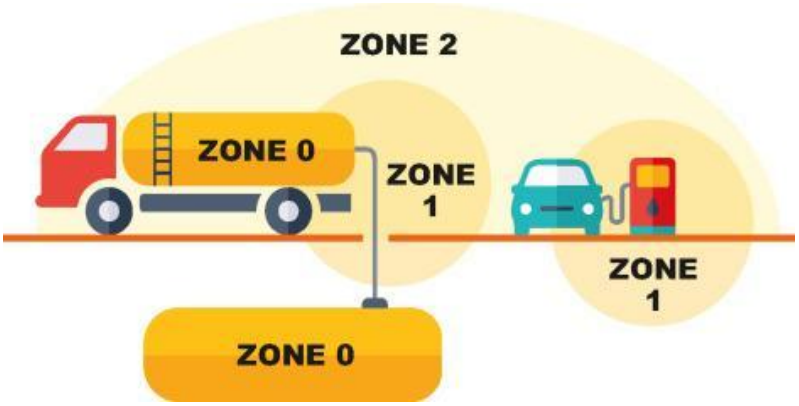
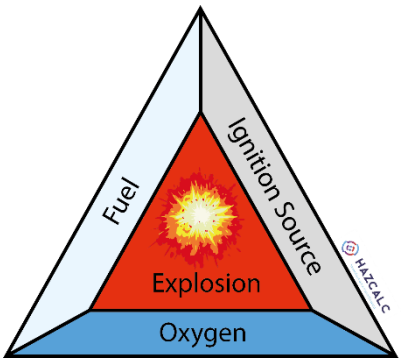
5.5 Ex Zones

Its very important to unedrstand **hazardous area classifications** and **equipment protection methods** in the context of explosive atmospheres (**EX zones**) is crucial for ensuring safety in industries such as oil and gas.





1. Hazardous Area Classification

Gas Zones

- **Zone 0**: Explosive gas atmosphere is continuously present or for long periods. Examples: inside process vessels or equipment where gas is continuously present.
- **Zone 1**: Explosive gas atmosphere is likely to occur occasionally. Examples: areas close to flanges, valves, gas chromatography, and connections where leaks, flow out or blowdown may happen during normal operations.
- **Zone 2**: Explosive gas atmosphere is not likely to occur, but seldom, if it does, it will be only for a short period. Examples: surrounding areas where leaks disperse quickly.

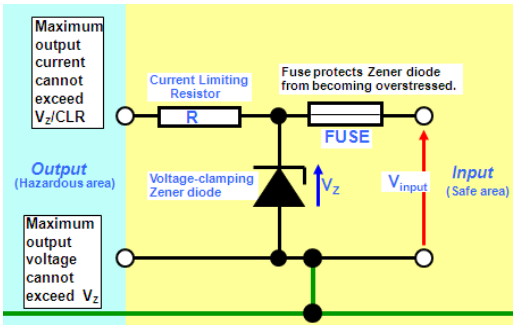
Dust Zones

- **Zone 20**: Combustible dust cloud is present continuously or for long periods. Examples: inside silos or hoppers where dust accumulates.
- **Zone 21**: Combustible dust clouds are likely to occur occasionally. Examples: areas around dust-generating equipment like mills or grinders.
- **Zone 22**: Combustible dust cloud is not likely to occur, but seldom, if it does, it will be for a short period. Examples: areas where dust might settle but can be disturbed.

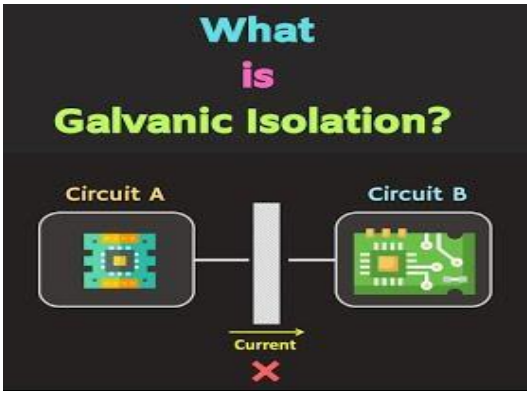
2. Intrinsically Safe (IS)

Intrinsic safety (IS) is a protection technique used to ensure that electrical and electronic equipment can operate safely in hazardous areas by limiting the energy available for ignition. Equipment is designed to operate with power levels below the threshold that could cause ignition, achieved through:

- **Energy Limitation**: The core of IS design is to ensure that the energy levels in the circuits are low enough to prevent ignition. This involves strict control over voltage and current levels.
- **Safety Barriers**: Devices called intrinsic safety barriers are used to limit the energy entering the hazardous area. These barriers can be Zener barriers or isolators.
    - **Zener Barriers**: Use Zener diodes, resistors, and fuses to limit voltage and current.



    - **Isolators**: Provide **galvanic** isolation between safe and hazardous areas, preventing energy transfer that could cause ignition.



- **Redundancy and Fault Tolerance**: IS systems often incorporate redundant safety measures to ensure that a single fault does not lead to hazardous conditions. This includes double fault tolerance designs.

