BANE-WELKER EQUIPMENT SINCE 1967

Employee Owned. Customer Focused.

ELECTRICAL DIAGNOSTICS COURSE

Circuit Fundamentals

1

General Shop Safety

- Always have at least one other person present when working with machines or test equipment.
- Safety glasses must be worn at all time when in the shop. Sunglasses are NOT substitutes for safety glasses.
- Only wear closed toe shoes. Sandals and other open toe shoes offer no protection from falling object and are prohibited.
- Do not wear loose clothing or jewelry. Tie back long hair.
- Arguments and horseplay are prohibited from the classroom and shop area.

2

General Shop Safety Continued

- Avoid Injury by following below list before maintaining or servicing any machine.
- Disengage all drives.
- Engage parking brake.
- Lower all attachments to the ground or raise and engage all safety locks.
- Shut off engine.
- Remove key from key switch.
- Switch off battery key, if installed.
- Wait for all machine movement to stop before servicing unit.

3

Equipment Safety Practices

- When entering the operators station maintain three points of contact.
- Don't dismount forward from the platform. NO jumping off equipment.
- Only one person on the operating platform at a time. NO riders.
- Before starting the machine honk the horn three times and wait 5 seconds to alert those around the machine.
- When driving the machine in tight quarters must have a spotter to assist in avoiding obstacles.

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Work Order Documentation

The purpose of the work order is to document important information about the repair process.

- The HEADER is for documenting the Customer information, machine information, and normally billing type.
- The BODY is used for documenting the three C's.
  - Complaint: What the customer has concerns about.
  - Cause: What caused the machine to fail.
  - Correction: What work you performed on the machine to make the repair.

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Electrical Theory

The three main symbols used for understanding electricity.

- Voltage (V)
- Current (A)
- Resistance Ω

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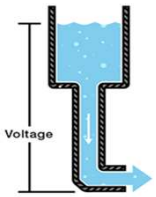
VOLTAGE

Is the energy potential between two points.

- Measured in units of volts.
- Generated mechanically or chemically
- Electrical pressure
- The pressure at the outlet of a tank represents voltage
- The amount of water above the outlet represents the amount of charge.



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VOLTAGE

The more water in tank, the higher the charge, the more pressure at the outlet.

48 volts

9 volts

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VOLTAGE

Two different types of voltage.

- **STATIC VOLTAGE** Without a load -12.6 V
- **DYNAMIC VOLTAGE** With a load -12.2 V

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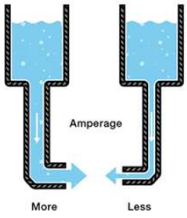
CURRENT

The flow of electrons through a conductor.

- Measured in units of amps
- Higher the pressure the higher the flow
- The two tanks have the same amount of "voltage" but different outlets size. Each would have different volume released.
- The measured volume released over a period is the current.
- Current is determined by the resistance of the load.



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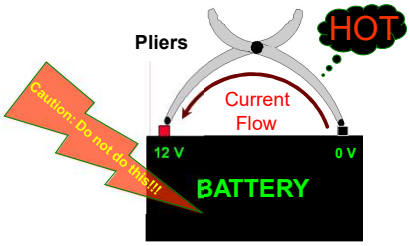
10

CURRENT

NO RESISTANCE
HIGH CURRENT FLOW



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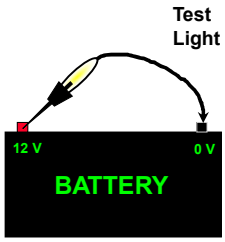
CURRENT

HIGH RESISTANCE
LOW CURRENT FLOW



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12

Resistance/ Continuity

Continuity tests if current can travel from one side to the other. Resistance is the difficulty to get there.

- Resistance is measured in units of ohms.
- All conductors offer some resistance to the flow of current.
- One ohm is the resistance that will allow one amp to flow when the voltage is one volt.
- Easier to get from one end to the other is less resistance.

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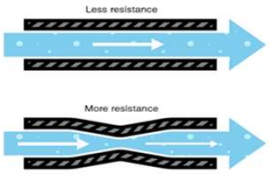
13

Resistance/ Continuity

Think of it as the two rivers below. Which one would be easier for water to flow down? The river bed is the conductor and the water is the voltage trying to pass through.



