



## Inspection

# **IEC 60079-17**-Explosive Atmosphere – Electrical installations Inspection and Maintenance

# MODULE V

## Inspection and maintenance



Equipment will only remain suitable for use in hazardous areas if it is inspected and maintained in accordance with its certificate of conformity, manufacturer instruction and relevant standards

The installation of any equipment may be subject to other standards as well as the manufactures documented specifications.

### STANDARD IEC

60079-17:

### Explosive Atmosphere – Electrical installations Inspection and Maintenance

This Standard comprises a series of Tables for the inspection of the various methods of explosion protection. Table 1 is an inspection schedule for types of equipment Ex 'd', Ex 'e' and Ex 'n'. Table 2 is for IS equipment and Table 3 for Pressurised Ex 'p' equipment. These Tables lists the areas to be inspected and are illustrated in the Toolbox guide. For each type of explosion protection three grades of Inspection are specified which are **'VISUAL'**, **'CLOSE'** and **'DETAILED'**

**IEC 60079-14 Edition 5 contains initial detailed inspection tables in Annex C**

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## Qualification of personnel



Personnel involved in INSPECTION and MAINTENANCE in hazardous areas must have a understanding of the various protection types, installation practices, regulations and the general principles of area classification, selection requirements, certification, marking etc. as was mentioned earlier.

It is essential for all workers to understand the requirements for working in a hazardous area, including PTW & isolation

60079-14 standard also defines three levels of personnel involved in Inspection and Maintenance of equipment in hazardous areas, is responsible person, technician, designer

We will again concentrate Maintenance (60079-17) standard:

- Operative/technician (inspection and maintenance)

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## Qualification of personnel



### Operative/technician (inspection and maintenance)

#### Knowledge and skills

- understanding of explosion protection principles;
- types of protection and marking;
- aspects of equipment design which affect the protection concept;
- understanding of certification and 60079-17
- importance of permit to work systems and safe isolation
- familiarity with the particular techniques to be employed in the inspection and
- maintenance of equipment
- comprehensive understanding of the selection and erection requirements of IEC 60079-14;
- repair and reclamation requirements of IEC 60079-19. (in general)

#### Competencies

- shall be able to demonstrate their competency and provide evidence of attaining the knowledge and skill requirements relevant to the types of protection and/or types of equipment involved.
- practical skills necessary for the inspection and maintenance
- Able to use DOSIER documentation



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## PPE



People can get statically charged through clothing. They must wear antistatic clothing, whereby not just the overalls must be antistatic, but also the upper clothing (jacket). And to be safe in fire-related terms as well, we should preferably wear cotton clothing underneath our overalls. The ATEX Directive and working conditions legislation require us to wear antistatic clothing in installations with an explosion hazard.

Antistatic clothing is marketed in two main groups. So-called conductive clothing and clothing that removes any charge via the outside air. We must not charge ourselves statically via our shoes either, so we must wear shoes with conductive soles or antistatic soles. Antistatic soles are soles that are slightly conductive, preventing static charging. All so-called S safety boots comply with this.



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## Principle causes of equipment deterioration



**Susceptibility to corrosion**

**Exposure to chemicals or solvents**



**Likelihood of accumulation of dust or dirt**

**Likelihood of water ingress**

**Exposure to excessive ambient temperatures**

**Risk of mechanical damage**

**Exposure to undue vibration**

**Training and experience of personnel can cause:**

**Unauthorised modifications or adjustment**

**Wrong maintenance. ie. Against Manufacturers Recommendations.**



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## Definition of inspection Grades (HOW)



**VISUAL** An inspection which identifies, without the use of access equipment or tools, those defects, e.g. missing bolts, which will be apparent to the eye. Hazardous area zone classification drawings will be required . This inspection **does not** require the de-energising of the equipment.



**CLOSE** Same as Visual but in addition, identifies those defects, e.g. loose bolts, which will be apparent only by the use of access equipment, e.g. step ladders (where necessary), and the use of **some tools**. Reference to the documentation be required HAC drawings, data sheets etc.. This inspection **does not** require the de-energising of the equipment.





**DETAILED** An inspection which encompasses those aspects covered by a **Close** inspection and, in addition, identifies those defects, e.g. loose terminations, which will only be apparent by opening the enclosure, and/or using where necessary, circuit diagram, tools and equipment. This inspection **does** require the de-energising of the equipment.

Required:

- HAC drawings,
- datasheets,
- possible IS loop calculations,
- other calculations etc.





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## When isolation required



1. Permit to work- follow site approved procedures.
2. Operate the **on-load double pole (phase & neutral)** Isolator switch of the circuit to be worked on.
3. Lock the isolator switch in the off position with a padlock and apply appropriate warning signs.
4. Ensure circuit is “Dead” using a approved voltage tester.

First test the voltage tester unit.

Then test the circuit.

Finally re-test the voltage tester unit.

Internal Circuits  
to be proved Dead

Test Lamp set

Proving Unit



All test instruments/ proving units to be approved and within calibration.

