

BASIC ELECTRICAL TERMS AND DEFINITIONS

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Modern society views electricity as an essential form of energy. Applications of electrical energy include such necessities as lighting, heating, ventilation, and refrigeration. Although we use electricity in many ways every day, many people find it can be difficult to understand.

Electricity is the flow of electrons from one atom to another. Scientists believe that electricity was first noted when ancient

people discovered the attraction between an amber rod and other materials.

The source of electricity for most of us is a local electrical power supplier (Figure 1). Electrical power is generated and distributed through a system of conductors.

Understanding electricity requires a knowledge of the basic electrical terms.

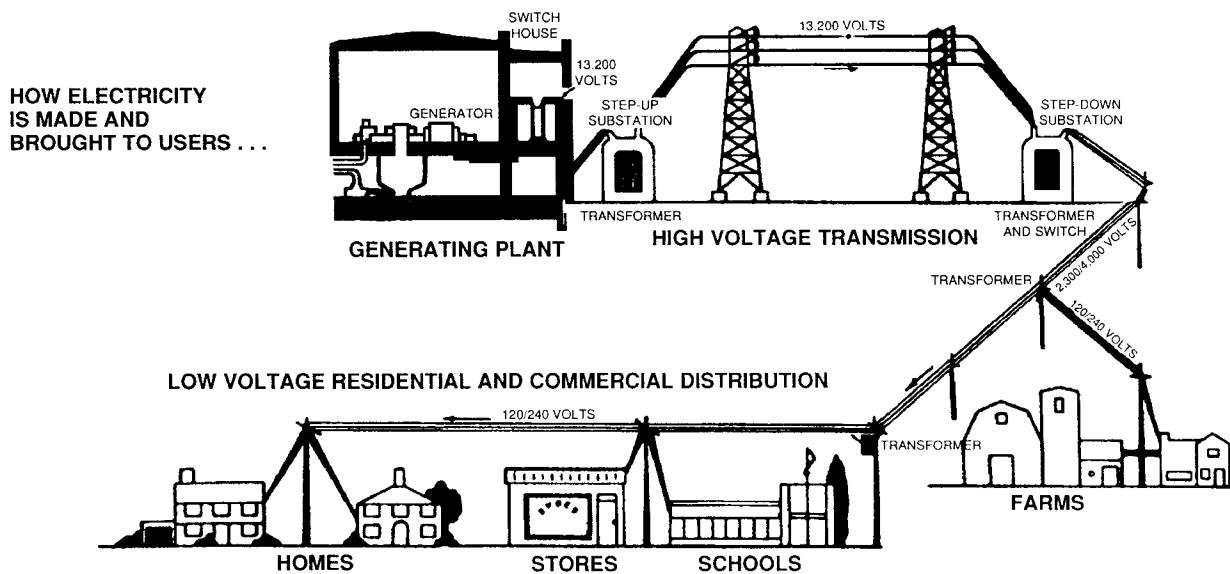


Figure 1. The distribution of electricity.

DEFINITION OF ELECTRICAL TERMS

Conductor: Any material that has a relatively low resistance to the flow of electricity. Conductive materials allow electrons to flow easily from one atom to another within the material. Most metals are good conductors. Copper and aluminum wire are the most common conductors (Figure 2).

Insulator: Any material that has a relatively high resistance to the flow of electricity. Insulative materials resist the movement of electrons from one atom to another. Glass, rubber, air, and many plastics are good insulators (Figure 2). Insulators are used to protect the wire from the environment and to protect people and animals from electric shock.

Circuit: A path of conductors which, when complete, allows an electric current to flow. These circuits are either in series or parallel.

Series Circuit: A circuit in which electricity has only one possible path through the circuit (Figure 3a).

Parallel Circuit: A circuit in which electricity has multiple paths through the circuit (Figure 3b).

Voltage: The "pressure" that causes electrons to flow. Voltage is a measure of the potential for current flow and may exist between objects without a flow of current. Voltage can be compared to water pressure which causes water to flow in a pipe.

Volt (V): A unit measure of voltage. In the United States, the two standard residential voltages are 120 volts and 240 volts.

Current: The flow of electrons through a conductor. An electric current can be compared to water flow in a pipe.

Ampere (A): A unit of measure for the intensity of an electric current flowing in a circuit. About one ampere of current is needed to power a 100 watt light in a typical 120 volt circuit.

Milliampere (mA): Equal to 1/1000th of an ampere.

Alternating Current (AC): One of the two types of electric current. Alternating current does not have a constant voltage: The alternating voltage builds to a maximum value, declines to zero, builds to maximum value in the other direction, and returns to zero (Figure 4a). This sequence is called one cycle. Almost all electricity supplied to farms and homes in the U.S. is 60Hz AC.

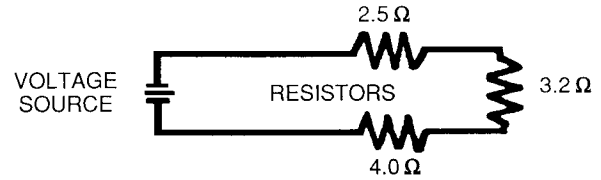


Figure 3a. Series circuit.



