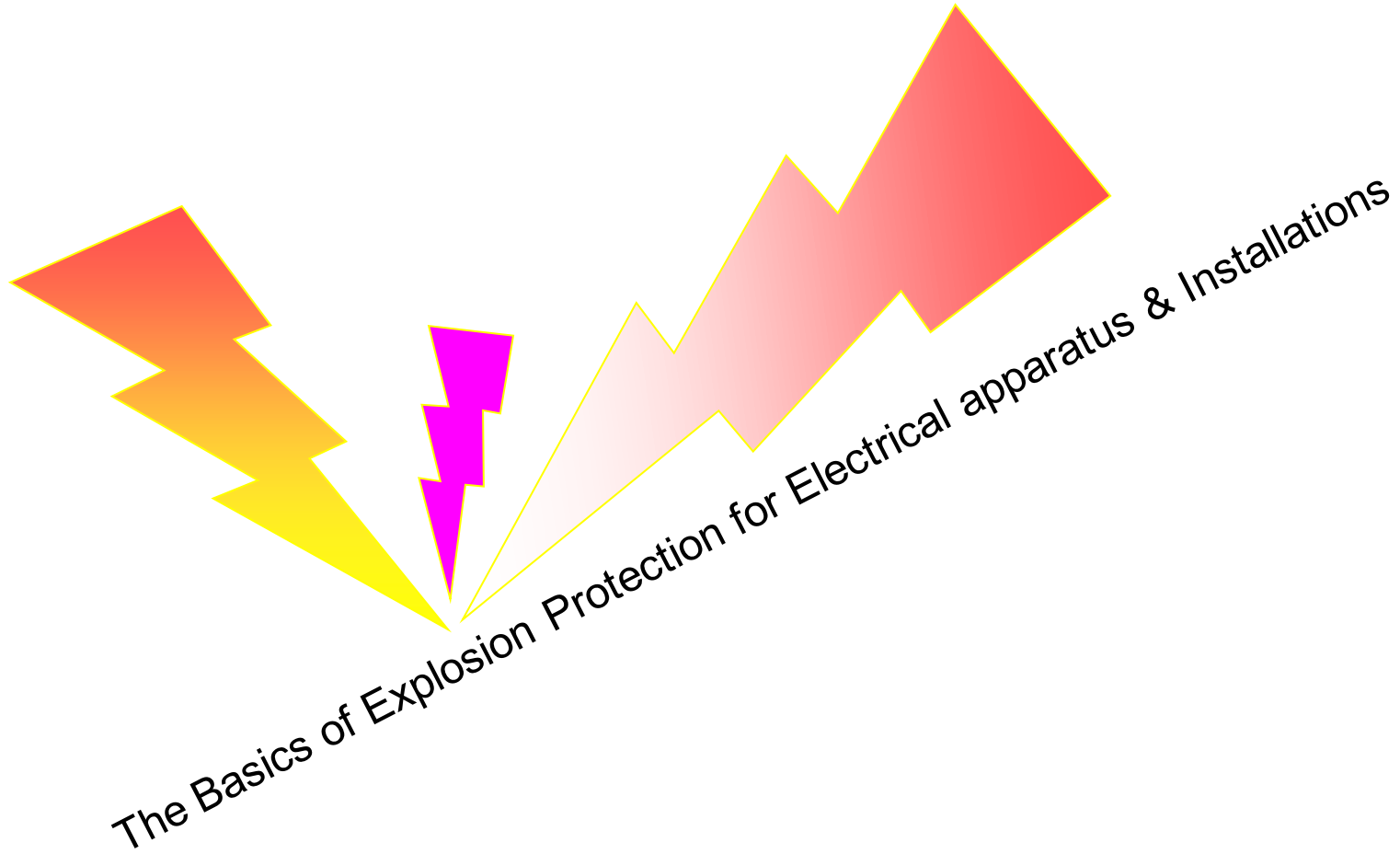


Art & Science of Ex



FLAMMABLE GAS / VAPOURS

Upper Explosive Limit

IGNITION

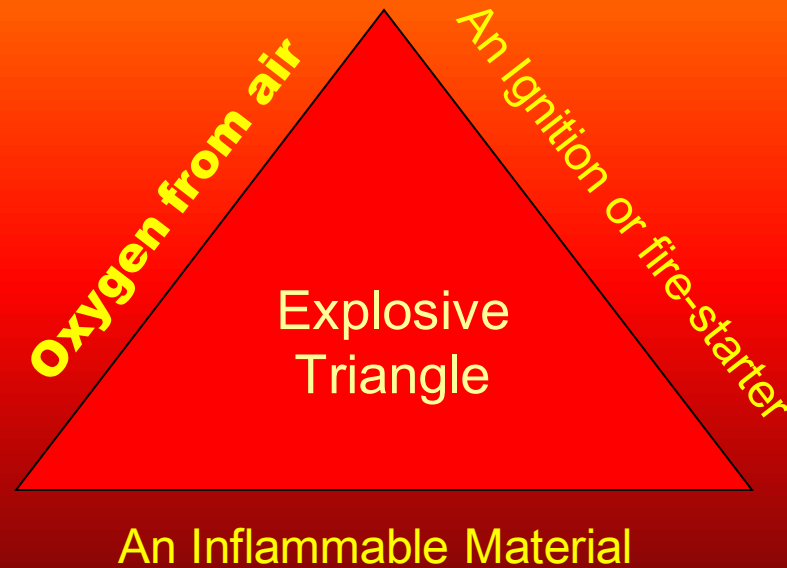
Lower Explosive Limit

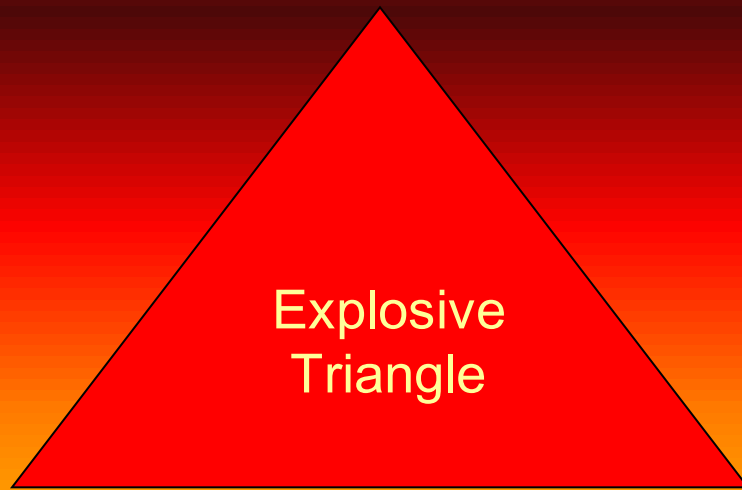
OXYGEN

(From air)