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## On site preparation-inspection

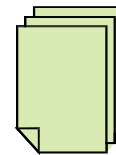


To implement an Inspection/Maintenance programme you must have:

1. Competent personnel
2. Hazardous Area drawings of the plant for Zone/EPL/Gas Group/Temperature Class.
3. Location of equipment in plant
4. Up-to-date Records of all Inspections & Maintenance Tasks for audit – insurance purposes.
5. Equipment Certification Documents available for each item of plant, i.e. 'X' - **Special Installation Conditions**



The maintenance of comprehensive records is an essential requirement for the safe operation of electrical equipment in hazardous areas. Experience has shown that modification and installation of additional equipment is not always recorded in the relevant documentation, datasheets, termination drawings, manufacturer literature, IS loop calculations etc.



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## Definition of inspection Types (When)



**INITIAL INSPECTION** - Normally carried out during equipment handover from installer or **before it is brought into service**. **Grade** of inspection shall be **Detailed**. Also after equipment change out or obtrusive works, a detailed inspection would also be required.

**PERIODIC INSPECTION** - Should be implemented to verify that the installation is being maintained in an appropriate condition for use in the hazardous area. Grade of inspection is usually Visual or Close. Various factors may influence the *Frequency* and Grade inspection the **interval should not exceed 3 years, unless a satisfactory justification is produced**.

**Note – Portable/handheld** equipment is prone to damage and needs inspected within a maximum interval of **one year**, at close grade. Enclosures that are frequently opened e.g. battery housings shall be given a detailed inspection at least every 6 months.

**SAMPLE INSPECTION** - May be implemented to either support or modify the frequency of **PERIODIC INSPECTIONS** and may be of a *grade* Visual, Close or Detailed.

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## inspection of “d”, “e”, “n” equipment



Check that:		Ex “d”			Ex “e”			Ex “n”		
		Grade of inspection								
		D	C	V	D	C	V	D	C	V
<b>A</b>	<b>EQUIPMENT</b>									
1	Equipment is appropriate to the EPL/Zone requirements of the location	X	X	X	X	X	X	X	X	X
2	Equipment group is correct	X	X		X	X		X	X	
3	Equipment temperature class is correct	X	X		X	X		X	X	
4	Equipment circuit identification is correct	X			X			X		
5	Equipment circuit identification is available	X	X	X	X	X	X	X	X	X
6	Enclosure, glass parts and glass-to-metal sealing gaskets and/or compounds are satisfactory	X	X	X	X	X	X	X	X	X
7	There are no unauthorized modifications	X			X			X		
8	There are no visible unauthorized modifications		X	X		X	X		X	X
9	Bolts, cable entry devices (direct and indirect) and blanking elements are of the correct type and are complete and tight									
	– physical check	X	X		X	X		X	X	
	– visual check			X			X			X
10	Flange faces are clean and undamaged and gaskets, if any, are satisfactory	X								
11	Flange gap dimensions are within maximal values permitted	X	X							
12	Lamp rating, type and position are correct	X			X			X		
13	Electrical connections are tight				X			X		
14	Condition of enclosure gaskets is satisfactory				X			X		
15	Enclosed-break and hermetically sealed devices are undamaged							X		
16	Restricted breathing enclosure is satisfactory							X		
17	Motor fans have sufficient clearance to enclosure and/or covers	X			X			X		
18	Breathing and draining devices are satisfactory	X	X		X	X		X	X	
<b>B</b>	<b>INSTALLATION</b>									
1	Type of cable is appropriate	X			X			X		
2	There is no obvious damage to cables	X	X	X	X	X	X	X	X	X
3	Sealing of trunking, ducts, pipes and/or conduits is satisfactory	X	X	X	X	X	X	X	X	X

# MODULE V

## inspection of “d”, “e”, “n” equipment



Check that:		Ex “d”			Ex “e”			Ex “n”				
		Grade of Inspection										
		D	C	V	D	C	V	D	C	V		
4	Stopping boxes and cable boxes are correctly filled	X										
5	Integrity of conduit system and interface with mixed system is maintained	X			X			X				
6	Earthing connections, including any supplementary earthing bonding connections are satisfactory (for example connections are tight and conductors are of sufficient cross-section) – physical check – visual check	X			X			X			X	X
7	Fault loop impedance (TN systems) or earthing resistance (IT systems) is satisfactory	X			X			X				
8	Insulation resistance is satisfactory	X			X			X				
9	Automatic electrical protective devices operate within permitted limits	X			X			X				
10	Automatic electrical protective devices are set correctly (auto-reset not possible )	X			X			X				
11	Specific conditions of use (if applicable) are complied with	X			X			X				
12	Cables not in use are correctly terminated	X			X			X				
13	Obstructions adjacent to flameproof flanged joints are in accordance with IEC 60079-14	X	X	X								
14	Variable voltage/frequency installation in accordance with documentation	X	X		X	X		X	X			
<b>C</b>	<b>ENVIRONMENT</b>											
1	Equipment is adequately protected against corrosion, weather, vibration and other adverse factors	X	X	X	X	X	X	X	X	X	X	X
2	No undue accumulation of dust and dirt	X	X	X	X	X	X	X	X	X	X	X
3	Electrical insulation is clean and dry				X			X				
NOTE 1 General: the checks used for equipment using both types of protection “e” and “d” will be a combination of both columns.												
NOTE 2 Items B7 and B8: account should be taken of the possibility of an explosive atmosphere in the vicinity of the equipment when using electrical test equipment.												

