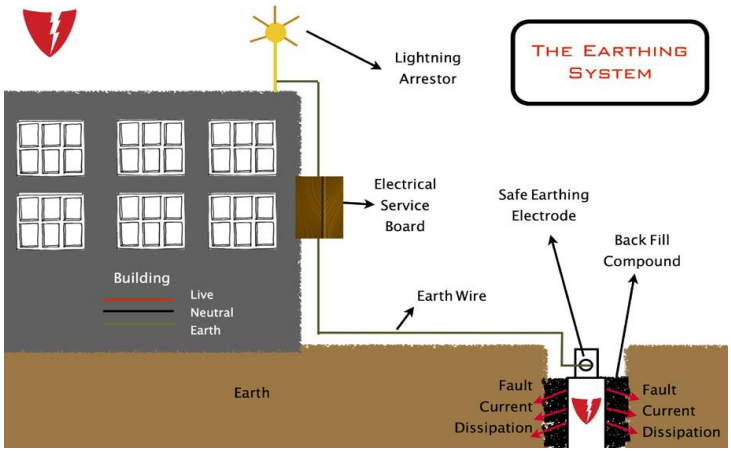
Earthing System

(PART-1)



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COGS GLOBAL

Authored by: Shubham Gupta

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Earthing System

INTRODUCTION

In an electrical installation, an earthing system (UK) or grounding system (US) connects specific parts of that installation with the Earth's conductive surface for safety and functional purposes. The point of reference is the Earth's conductive surface. The choice of earthing system can affect the safety and electromagnetic compatibility of the installation. Regulations for earthing systems vary considerably among countries, though most follow the recommendations of the International Electrotechnical Commission. Regulations may identify special cases for earthing in mines, in patient care areas, or in hazardous areas of industrial plants.

In addition to electric power systems, other systems may require grounding for safety or function. Tall structures may have lightning rods as part of a system to protect them from lightning strikes. Telegraph lines may use the Earth as one conductor of a circuit, saving the cost of installation of a return wire over a long circuit. Radio antennas may require particular grounding for operation, as well as to control static electricity and provide lightning protection.

International Electrotechnical Commission

Formation: 26 June1906
Headquarter: Geneva, Switzerland
Membership: 86 countries
President: Yinbiao Shu
Purpose: Standardization for electrical technology, electronic and related

The **International Electrotechnical Commission**[1] (**IEC**; in French: *Commission électrotechnique internationale*) is an international standards organization that prepares and publishes international standards for all electrical, electronic and related technologies – collectively known as 'electrotechnology". IEC standards cover a vast range of technologies from power generation, transmission and distribution to home appliances and office equipment, semiconductors, fibre optics, batteries, sloar technolog, nanotechnology and marine energy as well as many others.
IEC standards have numbers in the range 60000–79999 and their titles take a form such as *IEC 60417: Graphical symbols for use on equipment*. Following the Dresden Agreement with CENELEC the numbers of older IEC standards were converted in 1997 by adding 60000, for example IEC 27 became IEC 60027. Standards of the 60000 series are also found preceded by EN to indicate that the IEC standard is also adopted by CENELEC as a European standard; for example, IEC 60034 is also available as EN 60034.

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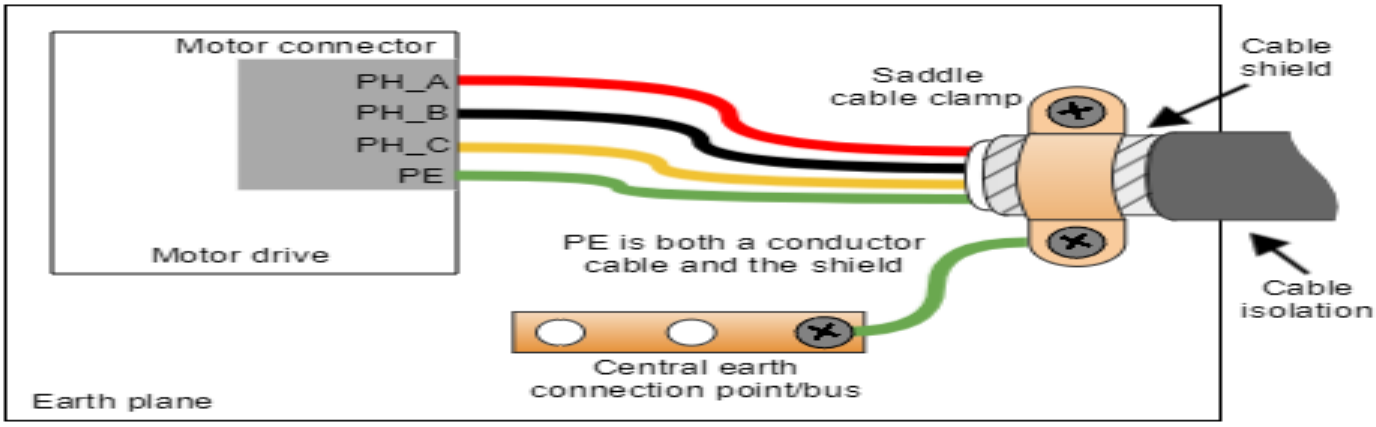
Protective Earthing

