

# Using Digital Multi-meters



## Continuity

Continuity is used to test circuits and components to assure that the circuits are intact and have no breaks in them. A wire can be tested to make sure it has no breaks in it. A heating element or fuse can be checked for continuity to make sure it is still intact inside.

To test for continuity:

Place meter on the audible resistance setting. (  $\Omega$  or +) )

Place each lead from the meter to each side of the wire or the component being tested.

- If the wire is intact the meter will beep and the display will read "0" ohms.
- If the wire is broken or the component is has a break internally, the meter will not beep and the display will either read "OL" (open line) or a high number of ohms which will mean there is too much resistance on the line.

## Resistance (Ohms)

Resistance is the opposition that a substance offers to the flow of electric current. It is represented either by the letter “R” or the Greek symbol ”  $\Omega$  “. Resistance is used mainly to test heating elements and temperature thermistors.

To test resistance:

Place meter on the resistance setting. (  $\Omega$  )

Place each lead from the meter on each side of the heating element or component being tested.

The meter will display the amount of ohms read through the component. This number can be used in ohms law to determine whether or not it is proper for the component.

Volts / Ohms = Amps

For example, a 208v heating element that measures 9 ohms should draw roughly 23 amps.

$$208 \text{ v} / 9 \Omega = 23.11 \text{ amps}$$

If the heating element reads too little resistance, the amperage will be too large for the wiring and thus the component needs to be replaced.

## Voltage

Voltage is the electric potential difference between two points and it is measured in volts. Voltage can be found in both DC (Direct current) and AC (Alternating current).

DC is voltage that is constant in its potential. It is like the power coming from a battery. DC voltage is easy and inexpensive to regulate and this makes it very popular for use with motors to control their speed.

AC is voltage that is constantly moving n potential in waves. It is found everywhere and it is very popular due to the fact that it can be transmitted for long distances with out much loss in potential.

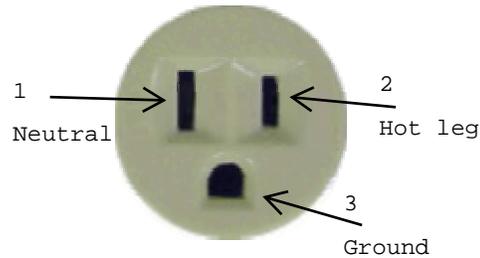
To test voltage:

Place meter on volts setting. DC or AC depending on the type of voltage being tested.

To test Outlets:

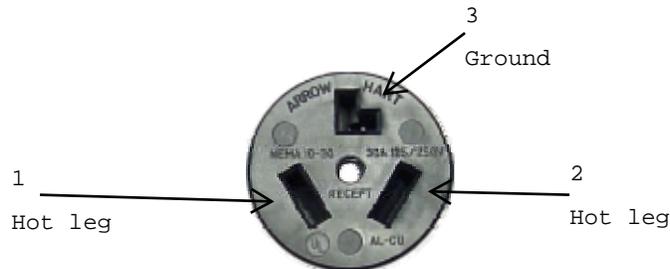
Determine what voltage the receptacle is rated for.

### 120-volt Outlets



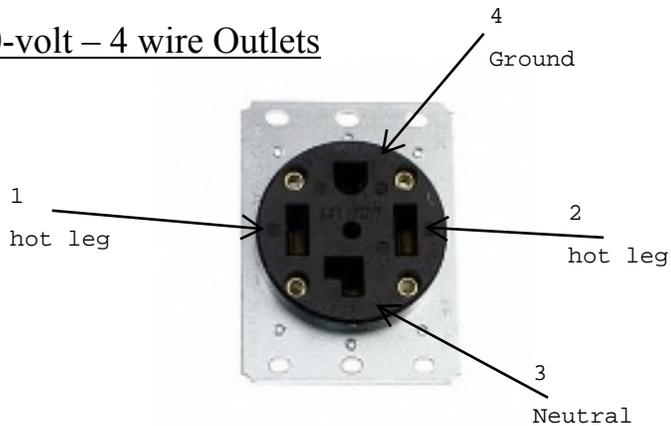
- Place one of the leads in position 1 and the other in position 2. The meter should display around 120v.
- Now place one of the leads in position 1 and the other in position 3. The meter should again read around 120v.