An EXPLOSION requires three elements

- 1 Flammable Material
- 2 Oxygen from air
- 3 An Ignition or fire-starter



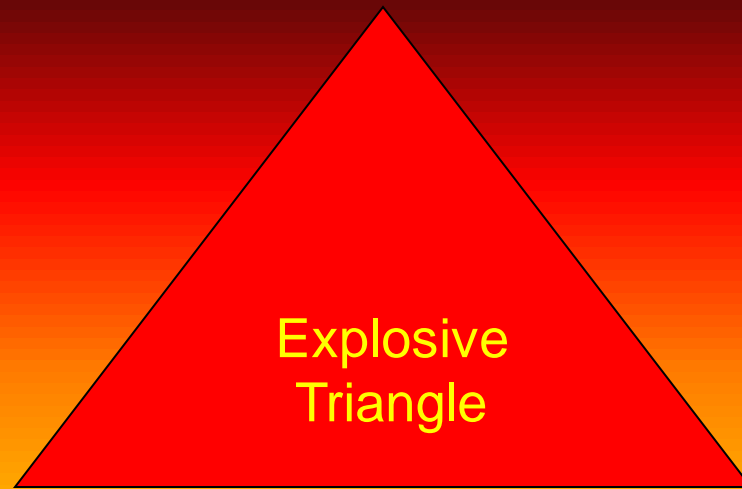


Explosive triangle is a way to harness the inherent energy by allowing its release through oxidization. This energy was packed millions of years ago inside the crucibles of cosmos.

This happens every time we use our motor car: ETs are deliberately created inside the internal combustion engine to get the required locomotion by TIMED and CONTROLLED explosions



It is the uncontrolled, uncontrollable, un-timed and thus unwanted Explosive Triangles which cause destruction and death.



WHAT Class (type) of Material

CLASS 1 inflammable material is in the form of GASES or LIQUIDS

CLASS 2 inflammable material is in the form of DUST or POWDER

CLASS 3 inflammable material is in the form of FIBRES or FLYINGS

HOW MUCH of the Material

This parameter is quantified indirectly by the magnitude of the TIME the ET remains present in a location

MORE MATERIAL LONGER LIFE (in case of ETS)

Simple Rule of Thumb is :

If an ET exists for more than 1000 Hours(>1000 / year) per year at a particular location then it is a HIGH RISK location and WE shall call it ZONE 0 for class 1

If an ET exists for more than 10 hours but less than 1000 Hours per year ($10 < \text{TIME} \leq \text{one year}$) at a particular location then it is a Moderate Risk location and WE shall call it ZONE 1 for class 1

If an ET exists for 10 Hours or less per year at a particular location then it is a Low RISK location and WE shall call it A ZONE 2 for Class 1

WE are the GOOD GUYS & WE are the GUARDIANS of the SPECIFICATIONS

WE are with

International Electro technical Commission IEC

Involvement with ET: Since 1947 (TC 31 was formed in 1948)

National Electrical Code NEC

Indirect involvement : Since 1897

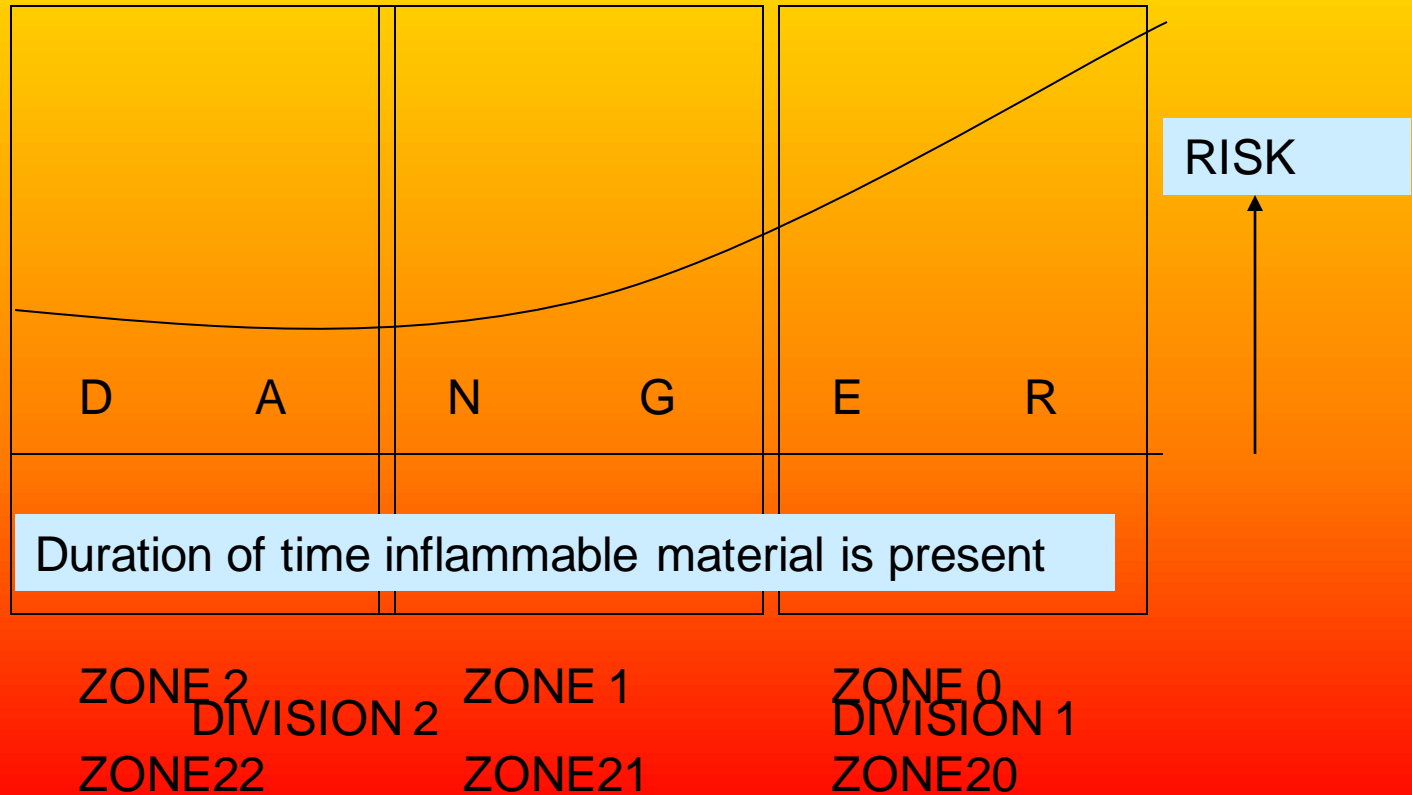
Direct involvement : 1920

There are many other authorized groups fully involved in research and development in this and related fields

Then there is the ever present silent majority.