Figure 3b. Parallel circuit.

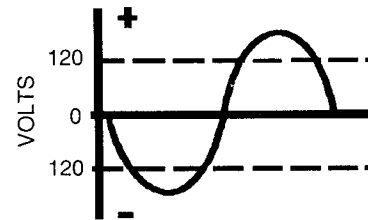


Figure 4a. Alternating current voltage.

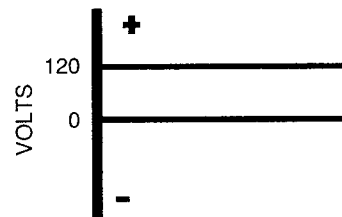


Figure 4b. Direct current voltage.

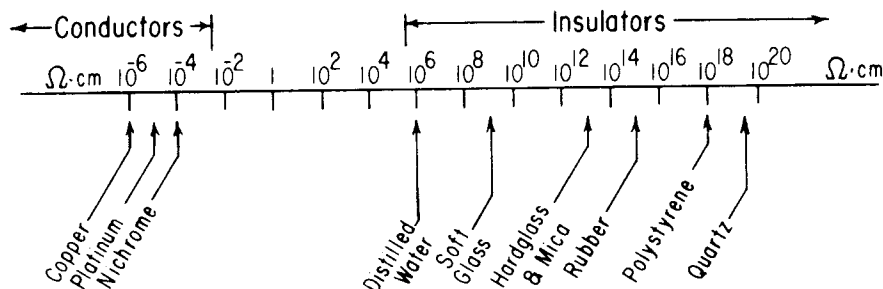


Figure 2. Resistivity chart of common conductors and insulators at 68° F.

Direct Current (DC): The second type of electric current. Direct current flows in only one direction in the circuit (Figure 4b). This current is maintained by a constant voltage typically supplied by a battery.

Resistance: The characteristic of materials that impedes the flow of electricity. All materials have electrical resistance (Figure 2). Electrical resistance can be compared to the friction experienced by water when flowing in a pipe. The two most important characteristics of resistance are: (1) heat is generated when electricity flows through a resistant material, (2) the voltage is decreased when electricity flows through a resistant material.

Ohm (Ω): A unit measure of resistance.

Ohm's Law: Explains the relationship between current, voltage, and resistance: Voltage (V) is equal to current (I) times resistance (R):

$$V = I \times R$$

Power: The rate of energy use. In electricity, energy is produced by moving electrical current through an electrical load. Power used over a period of time yields energy.

Watt (W): A unit of electrical power. Electrical power measured in watts is equal to the voltage (V) times the current (I):

$$W = V \times I$$

Kilowatt (kW): Equal to 1000 Watts.

Energy: Electrical energy is the amount of power used over a period of time. This energy can take many forms, such as heat (from a space heater), light, or work that might be done by an electric motor.

Watt-hour (Wh): A unit of electrical energy.

Kilowatt-hour (kWh): Equals 1000 Watt-hours. It is the product of power in kW and time in hours. For example, if 2 kW are used for 4 hours, 8 kWhs of energy will be used (2 kW x 4 hours); or if a 100 W light bulb is used for 4 hours, 0.4 kWhs of energy will be used (100 W x 1 kW/1000 Watts x 4 hours). Electrical energy is sold in units of kWh.

Kilowatt-hour Meter: The device used to measure electrical energy use (Figure 5).

Load: Anything which consumes electrical energy. Examples include lights, appliances, heaters and electric motors.

Ground: A conducting path between an electrical circuit or equipment and the earth. In alternating current systems, the purpose of grounding is for safety. If proper grounding is not maintained, risk of electrical shock, fires, and damage to appliances and motors greatly increases. A ground is often established using a conducting rod driven into the earth as shown in Figure 6.

Service: The conductors and equipment used to deliver energy from the electric supply system to the system being served (Figure 6).

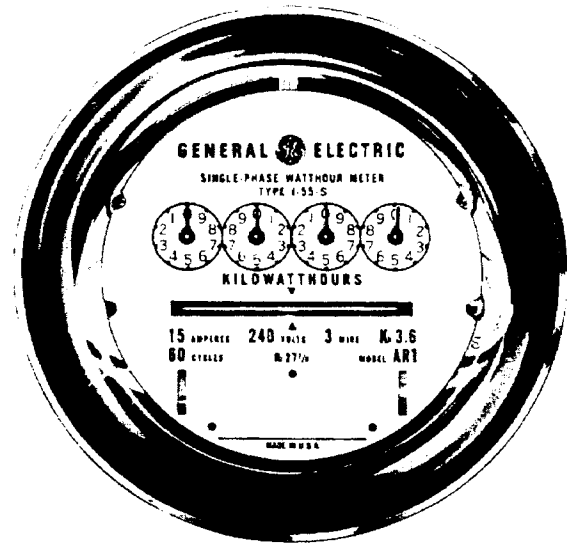


Figure 5. Kilowatt-hour meter.

