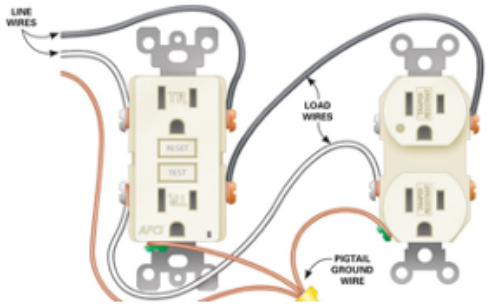
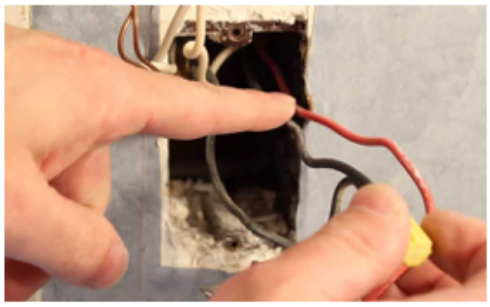
Receptacle and Lighting Hook-Up





Module Objectives

Upon completion of this module, you will demonstrate hooking up a receptacle and lighting circuit using the following skills:

- Installing the cable without damage
- Conducting termination of the cable (stripping and inserting)
- Conducting a successful hook-up of the cable
- Installing permanent cable tags
- Preparing for a quality inspection of your work

You will also demonstrate the following:

- Reading and applying a basic wiring diagram
- Choosing and installing the proper wire nuts
- Hooking up a receptacle and three different lights with a light switch

After completing this lesson, you should be able to discuss how to prepare and install cable without damage, including the proper means of cable termination, hook-up, and identification with permanent cable tags. You should also be able to discuss items checked during a post-work quality inspection and be able to read and use a basic lighting and receptacle wiring diagram.

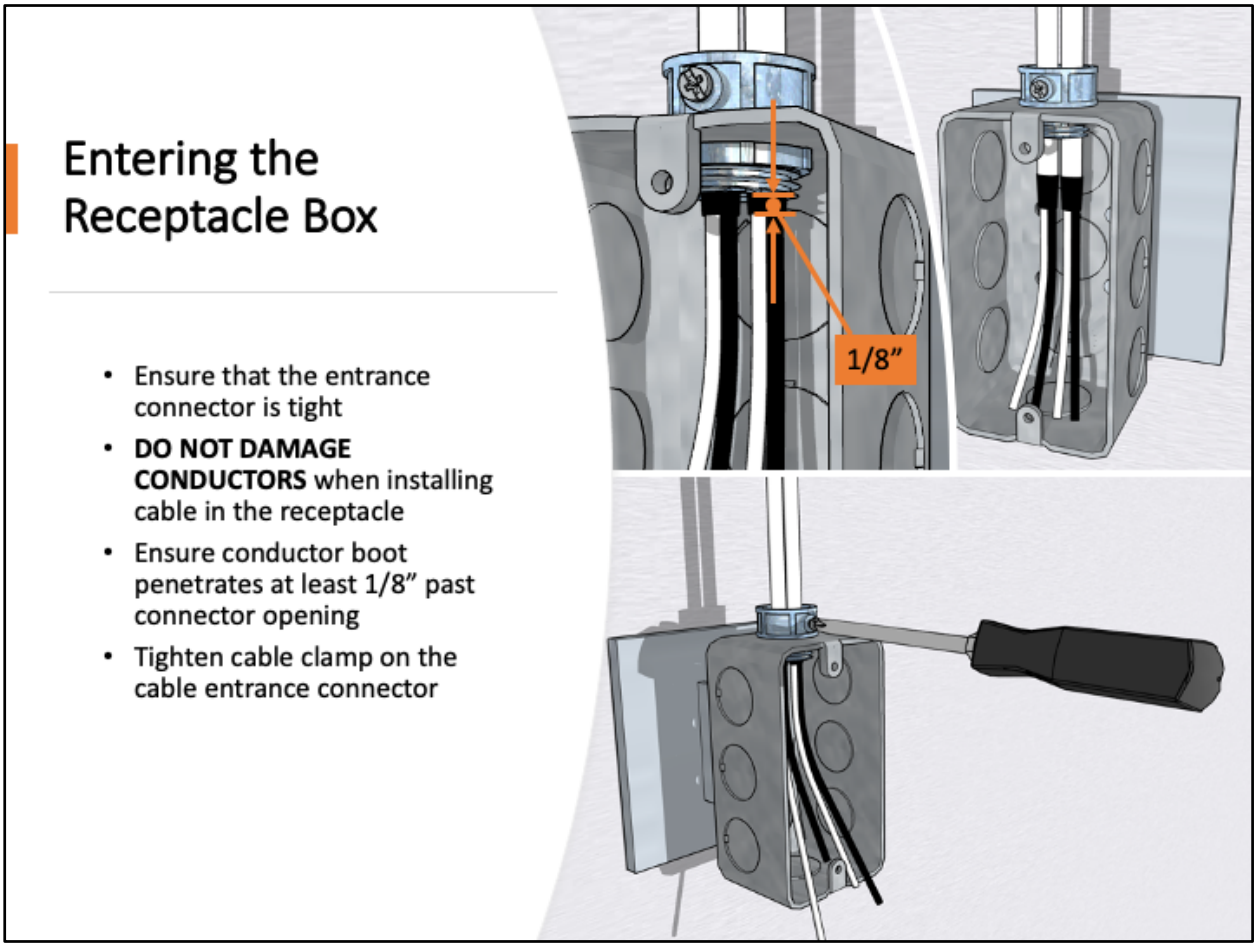
Ship's Non-Vital Equipment Receptacles

GFCI (Ground Fault Circuit Interrupter) :

- Like receptacles used at home
- Used for all 120 Volt appliances on the ship
- Examples include:
  - Computers
  - Clocks
  - Buffers
  - Hair Dryers
  - Toasters
  - Microwaves
  - Drink Machines

Receptacles for non-vital equipment on ships are essentially the same as receptacles used in the home.

