BASIC ELECTRICAL FUNCTIONS

ACCT-BVP2-3. Students will show understanding of basic electrical functions.

a. Describe the basic principles of electricity.

b. Calculate the amount of electricity required to operate lights and various other components used in this career field, per instructor's directions.

c. Describe safety procedures to be followed when working with electrical devices.

Electrical Safety

- Basic Principles of Electricity
- Alternating Current
- Basic Electric Circuits
- Safe Working Practices
- Maintenance

What is electricity ?

- A source of Energy
- Essential to modern life
- Extremely Dangerous
    - Cannot be seen or smelt
- Fatalities Each Year
  – It takes less than one (1) ampere to cause death.

Electric Current

- A flow of electrons !
- Certain materials ‘conduct’ better than others

Electric current

- Conductors
  - Metals such as copper, silver, gold and aluminium.
  - Loose electrons in abundance so charge can be transferred easily
  - Copper very common on cost basis

Electric current

- Summary
  - Movement of electrons
  - Best in soft metals
  - Measured in Amperes or Amps
  - Symbolised by ‘A’
    - i.e. a 13A fuse

Potential Difference

- Charge on an object
- Measured with respect to earth
- Also known as Pressure
- Water Analogy
  - Horizontal pipe – water does not flow
  - Raise one end – water flows out
  - A pressure difference exists

Potential Difference

- Raising pipe created a pressure difference
- Raising electric charge has same effect only electric current will flow

- Amount of current that flows dependant on conductor (…more water could flow in a bigger pipe…)

Potential Difference

- Summary
  - Difference of charge between two objects
  - Causes a current to flow
    - (water analogy)
  - Measured in Volts
  - Symbol ‘V’
    - i.e. 230V

Conductors and Insulators

- Conductors conduct electricity
- Insulators don’t
- Metals conduct
- Wood, plastic, air, oil and rigid glass do not conduct electricity (most of the time)

Resistance

- Back to the water pipe again!
  - A larger diameter pipe allows more water to flow than a smaller one
  - If a small diameter section of pipe is inserted into the large pipe the flow of water is restricted
- Some materials conduct electricity better than others (atomic structure different)

Resistance

- Small diameter wires (conductors) allow less electricity to flow than in similar bigger diameter wires

- The ease by which a material conducts electricity is known as resistance

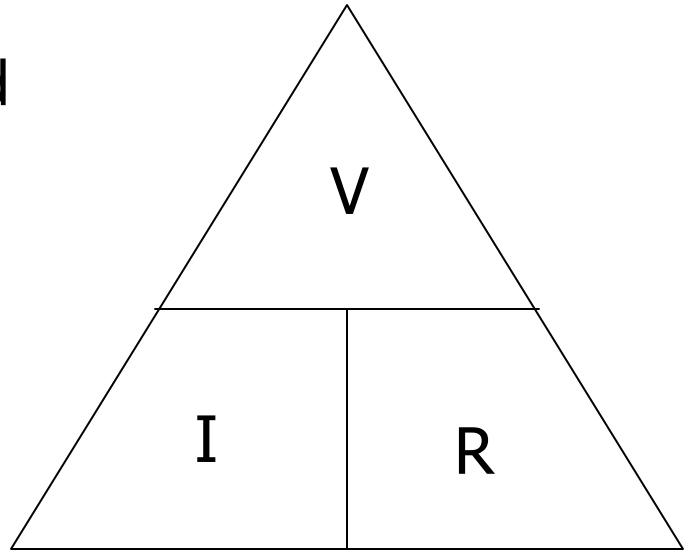
Relationships

- Electric Current - Amperes
- Potential Difference – Voltage
- Electrical Resistance

- All above are related to each other

Ohms Law

French physicist Ohm studied the relationship between Potential difference (V), Amperes, and Resistance.



His findings became known as Ohms Law

Where V = I * R, I = V / R & R = V / I

Sources of power

- Battery DC
- Mains Supply
- Portable Generators
- Solar panels

UK Electricity Supply System

- Electricity supplied to factories, offices and homes at 230 volts
- Large factories at 11000 volts or above
- Supply has alternating current (a.c.)
- Alternates at (frequency) of 50 cycles per second (50 Hertz or Hz)

Power

- When current flows energy is transmitted and usually consumed by a load
- Examples – heaters, lights, motion
  - Such devices must consume electricity because we have to pay for it!

Power

- Power = Volts X Amps (work done)
- Measured in Watts (W)
- Example – 2300 Watt electric kettle
  - Also referred to as 2.3 kilowatt (kW)

Summary

- Amps, Volts, Ohms
- Power

Effect of electricity on human body

- Burns
  - Surface
  - Deep tissue
- Electric Shock
  - Muscular Contraction
  - Asphyxia
  - Respiratory Arrest
  - Ventricular Fibrillation

