Unit 9
Circuit Conductors & Wire Size

Conductor Forms

- Most popular type of resistance wire is copper – (easy to work with)

There are 4 common conductor forms:
- Copper conductors used for wiring circuits can be made in the form of wire, cable, cord or printed circuit board.

Wire

- A solid wire is a single conductor covered by some form of insulation
- A stranded wire is a single conductor made up of small diameter wires running alongside each other. (Provides flexibility)
- Both are use in electronic equipment hook ups

Cable

- A larger stranded insulated wire or 2 or more separately insulated wires within a common covering.
- used in circuits that require large amount of current such as house wiring.

Large stranded cable

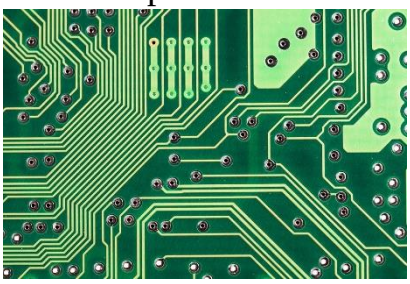
Multi-conductor cable

Cord

- A very flexible cable used to supply current to appliances or tools. Made of strands of very fine wire twisted together.

Printed circuits

- used in low current electronic equipment.
- consists of conducting paths of thin copper strips etched or printed on a flat insulated plate.



Conductor Insulation

- some factors to consider when selecting wire insulation are:
 *Circuit Voltage
 *Surrounding Temperature
 *Moisture
 *Conductor Flexibility

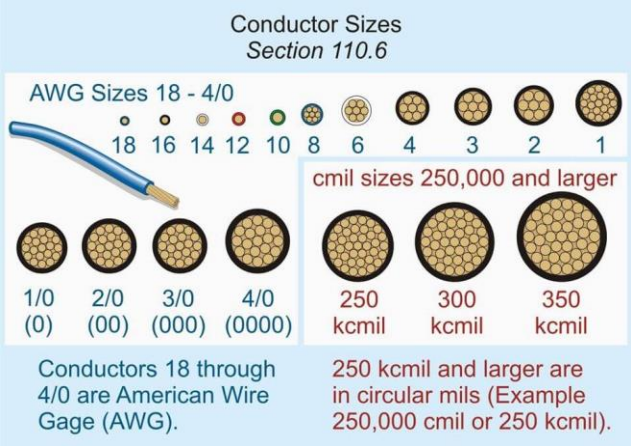
-Thermoplastic is commonly used as an insulator but regular thermoplastic sensitive to extreme temperature.
- type TW thermoplastic is weatherproof
- type TWH is weatherproof and heat resistant
- Neoprene is a special rubber type of insulation used on power cords on heat producing appliances such as kettles.

- Asbestos is another type of heat-proof insulation used in electric stoves for connections to heating elements and in braided cotton in cords for clothes irons.

- baked-on varnish insulation is found on the copper wire used in electric motor windings and relay coils.

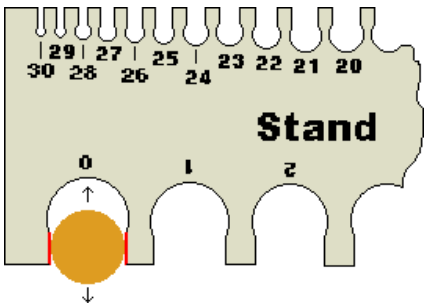
Wire Size

- solid wire size is determined by its diameter.
- For convince size is referred by an equivalent gauge number rather the actual diameter.
- The American Wire Gauge (AWG) table list sizes and consists of 40 sizes.
- AWG 40 is the smallest and AWG 4/0 the largest.
- the larger the gauge number the smaller the diameter



How to use a wire gauge

- Strip the insulation from the wire's end
- insert bare end into the smallest slot in which it fits (without using force)
- the number stamped below the slot is the AWG of the wire.



