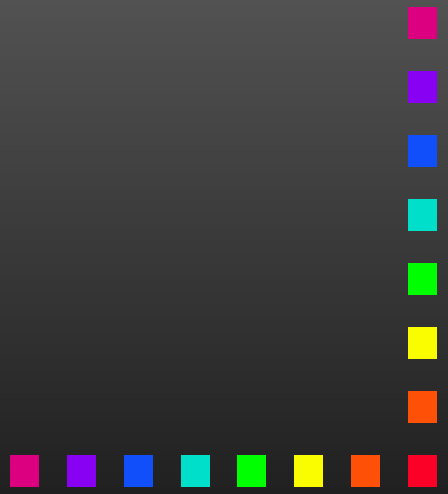
Electrical Principles and Wiring Materials



Principles of Electricity

- Electricity is a form of energy that can produce light, heat, magnetism, chemical changes
- Resistance: tendency of a material to prevent electrical flow
- Conductor: if electricity flows easily
- Insulator: material that provides great resistance

Amps, Volts, Watts

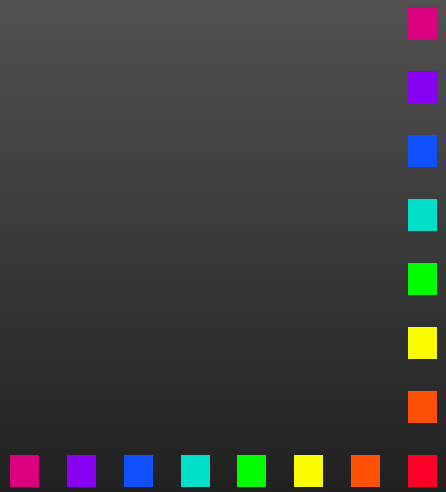
- Amperes: measure of the rate of flow of electricity in a conductor
- Volts: measure of electrical pressure
- Watts: measure of the amount of energy or work that can be done
- Ohms: measure of electrical resistance to flow

Ohm's Law

- Ohm = R
- Volts = E
- Amps = I
- Ohm's Law: E = IR

  I=E/R

  R=E/I

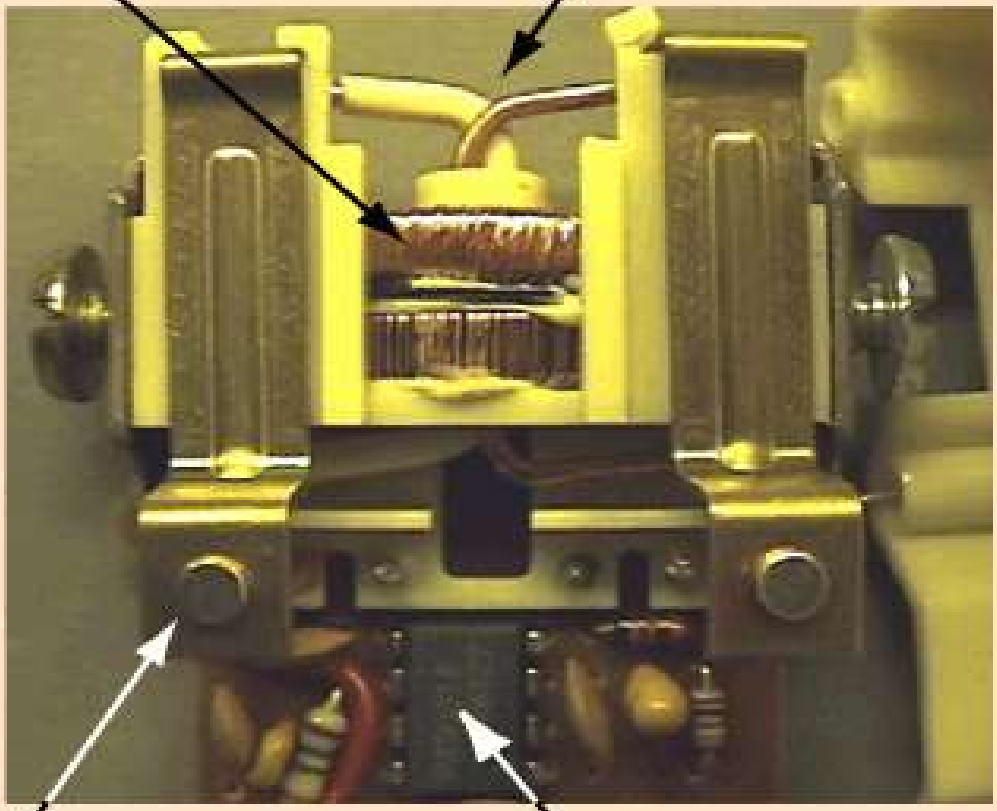


Electrical Safety

- Shock and Fire
- Never disconnect any safety device
- Don’t touch electrical items with wet hands or feet
- Don’t remove ground plug prong
- Use GFI in wet areas
- GFI- Ground Fault Interrupter
- Designed to protect from electrical shock by interrupting household circuit when there is difference in currents in “hot” and neutral wires.