Type of Protection Method	Equipment Code	Description	International Standard	Suitable for Zones
Intended to prevent a potential ignition arising	Ex e	Increased safety	IEC 60079-7	1, 2
	Ex nA	Type -n protection	IEC 60079-15	2
Intended to limit the ignition energy of the equipment	Ex ia	Intrinsic safety 'ia'	IEC 60079-11	0, 1, 2
	Ex ib	Intrinsic safety 'ib'	IEC 60079-11	1,2
	Ex ic	Intrinsic Safety 'ic'	IEC 60079-11	2
	Ex nL	Type -n protection	IEC 60079-15	2
Intended to prevent the explosive atmosphere contacting the ignition source	Ex p	Purge/pressurized protection	IEC 60079-2	1, 2
	Ex px	Purge/pressurized protection 'px'	IEC 60079-2	1, 2
	Ex py	Purge/pressurized protection 'py'	IEC 60079-2	1, 2
	Ex pz	Purge/pressurized protection 'pz'	IEC 60079-2	2
	Ex m	Encapsulation	IEC 60079-18	1, 2
	Ex ma	Encapsulation	IEC 60079-18	0, 1, 2
	Ex mb	Encapsulation	IEC 60079-18	1, 2
	Ex o	Oil immersion	IEC 60079-18	1, 2
	Ex nR	Type -n protection	IEC 60079-15	2
Intended to prevent an ignition from escaping outside the equipment	Ex d	Flameproof protection	IEC 60079-1	1, 2
	Ex q	Sand / powder (quartz) filling	IEC 60079-5	1, 2
	Ex nC	Type -n protection	IEC 60079-15	2
Special	Ex s	Special protection	See IEC 60079-0	0, 1, 2

3. Equipment Protection Methods

Explosion-Proof (Ex d)

- **Ex d**: Equipment with this designation is designed to suppress an explosion within its housing and prevent the transmission of the explosion to the surrounding atmosphere or any escaping flames would be cooled by the flame path. This method is suitable for Zone 1 and 2 areas.

Increased Safety (Ex e)

- **Ex e**: (e stands for impact resistant enclosure) Equipment designed with enhanced safety features to prevent the occurrence of sparks or excessive temperatures. This method does not allow the occurrence of arcs or sparks in normal service conditions and provides increased mechanical strength and improved insulation, Equipment that normally causes sparks is excluded from use within this method of explosion protection.

Other Types of Protection

- **Pressurized Enclosure (Ex p)**: Keeps the interior of the enclosure or room at a pressure higher than the surrounding atmosphere, preventing the entry of explosive gases. Often used for large electric motors or large control cabinets containing switchgear or circuit boards.
- **Oil Immersion (Ex o)**: The basic principle is to immerse the electrical parts in mineral oil, which will prevent any exposure of the arcing or sparking to an explosive atmosphere. It will also quench arcs and limit the temperature rise on electrical parts.
- **Encapsulation (Ex m)**: Ex m or Encapsulation is an explosion protection concept where electrical equipment that could potentially cause an ignition is encapsulated within a compound or resin so as to prevent contact with the explosive atmosphere.
- **REDUCED RISK (Ex n)**: Ex n or Reduced Risk protection is a standard of explosion protection applied to electrical equipment used in hazardous areas such that, in normal operating circumstances and in certain specified abnormal conditions, it is not capable of igniting a surrounding explosive atmosphere.
- **Powder Filled (Ex q):** Standard of explosion protection states that all equipment that has the potential to arc is contained within an enclosure filled with sand, quartz or glass powder particles.
- **Intrinsic Safety (Ex i)**: As mentioned beforehand, limiting energy to prevent ignition.
    - There are two main sub types to Ex i Intrinsic Safety protection, these being “ia” and “ib”, used for the classification of equipment intended for use in hazardous area locations and explosive atmospheres.
    - Type “ia” Intrinsic Safety protection allows for the occurrence of two faults during operation.
    - Type “ib” explosion protection allows for the occurrence of one fault during operation.

Reference:
[https://www.heatingandprocess.com/product/product-category/ex-i-intrinsic-safety-explosive-atmospheres-explosion-proof-protection-concepts/]

4. Industry Applications

Oil and Gas Industry

- **Offshore Platforms**:
    - **Zone 1**: Near wellheads, drilling areas, and processing units where gas release is expected during operations.