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## inspection of “i” equipment



Check that:		Grade of Inspection		
		Detailed	Close	Visual
<b>A</b>	<b>EQUIPMENT</b>			
1	Circuit and/or equipment documentation is appropriate to the EPL/zone requirements of the location	X	X	X
2	Equipment installed is that specified in the <u>documentation</u> – Fixed equipment only	X	X	
3	Circuit and/or equipment category and group correct	X	X	
4	Equipment temperature class is correct	X	X	
5	Installation is clearly labelled	X	X	
6	Enclosure, glass parts and glass-to-metal sealing gaskets and/or compounds are satisfactory	X		
7	There are no unauthorized modifications	X		
8	There are no visible unauthorized modifications		X	X
9	Safety barrier units, relays and other energy limiting devices are of the approved type, installed in accordance with the certification requirements and securely earthed where required	X	X	X
10	Electrical connections are tight	X		
11	Printed circuit boards are clean and undamaged	X		

# MODULE V

## inspection of “i” equipment



		Detailed	Close	Visual
<b>B</b>	<b>INSTALLATION</b>			
1	Cables are installed in accordance with the <u>documentation</u>	X		
2	Cable screens are earthed in accordance with the <u>documentation</u>	X		
3	There is no obvious damage to cables	X	X	X
4	Sealing of trunking, ducts, pipes and/or conduits is satisfactory	X	X	X
5	Point-to-point connections are all correct	X		
6	Earth continuity is satisfactory (e.g. connections are tight, conductors are of sufficient cross-section) for non-galvanically isolated circuits.	X		
7	Earth connections maintain the integrity of the type of protection	X	X	X
8	Intrinsically safe circuit earthing and insulation resistance is satisfactory	X		
9	Separation is maintained between intrinsically safe and non-intrinsically safe circuits in common distribution boxes or relay cubicles	X		
10	As applicable, short-circuit protection of the power supply is in accordance with the documentation	X		
11	Specific conditions of use (if applicable) are complied with	X		
12	Cables not in use are correctly terminated	X		
<b>C</b>	<b>ENVIRONMENT</b>			
1	Equipment is adequately protected against corrosion, weather, vibration and other adverse factors	X	X	X
2	No undue external accumulation of dust and dirt	X	X	X

# MODULE V

## inspection of “p” equipment



Check that:		Grade of inspection		
		Detailed	Close	Visual
<b>A</b>	<b>EQUIPMENT</b>			
1	Equipment is appropriate to the EPL/zone requirements of the location	X	X	X
2	Equipment group is correct	X	X	
3	Equipment temperature class or surface temperature is correct	X	X	
4	Equipment circuit identification is correct	X		
5	Equipment circuit identification is available	X	X	X
6	Enclosure, glasses and glass-to-metal sealing gaskets and/or compounds are satisfactory	X	X	X
7	There are no unauthorized modifications	X		
8	There are no visible unauthorized modifications		X	X
9	Lamp rating, type and position are correct	X		
<b>B</b>	<b>INSTALLATION</b>			
1	Type of cable is appropriate	X		
2	There is no obvious damage to cables	X	X	X
3	Earthing connections, including any supplementary earthing bonding connections, are satisfactory, for example connections are tight and conductors are of sufficient cross-section			
	– physical check	X		
	– visual check		X	X