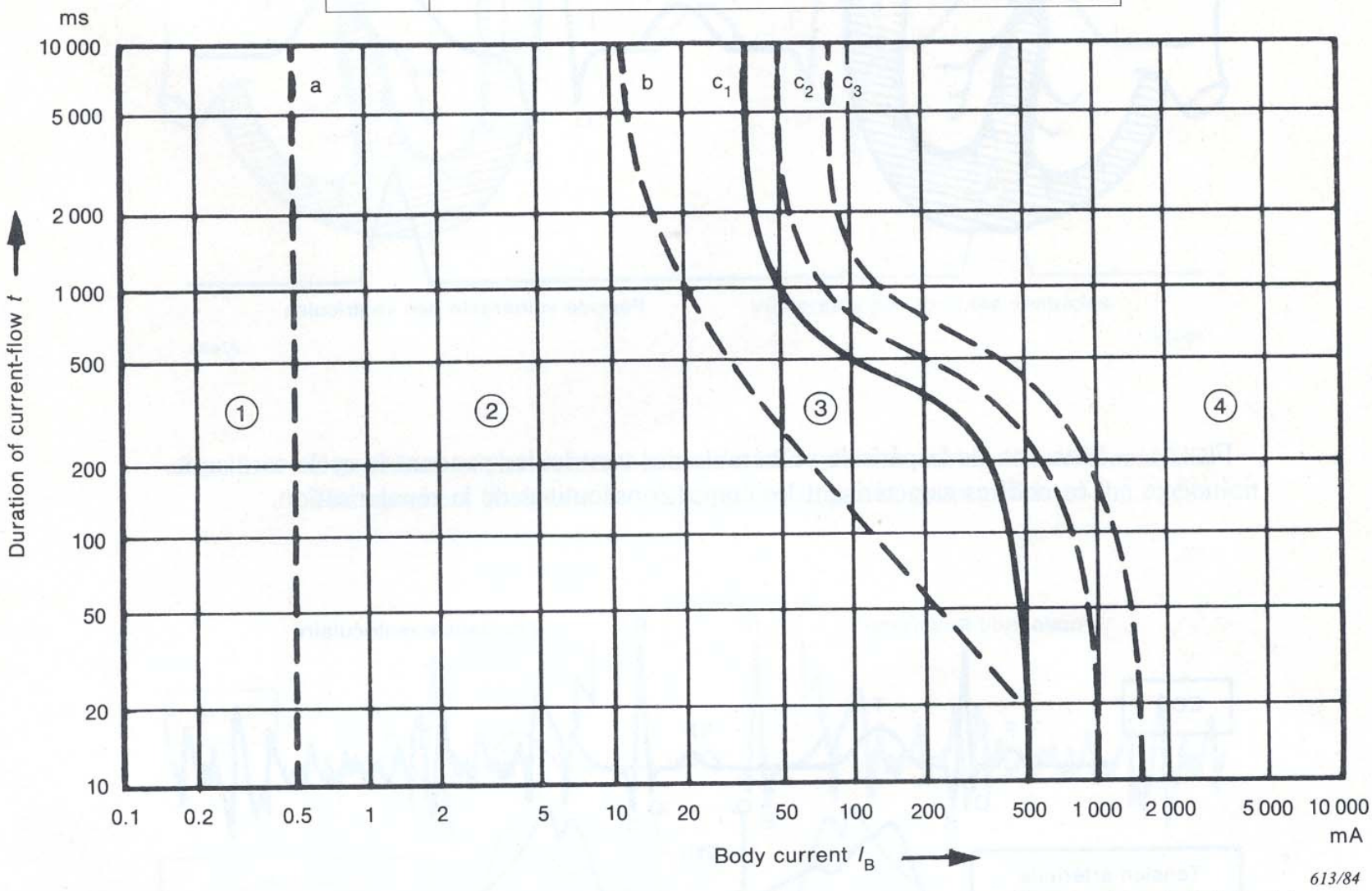
Ventricular Fibrillation

- Factors are Current / Time & Physiological Structure of body
- Can occur at 30mA (0.03 A)
- Causes heart to ‘flutter’
- Muscle cannot open / close properly
- Does not pump
- Lack of oxygen to brain - DEATH

Electric shock

- 0.5mA – 6mA tingling sensation ‘Threshold of perception.’
- 10mA – 16mA muscular contraction sets ‘Threshold of danger’
- 30mA – 60mA & above prolonged exposure can be FATAL
- Death can occur in a fraction of a second

IEC 479 Curves



Notes 1. — As regards ventricular fibrillation, this figure relates to the effects of current which flows in the path "left hand to feet". For other current paths, see Clause 5 and Table III.

2. — The point 500 mA/100 ms corresponds to a fibrillation probability in the order of 0.14%.

For info only

IEC 479 curves

- Zone 1 - No danger
- Zone 2 - Usually No effects
- Zone 3 – Reversible damage, no fibrillation, breathing difficulties
- Zone 4
    - 5% chance of fibrillation C1- C2
    - 50% chance of fibrillation after C3

For info only

Electric Shock - Treatment

- Isolate supply immediately – Dial 911
- If you cannot isolate DO NOT attempt to touch casualty
- Physically remove victim using non-conducting implements
- Check for pulse / breathing, give artificial respiration if necessary

Electrical circuits

- Consist of
  - Power Source
  - Connecting cables
  - Electrical equipment (energy converter)

Electrical circuits - Earthing

- Very important for safety !
- Prevents conducting parts of equipment (i.e.. metal frames or lids), which do not normally conduct electricity from becoming live during faults.

No earthing of equipment

- No bonding
- Person can receive an electric shock if equipment becomes faulty

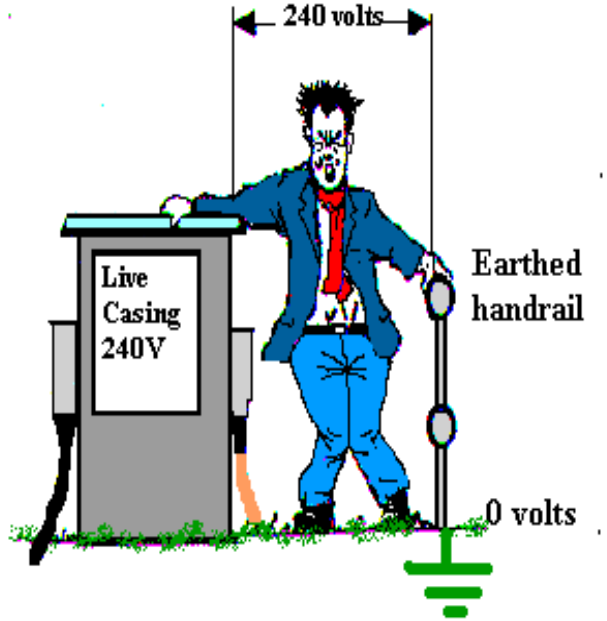


Fig. 2 No Bonding - UNSAFE

Equipment bonded together

- All equipment bonded together
- No potential (voltage) difference between live casing and handrail
- If case becomes live fuse should blow
- Equipotential Bonding

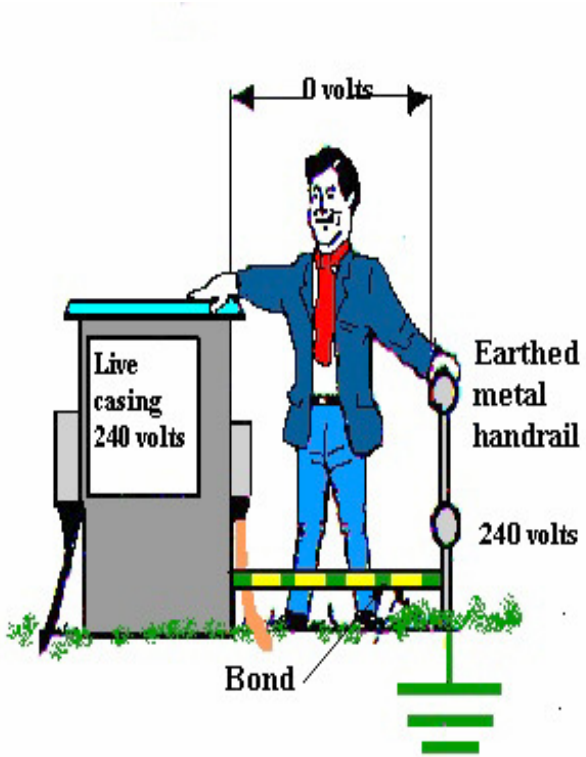


Fig.3 Earthed equi-potential Bonding - SAFE

Fuses and RCD's

- Fuses
  - essential for safety, will cut off supply at a certain current level i.e. 13A, 5A, 3A mains supply fuse
  - Fuse has a 'fuseable' wire element which heats up when current flows
  - Excessive current = excessive heat & wire melts preventing current flow
- RCD's
  - Residual current device
  - Compares current in Live & Neutral if different and above a certain value supply switched off

Work on Electrical Equipment

- Always ISOLATE supply
  - Switch off using a device that will create an air gap that should not fail
  - Lock off where possible to prevent inadvertent switching ON whilst work taking place
  - Always test conductors in a reliable way before touching (i.e.. test the test device before and after use!)
- Permit to work may be required for higher voltage or complex installations

Safe values of Voltage

- 55 VAC systems have not caused anybody to be electrocuted
- Often referred to as a 110VAC centre tapped earth supply (CTE) yellow coloured equipment
- Less than 120 VDC considered to be safe

Double Insulation

- Lots of portable equipment is Double Insulated
- Extra layer of insulating material over live conductors to prevent exposure of conductors
- Can mean that an earth conductor is not required – risk reduced by additional insulation.

Electrical Fires / Arcs / Explosions

- Fires
  - Overheating, arcing & sparking
- Arcs
  - Generated during faults / flashover (Lightning)
  - Very high temperatures / causing burns
- Explosions
  - Flammable substances give off vapours
  - Electrical sparks can ignite (i.e.. domestic light switch)

Electrical equipment selection

- Must be suitable for environment
  - Wet, dusty, flammable gases, mechanical strength, corrosive atmospheres (maggot farms)
  - Must be maintained in good condition
  - Failure to select suitable equipment and maintain it often results in incidents at a later date

Maintenance of Portable Electrical Equipment

- Many accidents result from 230 volt portable equipment
- Pressure Washers / Vacuum Cleaners
- Resulting from
  - Incorrect selection
  - Inadequate maintenance / poor repairs
- Most important checks are easy to do !