The dedicated & self committed engineers

A constant source of valuable feed-back & innovation.



Obviously both of these authorized groups cover the whole dangerous domain of ET, but the approaches are a bit different.

The gases which form part of the ET have certain distinct properties which enable us to form GAS GROUPS.

The Legendary Group Leader is

METHANE

The explosive gas which is found in coal mines. The nightmare of the coal miners.

The fuel of our industry.

Colorless, odorless but explosive. This is the material which started the whole PHILOSOPHY and later the ART of explosion protection.

Its enormous hidden energy and ruthless manifestation in explosions and deaths of miners inspired Humphrey Davy and his contemporaries like George Stephenson to develop the

MINERS' SAFETY LAMP

That was in 1815 and later, some times after 1900 when ELECTRIC lamps & fixtures were installed in the mines, the humanitarian side of the ELECTRICAL ENGINEERING practices formed the EXPLOSION PROTECTION SCIENCE.

THIS IS THE HUMANITARIAN SIDE OF ELECTRICAL ENGINEERING

The unique parameters like Ignition Temperature, minimum ignition energy and other properties are defined in the GAS GROUPS.

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	NEC	A	B	C	D	Min	E	F	G
IEC					T5 100C				
I						Methane			
II A		T2 300C	T3 200C	T4 135C	Propane				
II B				Ethylene					
II C	T6 85C	Acetylene	T1 450C						

That was a brief analysis of the inflammable material; one side of the ET

Now let us look at the other two sides of the ET

One of the other side is OXYGEN which manifests itself as part of AIR. Nothing remarkable about it

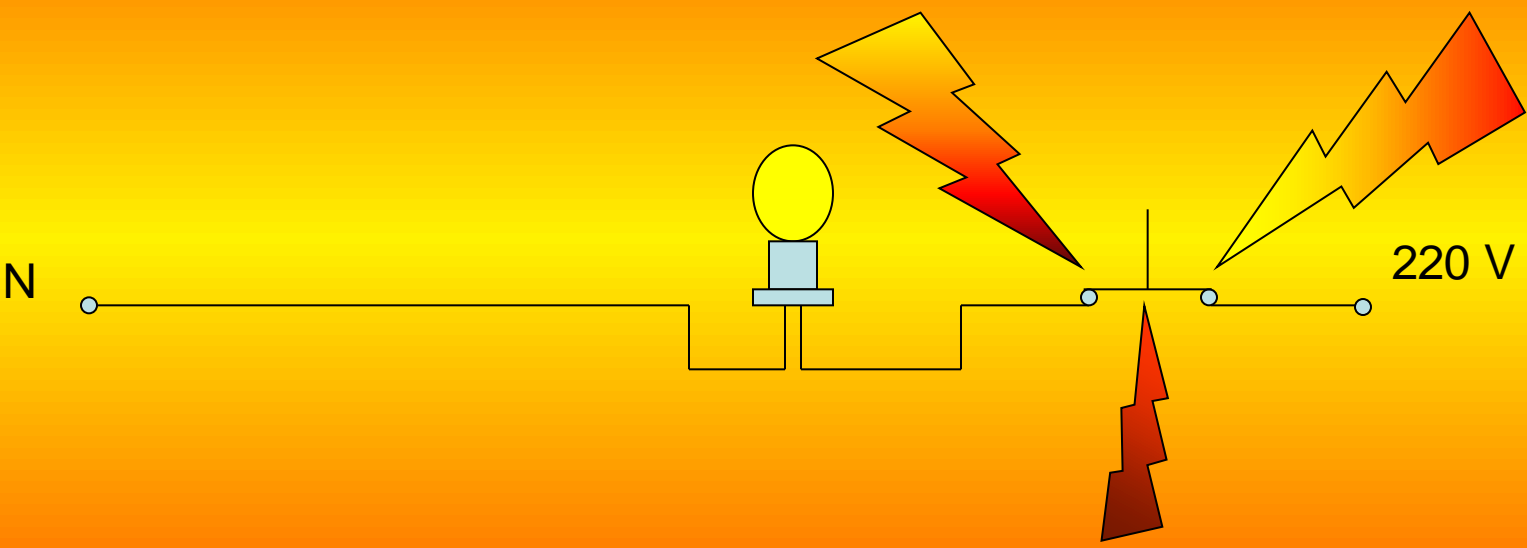
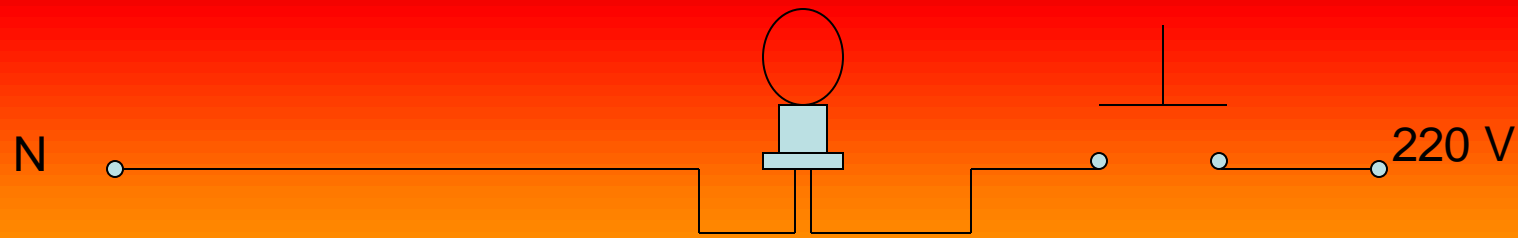
The remaining side is THE SOURCE OF IGNITION

THE FIRE STARTER

The list is long and on top of the list is

THE ELECTRIC SWITCH

Each time when switch is operated; spark appears



And thanks to years of research,
development, designing & testing

It usually **DISSAPEARS**

This is the account of the events which takes place inside an ordinary
switch

The strategy so far has been to know our the enemy. The Explosive Triangle, so that we may protect ourselves and our investments from destructive powers of ET

We can protect ourselves in two ways:

FIRST OR PRIMARY PROTECTION (first defense line)

BY not dealing with ETs at all-----by using substitute materials.