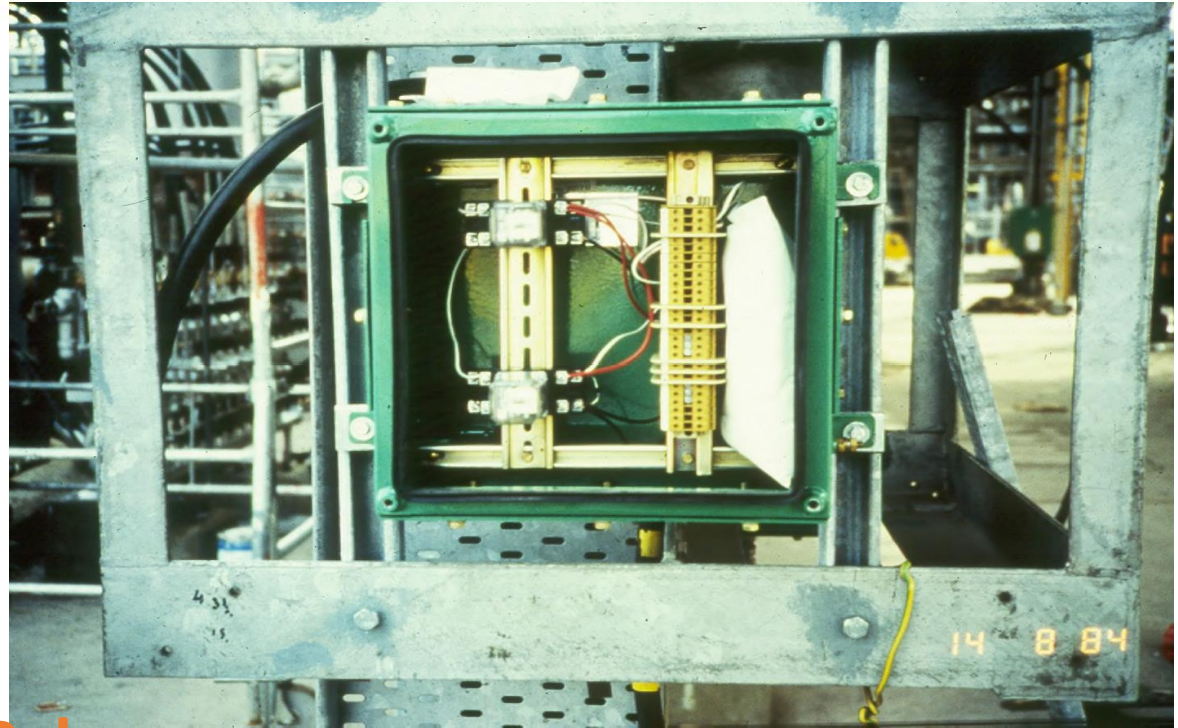
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## inspection of “p” equipment



<b>B</b>	<b>INSTALLATION</b>			
4	Fault loop impedance (TN systems) or earthing resistance (IT systems) is satisfactory	X		
5	Automatic electrical protective devices operate within permitted limits	X		
6	Automatic electrical protective devices are set correctly	X		
7	Protective gas inlet temperature is below maximum specified	X		
8	Ducts, pipes and enclosures are in good condition	X	X	X
9	Protective gas is substantially free from contaminants	X	X	X
10	Protective gas pressure and/or flow is adequate	X	X	X
11	Pressure and/or flow indicators, alarms and interlocks function correctly	X		
12	Conditions of spark and particle barriers of ducts for exhausting the gas in hazardous area are satisfactory	X		
13	Specific conditions of use (if applicable) are complied with	X		
<b>C</b>	<b>ENVIRONMENT</b>			
1	Equipment is adequately protected against corrosion, weather, vibration and other adverse factors	X	X	X
2	No undue accumulation of dust and dirt	X	X	X

# Ex 'e' enclosure in Zone 1 (2G/Gb) area Area



## Additional Two Relays

What is the fault?

No ignition allowed in Ex e enclosure

What is the grade of inspection?

Detailed

What is the remedial action?

