

ELECTRICAL SAFETY

HOSPITALS AND MEDICAL LOCATIONS

As per IS732 & IS17512 (IEC 60364 -1 TO 6 & IEC 60364-7-710)



Electricity and Safety in Hospitals.

Electrical Installation in Hospitals are critical due to its working environment and sensitivity such as:

1. WET Areas, where chance of electric shock is high for the patient and the medical staff.
2. Oxygen enriched areas, where the chance of fire is high.
3. Life supporting equipment connected to patients having applied parts by passing skin.
4. Medical electrical equipment or system producing Electro Magnetic Environment (EMI)
5. Availability of power and stand by power, change over etc
6. Highly sensitive electronic systems

The IS 732 & IS 17512 explains the requirement of electrical installations in Hospitals and Medical locations. These standards are adopted from IEC 60364. These standards provide an over view of the required safety measures. Safety in hospitals and medical locations are ensured by a series of safety measures including the ones recommended in IS 732 / 17512, such as

1. Low touch voltages to avoid shock hazard by protective equipotential bonding.
2. Continuity of supply during a fault by an IT supply (called as OT panels)
3. Over current and earth fault protection in oxygen enriched areas. Faster disconnections and avoidance of arc/spark.
4. Over voltage protection such as protection from a temporary over voltage due to a fault in HV system to ensure reliability of systems connected to a supply transformer
5. EMC

Some of these safety measures are specific to India due to poor quality and non complied power supply by the utilities. Large dependency to DG's are also specific to India, where additional measures than the recommendations of the standard are necessary.



- Design support for Medical locations in hospitals for compliance to IS732 & IS17512.
- Risk Management to Medical devices as per ISO 14971.
- Trainings in electrical safety measures to maintenance and medical staff.
- Supply, Installation and Testing of Safety measures as per IS732 & IS17512.
- Periodic testing and training the maintenance team of the client for periodic verification

Technical Considerations for safety in Hospitals & Medical Locations

- Medical locations are classified into Group 0, Group 1 and Group 2.
- Group 0: Medical electrical equipment can be brought into contact with the patient or needs to be touched by the patient.
- Group 1: Medical electrical equipment used externally.
- Group 2: Medical electrical equipment are used in applications such as intracardiac procedures, operating theatres and vital treatment where discontinuity of the supply can cause danger to life.
- ME EQUIPMENT (ME): Equipment having an applied part or transferring energy to or from the patient.
- ME SYSTEM (MES): Combination of equipment, at least one of which is ME equipment to be inter-connected by functional connection or by use of a multiple socket-outlet.

Medical Equipment or its parts are categorized as AP & APG with specified requirements on construction, marking and documentation to avoid sources of ignition in a flammable anesthetic mixture with air (AP) or with oxygen or nitrous oxide (APG). Environment in which the concentration of oxygen is greater than 25 % for ambient pressures up to 110 kPa or the partial pressure of oxygen is greater than 27.5 kPa at ambient pressures exceeding 110 kPa is called as oxygen rich environment. ME & MES used in an oxygen rich environment shall be classified for such use.



Mandatory safety measures for electrical installation in Hospitals

The electrical installation of every hospital and medical location shall be designed, erected and tested as per IS 732 & IS17512. TN-S type electrical distribution is recommended and used. The conventional touch voltages in general locations and group 0 locations shall not exceed 50 V and in group 1 and group 2 medical locations, shall not exceed 25 V.