But this is not possible all the time-- for example there is no substitute for SUI GAS.

Another way is to keep the ET handling area as ventilated as possible, so that the mixture never reaches that critical concentration.

SECONDARY DEFENSE LINE

SECONDARY DEFENSE LINE

The underlying strategy is to first accept the fact that we have to use the flammable materials and Explosive triangles will definitely be formed to generate Hazardous Area

Electrical Side

Design & fabricate & use specially designed electrical components so that the ETs do not get a chance to form .

Since all of the electrical components are heat , and in turn FIRE Starters, so first of all let us control this inherent property.....

By

- Confinement / Enclosing
- Dilution
- Separation
- Defusing /reduction

The Hazardous Area

Definition : Technically a hazardous area is an industrial facility processing materials which may form explosive mixture with air and may cause explosion upon ignition

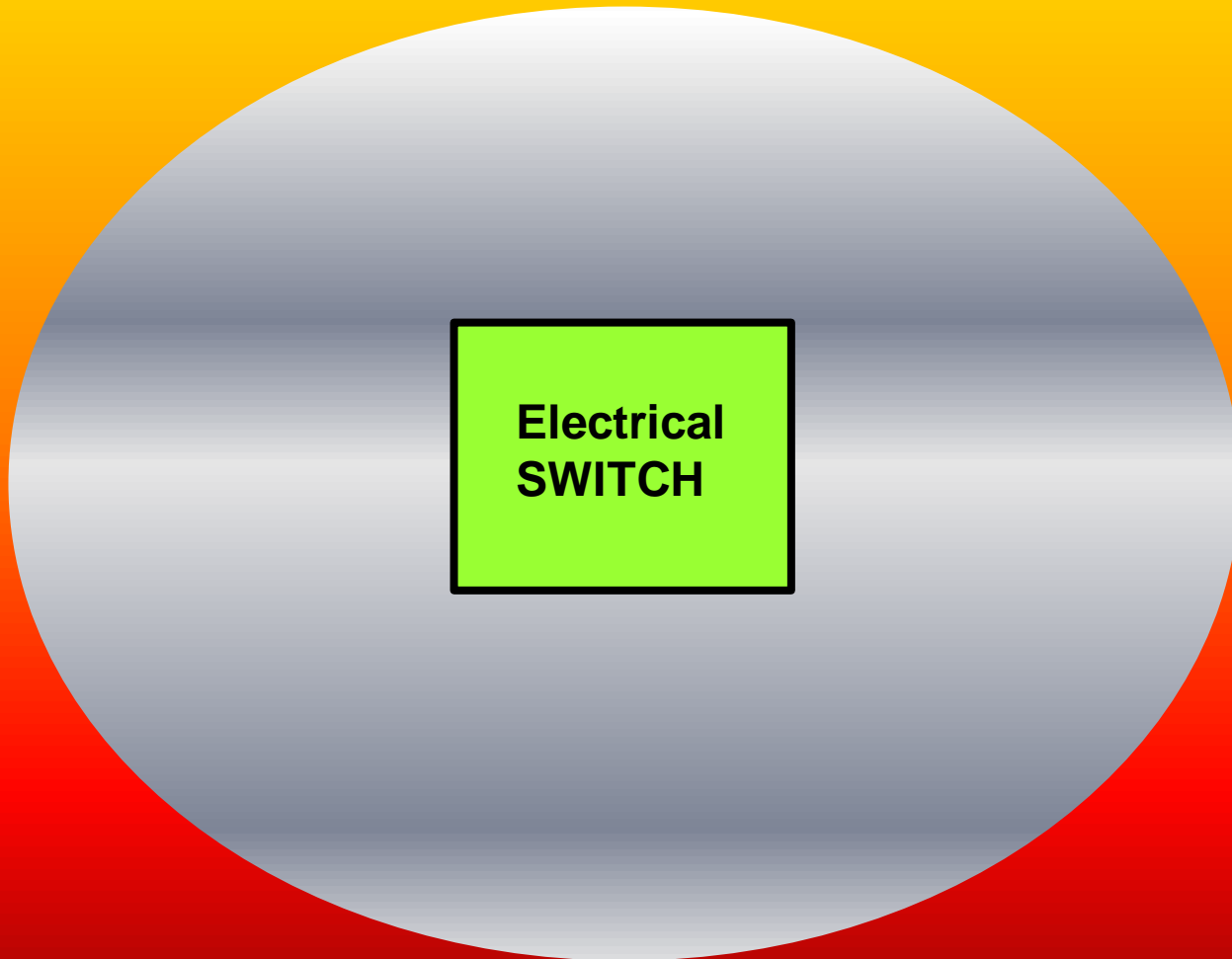
Explosive Atmosphere

Mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapor, mist or dust, in which after ignition, combustion spreads throughout the unconsumed mixture

(IEC 60079-0, definition 3.22)