Remove relays to an Ex d enclosure

# Ex 'd' Box in a Zone 1 (2G/Gb) IIC T5 Area



Equipment label:  
II 2G  
Ex d IIB T4 Gb



**What is the fault?**

**Wrong Gas group**

**Wrong T Rating**

**What is the grade of inspection?**

**Close Inspection**

**What is the remedial action?**

**Replace with appropriate enclosure**

# Ex 'd' Box in a Zone 1 (2G/Gb) IIC T5 Area



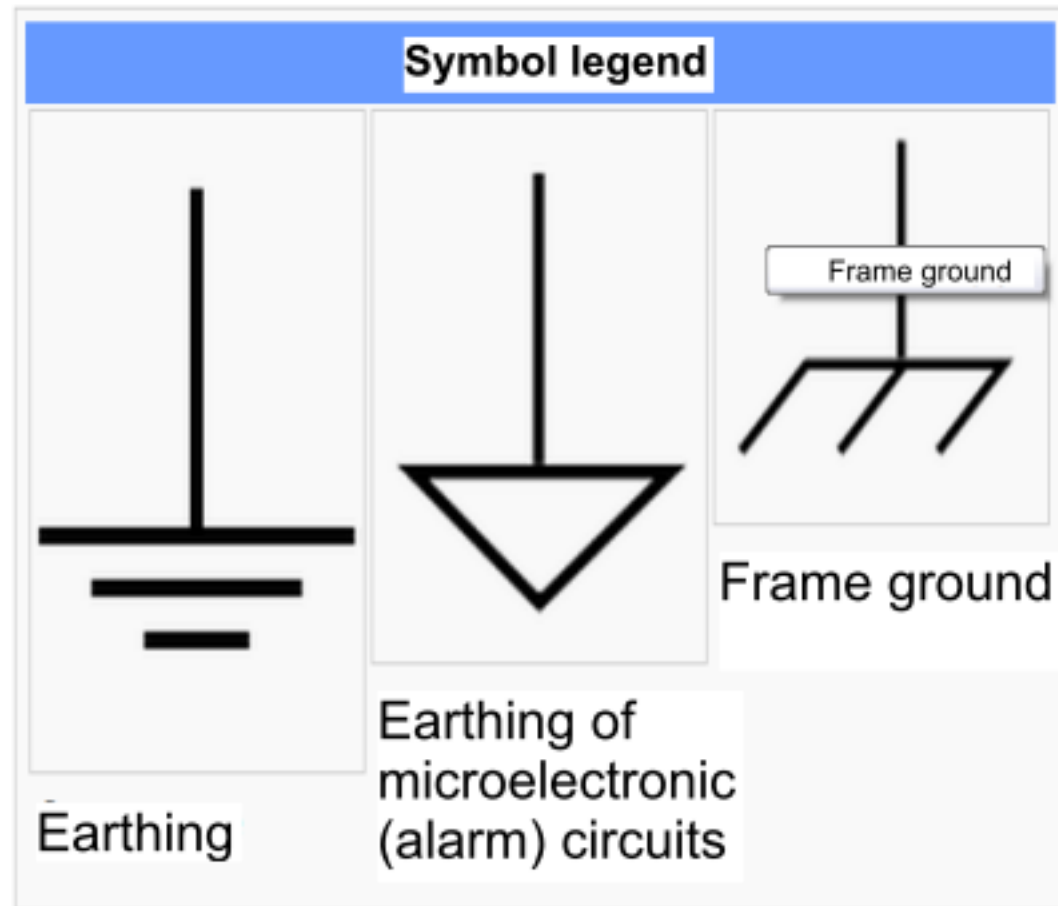
Equipment label:  
II 2GD  
Ex d IIC T6 Gb



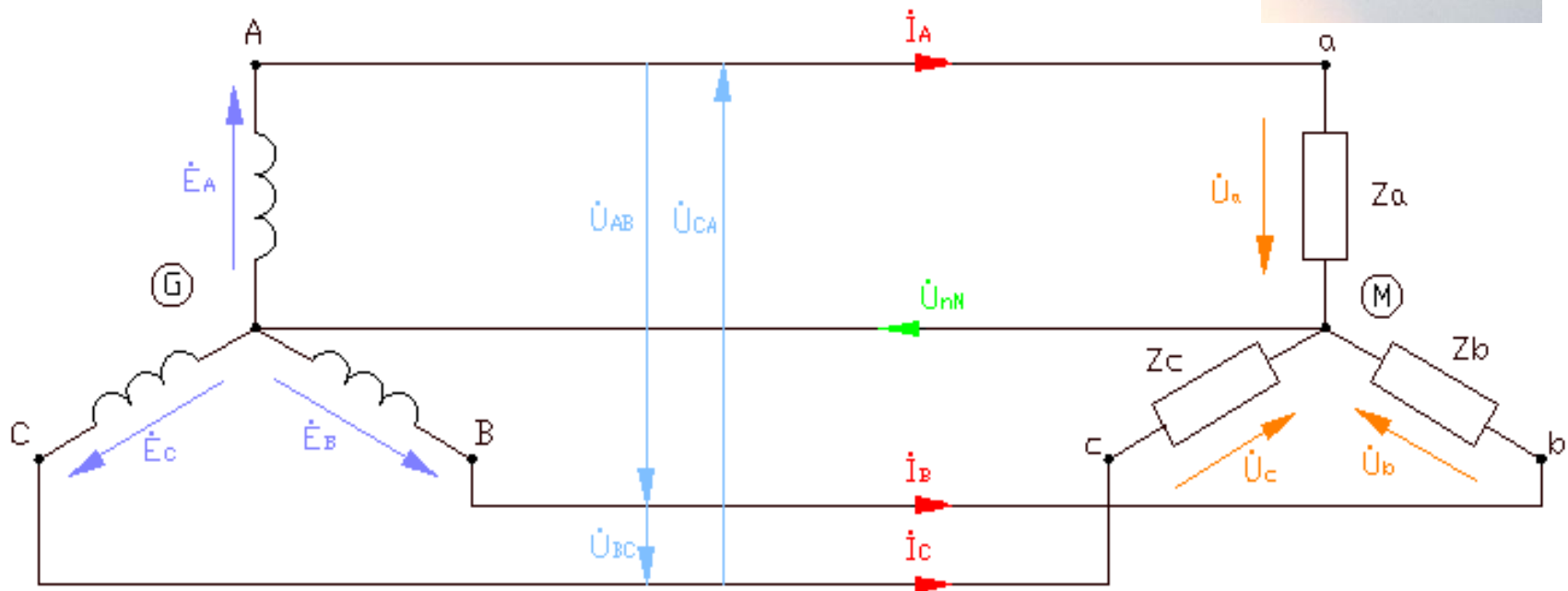
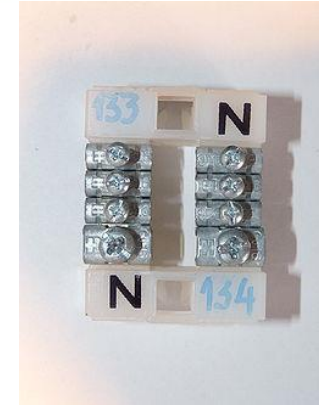
- What is the fault? **No certified stopper plug fitted**
- What is the grade of inspection? **Visual Inspection**
- What is the remedial action? **Replace with Ex d certified plug/stopper**



