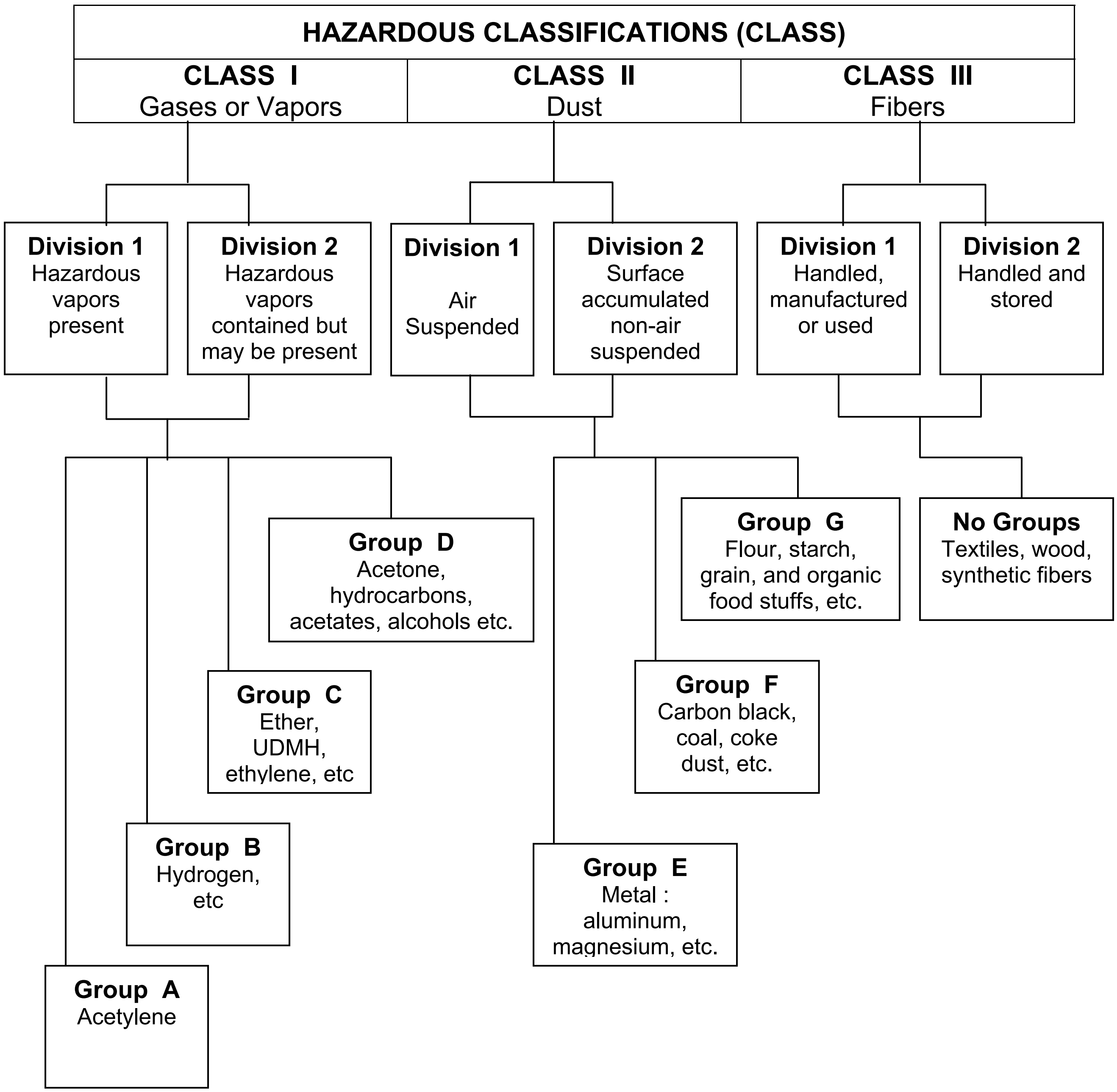
GENERAL NOTES ON CLASSIFICATION OF HAZARDOUS LOCATION

(IN ACCORDANCE WITH ARTICLE 500; AMERICAN NATIONAL ELECTRICAL CODE- 1984)



Wiring in Class I Locations

Note: See National Electrical Code for description and use of wiring systems. Division O wiring is not presently required by National Electrical Code. Divisions 1 and 2 wiring per 1975 National Electrical Code. Division O requirement are provisional recommendations only and do not represent a proposed standard.