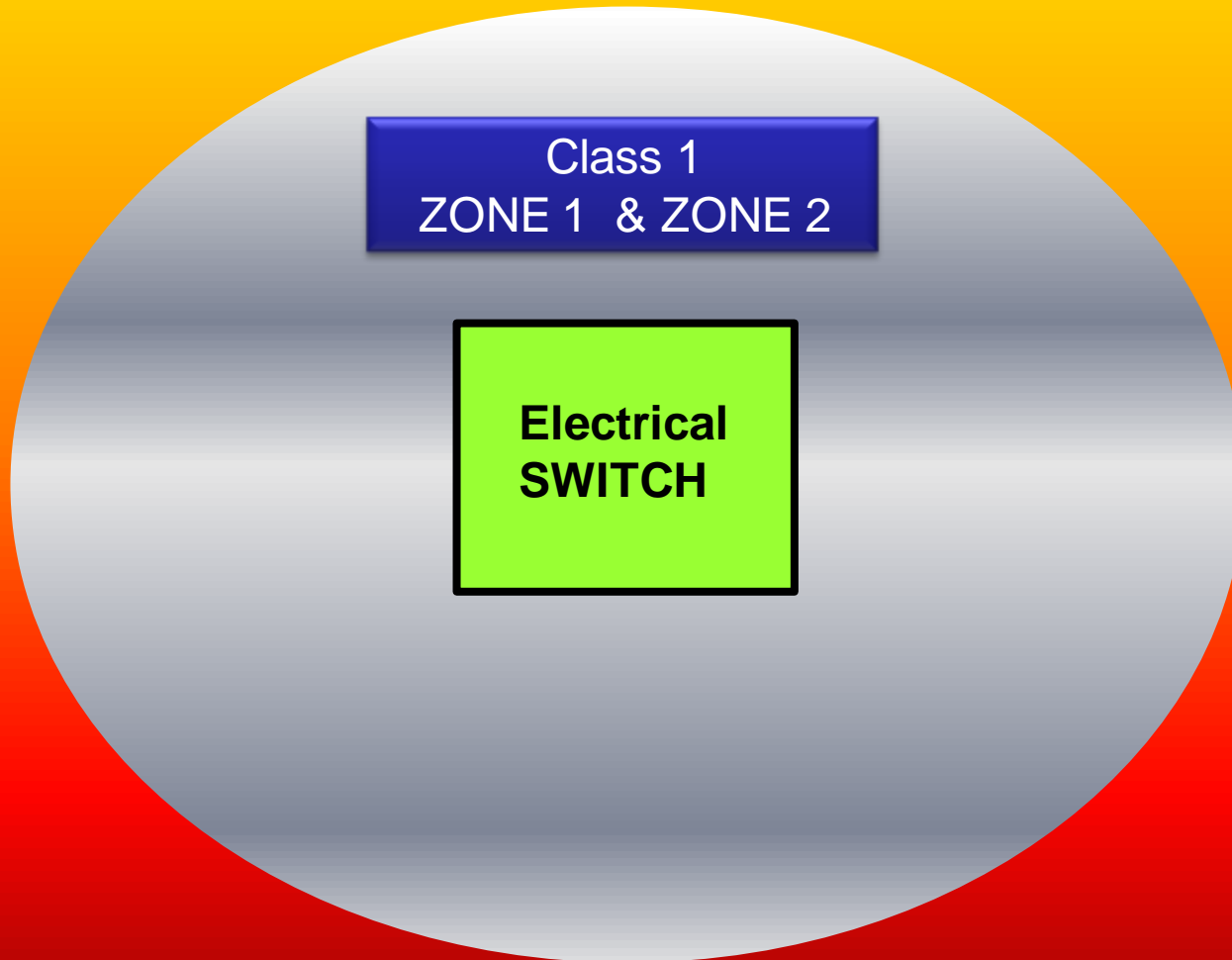
- Explosive Gas Atmosphere
- Explosive Dust Atmosphere
- Explosive Fibers/Flying Atmosphere

The most logical method is to enclose or confine the electrical component and separate it from the Hazardous Area



**This enclosure is called 'd' enclosure and technique is the FLAMEPROOF /
EXPLOSION PROOF**

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Related IEC Standard is IEC 60079-1

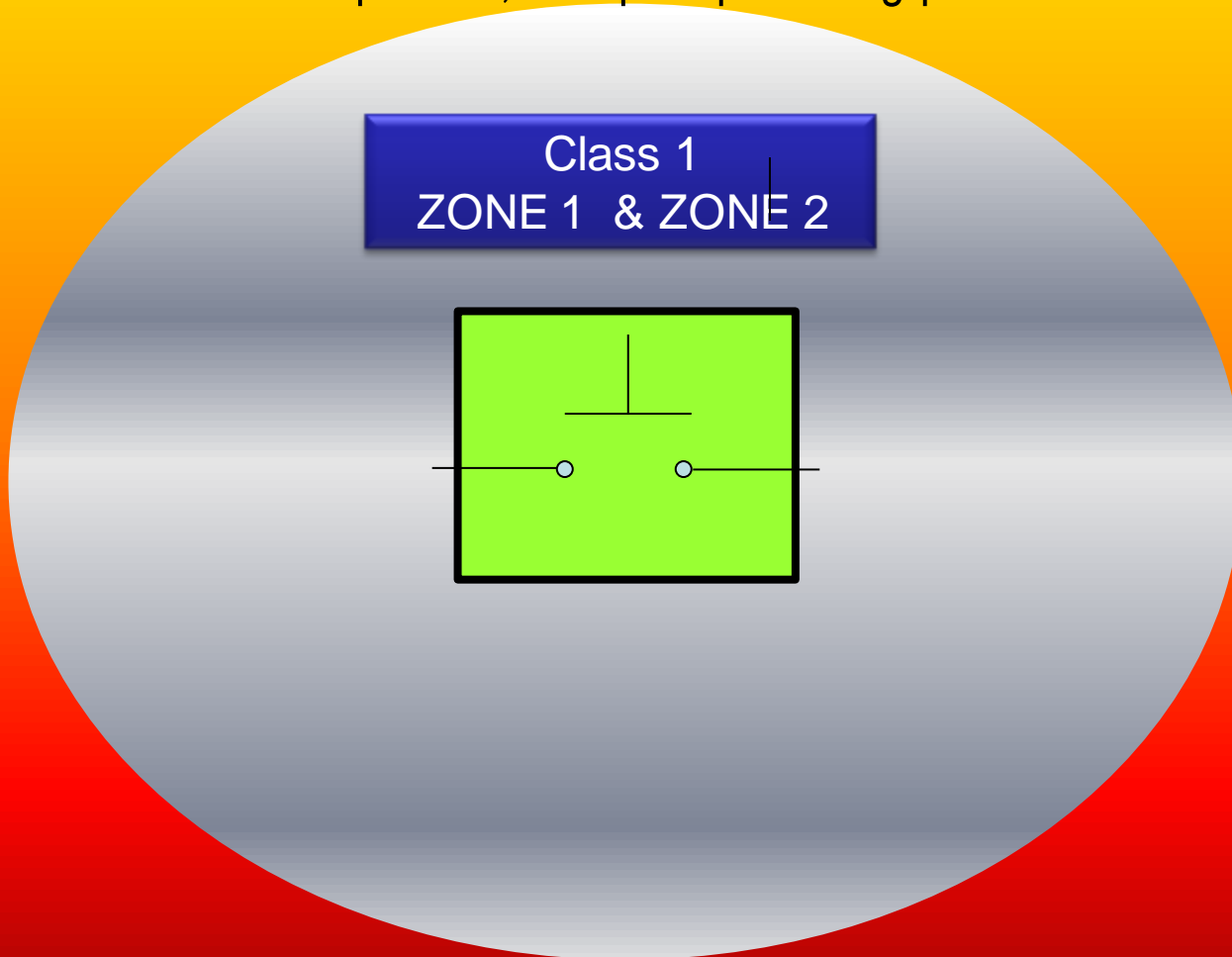
This techniques is used to utilize the Industrial type electrical components :-