Maintenance of Portable Electrical Equipment

- Visual Inspection
  - Check flexible mains cable for damage to insulation
  - If insulation is damaged – REPLACE
  - DO NOT wrap conductors together and tape up
  - So called ‘Electrical Insulation Tape’ will not provide a sufficient barrier between you and a potentially fatal electric shock – as has been proven on many occasions

Maintenance of Portable Electrical Equipment

- Plug
  - Check that only the outer insulation has been clamped / gripped. Clamping inner conductor insulation will potentially lead to exposure of live terminals.
  - Is fuse correct rating (Instructions should advise correct current value – DO NOT use a nail)
  - Check that all 3 pins are present and in good condition

Maintenance of Portable Electrical Equipment

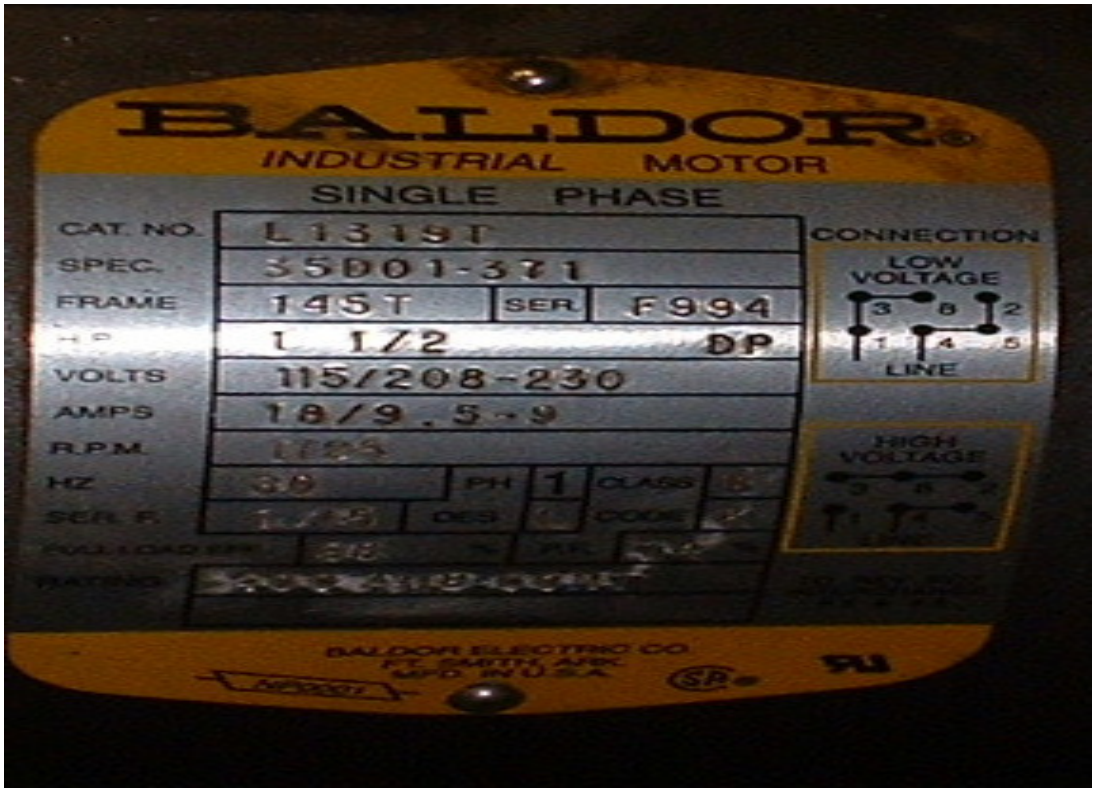
- Testing
  - Only by a competent person
  - Earth bond test
  - Insulation test
  - On-load test

- Guidance – HSE HS(G) 107 (£5) 'Maintaining portable and transportable electrical equipment'

Electricity

Calculating the amount of electricity needed to operate….stuff.

When installing new appliances, equipment, tools, or any type of electrical convenience, it is important to know the electrical requirements for the item that you wish to connect.



It is equally important to know the availability and capacity of your electrical service.

Amps Volts Watts

The following relationship exists between Amps, Volts and Watts.

Amperes are a measure of the rate of flow of electricity in a conductor.

Volts are a measure of electrical pressure.

Watts are a measure of the amount of energy or work that can be done by amperes and volts.

Amps Volts Watts

Thus, the following relationship exists.

Work = Pressure x Flow

Or

Watts = Volts x Amperes

Amps Volts Watts

This formula is commonly referred to as the West Virginia Formula

$$W=VA$$

When we know any two variables of the formula, we can calculate the other.

Formulas

Watts = Volts x Amps

Volts = Watts / Amps

Amps = Watts / Volts

Calculating Amperage

If we have a 100 watt lamp plugged into a 120 volt receptacle, we can determine the rate of flow or the amperes for that circuit.

Amps = 100 Watts / 120 Volts

100 / 120 =.833 Amps

Calculating Watts

If a water heater operates at 20 amps on a 240 volt circuit, what is the wattage of the appliance?

Watts = 240 Volts x 20 Amps

4800 Watts =240V x 20A

Watts=4800

Calculating Volts

If an electric motor operates at 2880 watts and 12 amps, what would be the voltage requirement for that motor?

Volts = 2880 Watts / 12 Amps

2880 / 12 = 240 Volts

Circuit Calculations

When installing branch circuits, it is important that we know the following information before we can begin.

- The number of loads on the circuit.
- The Watts of each load.
- The Amperes required by each load .
- The Voltage required by the load.
- The distance from the service panel to the load.

Circuit Calculations

Our first example will be to install a branch circuit for lights in a shop building.

The load will be ten 120 watt light bulbs.

The lights will operate on a 120 volt circuit.

We can determine the amperage on this circuit by using the formula A= W / V.

The amperage on this circuit will be the number of lights (10) x 120 Watts /120 Volts =10 Amps.

Now we can correctly match our wire size and circuit breaker for the installation we desire.

Circuit Calculations

Next we will install a individual branch circuit that will be used to operate an air compressor. The motor information plate reads that it operates on 120/240 volts and requires 15.4 / 12.1 amps.

In this scenario, we do not need to make any calculations for voltage or amperage, and the watts will not need to be known to make this connection.

However, the first amperage reading of 15.4 indicates the amperage that should be used when Calculating for a 120Volt circuit. 12.1 amps should be used for a 240 volt connection.

Circuit Calculations

Next we will install a individual branch circuit for a hot tub. The hot tub operates two 3 HP pump motors which require 240 volts and 7.2 / 5.3 amps. The heater is a 240 volt, 5500 watt element. The air blower is a 240 volt, 2 amp motor.

Now lets determine the size circuit interrupter we need.

The 2 motors will account for 14.4 amps.

The air blower will account for 2 amps.

We will have to calculate the amperage for the heater.

A = W/V

A = 5500 / 240 or Amps = 22.9

Our total amperes is 14.4 + 2 + 22.9 = 39.3

Now we can determine the wire size and the circuit interrupter size needed.

Circuit Calculations

Voltage Drop

As electricity travels through conductors, it meets resistance and looses pressure or volts. The farther it has to travel, the greater the drop in voltage. This is called Voltage Drop.

TABLE 26 ELECTRICAL WIRE SIZES FOR COPPER AT 115–120 VOLTS

Load in Amps	Minimum Allowable Size of Conductor: In Cable, Conduit, Earth — Types R, T, TW	In Cable, Conduit, Earth — Types RH, RHW, THW	Overhead in Air* — Bare & Covered Conductors
5	12	12	10
7	12	12	10
10	12	12	10
15	12	12	10
20	12	12	10
25	10	10	10
30	10	10	10
35	8	8	10
40	8	8	10
45	6	8	10
50	6	6	10
60	4	6	8
70	4	4	8
80	2	4	6
90	2	3	6
100	1	3	6
115	0	2	4
130	00	1	4
150	000	0	2
175	4/0	00	2
200	250	000	1

COPPER up to 200 Amperes, *115- 120 Volts,* Single Phase, Based on 2% Voltage Drop

Length of Run in Feet

Compare size shown below with size shown to left of double line. Use the larger size.