Longitudinal transformer senses difference between "hot" and neutral wires

Current from "hot" and neutral pass through transformer in opposite directions.



Contacts break both "hot" and neutral in case of fault current

Comparator provides very sensitive detection of difference between "hot" and neutral

Electrical Safety

- Discontinue use of extension cord that feels warm
- Don’t put extension cords under carpet
- Install wiring according to NEC
- Blown fuse or breaker, determine cause
- Don’t replace fuse with larger fuse
- Don’t leave heat producing appliances unattended
- Heaters & lamps away from combustibles

Electrical Safety

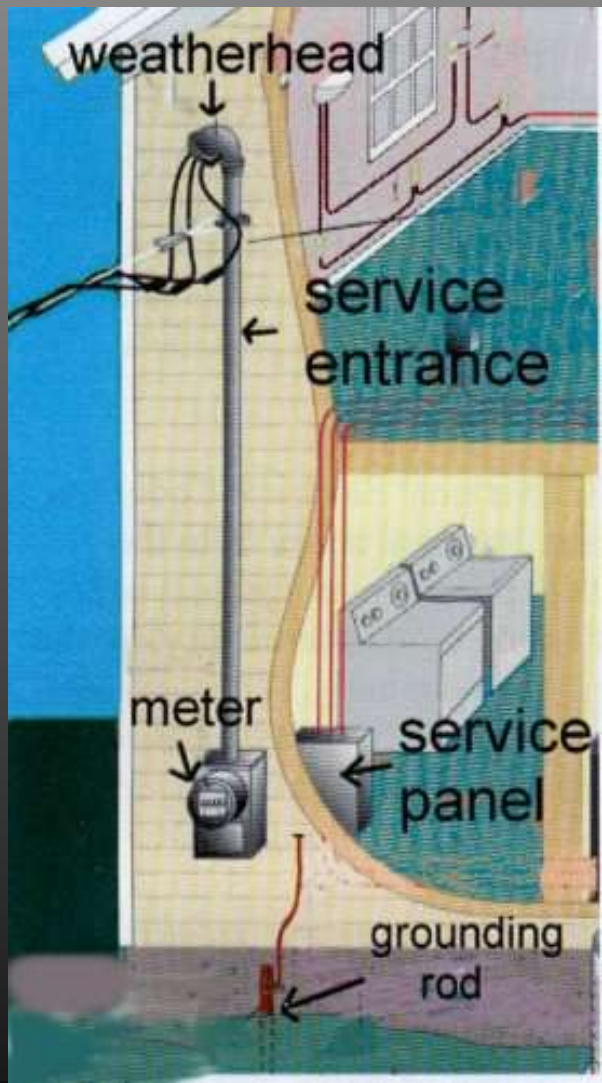
- Don’t remove back of TV (30,000v when off)
- Electric motors lubricated, free of grease etc.
- Keep appliances dry
- Don’t use damaged switches, outlets, fixtures, extension cords
- Follow manufacturer’s instructions for installation and use of electrical equipment

Service Entrance

- Power from power company
- Transformer: drops volts from 25,000 volts to 240 volts
- Service drop: wires etc from transformer to house
- Entrance head: weather-proof at house
- Meter: $$$
- Service Entrance Panel (SEP): box with fuses or breakers

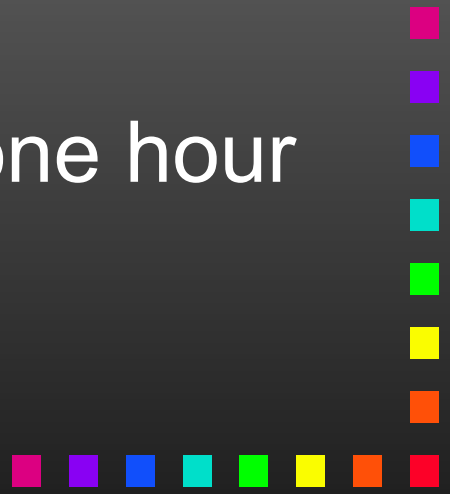
Service Cable Entrance

- The service cable runs down the outside of the wall to the level of the breaker box
- Weatherhead = conduit entrance cap



Electric Meter

- Kilowatthours: how electricity is sold
- Kilo = 1000
- Watthour = use of 1 watt for one hour
  - 100 watt light bulb for 1 hour - 100 watthours
- Kilowatthour = 1000 watts for one hour

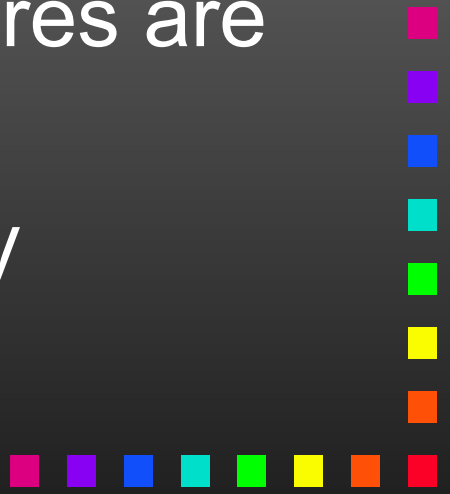


Branch Circuits

- usually begin at SEP
- branch out into a variety of places
- only 1 motor or;
- series of outlets or;
- series of lights
- use correct size wire and fuse or breaker

