

Bonding Frames of Major Appliances

The technical information provided herein is to assist qualified persons in planning and installing electric service to farms and residences. **Qualified person** is defined in Article 100 of the National Electrical Code (2008 edition) *as one who has the skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved.* Qualified persons are encouraged to review the National Fire Protection Association (NFPA) 70E-2004, Standards for Electrical Safety in the Workplace, for electrical safety training requirements. **A person who is not qualified should not attempt the planning and installation of electric service.**

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Note: Any reference to “Code” or “Code Handbook” in the following information refers to the 2008 National Electrical Code and the NEC 2008 Handbook respectively.

Section 250.140 of the Code refers to proper bonding methods of major appliances including electric ranges, wall-mounted ovens, counter-mounted cooking units, electric clothes dryers as well as the outlet or junction boxes that are part of the circuits for these appliances.

Reason for 250.140

Some major appliances normally considered as 240-volt appliances actually use both 240 volts and 120 volts in its operation. An example of this is a clothes dryer that uses 240 volts for the heating coils, but 120 volts for the timer and drum motor. Another example is a “dual fuel” combination stove/range, where you need 240 volts for the electric elements in the oven and 120 volts for the electronic circuitry that ignites the gas burners on top. Still another example is an older model 240-volt electric range that has a convenient 120-volt receptacle on its working top.

If a 3-wire 240-volt circuit (consisting of 2 energized conductors and a grounded conductor) is used in these applications — without a fourth conductor to act independently as an equipment grounding conductor — the grounded conductor actually carries current when the 120-volt devices are in use. Since this grounded conductor is actually attached to the frame of the appliance, this causes a potentially unsafe condition — unless the 3-wire branch circuit for the appliance is wired correctly.

However, by utilizing a 4-wire branch circuit, there is a dedicated grounded conductor (neutral) as well as a dedicated equipment grounding conductor — each acting independently — making the appliance safe for use. The neutral conductor carries the current when the 120-volt devices are in use and **is not connected** to the frame of the appliance. The

equipment grounding conductor **is connected** to the frame and safely carries away current if a fault should arise — causing the circuit's over-current protection device to open.

It is interesting to note that if purchasing a new 240-volt major appliance today — it no longer comes supplied with a cord. The buyer has to choose whether to purchase a 3- or 4-conductor cord, which of course, depends on the type of circuit on which the appliance will be installed.

The major appliance circuit

Please be aware that the Code doesn't make you change your **existing** 3-wire branch circuit for your major appliance to a 4-wire circuit. However, it does require you to follow certain wiring requirements to ensure your appliance with a 3-conductor cord is safe for use.

The Code does require, however, that any **new** installation of a branch circuit for your major appliance **must be a 4-wire circuit**, even if an appliance presently having a 3-conductor cord will be used on that circuit.

The following two examples and the following drawings explain these requirements in more detail.

Example 1 — Using an appliance on a 4-wire circuit.

Any used or new appliance installed on a 4-wire circuit must use a 4-conductor cord. If the used appliance already has a 3-conductor cord, the cord must be replaced with a 4-conductor cord. If it is a brand new appliance, purchase a 4-conductor cord.

When wiring the 4-conductor cord to the appliance, check to see if a ground strap or bonding jumper exists between the neutral terminal and the appliance frame. If so, **it must be removed**.

To wire the cord, fasten the green-colored grounding conductor to the appliance frame. The black-colored conductor connects to the black terminal (L1); the red-colored conductor connects to the red terminal (L2); and the white conductor connects to the neutral (N) terminal.

Example 2 — Using an appliance on a 3-wire circuit.

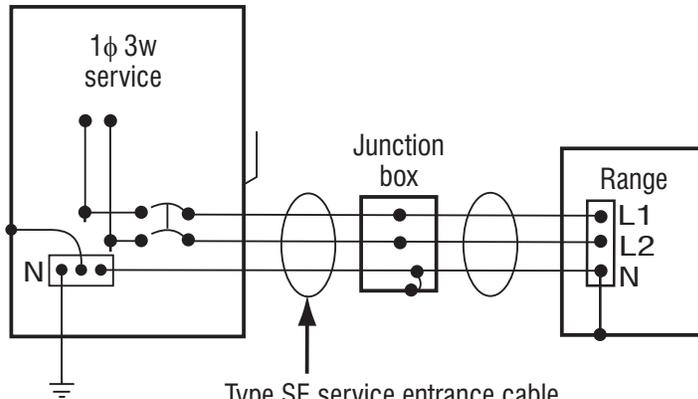
An appliance may be installed on a 3-wire circuit only if **ALL** of the following conditions are met:

- The supply circuit is 120/240-volt, single phase, 3-wire or 208Y/120-volt derived from a 3-phase, 4-wire, wye-connected system.
- The grounded conductor is not smaller than 10 AWG copper or 8 AWG aluminum.
- The grounded conductor is insulated, or the grounded conductor is uninsulated and part of a Type SE service entrance conductor cable and the branch circuit originates at the service equipment.
- Grounding contacts of receptacles furnished as part of the appliance are bonded to the appliance.