Load in Amps	30	40	50	60	75	100	125	150	175	200	225	250	275	300	350	400	450	500	550	600	650	700
5	12	12	12	12	12	12	12	10	10	10	10	8	8	8	8	6	6	6	6	4	4	4
7	12	12	12	12	12	12	10	10	8	8	8	8	6	6	6	6	4	4	4	4	4	3
10	12	12	12	12	10	10	8	8	8	6	6	6	6	4	4	4	4	3	3	2	2	2
15	12	12	10	10	10	8	6	6	6	4	4	4	4	4	3	2	2	1	1	1	0	0
20	12	10	10	8	8	6	6	4	4	4	4	3	3	2	2	1	1	0	0	00	00	00
25	10	10	8	8	6	6	4	4	4	3	3	2	2	1	1	0	0	00	00	000	000	000
30	10	8	8	8	6	4	4	4	3	2	2	1	1	1	0	00	00	000	000	000	4/0	4/0
35	8	8	8	6	6	4	4	3	2	2	1	1	0	0	00	00	000	000	4/0	4/0	4/0	250
40	8	8	6	6	4	4	3	2	2	1	1	0	0	00	00	000	000	4/0	4/0	250	250	300
45	6	8	6	6	4	4	3	2	1	1	0	0	00	00	000	000	4/0	4/0	250	250	300	300
50	6	6	6	4	4	3	2	1	1	0	0	00	00	000	000	4/0	4/0	250	250	300	300	350
60	4	6	4	4	4	2	1	1	0	00	00	000	000	000	4/0	250	250	300	300	350	400	400
70	4	4	4	4	3	2	1	0	00	00	000	000	4/0	4/0	250	300	300	350	400	400	500	500
80	2	4	4	3	2	1	0	00	00	000	000	4/0	4/0	250	300	300	350	400	400	500	500	600
90	2	3	4	3	2	1	0	00	000	000	4/0	4/0	250	250	300	350	400	500	500	500	600	600
100	1	3	3	2	1	0	00	000	000	4/0	4/0	250	250	300	350	400	500	500	500	600	600	700
115	0	2	3	2	1	0	00	000	4/0	4/0	250	300	300	350	400	500	500	600	600	700	700	750
130	00	1	2	1	0	00	000	4/0	4/0	250	300	300	350	400	500	500	600	600	700	750	800	900
150	000	0	2	1	0	000	4/0	4/0	250	300	350	350	400	500	500	600	700	700	800	900	900	1M
175	4/0	00	2	1	0	000	4/0	250	300	350	400	400	500	500	600	700	750	800	900	1M		
200	250	000	1	0	00	000	4/0	250	300	350	400	500	500	500	600	700	750	900	1M			

Voltage Drop

When we plan for a circuit, we must take into consideration the distance from the service panel to the load. By knowing the distance between the load and the service panel, and the amperage required by the load, and the circuit voltage required, we can refer to a chart that will to determine the size conductor needed for the circuit. This chart will take into account the type of conductor and give us the information needed.

Circuit Capacity

Sometimes we need to know if an existing general purpose branch circuit can provide service to an added load.

An example of this would be plugging in an air conditioner to an existing receptacle.

If the circuit already provides service to other loads such as a television or a stereo, then the amperage for each of those would need to be determined.

If the air conditioner operates on 120 volts and 2000 watts, lets determine the amps.

A = W / V

Amps = 2000 / 120

Amps = 16.7

This would be to much for a 15 amp circuit to run the air conditioner by itself.

The circuit interrupter could be upgraded to a 20 amp interrupter if the wire size and receptacle ratings meet the requirements for a 20 amp circuit.

Review

- Watts = work Amperes = rate of flow Volts = Pressure
- Watts = Volts x Amperes or W = VA
- W=VA is referred to as the West Virginia Formula
- When planning a circuit we must know the number of loads, the amperes of each load, the voltage requirement for each load, the watts for each load and the distance from the service panel to the load.
- Voltage drop is a loss of voltage due to resistance in the conductor.

Calculating Electric Power

With the information we have discussed in this section, you should be able to plan and determine the needs for some common types of branch circuits.

If you are ever unsure about your plan for a electrical connection, you should seek professional help before continuing.

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
- Discontinue use of extension cord that feels warm
- Don’t put extension cords under carpet

Electrical Safety

- 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
- Don’t remove back of TV (30,000v when off)
- Electric motors lubricated, free of grease etc.

Electrical Safety

- 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

Electric Meter

- Kilowatt-hours: how electricity is sold
- Kilo = 1000
- Watt-hour = use of 1 watt for one hour
  - 100 watt light bulb for 1 hour - 100 watt-hours
- Kilowatt-hour = 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 aluminum 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

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

Lighting

Unit Subtitle: Lighting Safety

TV LIGHTING SAFETY

1. Wear protective gloves when handling lights and accessories

TV LIGHTING SAFETY

2. Have another student hold the ladder while you are hanging, adjusting, or taking down a light
3. Never attempt to move the ladder while someone is on the ladder

TV LIGHTING SAFETY

4. Be certain the light is secured to the grid by a firmly tightened c-clamp and safety chain

5. When hanging or adjusting a light, stand behind the light, not in front of or next to the light

TV LIGHTING SAFETY

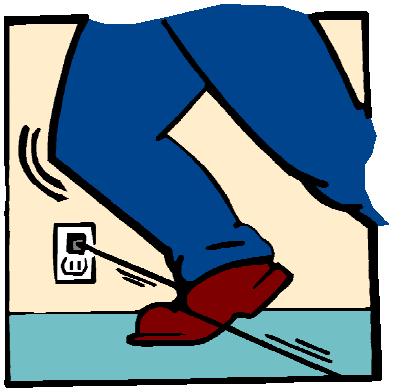
6. When connecting a light to electrical power:
   - stand behind the light
   - keep the barn doors closed until the light is secured to the grid, or attached to a stand
   - make sure the power to the outlet is OFF before you plug in the light
   - open the barn doors before turning on the light
   - do not look into the light when illuminated

TV LIGHTING SAFETY

7. Always take your time
   - Sudden jolts can cause the lamp to malfunction
8. Do not rush when working with lights and lamps
   - Rushing may cause you to slip or fall off the ladder

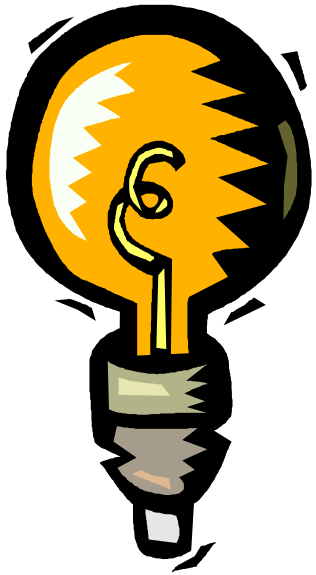
TV LIGHTING SAFETY

9. Avoid using Extension cords
   - If necessary, use heavy gauge extension cords
   - Keep extension cords out of traffic areas