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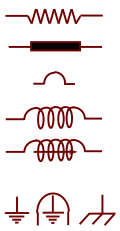
14

HOW TO READ ELECTRICAL DIAGRAMS



RESISTANCE OR LOAD
RESISTANCE OR LOAD
WIRE PASSOVER
INDUCTOR (COIL)
INDUCTOR (SOLENOID)

GROUNDS

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15

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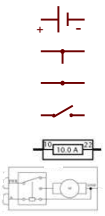

BATTERY
CONNECTION SPLICE
TERMINAL CONNECTION
SWITCH (OPEN)
FUSE
STARTER

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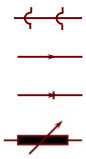
16

HOW TO READ ELECTRICAL DIAGRAMS



CROSSOVER
DIRECTION OF CURRENT
DIODE (ONE-WAY)
VARIABLE RESISTANCE

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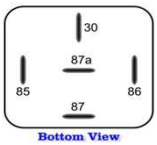
17

HOW TO READ ELECTRICAL DIAGRAMS

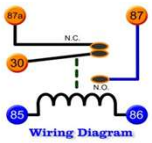


Bottom View

N.C. = Normally Closed
N.O. = Normally Open

30 - Common
87a - Normally Closed
87 - Normally Open

85 - Coil Ground
86 - Coil Control



Wiring Diagram

86 is power from a switch
85 goes to ground.
30 is coming from power supply (battery typically fused)
87a is normally closed contact in relay.
87 is what powers the load that we are energizing

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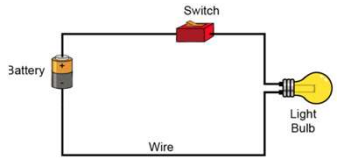
18

Electrical Circuits

Is a path for transmitting electric current. Circuits will have devices that give off energy, such as a battery or a generator. Also devices that use current, such as lamps, motors, and coils for example.



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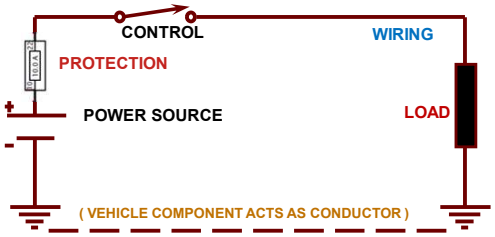
19

PARTS OF A BASIC CIRCUIT



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TYPES OF CIRCUITS

- **Series Circuit** (High Circuit Resistance)
- **Parallel Circuit** (Low Circuit Resistance)
- **Series / Parallel Circuit**

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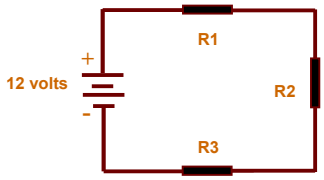
SERIES CIRCUIT

- One or more loads
- One path for current flow



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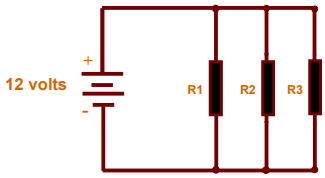
PARALLEL CIRCUIT

- More than one load
- More than one paths for current



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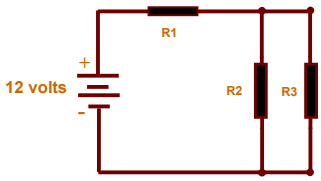
23

SERIES / PARALLEL CIRCUIT

- More than two loads
- Some loads connected in series
- Some loads connected in parallel



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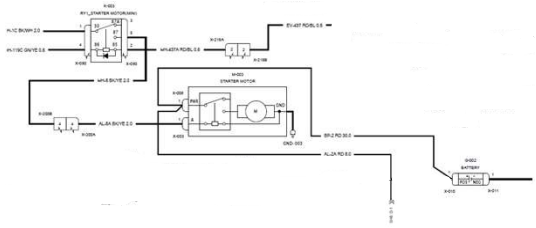
Tractor Starting Circuits



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Battery Load Testers

Is a device used to test the Cold Cranking Amps (CCA) of a battery. To determine what the amps of a battery should be, refer to the data tag on the battery.

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26

Battery Load Testers

They work by applying load to a battery while monitoring the voltage response at the same time. This will determine how much power (not voltage) is in the battery.

By connecting the red clamp to the positive post of the battery and the black clamp to the negative post of the battery, we can load test the battery by turning the load switch on and monitoring the gauge.

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27

Battery Load Testers

The battery must maintain 9.6 volts or greater for 15 seconds when tested.

Keep in mind the battery may test 12.6 volts, however the CCA that it is able to output may be below specification.

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28