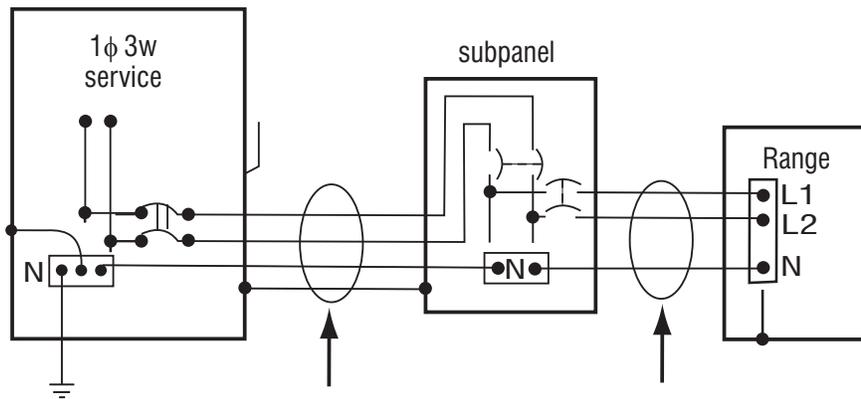
After ensuring that all of the above conditions for a 3-wire circuit are met, the appliance can then be connected utilizing a 3-conductor cord. A ground strap or bonding jumper of adequate size **must be installed** between the neutral (N) terminal and the appliance frame. If the appliance already has a 3-conductor cord installed, don't assume that this bonding jumper is in place — check to find out.

Since a 3-conductor cord is usually not color-coded, the middle conductor is connected to the neutral terminal. The remaining two conductors are connected to L1 and L2 respectively.

Special Allowances in Existing Installations Only



Type SE service entrance cable
with insulated or uninsulated
grounded neutral conductor is permitted
since the branch circuit originates at the
Service Equipment

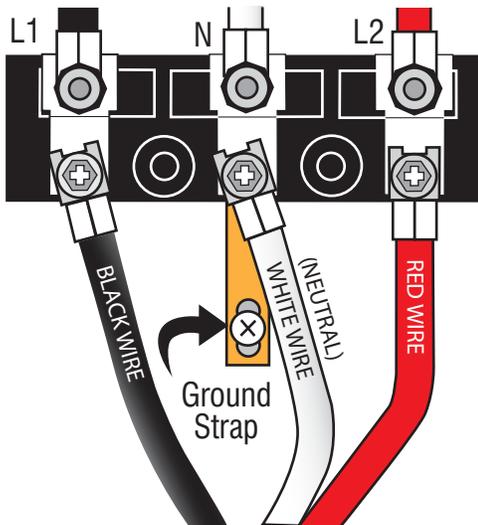


Grounding conductor
included or provided

- Type SE service entrance cable with uninsulated grounded neutral conductor is not permitted since the branch circuit did not originate at the Service Equipment.
- Existing 3-wire cable (SE, NM, etc.) is permitted if neutral conductor is insulated.

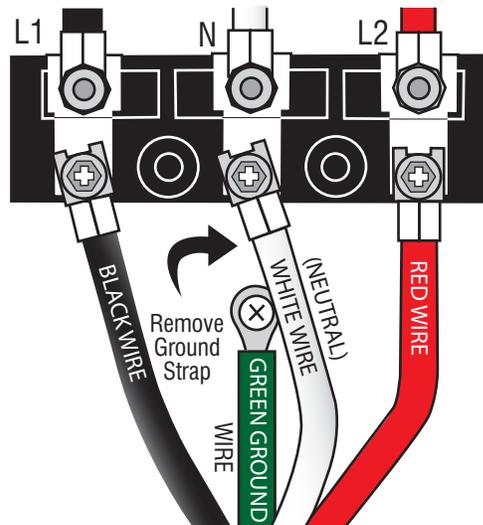
Older Homes and Electric Ranges

3-wire hook up

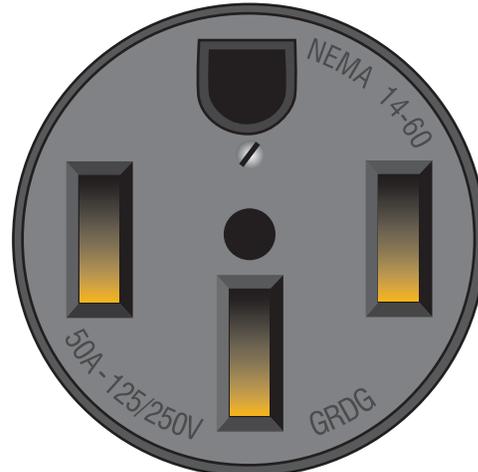


Newer Homes and Electric Ranges

4-wire hook up



**NEMA 10-50R 50AMP-
125/250VOLT**



**NEMA 14-50 50AMP-
125/250VOLT**