An earth ground connection of the exposed conductive parts of electrical equipment helps protect from electric shock by keeping the exposed conductive surface of connected devices close to earth potential, when a failure of electrical insulation occurs. When a fault occurs, current flows from the power system to earth. To protect equipment from damage due to leakage current, residual-current sensing circuit breakers detects the leakage current and interrupt the circuit. These devices may allow more ground fault current to pass than a device intended to protect people from electric shock. Although over current protection, fuse or circuit breaker are available in circuits for complete isolation of power, their operating level is too high. To ensure the voltage on exposed surfaces is not too high; the impedence (resistance) of the connection to earth must be kept low relative to the normal circuit impedance.

An alternative to protective earthing of exposed surfaces is a design with "double insulation" or other precautions, such that a single failure or highly probable combination of failures cannot result in contact between live circuits and the surface. For example, a hand-held power tool might have an extra system of electrical insulation between internal components and the case of the tool, so that even if the



insulation for the motor or switch fails, the tool case is not energized.

Terminology-

Electric shock- Electrical injury is a physiological reaction caused by electric current passing through the body. The injury depends on the density of the current, tissue resistance and duration of contact. Very small currents may be imperceptible or produce a light tingling sensation. A shock caused by low and otherwise harmless current could startle an individual and cause injury due to jerking away or falling. Stronger currents may cause some degree of discomfort or pain, while more intense currents may induce involuntary muscle contractions, preventing the person from breaking free of the source of electricity.[Still larger currents result in tissue damage and may trigger ventricular fibrillation or cardiac arrest. If death results from an electric shock the cause of death is generally referred to as electrocution

Prevention-

Use of insulated gloves, insulated boots, mats and tools.

Protecting electrical circuit with a residual-current device (RCD)

Over current protection-In an electric power system, overcurrent or excess current is a situation where a larger than intended electric current exists through a conductor, leading to excessive generation of heat, and the risk of fire or damage to equipment. Possible causes for overcurrent include short circuits, excessive load, incorrect design, an arc fault, or a ground fault. Fuses, circuit breakers, and current limiters are commonly used overcurrent protection (OCP) mechanisms to control the risks. Circuit breakers and fuses protect circuit wiring from damage caused by overcurrent.

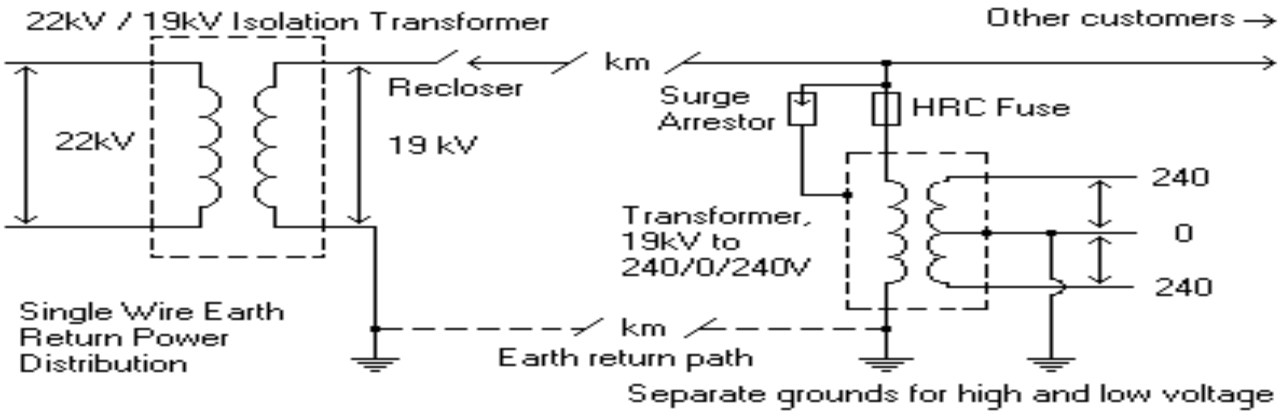
Fuse-A fuse is an electrical safety device that operates to provide overcurrent protection of an electrical circuit. Its essential component is a metal wire or strip that melts when too much current flows through it, thereby stopping or interrupting the current. It is a sacrificial device; once a fuse has operated it is an open circuit, it must be replaced or rewired, depending on type.