Wiring System	Division O		Division 1		Division 2	
	Intrinsically Safe	Not Intrinsically Safe	Intrinsically Safe	Not Intrinsically Safe	Intrinsically Safe	Not Intrinsically Safe
Threaded rigid metal conduit: Explosion proof wiring	A	See Notes 1 or 2	A	A	A	A
Flexible metal fitting: explosion proof type	A	See Notes 1 or 2	A	A	A	A
Type MI cable	A	See Note 2b	A	A	A	A
Type ALS, CS, MC, SNM, TC Cable	A	NA	A	NA	A	A
Flexible metal conduit	A	NA	A	NA	A	Aa
Liquid tight flexible metal conduit	A	NA	A	NA	A	Aa
Electrical metallic tubing	A	NA	A	NA	A	See Note 2
Intermediate metal conduit	A	NA	A	NA	A	See Note 2
Flexible cord	A	NA	A	See Note 3c	A	Aac
Other recognized rigid raceway and wireways suitable for wiring in non-Hazardous locations	A	NA	A	NA	A	NAd
Any other wiring method suitable for non-hazardous locations	A	NA	A	NA	A	NAd

A – Acceptable; NA – Not acceptable : a – Acceptable only where flexibility needed; b – Acceptable only with termination fittings approved for Class1.Division 1 locations of the proper group; c – Extra hard usage type only acceptable; d – Acceptable using any wiring method suitable for wiring in non-hazardous locations if circuit confirms to Note 2.

Note 1 – Acceptable if entire conduit system and all enclosures purged and pressurized. Type X purging. Acceptable if entire conduit system and all enclosures purged and pressurized. Type Y purging and circuit has no ignition capable parts (arcing, sparking or high temperature) under normal operating conductions (see NFPA 496)

Note 2 Acceptable if circuit, under normal operating conditions, cannot release sufficient energy to ignite hazardous atmospheric mixture when any conductor opened, shorted to ground, or shorted to any other conductor in same cable or raceway.

Note 3 Acceptable only on approved portable equipment where provisions made for cord replacement.

Wiring in Class II Locations

Note : See National Electrical Code for description and use of wiring systems.

Wiring System	Division 1		Division 2	
	Intrinsically Safe	Not Intrinsically Safe	Intrinsically Safe	Not Intrinsically Safe
Threaded rigid metal conduit: Dust-ignition-proof wiring	A	A	A	A
Flexible metal fittings: dust-ignition-proof type	A	A	A	A
Type MI Cable	A	Ab	A	A
Type MC Cable	Ac	NA	A	A
Types ALS, CS, SNM and TC cables	A	NA	A	Ad
Flexible metal conduit	Ac	NA	A	Aa
Liquid tight flexible metal conduit	A	Aa	A	Aa
Intermediate metal conduit	A	NA	A	NA
Flexible cord	Af	Aa,e,f	A	Aae
Dust-tight wire ways and raceways	A	NA	A	A
Any other wiring method suitable for non-hazardous locations	Af	NA	A	NA

A – Acceptable:

NA – Not acceptable

a – Acceptable only where flexibility needed;

b – Acceptable only with termination fittings approved for class II, Division 1 locations of the proper group;

c – Not acceptable when electrically conductive dusts will be present.

d – Type TC cable not acceptable;

e – Extra hard usage type only acceptable;

f – Acceptable only with dust-tight seals at both ends when electrically conductive dusts will be present.

CLASSIFICATION OF HAZARDOUS LOCATION IN EUROPE

- In Europe the classification has been adopted as per IEC-79-1. According to this classification, the hazardous locations have been divided into 3 zones as given below:

ZONE – 0 :

- An area in which the explosive air/gas mixture is continuously present or present for a long period.