- MCCB
- MCB
- CONTACTORS
- SWITCHES
- LINE-UP TERMINALS
- More

First the empty enclosure is certified and then the assembly is tested for the possible explosion and resulting pressure

The First Variation

Instead of the whole component , the spark-producing part is enclosed and certified .

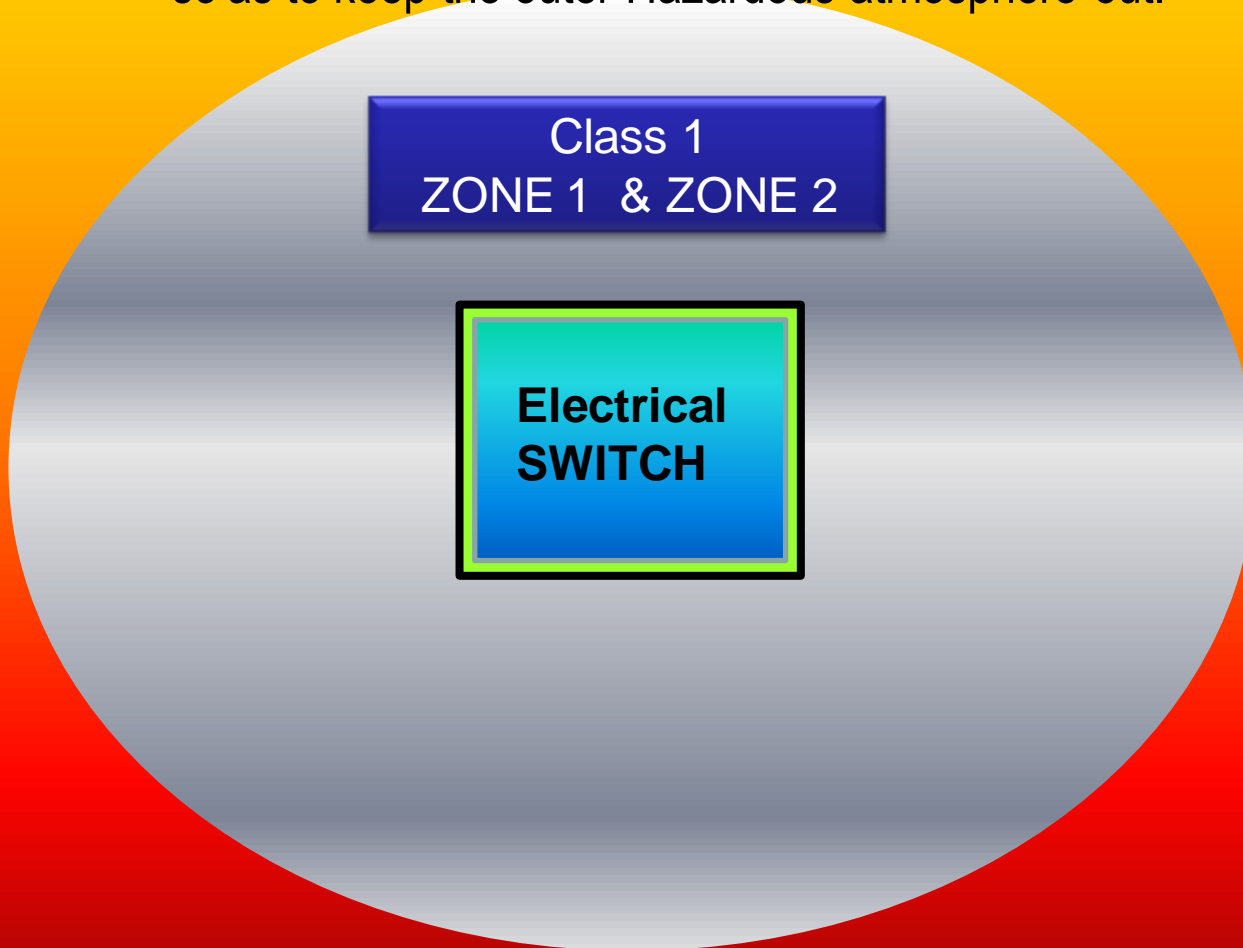


Controlled & specified in IEC 60079-7

This enclosure is called 'e' enclosure and technique is 'INCREASED SAFETY'

The Second Variation

The switch & the enclosure is flushed & filled with inert gas at a slightly higher pressure so as to keep the outer Hazardous atmosphere out.