TV LIGHTING SAFETY

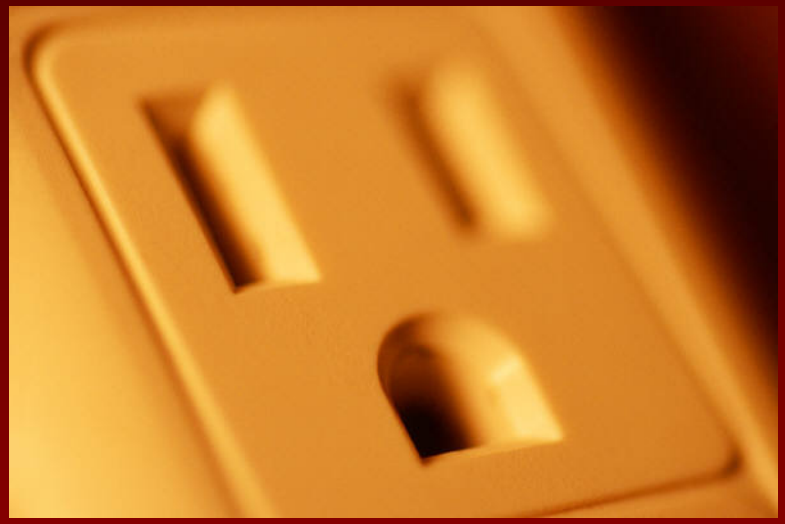
10. Never look directly into a light as it is illuminated
11. Never handle any lamps with your bare hands
    - The oil from your hands can cause the lamp to malfunction
12. Always report burned out lamps, so a new lamp can be installed



TV LIGHTING SAFETY

13. In case of malfunction, remove the light from the studio or case, and place the light in the office
    - Be sure to label the light as malfunctioning
14. If an accident occurs, report the accident immediately

General Electrical Safety



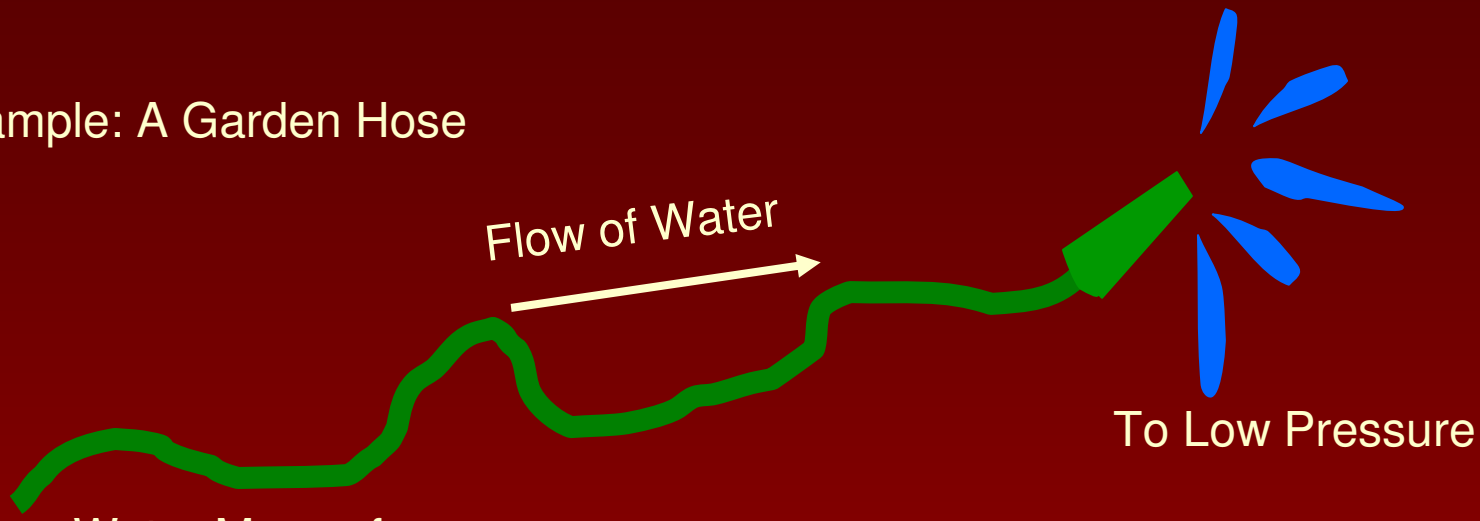
The OSHA e-tool electrical safety presentation was used to create this presentation

Training Objectives

- Describe how electricity works
- Describe how shocks occur
- Describe how electrical current affects the body
- Describe the most common ways individuals are injured using electricity
- Provide solutions to avoid being injured while using electricity

How Electricity Works

Example: A Garden Hose



The same thing occurs in an Electrical Wire

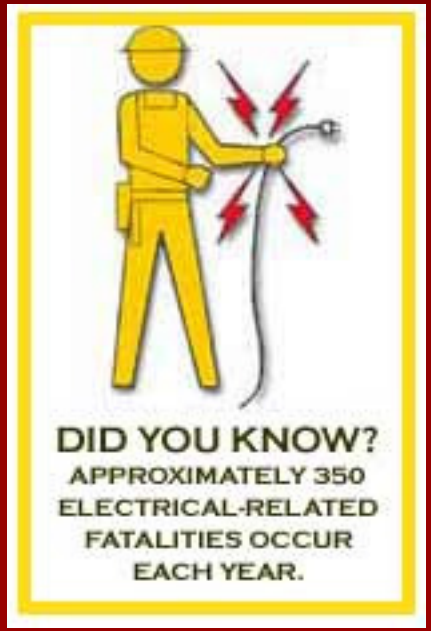
Current Moves from
High Voltage

To Low Voltage

Electrical Shocks

- Electricity travels in closed circuits, normally through a conductor
- Shock results when the body becomes part of the electrical circuit
- Current enters the body at one point and leaves at another

Note: Ground circuits provide a path for stray current to pass directly to the ground, and greatly reduce the amount of current passing through the body of a person in contact with a tool or machine that has an electrical short. Properly installed, the grounding conductor provides protection from electric shock.



How Electrical Current Affects the Body

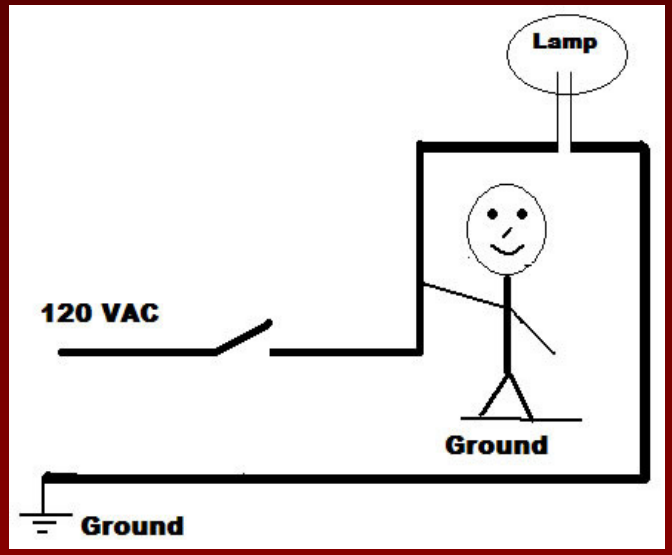
Current (Amps)	Human Reaction
0.001	Perception level. Just a faint tingle.
0.005	Slight shock felt; not painful but disturbing. Average individual can let go.
0.006-0.025 (Women)	Painful shock, muscular control is lost.
0.009-0.030 (Men)	This is called the freezing current or "let-go" range.
0.050-0.150	Extreme pain, respiratory arrest, severe muscular contractions.
1 - 4.3	Ventricular fibrillation.
10	Cardiac arrest, severe burns and probable death.