ZONE – 1

- An area in which an explosive air/gas mixture is likely to occur in normal operation.

ZONE – 2

- An area in which the explosive air/gas mixture is not like to occur, but, if it does, only for short period.

CLASSIFICATION OF HAZARDOUS AREA IN INDIA (IS 5572)

- In India the classification of hazardous locations are divided into 3 main divisions which are mainly based on IEC 79-1 as Division – 0, Division – 1 and Division – 2.

DIVISION – 0

- An area in which hazardous atmosphere is continuously present. This classification is applicable only where it is expected that hazardous atmosphere will exists continuously.

DIVISION – 1

- An area in which hazardous atmosphere is likely to occur under normal operating conditions. This classification is applied to area in which the hazardous atmosphere is likely to occur at any time.

DIVISION – 2

- An area in which hazardous atmosphere is likely to occur only under abnormal operating conditions.

DIFFERENCE BETWEEN EUROPIAN, AMERICAN AND INDIAN PRACTICES IN RESPECTS OF HAZARDOUS LOCATIONS

Intermittent	**Continuous Hazard**	**Intermittent Hazard**	**Abnormal condition Hazard**
IEC/EUROPE	ZONE 0	ZONE 1	ZONE 2
USA/CANADA	DIVISION - 1		DIVISION – 2
INDIAN	DIVISION – 0	DIVISION - 1	DIVISION – 2

Intrinsic Safety

Now a days Intrinsic Safety is more relevant as BHEL is involved more in Gas Turbine based projects where safety is of paramount importance.

METHOD OF EXPLOSION PROTECTION

To enable electrical equipment to be used safely in such environments, different explosion protection techniques have been developed over the years. National, or in some cases international, standards and codes of practice govern each technique and define in detail how the equipment should be designed and applied. National certifying authorities ensure design compliance and national inspectorates have the right to vet each installation. All explosion protection equipment located in a hazardous area has been classified according to the maximum surface temperature that it can produce.

Though there are different protection techniques for different applications, the familiar ones are:

1. Explosion proof enclosure technique
2. Segregation technique viz.

a) Pressurization

b) Encapsulations

3. Prevention technique of limiting thermic and electrical energy to safe level. (Intrinsic Safety)

Techniques 1 and 2 are familiar methods of preventing sparking or heating in electrical equipment from causing explosion. However, technique 3 (intrinsic safety) relates to the entire electrical circuit and is generally limited to application in process measurements and control system and also lowest cost technique.

PRINCIPLE OF INTRINSIC SAFETY:

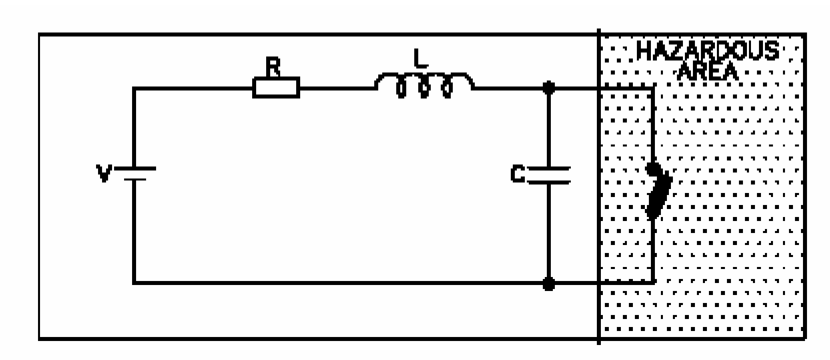


fig.1

Intrinsic safety (IS) is based on the principle of restricting the electrical energy available in hazardous area circuit such that any sparks or hot surfaces that may occur as a result of electrical faults are too weak to cause ignition. i.e. energy that can be released by circuit must be lower that the minimum ignition energy of the air/gas mixture present in the hazardous location. No matter how complex an electrical circuit, i.e. resistive or inductive or capacitive or combination of all, if the circuit satisfies the safety criteria, the circuit can be considered intrinsically safe. All the Intrinsic Safety equipment is designed and certified as being safe for a particular group of gases.