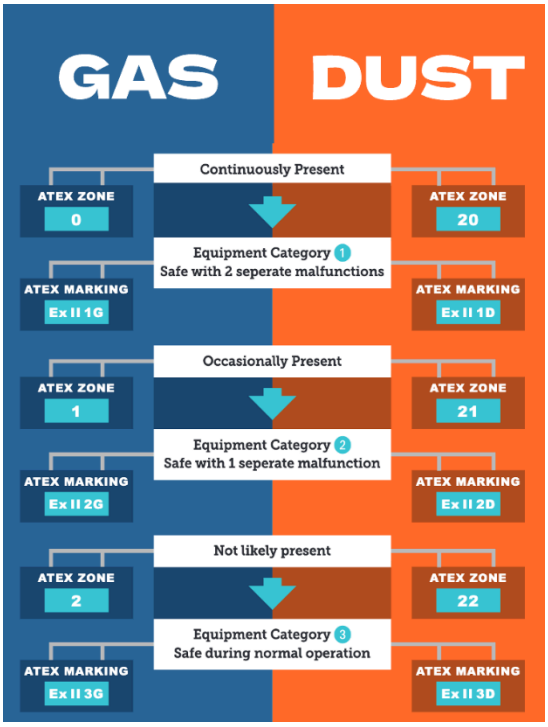
    - **Zone 2**: Surrounding piping, storage areas, chromatography, and locations where gas might disperse quickly.
    - **Safe Zones**: Control rooms, living quarters, and technical rooms where explosive atmospheres are not expected.
- **Refineries and Petrochemical Plants**:
    - **Zone 0**: Inside process vessels and tanks.
    - **Zone 1**: Around pumps, compressors, and areas where leaks are expected.
    - **Zone 2**: Surrounding equipment, maintenance areas, and zones where gas presence is rare.

5. Certification Processes

Equipment used in hazardous areas must be certified to ensure compliance with safety standards. Two main certification systems are widely recognized:

ATEX (EU)

- **Directive 2014/34/EU**: Regulates equipment and protective systems for explosive atmospheres within the EU.
- **ATEX Certification**: Products must undergo rigorous testing and compliance checks by notified bodies.
- **Marking**: Certified equipment is marked with the EX symbol and relevant zone information (e.g., II 1G Ex d IIC T4 for Zone 1 gas environments).
- **Diagram below**:

- 

IECEx (International)

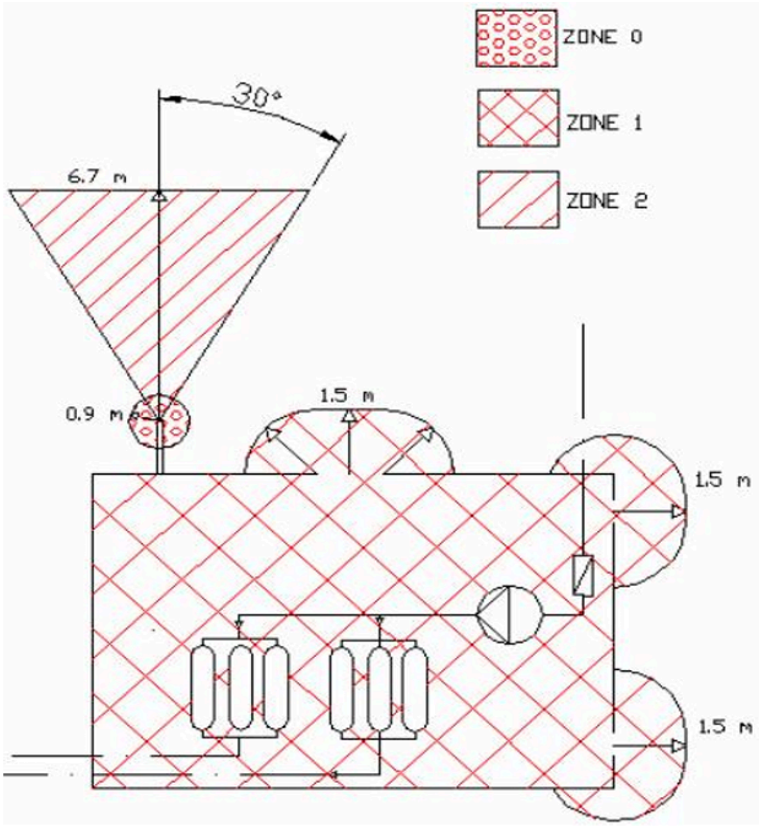
- **IECEx System**: Provides a globally recognized certification for equipment used in explosive atmospheres.
- **Certification**: Products are tested and certified according to IEC standards.
- **Marking**: Similar to ATEX, with detailed markings indicating the protection method and applicable zones.

6. Zoning Diagrams and Visual Representations

Visual zoning diagrams clarify the layout and extent of hazardous areas. These diagrams typically show:

- **Boundaries**: Clear marking and mapping of different zones (0, 1, 2 for gas and 20, 21, 22 for dust).
- **Potential Sources of Release**: Identifying equipment and locations where explosive atmospheres might originate.
- **Safe Areas**: Blanked or Highlighting areas deemed non-hazardous.

Example of a Zoning Diagram



For example, an offshore platform with the following layout:

- **Zone 0**: Inside certain process equipment or tanks.
- **Zone 1**: Around drilling rigs, near wellheads, chromatigraphy, and processing areas.
- **Zone 2**: Piping systems, storage areas, and maintenance zones.
- **Safe Zones**: Control rooms, quarters platform, and technical rooms.

7. References for Further Reading

- **ATEX Directive**: EU Law
- **IECEx System**: IECEx Official Site
- **National Electrical Code (NEC) Articles on Hazardous Locations**: NFPA