Note: some smaller microwave ovens use 10.0 Amps (10,000 milliamps) and common florescent lights use 1 Amp (1,000 milliamps)

Electrical Shock

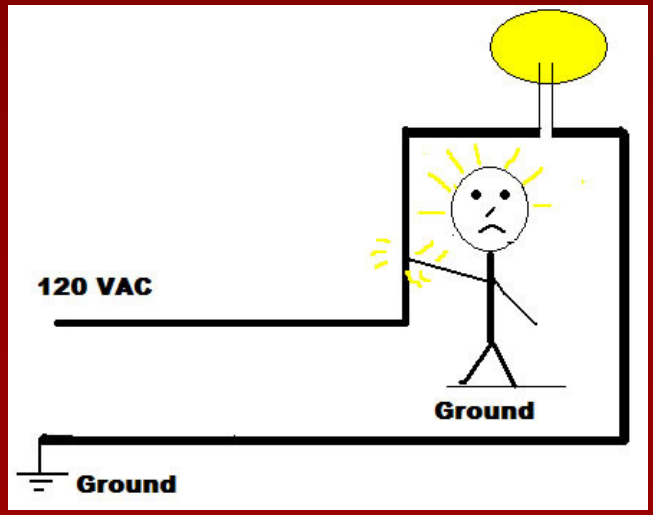
- Electric shock occurs when the human body becomes a conductor, completing the path for current to flow
- Basic electrical safety is that if a path is not complete, current will not flow, and shock will not occur
- Like water, electricity will take the path of least resistance. Current will most likely flow through a circuit instead of a human body unless the body presents a path of lower resistance.

Electrical Shock



Open circuit with worker grounded

Worker receiving electrical shock from lighting circuit



Effects of Shock

- Effects of electrical shock range from mild tingling to heart failure, depending on the amount of current
- Current as low as 50 milliamps can cause heart fibrillation
  - Heart fibrillation is where the ability of the heart to pump in a regular rhythm is disrupted
  - Given enough time in this state, it is usually fatal

Effects of Shock

- Severity of a shock is determined by amount of current and the path through the body
- If the current path is through the heart, there is a much greater chance of death than if the current passes from one finger to another
- At lower currents, respiratory paralysis can occur, also potentially fatal

Effects of Shock

- Direct effects include pain, paralysis, heart fibrillation, or tissue burn
- Indirect effects include confusion, amnesia, headaches, or breathing and heart irregularities
- Problems may last several days and progress into vision abnormalities and swelling of affected areas
- Over a victim's lifetime, long range effects may include paralysis, speech/writing impairment, loss of taste, and other disorders

What To Do When A Person Is Shocked

If victim is still engaged with or attached to the circuit:

- De-energize the circuit, if possible
- Remove victim from the circuit using non-conductive material (i.e., length of dry rope, dry broomstick, or leather belt)
- Call 911 (cells phones at SNL call 844-0911) for help immediately
- Apply artificial respiration and CPR, if necessary

If victim is conscious, they still need medical treatment as soon as possible.

Burns

The most common shock-related injury is a burn. Burns suffered in electrical incidents may be one or more of the following three types:

- **Electrical Burns** cause tissue damage, and are the result of heat generated by the flow of electric current through the body. *Electrical burns are one of the most serious injuries you can receive and need to receive immediate medical attention.*

- High temperatures near the body produced by an electric arc or explosion cause **Arc or Flash Burns** (also need prompt medical attention)

- **Thermal Contact Burns** occur when skin comes in contact with overheated electric equipment, or when clothing is ignited in an electrical incident.

Note: the graphic pictures were not included. But if you would like to view them click http://www.osha.gov/SLTC/etools/construction/electrical_incidents/burns.html

Internal Injuries

- Our bodies use small electrical currents to transmit signals through the nervous system and contract muscles,
  - Extra electrical current flowing through the body can cause serious damage.

- Medical problems can include internal bleeding, tissue destruction, and nerve or muscle damage.

- Internal injuries may not be immediately apparent to the victim or observers; however, left untreated, they can result in death

Involuntary Muscle Contraction

- Muscles violently contract when stimulated by excessive amounts of electricity
- These involuntary contractions can damage muscles, tendons, and ligaments, and may even cause broken bones.
- If the victim is holding an electrocuting object, hand muscles may contract, making it impossible to drop the object.

Note: injury or death may result from a fall due to muscle contractions.

Water and Conduction

Conductors- Substances with relatively little resistance to the flow of electrical current (e.g., metals).

Water- influences the conductive properties of some materials
Dry wood is a poor conductor
Wood saturated with water becomes a ready conductor

Use ***extreme caution*** when working with electricity where there is water in the environment or on the skin.

Human Skin & Resistance

Dry Conditions ⟶ Human Skin is Resistant

Current = Volts/Ohms = 120/100,000 = 1mA (0.001A)

-Barely perceptible level of current

Wet Conditions ⟶ Skin's Resistance drops dramatically

Current = Volts/Ohms = 120/1,000 = 120mA (0.12A)

-Sufficient current to cause ventricular fibrillation

A low voltage electrocution becomes much more hazardous in a wet condition

High voltage electrical energy greatly reduces the body's resistance by quickly breaking down human skin. Once the skin is punctured, the lowered resistance results in massive current flow.

Low Voltage = Hazardous

- Muscular contraction caused by stimulation does not allow a victim to free himself from a circuit
- The degree of injury increases with the **length of time** the body is in the circuit.
- Thus even relatively low voltages can be extremely dangerous.

LOW VOLTAGE
DOES NOT IMPLY
LOW HAZARD!

An exposure of 100mA for 3 seconds can cause the same amount of damage as an exposure of 900mA for .03 seconds

Ground-Faults

(The Most Common Form of Electrical Shock)

A ground-fault occurs when current flowing to the load (drill, saw, etc.) does not return by the prescribed route.

In a simple 120 volt circuit, current travels through the black (ungrounded) wire to the load and returns to the source through the white (grounded) wire. If some or all of the current does not travel back through the white wire then it has gone somewhere else, usually to ground.

A person's body can act as the path to ground when a fault occurs.

Ground-Fault Incidents

Use GFCI's for protection against ground-faults

1. A double insulated drill (no ground pin) was used in a wet location. Water entered the drill housing and current flowed through the water and user, and then back to its source.

2. An individual with moist hands was electrocuted while winding up a damaged extension cord when their skin contacted exposed wiring in the extension cord.

(This fatality occurred in Utah)

Ground-Fault Protection

The ground-fault circuit interrupter (GFCI) works by comparing the amount of current *going to* and *returning from* equipment along the circuit conductors. When the amount *going* differs from the amount *returning* by approximately 5 milliamperes, the GFCI interrupts the current within as little as 1/40 of a second.

Note: A GFCI will *not* protect you from line contact hazards (i.e. a person holding two "hot" wires, a hot and a neutral wire in each hand, or contacting an overhead power line). However, it protects against the most common form of electrical shock hazard, the ground-fault. It also protects against fires, overheating, and destruction of wire insulation.

Ground-Fault Protection

Use ground-fault circuit interrupters (GFCIs) on all 120-volt, single-phase, 15- and 20-ampere receptacles that will be used to supply temporary power (i.e. hand tools and other portable equipment).

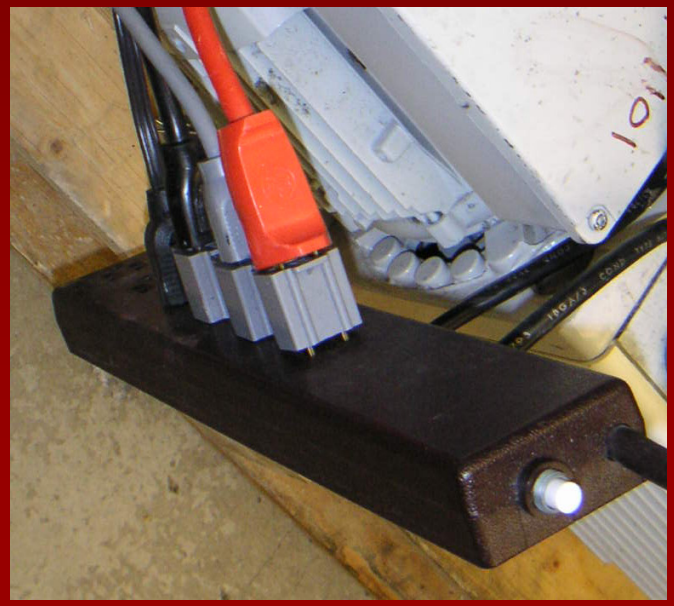
-Portable GFCIs, like this one, are available for situations where GFCI protection is not otherwise provided-

Follow manufacturers' recommended testing procedure to insure GFCIs are working correctly.