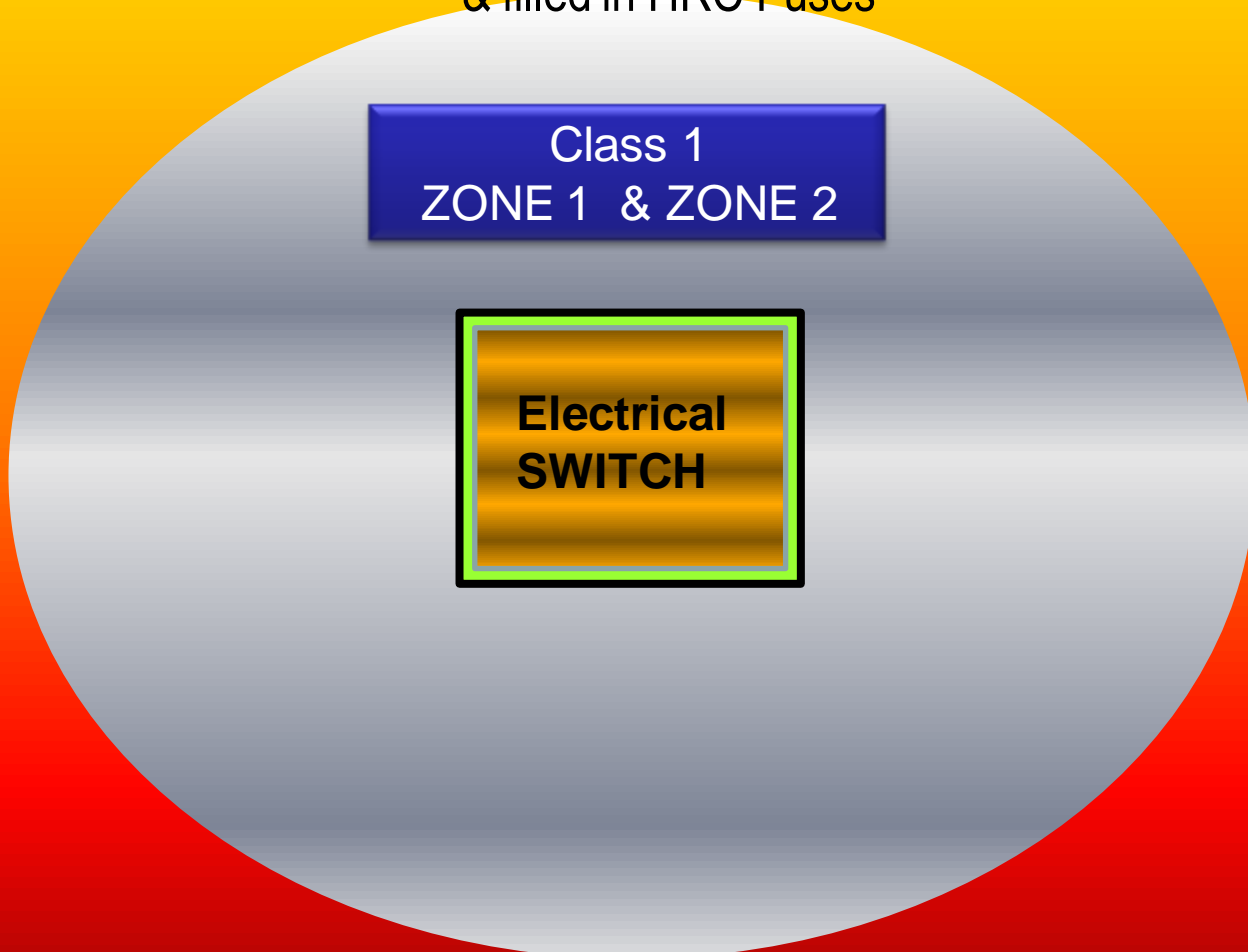


Controlled & specified in IEC 60079-2

This enclosure is a specially built pressurized enclosure and technique is pressurized enclosure protection or 'p'

The Third Variation

The switch & the enclosure is flushed & filled with inert powdery material , such as found & filled in HRC Fuses

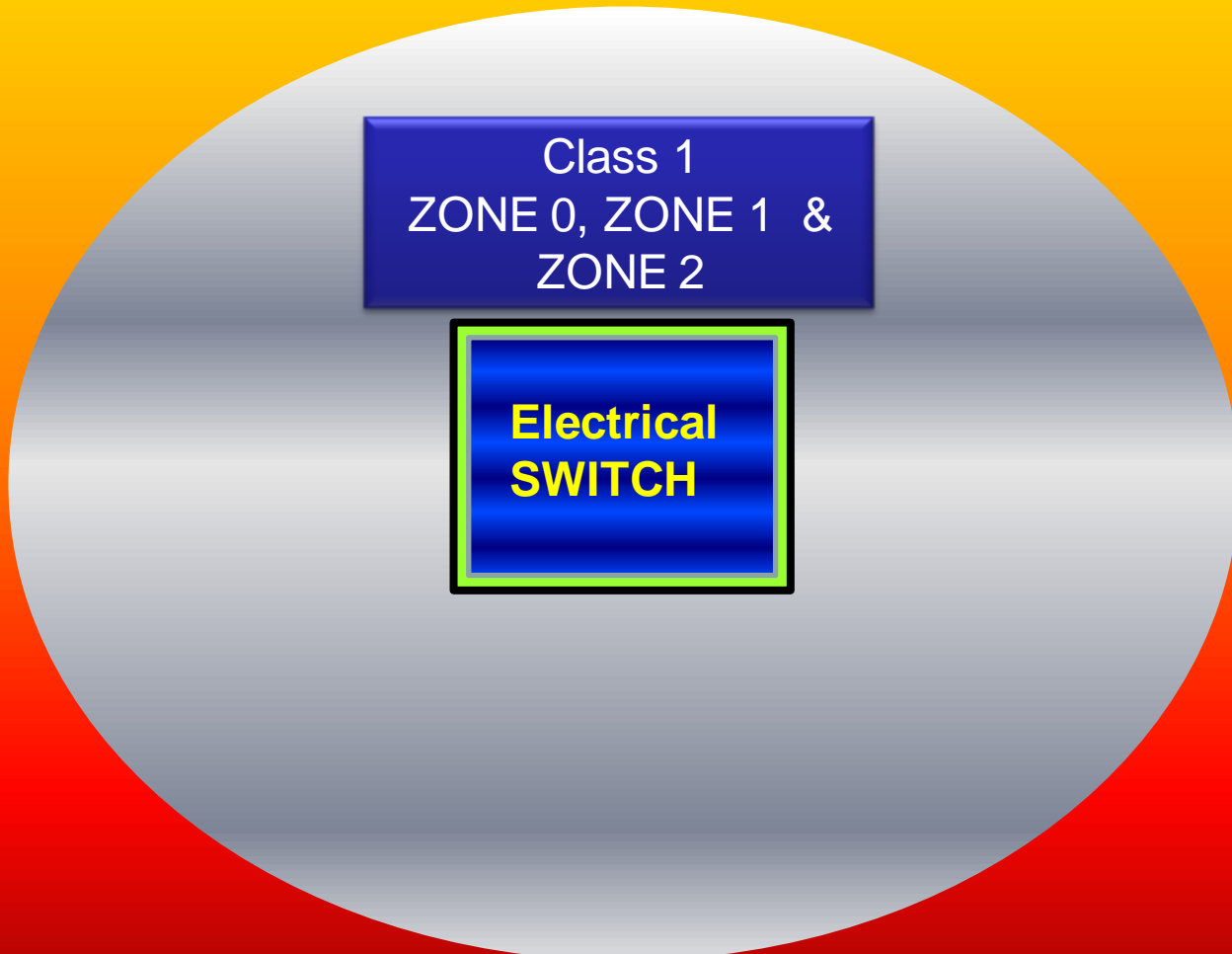


Controlled & specified in IEC 60079-5

This enclosure can be metallic or non-metallic and the technique is 'powder filling' and abbreviated as 'q'