INTRINSIC SAFETY PRACTICE:

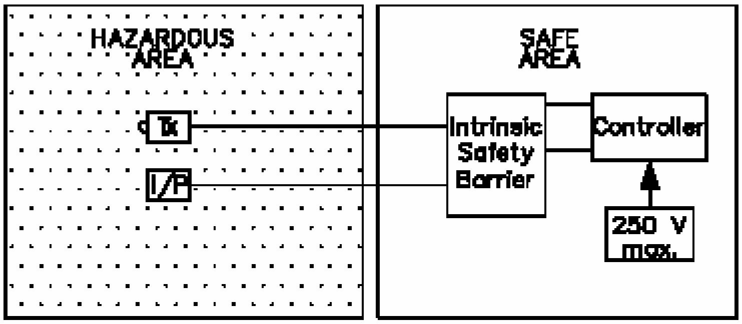


fig 2

Intrinsic Safety Practice involving safe and hazardous area equipment is achieved through a separate IS interface. The rules governing how these instruments and devices interconnected and installed are similar (though not identical) in all countries.

INTRINSIC SAFETY BARRIERS:

"Barriers" can be two types:

- Passive barriers or Diode Safety Barriers
- Active barriers or Galvanically Isolated Safety Barriers

PASSIVE BARRIERS:

Passive barriers are very simple from a circuit point of view. (Fig 2)

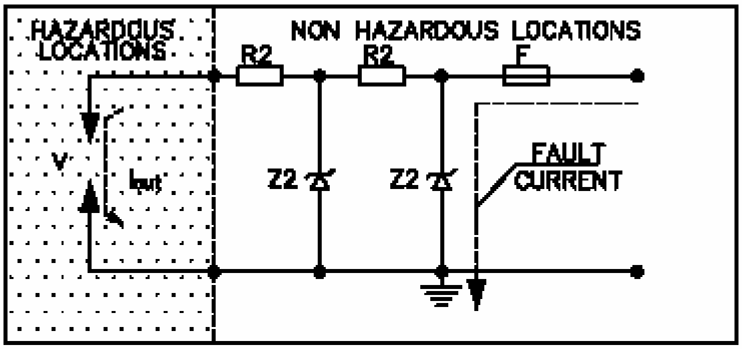


fig 3

Zener diodes Z1 and Z2 limit the no load voltage output of the barrier to the value of the Z- Voltage plus tolerance. The fuse 'F' is selected to suit the current / Time characteristic of the Z diodes, so that under no circumstances can the actual loading on the diodes exceed 50% of their current rating. Based on the voltage limit of the diodes, resistor R2 limits the possible short circuit to an acceptable value (e.g. 150 m A at 25 V) R1 is a measurement resistance which has only a restricted influence on the function of the barrier it allows the integrity of the diodes to be checked, during factory quality control after encapsulation. The efficiency of the passive barriers in limiting the maximum energy toward the HAZARDOUS LOCATION depends on the integrity of the barrier ground connection.

The main advantages of the passive barriers are:

- Simple and reliable functioning

The disadvantages of the passive barriers are:

- Require an equipotent ground system
- The limiting resistor reduces the voltage available for the transmitter and introduces errors when connected to resistance temperature detectors.

ACTIVE BARRIERS

Galvanically isolated active barriers are power supplies or signal conditioners that transmit or receive signals from hazardous location in an isolated way. The main difference between a passive barrier and a galvanically isolated one is in the safety components used to obtain the isolation between the non-hazardous location and the circuit related to the intrinsic safety. The main advantages of active barrier compared to the passive barrier are:

- Ground system is not required
- Grounded sensors can be used
- Better measurement accuracy

Note:

Simple passive sensors (i.e. thermocouple, resistance detector, contacts, LED, etc.,) can be directly placed in hazardous location and do not require any certification. Energy storing or current /voltage Producing apparatus (i.e., transmitters, I/P, solenoid valve, etc.) used in hazardous location must be certified.