### PE (Protective Earthing)



### Neutral conductor





# Natural earthing

# Artificial earthing

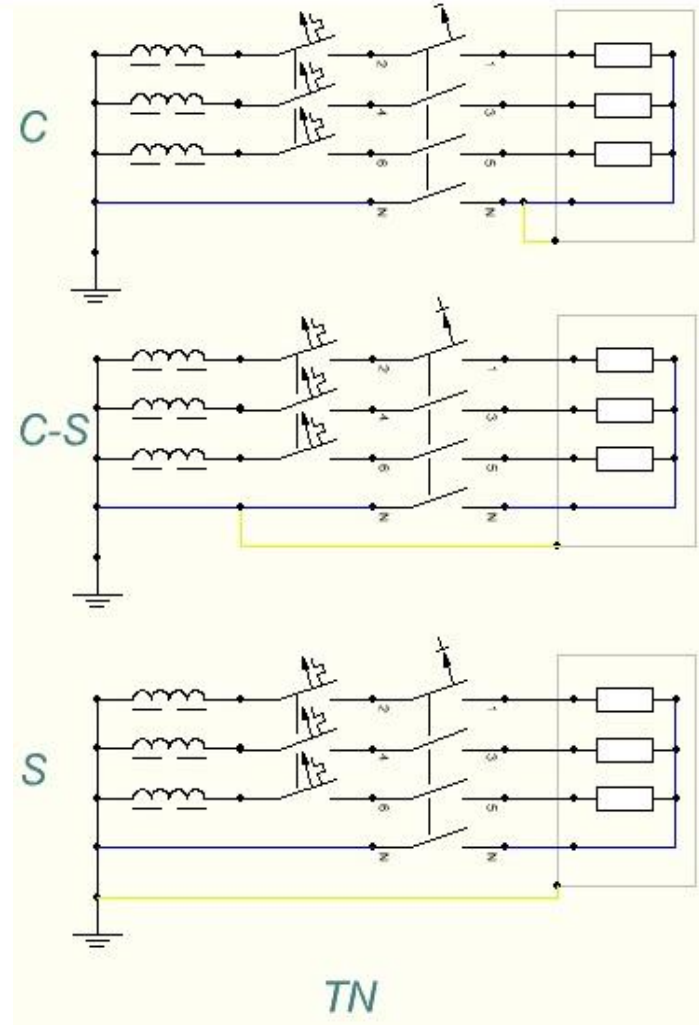
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## Earthing, earthing systems



**TN** system is a system, in which the neutral of a power source is dead earthed, and exposed conductive parts are connected to the dead-earthed neutral of the source through the PE – conductors;

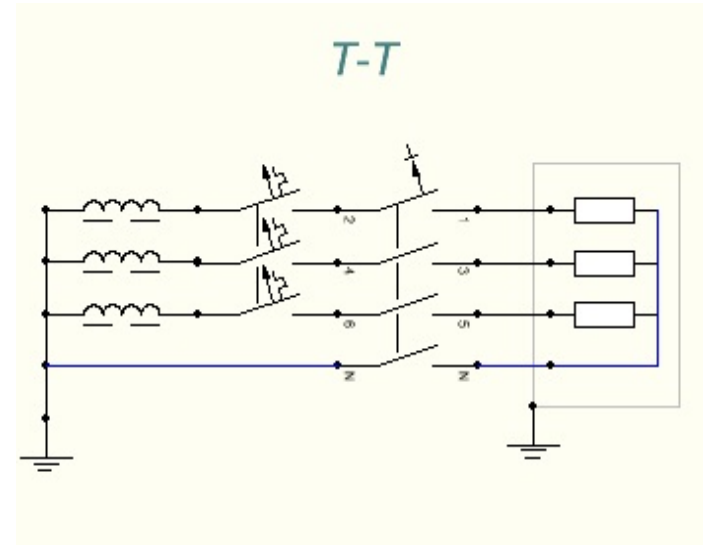
...it shall be type TN-S in the hazardous area. At any point of transition from TN-C to TN-S, the protective conductor shall be connected to the equipotential bonding system in the non-hazardous area.





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## Earthing, earthing systems



If a type of system earthing **TT** (separate earths for power system and exposed conductive parts) is used, then it shall be protected by a residual current device.