### 220-volt - 3-wire Outlets



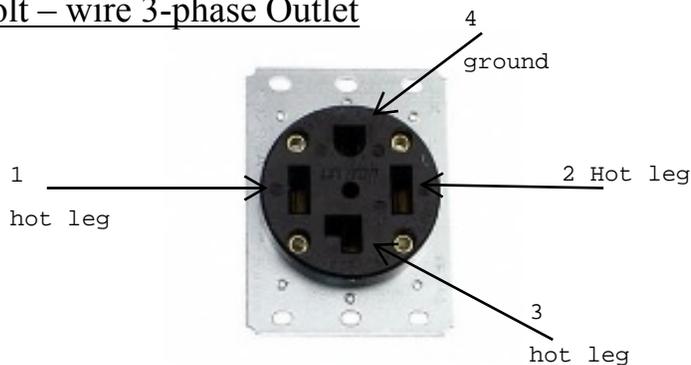
- Place one of the leads in position 1 and the other in position 2. The meter should display around 205v to 240v.
- Then, place one of the leads in position 1 and the other in position 3. The meter should display around 120v.
- Now, place one of the leads in position 2 and the other in position 3. The meter should display around 120v.

### 220-volt – 4 wire Outlets



- Place one of the leads in position 1 and the other in position 2. The meter should display around 205v to 240v.
- Then, place one of the leads in position 1 and the other in position 3. The meter should display around 120v.
- Then, place one of the leads in position 2 and the other in position 3. The meter should display around 120v.
- Then, place one of the leads in position 1 and the other in position 4. The meter should display around 120v.
- Now, place one of the leads in position 2 and the other in position 4. The meter should display around 120v.

### 220-volt – wire 3-phase Outlet



- Place one of the leads in position 1 and the other in position 2. The meter should display around 205v to 240v.
- Then, place one of the leads in position 1 and the other in position 3. The meter should display around 205v to 240v.
- Then, place one of the leads in position 2 and the other in position 3. The meter should display around 205v to 240v.
- Then, place one of the leads in position 1 and the other in position 4. The meter should display around 120v.
- Now, place one of the leads in position 2 and the other in position 4. The meter should display around 120v.

- Now, place one of the leads in position 3 and the other in position 4. The meter should display around 120v.

### To test other components:

#### Coils: (Inlet valves, heating elements, dump valves, fan motors, motors, contactors, etc)

Place each lead of the meter on each of the wires going to the component. The meter should read 120v or 240v depending on what the component is rated for. If the voltage is present but the component is not working, then the component should be replaced. If voltage is not present, then the problem most likely lies somewhere else in the unit.

#### Switches: (switches, thermostats, hi-limits, fuses, etc)

Place one lead of the meter on a ground reference point on the unit, something metal or a green exposed wire on the unit. Place the other lead on each side of the component, the voltage reading should be the same on both sides. If they are, the component should be in good working order. If the voltage is different, then the problem is in the component and it should be replaced.

**Note: When testing switch components on a 220v heating system like a Bunn unit, one side of the heating element should be disconnected and safe off before performing the above test to avoid reversed voltage readings.**

## Wattage

Watt is a power rating given to components to show the amount of power used by that particular component. Wattage is important to us to help us determine the amount of current (amps) that a particular component will draw. Using ohms law, we can determine whether or not a component is working properly.

Watts = Amps x Volts

Or

Amps = Watts / Volts

If a heating element is rated at 6000 watts and 220 volts. Then by Ohm's law we can determine that said heating element should draw 27.27 amps.

$6000 \text{ w} / 220 \text{ v} = 27.27 \text{ amps.}$

If the amp reading we get should be close to the calculation. If it isn't, then we most likely have a heating element that is not working properly and it should be replaced.

## Current (Amps)

Current is the rate of charge flow past a given point in an electric circuit. Measured in amperes. It is basically the amount charge flowing through a wire at any particular point, this current is being sent from a working component in a circuit. The higher the wattage or power used by the component, the higher the current and thus the amps go up.

To test for current:

Clamp the meter around the wire going to the component that is being tested.

- If current is present, then the component is working fine as long as the amp reading is consistent with the amp rating on the unit and the component.
- If current is not present, then the component needs to be tested to make sure voltage is present using the above methods. If voltage is present and the wire still carries no current, then the component is no good and should be replaced.

**Notes: Heating elements are the most common components tested for current, most other components draw very little current and thus amp readings are very hard to read on.**