Conductor Ampacity

- Ampacity of a conductor is the maximum amount of current it can safely carry
- this is determined by material, gauge size, type of insulation and conditions in which it is installed.
- Copper is a better conductor than Aluminum so it can carry more current for a given gauge
- the smaller the gauge number the larger the conductor and the more current it can carry

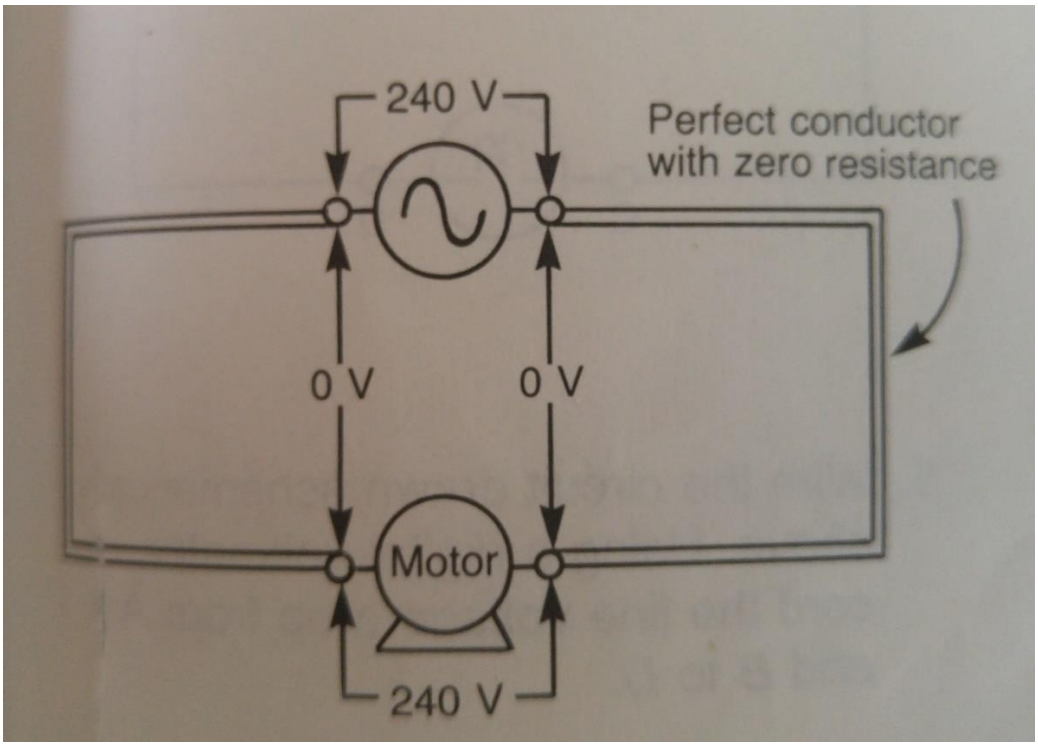
List of common ampacity

- the Canadian Electrical Code contains tables that list the ampacity for every type of conductor size, insulation and operating condition. These tables should be referred to for specific installations.
- below are some common copper conductor sizes used inside an insulated cable for circuits in a home.