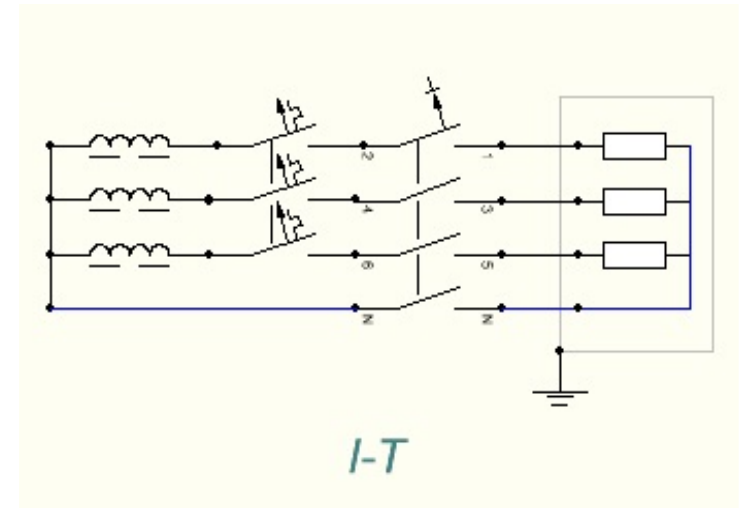
Where the earth resistivity is high, such a system may not be acceptable.

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## Earthing, earthing systems



If a type of system earthing IT (neutral isolated from earth or earthed through an sufficiently high impedance) is used, an insulation monitoring device shall be provided to indicate the first earth fault.



If the first fault is not removed, a subsequent fault on the same phase will not be detected, possibly leading to a dangerous situation.

Local bonding, known as supplementary equipotential bonding, can be necessary

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## Earthing, earthing systems



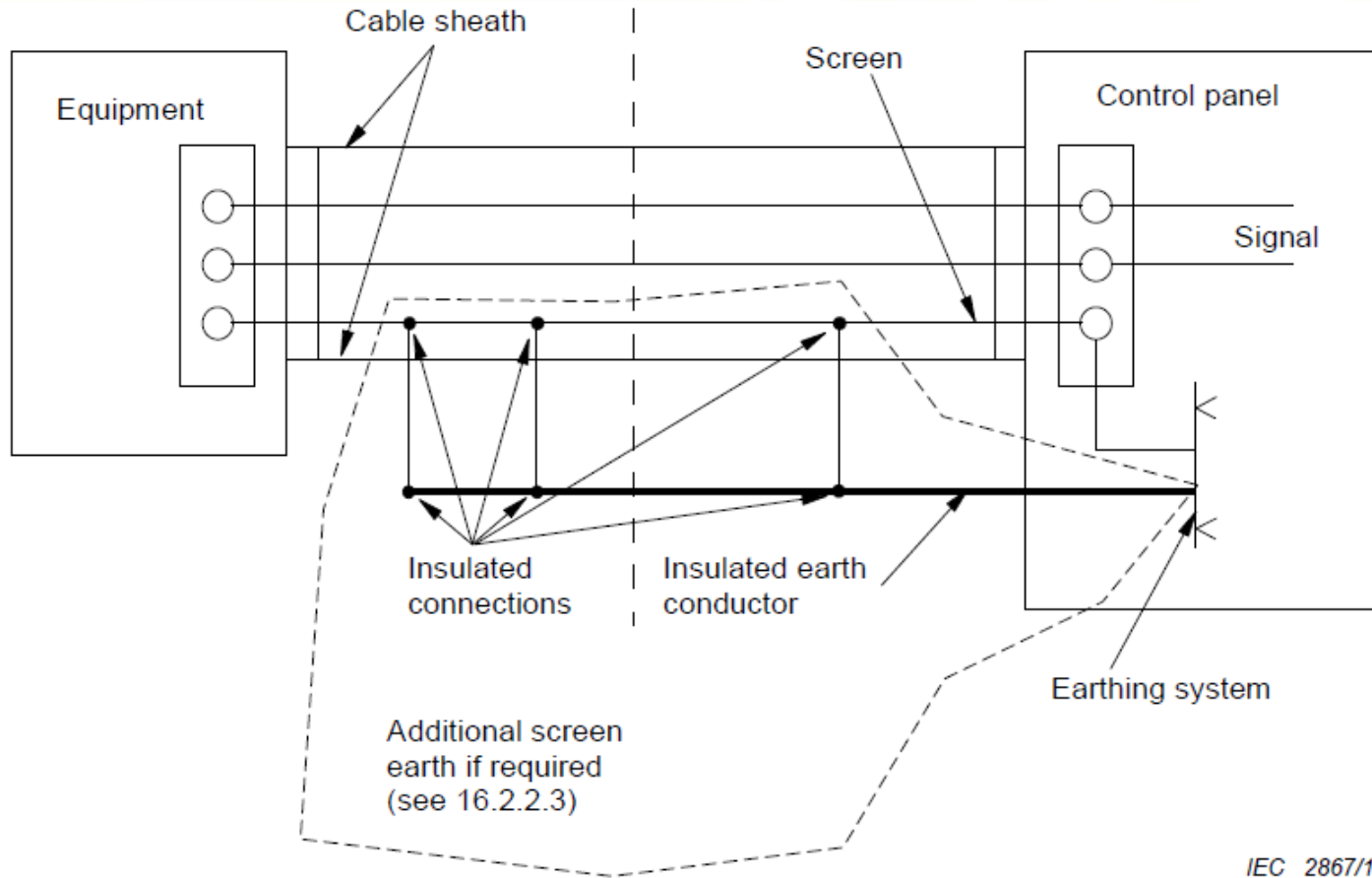
In a TT (terre-terre) earthing system, the protective earth connection for the consumer is provided by a local earth electrode, (sometimes referred to as the Terra-Firma connection) and there is another independently installed at the generator. There is no 'earth wire' between the two. The fault loop impedance is higher, and unless the electrode impedance is very low indeed, a TT installation should always have an RCD (GFCI) as its first isolator.