Important - Plug this end directly into the electrical source, not another flexible cord.

Grounding - How Do I Avoid Hazards

- Ground all power supply systems, electrical circuits, and electrical equipment
- Do not remove ground pins/prongs from cord- and plug-connected equipment or extension cords
- Use double-insulated tools
- Ground all exposed metal parts of equipment



Avoid Contact With Power Lines

- **Locate** power lines in your work area before you begin working
- Prior to digging, **call** 1-800-662-4111 to have utilities identify and mark any buried lines.
- Keep yourself and all objects at least **10-feet away** from all energized power lines.
- Have power lines **de-energized** and grounded prior to beginning your work.
- Use **non-conductive** ladders (fiberglass) and other tools.

Using Equipment in a Manner Not Prescribed By The Manufacturer

Shock, fire, loss of life and property?

If electrical equipment is used in ways for which it is not designed, you can no longer depend on safety features built in by the manufacturer. This may damage property and cause employee injuries or worse

Note: Junction boxes such as this one must be mounted properly.

Common Examples of Equipment Used in A Manner Not Prescribed

- Using multi-receptacle boxes designed to be *mounted* by fitting them with a power cord and placing them on the floor.
- Fabricating extension cords with ROMEX® wire.
- Using equipment outdoors that is labeled for use only in dry, indoor locations.
- Using circuit breakers or fuses with the wrong rating for over-current protection, e.g. using a 30-amp breaker in a system with 15- or 20-amp receptacles (protection is lost because it will not trip when the system's load has been exceeded).
- Using modified cords or tools, e.g., removing face plates, insulation, etc.
- Using cords or tools with worn insulation or exposed wires.

REMEMBER - ONLY USE EQUIPMENT IN A MANNER PRESCRIBED BY THE MANUFACTURER

Flexible Cords Not Used Properly

The following cords are improperly wired directly to the electrical circuit, are not protected by a GFCI, and are two-wire cords that are not grounded and not rated for hard- or extra-hard service.

Temporary (flexible wiring) must not be used in place of permanent wiring. Multioutlet surge protection such as this can be used to supply power to equipment that needs surge protection, but not used to provide more outlets due to the lack of permanent wiring.

Note: a common OSHA violation.

Extension type cords that are not 3-wire type, not designed for hard-usage, or that have been modified, increase your risk of contacting electrical current, and must not be used at BYU.

Flexible Cord Safe Practices

- Only use factory-assembled cord sets.
- Use only extension cords that have a ground wire (3-wire type).
- Use only extension cords that are marked with a designation code S, ST, SO, and STO for hard service, and SJ, SJO, SJT, and SJTO for junior hard service.
- Use only cords, connection devices, and fittings that are equipped with strain relief.
- Remove cords from receptacles by pulling on the plugs, not the cords.
- Remove from service flexible cords that have been modified or damaged

Protect flexible cords from damage.

Remember

- Visually inspect all electrical equipment before use.
- Remove any equipment with frayed cords, missing ground prongs, cracked tool casings, etc. from service.
- Apply a warning tag to any defective tool and do not use it until it has been properly repaired.

OSHA e-Tool

OSHA's e-tool can be viewed online at:

www.osha.gov/SLTC/etools/construction/electrical_incidents/mainpage.html

Remember . . . Be Careful Out There!

~ The End ~

STUDY QUESTIONS

Directions: On your own paper WRITE the following questions and their answers.

1. What is electricity?
2. What are 3 things that conduct electricity?
3. What is Ohm's law?
4. What are some sources of power?
5. What are the effects of electricity on the human body?
6. How many amps does it take to cause death?
7. What are the proper steps to take when someone has suffered electrical shock?
8. What do electrical circuits consist of?
9. What is the first thing you should do when working on/repairing electrical equipment?
10. What does it mean to be double insulated?

STUDY QUESTIONS

Directions: On your own paper WRITE the following questions and their answers.

11. What is an arc in electrical terms?
12. Why is it important to check everyday portable equipment before use?
13. Does electrical tape really protect you from electric shock?
14. If you have a 250 Watt lamp plugged into a 120 Volt receptacle, what is the rate of flow of the amperes for that circuit?
15. If a lighting grid operates on 40 amps on a 240 volt circuit what is the wattage of the grid?
16. If an electric generator used to power a lighting grid operates at 3820 watts and 10 amps, what would be the voltage required for that generator.
17. If I want (20) 220 watt lamps on a circuit operating with 120 volts, what is the amps of the circuit.

Using Ohm's Law, complete the following:

18. Given I=15A, R=2 find I
19. Given E=250V, R=5, Find I
20. Given E=100V, I=0.01A, Find R

VOCABULARY/TERMINOLOGY

Directions: On your own paper WRITE the Terms and their definitions as they apply to this section.

1. Amperes
2. Conductor
3. Insulator
4. Resistor
5. Voltage
6. Power
7. Watts
8. Kilowatt
9. Earthing/Grounding
10. Fuses
11. RCDs
12. West Virginia Formula
13. GFI
14. NEC
15. Breaker
16. Transformer
17. Service Drop
18. Entrance Head
19. Meter
20. SEP

PROJECTS

In this class you are expected to complete 3 major categories of projects.

1. The school news show (1 show is due every 2 weeks)
2. Adobe Premiere Tutorials (1st 9 weeks)
3. Adobe After Effects Tutorials (2nd 9 weeks)

*Students will work on tutorials with a partner and they will work at their own pace, but all tutorials are expected to be completed.

PROJECT

CREATING SEHS NEWS SHOW

In this project you will have 9 school days (unless we have a holiday) to produce a completed SEHS Southside News Show. You will present your show in class on Friday Every 2 weeks. Each news show will be uploaded to the school website by midnight on the Thursday that the news show is due and the show must be viewable on the school website for everyone to see on Friday. NO EXCEPTIONS!

You will work with a partner to create a piece of the news show. Each piece of the news show will be assembled into a complete show.

You completed show must be between 10 and 15 minutes in length.

When leaving the classroom, you must tell Mr. Keith exactly where you will be and you may only be gone for a maximum of 20 minutes.

When you finish your piece, you should help any other group that is not yet finished. This is a TEAM project and the entire class will receive the same grade. If the news show is not finished and posted to the school website by the deadline everyone in the class will receive a grade of 50 for that particular news show.

GOOD LUCK AND HAVE FUN!

PROJECT

SEHS NEWS SHOW SPOT ASSIGNMENTS

Group 1: Anchors (2) Responsible for anchoring the news show, writing scripts, creating cue cards if needed, acting as producers for entire show.

Group 2: Editing (2) Responsible for editing the entire news show together, exporting it to tape, DVD, and/or internet. You must also act as camera men for other groups when they need someone to film their spots. (Must create intro & closing for 1ST News show and it will be used for all future shows)

Group 3: Commercial (2) create a commercial for something in the school.

Group 4: PSA (Public Service Announcement) (2) Create a public service announcement dealing with something important to the students, faculty and staff at the school.