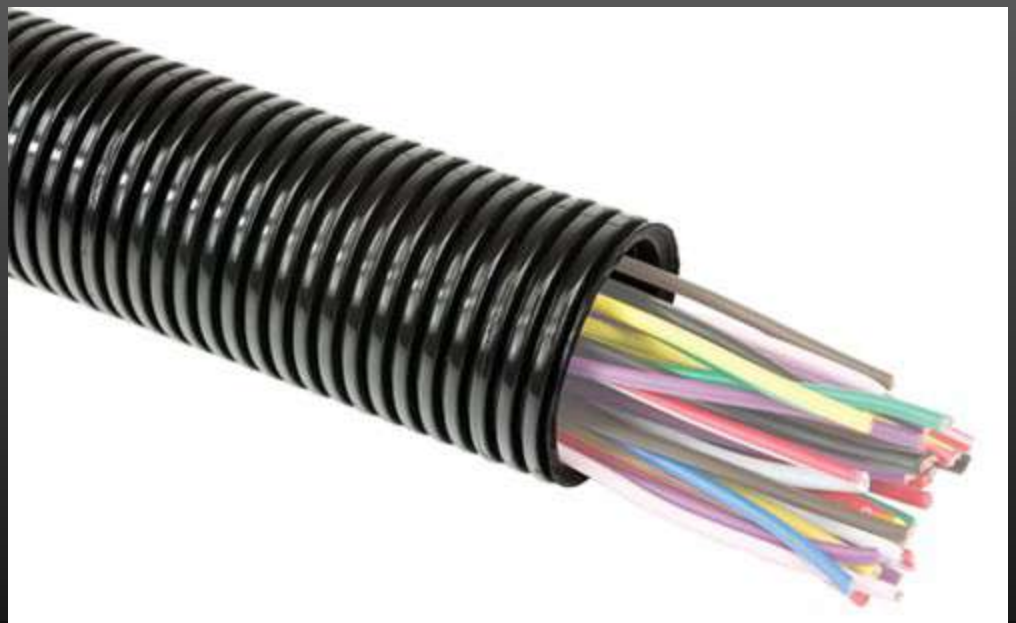
Types of Cable

- Nonmetallic sheathed cable: copper or alluminum wire covered with paper, rubber, or vinyl for insulation
- Armored cable: flexible metal sheath with individual wires inside. Wires are insulated
- Conduit: tubing with individually insulated wires



Conduit

- Flexible Metal Conduit
- Steel Conduit
- Polyflex



Wire Type and Size

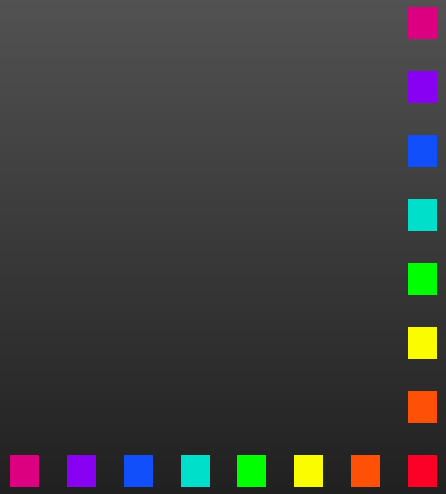
- copper
- No 14 (14 gauge) = 15 amp circuits
- No 12 = 20 amps
- No 10 = 30 amps
- aluminum use one size larger
- lower gauge number = larger wire
- No 8 and larger use bundles of wires
- current travels on outer surface of wire, so a bundle of smaller wires can carry more

Voltage Drop

- loss of voltage as it travels along a wire
- lights dim, motors overheat
- larger wires have less voltage drop for a given amount of current
- longer wire = greater problem
- must increase wire size as distance increases

Wire Identification

- Type of outer covering, individual wire covering, cable construction, number of wires
- Wire type stamped on outer surface



Wire Types

- Type T - dry locations
- Type TW - dry or wet
- THHN - dry, high temps
- THW and THWN - wet, high temps
- XHHW - high moisture & heat resistance
- UF - direct burial in soil but not concrete

Wire Identification

- Color coded: black, red, & blue = positive or hot wires which carry current to appliances
- White = neutral wires carry current from appliance back to source
- Green or Bare = ground all metal boxes and appliances

Wire Identification

- Wire Size: 12-2 has two strands of No. 12 wire (black & white)
- 12-2 w/g same, with one green or bare
- 12-3 has three strands of No. 12 (black, red, white)
- 12-3 w/g same, with green or bare

- 12-2 w/g
- 12-2
- 12-3 w/g
- 12-3