In an IT network (isolé-terre), the electrical distribution system has no connection to earth at all, or it has only a high impedance connection.

	TT	IT	TN-S
Earth fault loop impedance	High	Highest	Low
RCD preferred?	Yes	N/A	Optional
Need earth electrode at site?	Yes	Yes	No
PE conductor cost	Low	Low	Highest
Risk of broken neutral	No	No	High
Safety	Safe	Less Safe	Safest
Electromagnetic interference	Least	Least	Low
Safety risks	High loop impedance (step voltages)	Double fault, overvoltage	Broken neutral
Advantages	Safe and reliable	Continuity of operation, cost	Safest

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## Earthing, earthing systems



What type of system used here?

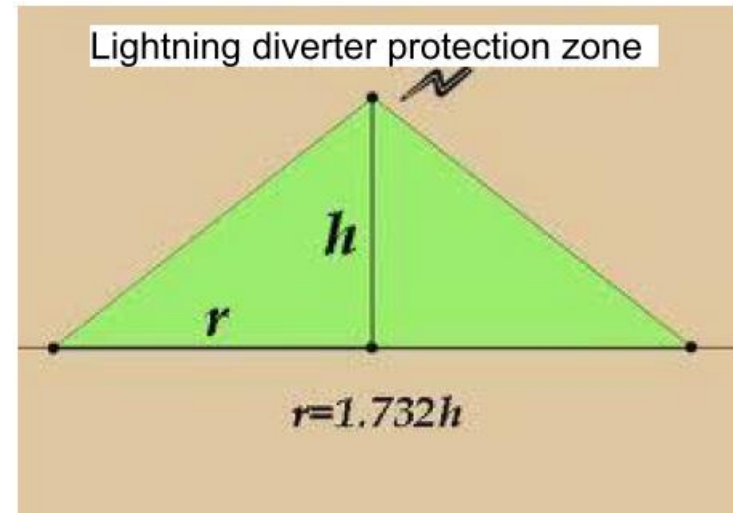
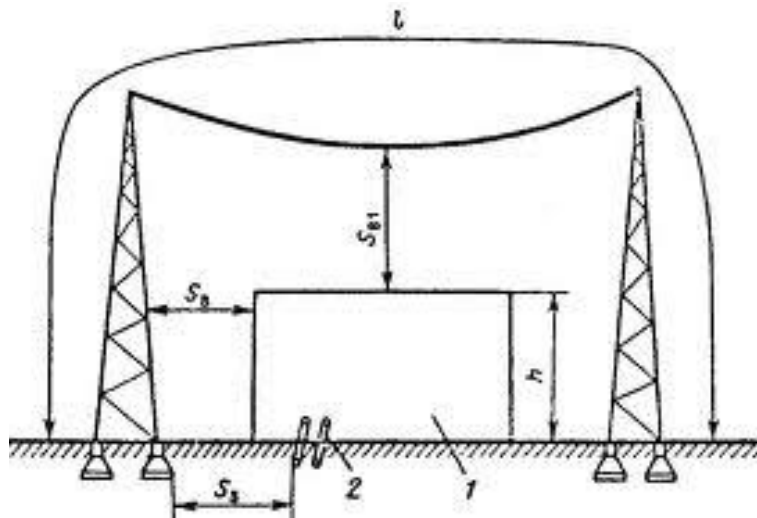


**Lightning conductor** is a device that is installed on buildings and structures, and serves to protect from lightning.

**Lightning protection** is a set of technical solutions and special devices to ensure safety of the building, property and people in it.



- Types
- lightning protection grid;
  - stretched lightning protection cable;
  - lightning protection rod.





### Surge Protection Devices (SPD)

**Type 1** able to conduct all energy of a typical stroke of lightning and stay unbroken.

**Type 2** unable to withstand a stroke of lightning and stay unbroken, without the aforementioned Type 1

**Type 3** requires to apply Types 1 and 2 first and is installed directly next to the user.