The Fourth Variation

The switch & the enclosure is filled with cast resin in the factory and totally encapsulated

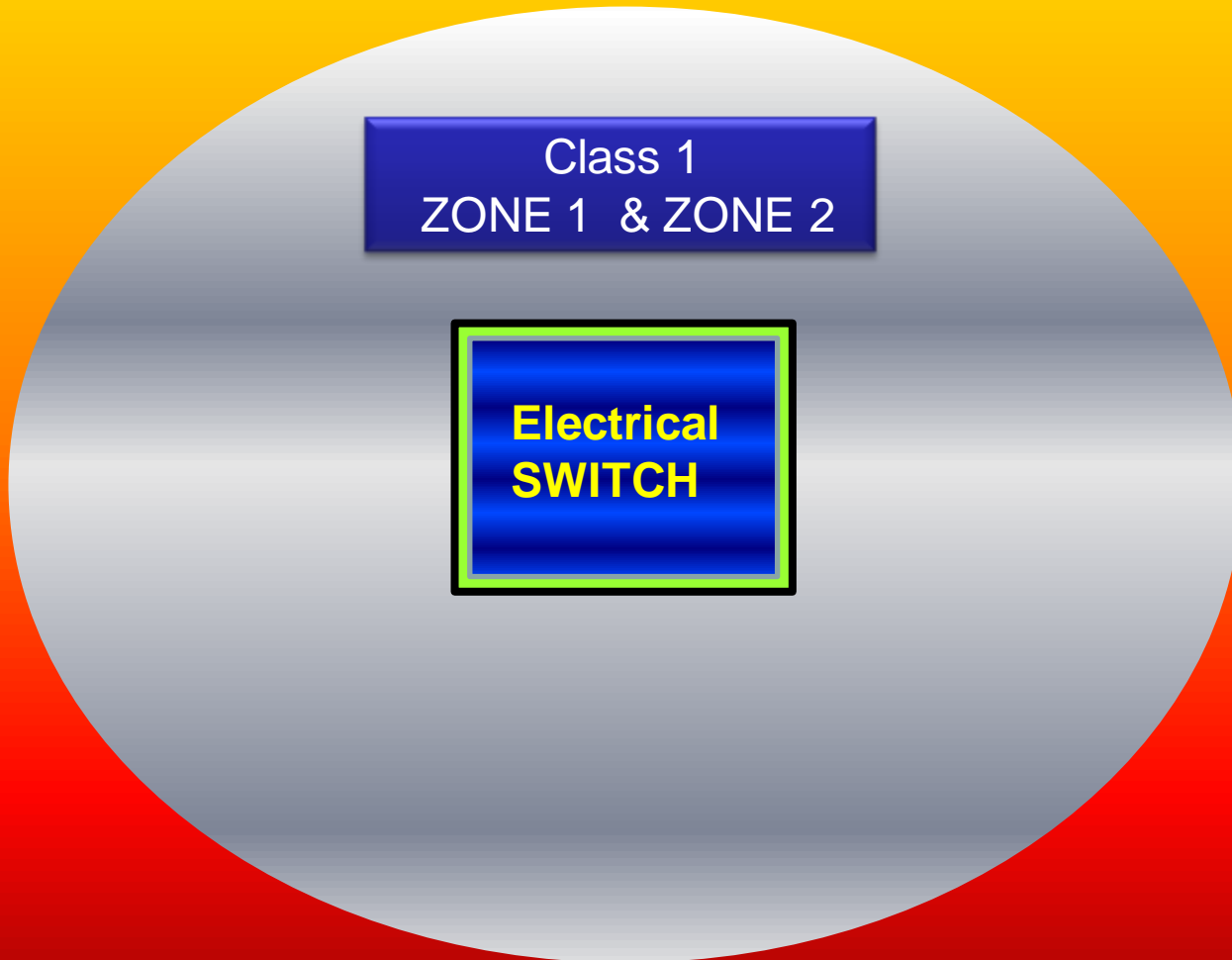


Controlled & specified in IEC 60079-18

This enclosure can be metallic or non-metallic and the technique is encapsulation abbreviated as 'm'

The Fifth Variation

The switch & the enclosure is filled with insulating oil



Controlled & specified in IEC 60079-6

This enclosure can be metallic or non-metallic and the technique is called OIL IMMERSION abbreviated as 'o'

The NEXT Variation

Take the power out of the switch. Keep it around 25 milli Watts.

When the power is limited to 25 mW then it is no-longer a power handling switch it becomes an electronic switch .Fit for process automation and control

Class 1
ZONE 0, ZONE 1 &
ZONE 2

1-0

Controlled & specified in IEC 60079-11

This enclosure can be metallic or non-metallic and the technique is called INTRINSIC SAFETY' abbreviated as "

NEW DOMAIN

The ZONE2

Class 1
ZONE 2

Controlled & specified in IEC 60079-15

A complete domain in itself abbreviated by letter 'n'

The related documents

The specification , which define the parameters related to Hazardous Area

IEC	60079
NEC	500
	505

Then there are IEC documents for selection , maintenance & installation of electrical components in the hazardous Area



This Hexagon Logo with “Ex” marked inside is as per specification of ATEX (ATmosphères EXplosives) . This mark along with the EC mark, is carried by all equipment complying with the ATEX directives.

Two terms or references will help us to recognize & identify the Hazardous Areas related Electrical Equipments

IEC

60079

NEC

500

505



Let us examine a label on ,a Hazardous Area Certified , electrical equipment