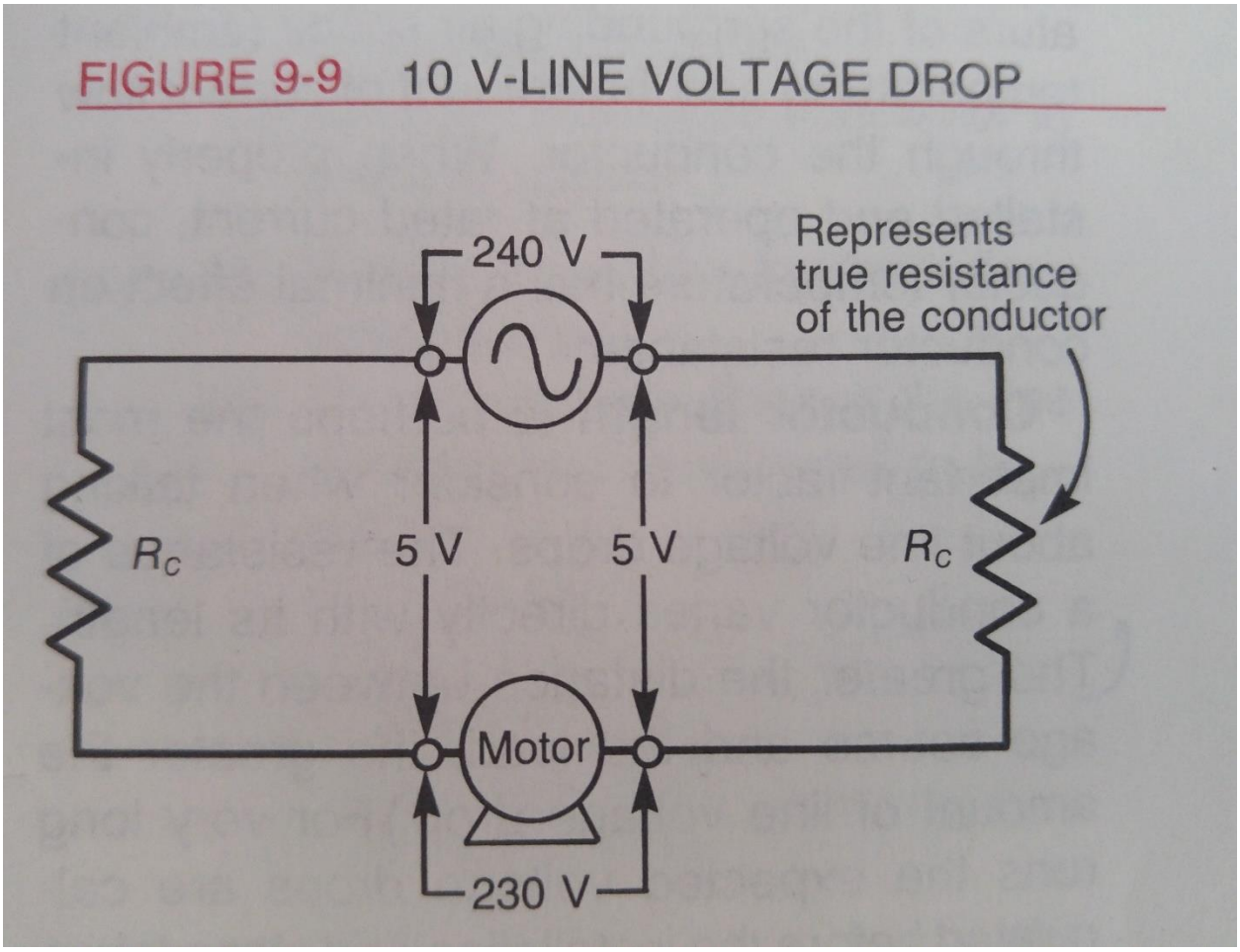
AWG	Ampacity	Application
#14 copper	15A	Lighting and receptacle branch circuits
#12 copper	20A	Electric heating circuits and 240 V water heaters rated up to 4500 W.
#10 copper	30A	Electric dryers rated up to 7000 W.
#8 copper	40A	Electric ranges rated up to 12000 W

Conductor Resistance

- The resistance of the wire conductors of the circuit is low when compared to that of the load
- In most circuits the conductors are treated as being perfect conductors of electricity so as a result they are said to have zero resistance
- THUS in this case the voltage value of the source is the same as that across the load. (NO Voltage is lost in the line)



- In some circuits the resistance of the conductors is important and must be taken into account
- This is often the case where the load is located some distance from the voltage source.
- The difference in voltage between the voltage source and the load is called the **line voltage drop**.



Example) the line voltage drop for the above circuit is:

5 V + 5 V = 10 V

Example) the voltage applied to the motor for the circuit drawn above is:

240 V - 10 V = 230 V

Line Voltage Drops

- It is always desirable to keep the line voltage drop as low as possible. (So you don't rob the load of energy)
- Line voltage drops are kept low by keeping the resistance of the wires low

- The resistance of the length of wire is determined by:
 *type of metal used
 *the operating temperature
 *length of the wire
 *AWG size or Cross sectional area of a wire

- The resistance of a conductor varies with temperature. For copper the higher the temperature the higher the resistance.

- Conductor length is perhaps the most important factor to consider when talking about the voltage drops.
* The greater the distance between the voltage source and the load, the greater the amount of load voltage drop

- AWG Size of the conductor is the most important factor in correcting for excessive line voltage drops. The greater the cross-sectional area of the conductor, the lower is its resistance.
*increase wire diameter above the rated current capacity to
reduce line voltage losses