Group 5: Feature Story (2) Create a news story dealing with the most important thing going on at school this week.

Group 6: News Story 2 (2) Create a news story dealing with the second most important thing going on at school this week or that will be coming up soon.

PROJECT

Group 7: Sports (2) Create a highlight spot of all of the sporting events from the previous week and upcoming week.

Group 8: Entertainment & Fashion “STANGTAINMENT” (2) Story dealing with Music, Movies, and Fashion

Group 9: Team of the week (2) Choose a team or club to highlight for the weeks show present them with a certificate & interview them.

Group 10: Faculty Staff Member of the week (2) – Take a vote within your classroom on who should be the faculty/staff member of the week present them with a certificate & interview them.

Group 11: World, National, & State Headlines (2)- Find out what is important to you as students and give a brief update.

Group 12: Producer & Director (2)- Mr. Keith is the executive producer and director, but these two students run the show and are responsible for everyone else’s action during the production of the show. These two students are responsible for creating the script and storyboard and making sure that everyone follow the script and storyboard. These two students are the only ones that can ask Mr. Keith questions about how something should be done.

PROJECT

Group 13: Set design, wardrobe, and make-up (2)- These two students are responsible for creating the backdrop for the set, staging materials coordinating wardrobe for the talent, and applying make-up as needed.

Group 14: Camera and Lighting crew (2) These two students are responsible for all camera and lighting needs.

**Keep in mind that most of these groups may choose to use animation in the production of their pieces.

PROJECT

SAMPLE SCRIPT

If you put this into a PowerPoint, you can use the computer like a teleprompter and you won't have to use these papers. You may still want to have the papers lying on your desk just in case there is a computer glitch and your computer/teleprompter doesn't work.

IT IS VERY IMPORTANT THAT YOU TALK TO EACH ONE OF THE GROUPS THAT ARE CREATING THE STORIES FOR THE SHOW. YOU NEED TO FIND OUT WHAT THEY WILL BE PRESENTING AND HOW THEY WILL BE PRESENTING IT SO THAT YOU CAN MAKE YOUR SCRIPT WORK WITH THE STORIES THAT WILL BE SHOWN.

Remember how you word things. If you are taping part of a show that will air the next day, make sure that you say today instead of tomorrow. It wouldn't make any sense to people if they were watching a news show on the day of Friday the 13th and you said "tomorrow is going to be Friday the 13th" because you taped the spot on Thursday the 12th.

<u>SOUTHSIDE NEWS 6TH EDITION</u>

ROLL INTRODUCTION FOOTAGE

Anchor 1: Hello and welcome to this 6th edition of the Southside news my name is _____

Anchor 2: and my name is _____ and we are your hosts for this weeks show.

PROJECT

(Story #1 – Feature Story) **I know that everyone loves wearing their uniforms, but lets take a look at the upcoming fashion show where some of our very own students are designing and modeling their own unique styles.**

ROLL FASHION SHOW FOOTAGE

Anchor 1: It looks like this year's fashion show is going to be fabulous! Everyone should really try to get to the fashion show and support such a good cause.

(*Story #2 Faculty/Staff Member of the Week*) We really do have some hard working teachers at our school. Lets see who our Faculty/Staff Member of the week is this week.

ROLL FACULTY/STAFF MEMBER OF THE WEEK FOOTAGE

Anchor 2: Coach Onarato is really great teacher on and off the field. It is easy to see why he was this week's choice.

(Commercial) The SEHS school store is one of Southside News' biggest sponsors. Lets see what they have to offer.

ROLL SCHOOL STORE COMMERCIAL FOOTAGE

Anchor 1: I really need to get into the school store. I didn't know they had so much to offer!

(Story #3 SEHS Team/Club spotlight) **This week we are going to take an inside look at our AFJROTC program. The AFJROTC is this week's SEHS Team of the Week.**

PROJECT

ROLL SEHS TEAM/CLUB SPOTLIGHT FOOTAGE

Anchor 2: I'm not sure that the Air Force is for me, but it sounds like those classes are really preparing our students for the armed services.

(Public Service Announcement (PSA)) Did you know that April is Alcohol awareness month? Alcohol and drug related deaths are one of the top killers of high school students. This Public Service Announcement will give us some valuable information to keep us alive and healthy.

ROLL PSA FOOTAGE

Anchor 1: That will definitely make me think twice about messing around with drugs and alcohol.

(Story #4 This week in Sports) We have had some action packed sporting events over the last week or two, lets take a look at some of the highlights and see what's coming up in SEHS Sports.

ROLL THIS WEEK IN SEHS SPORTS FOOTAGE

Anchor 2: Man, can you believe those scores! Looks like we are really dominating!

----------Announcements------Check with Mr. Keith or Mrs. Cyndy Hendricks for current announcements----------

And now, we will turn to the announcements.

Any student that parks in a space that was not assigned to them by SEHS or have not purchased a parking pass will be fined $20.00 each day they are parked illegal. NO EXCEPTIONS WILL BE MADE!

PROJECT

Anchor 1: Junior dues are now $75. Please see Mrs. Blanks in the front office.
Anchor 2: The competition is on …ECHS verses SEHS. Which school is the biggest Subway lover? Bring in your lunch card or student ID to any Effingham Subway any day from 2PM to 6PM and receive a 6" Sub for 99 cent. The school that purchases the most will receive a Grand Prize.
Anchor 1: Jean Day Friday, April 25th. All faculty and students, who purchase a Relay for Life T-shirt, will be allowed to wear jeans with their purchased t-shirt on Friday, April 25th. T-shirts are in honor of Mrs. Cathy Leaf. The cost is $15.00. All proceeds go to the American Cancer Society. Friday will be the last day for faculty and students to purchase a t-shirt.
Anchor 2: FFA Members If you would like to fill out the Green Hand, your 1st year award, or chapter farmer or proficiency award, they will be due by March 28th. If you would like to be considered for star green hand or star chapter farmer, see Mr. Mock or Mr. Montford. (Announce until March 28th)
Anchor 1: There will be an FBLA meeting in Mrs. Ross' room today (3/25/08) at 3:30. All members need to attend.

PROJECT

Anchor 2: "Any rising junior or senior interested in signing up for the work-based learning program for the 2008-2009 school year needs to see Ms. Truluck inside room 300 BEFORE school, AFTER school or in-between classes to pick up an application. Please do not come during class, as applications will not be given out during class. All applications will need to be returned no later than Friday, April 18." Would you please announce beginning tomorrow and run through Friday, April 11. Thanks.

Anchor 1: Chick-fil-A Biscuits are being sold today for the Relay for Life. All monies raised from this and next week will go to our team for the walk.

Anchor 2: The final deadline for Grad Bash payments is March 30.

Anchor 1: Congratulations to Isaiah Broomfield. He placed 1st in the State Literary Competition in the Boy's Essay.

Anchor 2: Would you like to be part of the Southside News crew, but can't get into Mr. Keith's classes due to a schedule conflict? Mr. Keith is looking for creative students who would like to do humorous skits about the school or student life, cartoons, anime, and other stuff as part of our new show called "Southside Stories". 'Southside Stories" will be a Saturday Night Live type show. Students will be asked to meet after school on Mondays and Thursdays from 3:30-5:00pm. See Mr. Keith in Room 615 or drop him an email if you are interested.

PROJECT

Anchor 1: This concludes this week's announcements. If you have an announcement, a good idea for a story that you think should be featured on our show, or if you would like to join TSA or the Video club and help make shows like this one or the new Southside Stories show that will be similar to Saturday Night live, please see or email Mr. Keith in room 615.
Anchor 2: This has been the 6th edition of the Southside news my name is _____
Anchor 1: and my name is _____, thanks for watching.
Anchor 2: See you next time!
ROLL CLOSING