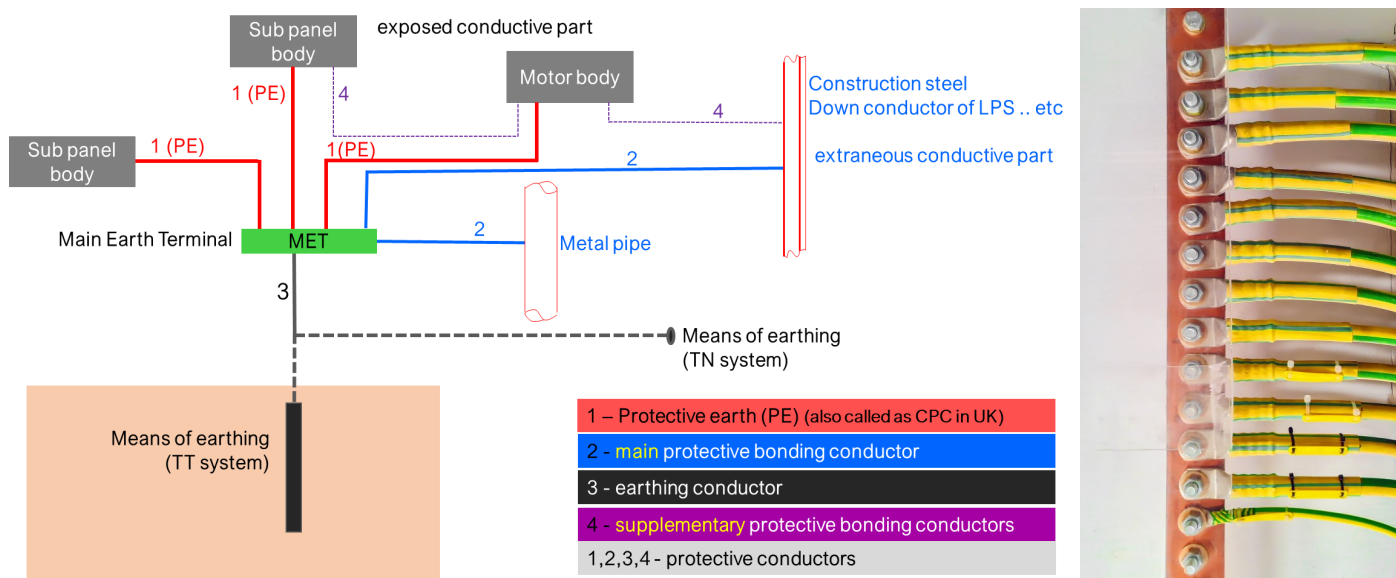
Main Protective equipotential bonding is necessary in addition, to supplementary equipotential bonding in group 1 and group 2 locations.

Group 2 Medical locations such as Operation theatres, ICU, etc. shall have medical IT system in order to ensure continuity of supply during first fault, with insulation monitoring devices and leakage current detection system.

Electrical devices such as socket-outlets and switches shall be installed at certain distance from any medical gas-outlets, to minimize the risk of ignition of flammable gases.

Equipotential Bonding (Main and Supplementary) as the first safety measure in hospitals

Equipotential bonding is a mandatory safety measure in hospital and the first safety measure against electric shock. A TN-S system for general locations improves safety due to the high efficiency of Automatic Disconnection of Supply (ADS).



Equipotential Bonding and challenges: ME and MES suppliers and engineers working in the field and the doctors who operate these equipment always recommend a dedicated earthing (by the way of a separate earth electrode in soil) in hospitals as a result the most vital safety measure is violated. In addition the transformer and DG follow connections to separate earth pits which add the violation. Convincing the involved parties and implementing the proper protective measure is always a challenge and need high skills and though knowledge of the application.

Medical Isolation Panels:

Medical Isolation panels or medical IT system in hospitals is an additional safety measure recommended in group 2 medical locations for the final equipment to ensure continuity of supply during a fault. The same final circuit is connected to more than one medical equipment, located within the patient environment. Several safety conditions to be fulfilled in order to achieve the recommended safety measure by medical IT system.

The challenge in this case is the general belief that Medical IT system alone can offer complete safety in medical locations, the fact being medical IT system along with other protective measures ensure high degree of safety. However the other protective measures are rarely carried out in hospitals.

Measures against EMI / Current loops / Temporary Over Voltages

Most often failure or malfunction of one equipment are due to EMI / current loops and TOV's Careful selection and erection in coordination with testing and rectification of the mistakes are essential to ensure safety. EMI is due to ME's whose are producing EM field during its operation. Current loops are due to various reasons including routing of conductors and TOV's are due to reasons such as Fault in HV side of a connected transformers.

Mandatory safety measures for electrical installation in Hospitals

In addition to the verifications specified in IS732 medical location need additional tests such as:

- Functional test of IMD's of medical IT systems, its indications and alarms. (annually)
- Test the efficiency of supplementary equipotential bonding and the integrity of the facilities required for equipotential bonding (once in 2 years).
- Integrity of the safety services (monthly)
- Measurements of leakage current of the output circuit and of the enclosure of medical IT transformers in no-load condition (once in 2 years).
- Checking of the tripping of RCDs at $I_{\Delta n}$: not more than 12 months.

Special Guidance from CAPE for special application

- ME equipment and ME systems, need all tests as per IEC 62353 before putting into service, during maintenance, inspection, servicing and after repair or on occasion of recurrent tests
- The safety services need special attention.

We guide and train your engineers to implement these safety measures.



ONE STOP FOR ALL ELECTRICAL SAFETY MEASURES IN HOSPITALS

- Implementation of TN-S system with Protective equipotential bonding and Supplementary equipotential bonding
- Medical IT panels
- Periodic Verifications
- Compliance to ISO 14971 (Risk Management)
- Compliance to IEC 62353 of ME and MES
- EMI and Protection from TOV's
- Compliance to IS732 for general electrical safety
- Compliance to IS17512 for medical locations



- Design
- Risk Management
- Trainings
- Supply, Installation and Testing of safety measures
- Periodic testing and training

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