Circuit Breaker- A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by excess current from an overload or short circuit. Its basic function is to interrupt current flow after a fault is detected. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation.

Impedence- Electrical impedance is the measure of the opposition that a circuit presents to a current when a voltage is applied. Quantitatively, the impedance of a two-terminal circuit element is the ratio of the complex representation of the sinusoidal voltage between its terminals, to the complex representation of the current flowing through it. In general, it depends upon the frequency of the sinusoidal voltage. Impedance is a complex number, with the same units as resistance, for which the SI unit is the ohm (Ω). Its symbol is usually Z, and it may be represented by writing its magnitude and phase in the polar form $|Z|\angle\theta$.

Functional Earthing

A *functional earth* connection serves a purpose other than electrical safety, and may carry current as part of normal operation. For example, in a single wire earth return power distribution system, the earth forms one conductor of the circuit and carries all the load current. Other examples of devices that use functional earth connections include surge suppressors and electromagnetic interference filters



Terminology-

Single wire earth return- **Single-wire earth return** (**SWER**) or **single-wire ground return** is a single-wire transmission line which supplies single-phase electric power from an electrical grid to remote areas at low cost. Its distinguishing feature is that the earth (or sometimes a body of water) is used as the return path for the current, to avoid the need for a second wire (or *neutral wire*) to act as a return path.Single-wire earth return is principally used for rural electrification, but also finds use for larger isolated loads such as water pumps. It is also used for high-voltage direct current over submarine power cables. Electric single-phase railway traction, such as light rail uses a very similar system. It uses resistors to earth to reduce hazards from rail voltages, but the primary return currents are through the rails.

Surge Suppressor- A surge protector (or spike suppressor, or surge suppressor, or surge diverter is an appliance or device designed to protect electrical devices from voltage spikes. A transient surge protector attempts to limit the voltage supplied to an electric device by either blocking or shorting current to reduce the voltage below a safe threshold. Blocking is done by using inductors which inhibit a sudden change in current. Shorting is done by spark gaps, discharge tubes, zener-type semiconductors, and MOVs (Metal Oxide Varistors), all of which begin to conduct current once a certain voltage threshold is reached, or by capacitors which inhibit a sudden change in voltage. Some surge protectors use multiple elements.

Surge protectors for homes can be in power strips used inside, or a device outside at the power panel. Sockets in a modern house uses three wires: line, neutral and ground. Many protectors will connect to all three in pairs (line–neutral, line–ground and neutral ground), because there are conditions, such as lightning, where both line and neutral have high voltage spikes that need to be shorted to ground.

Electromagnetic interference-Electromagnetic interference (**EMI**), also called **radio-frequency interference** (**RFI**) when in the radio frequency spectrum, is a disturbance generated by an external source that affects an electrical circuit by electromagnetic induction, electrostatic coupling, or conduction. The disturbance may degrade the performance of the circuit or even stop it from functioning. In the case of a data path, these effects can range from an increase in error rate to a total loss of the data[1] Both man-made and natural sources generate changing electrical currents and voltages that can cause EMI: ignition systems, cellular network of mobile phones, lightning, solar flares, and auroras (northern/southern lights). EMI frequently affects AM radios. It can also affect mobile phones, FM radios, and televisions, as well as observations for radio astronomy and atmospheric science.