **Group I** | Mines where combustible dusts or ignitable fibers and flyings are present continuously or for long periods of time. | Class I Flammable Gases |
| **Group II** | Atmospheres other than mines | |
| **IIA** | Atmospheres containing propane, acetone, benzene, butane, methane, petrol, hexane, paint solvents or gases and vapors of equivalent hazard. | |
| **IIB** | Atmospheres containing ethylene, propylene oxide, ethylene oxide, cyclopropane, ethyl ether, or gases and vapors of equivalent hazard. | |
| **IIC** | Atmospheres containing acetylene, hydrogen, carbon disulfide or gases and vapors of equivalent hazard. | |
| **Sub-Groups A, B, C, D** | Types of Gases (Flammable) | Class II Combustible Dusts |
| **Sub-Groups E, F, G** | Types of Combustible Dusts | |

| | |
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| **T4** | ***Temperature Class***—This refers to the auto ignition temperature of expected flammable gases or vapors in the atmosphere. A lower temperature indicates a more hazardous atmosphere because an explosion can occur more easily. The temperature class rating means the instrument can be used in atmospheres containing materials with auto ignition temperatures of that temperature class or atmospheres containing materials with higher auto ignition temperatures without causing an explosion. |

| Max Surface Temperature | T class |
|---|---|
| 450 °C | T1 |
| 300 °C | T2 |
| 200 °C | T3 |
| **135 °C** | **T4** |
| 100 °C | T5 |
| 85 °C | T6 |

| | |
|---|---|
| **Ga** | ***Equipment Protection Level (EPL)—***EPL indicates the risk of ignition intrinsic to the equipment, based on the possibility of the presence of flammable gases or vapors. Equipment Protection Level is independent from the type of protection adopted to make the instrument intrinsically safe. **Instruments with Equipment Protection Level Ga are intended for use in atmospheres that are expected to have the presence of flammable gases and vapors most of the time, like in a gasoline storage tank.** Equipment with the highest EPL of Ga, can also be used in lower EPL Zones that may not contain flammable materials. |

| Zone | Equipment Protection Level (EPL) |
|---|---|
| **0 – presence of flammable gases or vapors expected most of the time** | **Ga** |
| 1 – presence of flammable gases or vapors expected in rare situations | Gb |
| 2 – presence of flammable gases or vapors only during fault conditions | Gc |

**NOTE**: For simplicity, only Directives, Divisions, Zones, and Groups in the IEC, ATEX, IECEx, CSA, and DL schemes are references in this document. There are many more components of these schemes that apply to electronic instruments for use in explosive environments.

### What is IECEx?

IECEx is an internationally accepted Conformity Mark designating that an electronic instrument conforms with the International Electronics Certification for equipment used in Explosive Environments. Requirements are very similar to ATEX requirements. Equipment manufacturers can often use IECEx certification to obtain the ATEX marking with no additional testing requirements.

### What is ATEX?

ATEX is a combination of European Union directives related to the safety of equipment and the use of this equipment. To protect people working in potentially hazardous atmospheres, all equipment with a potential ignition source must meet design requirements specified by 94/9/EC. European countries that have adopted ATEX require all equipment be designed to comply with these requirements as minimum health and safety requirements.

Equipment sold in the European Union for use in hazardous atmosphere must have ATEX rating and bear the ATEX mark.

### What is CSA?

CSA is the Canadian Standards Association, a non-profit association that develops public safety standards for business, industry and governments around the world. CSA is a Nationally Recognized Testing Laboratory, which means they serve as an independent review to ensure equipment passes required certification for use in hazardous atmospheres and other safety requirements. In the United States, the Occupational Safety and Health Administration (OSHA) considers the CSA mark to qualify as an alternative to the UL mark.

### What is UL?

Underwriters Laboratory (UL) is the world's largest non-profit product safety testing and certification organization. In the US, the UL mark is recognized as the stamp of approval that the equipment meets basic safety design requirements.

## How is Intrinsic Safety Rating Achieved?

Manufacturers of electronic instrumentation submit instruments to certified testing agencies for Intrinsic Safety Certification. These certified agencies follow the testing criteria set by the International Electrotechnical Commission (IEC) or other standard committees. If the instrument passes the testing criteria, a "certificate of conformance" is issued that proves the instrument meets or exceeds the established test criteria. Only instrument designs that have these certificates of conformance can be labeled with the respective intrinsic safety labeling on the instrument case.

See Application Note EXPMN-016–"SidePak AM520i Personal Aerosol Monitor Intrinsic Safety Rating". For further information visit www.tsi.com/IntrinsicSafety.





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