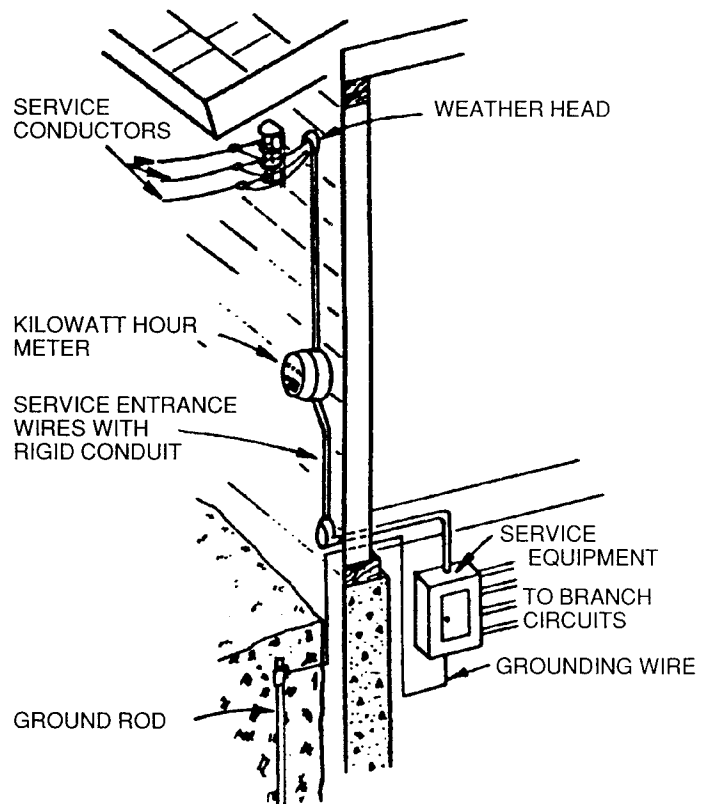


Figure 6. System for delivery of electrical power to a residence.

Fuse: A circuit interrupting device used to protect against excessive current flow in conductors. A metal link in the fuse will melt (the fuse “blows”) and breaks the circuit when the current becomes excessive. When this metal link melts, the fuse is destroyed and can not be reused. After correcting the cause of the failure, the fuse can be replaced using a similar fuse with the same size rating. Two types of alternating current fuses are used: plug fuses and cartridge fuses (Figure 7a,7b).

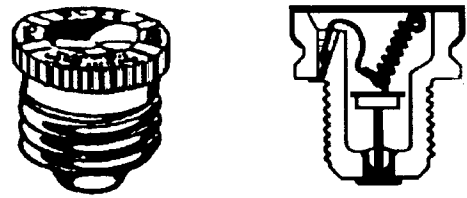


Figure 7a. Plug type fuse

Circuit Breaker: A time-delay circuit interrupter that automatically opens the circuit when current flow exceeds the breaker rating for a short period of time. To restore service, it is necessary to reset (close) the circuit breaker after identifying and correcting the cause of the overload or failure. A typical circuit breaker is shown in Figure 8.

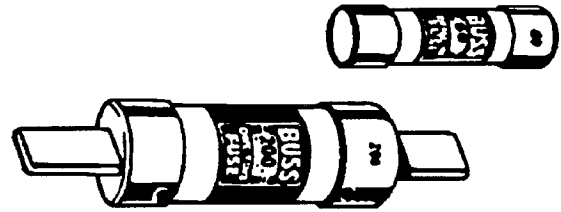


Figure 7b. Cartridge type fuses.

Ground Fault Circuit Interrupters (GFCI): Specifically designed current sensing devices that detect as little as 5mA of current leakage (current flow to a ground fault) and cut the circuit current almost instantaneously to provide shock protection. GFCIs are available for permanent installation at the service entrance or convenience outlets and as portable protective devices (for operating portable tools, etc.).

Contact the North Dakota State Electrical Board (Phone 701-224-2822) or a local inspector for more details.

Useful references on basic electrical wiring include:

Agricultural Wiring Handbook, published by the National Food and Energy Council, Columbia, MO.

Farm Buildings Wiring Handbook, published by the Midwest Plan Service (MWPS-28).

Both references are available through the NDSU Extension Service, Agricultural Engineering Department, or your local extension agent.

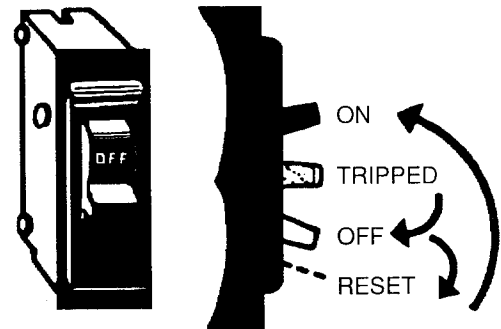


Figure 8. Circuit breaker.