G-F-C-I or Ground Fault Circuit Interrupt receptacles trip to open the connection to the source conductor if a ground is detected. This secures power to the receptacle and to all other receptacles or loads downstream on the same circuit, protecting people and equipment. Most loads are 120 volt – just like in the home.



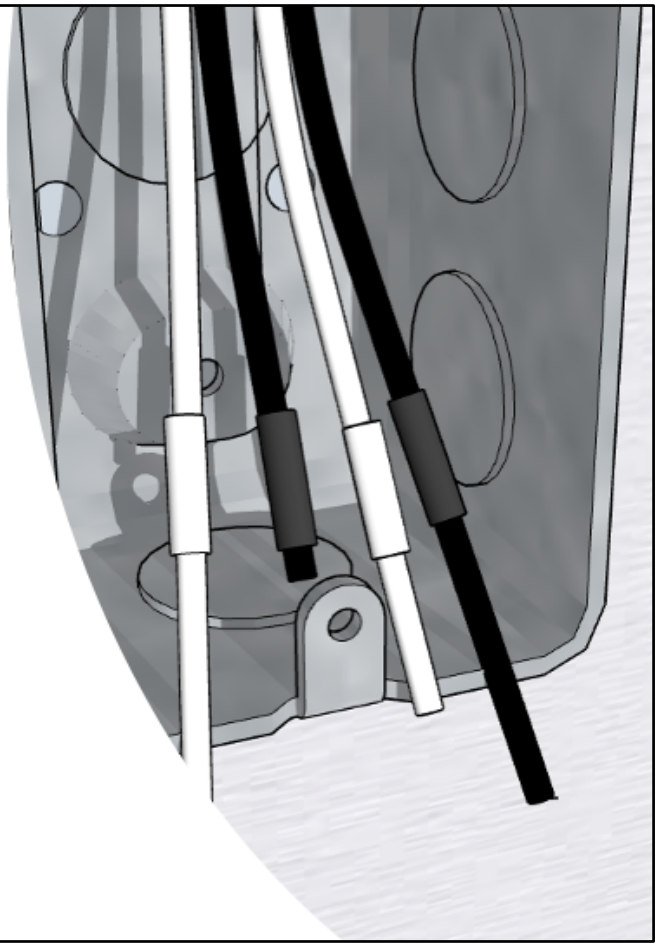
The opening in a receptacle box where the cable enters is designed to be very tight around the cable. Be careful when inserting and connecting cables to ensure conductors are not damaged. If a conductor is damaged, it can often be repaired with self-sealing heat shrink tape or heat shrink tubing.

Cable boots should extend at least 1/8 inch past the opening into the box. Tighten the cable clamp around the cable.

Ensure that all opening spaces around the cable are closed with duct seal. We’ll talk more about duct seal later in the lesson.

Sleeving

- Make sure the
  - Black sleeving is on the black conductor
  - White sleeving is on the white conductor
- Ensure you use the proper size sleeving. It should fit snugly on the lug.
- Submarine standard practice is to use marked heat-shrink sleeving

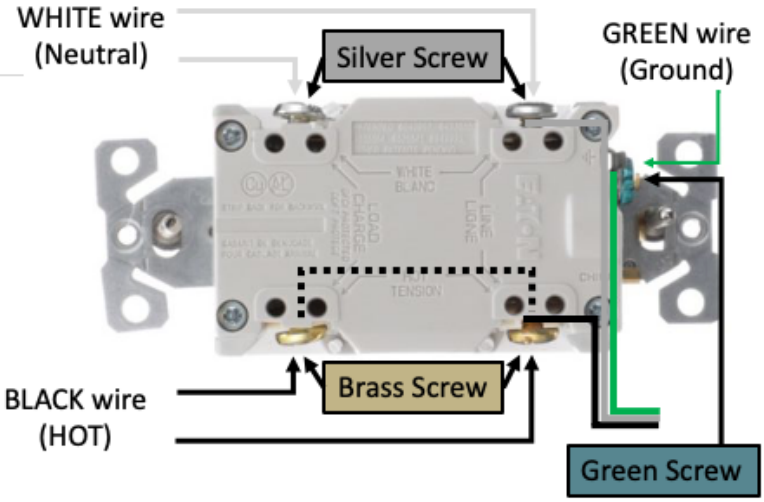


Sleeving helps with conductor identification and provides some protection. When used, ensure the correct color is used: black sleeving on black conductors and white sleeving on white conductors. If the conductors are black and white, sleeving is not required.

Sleeving should not be used if lugs are not being used and the conductors are color coded.

Hook-Up

- **Black** wire (HOT) to BRASS screw
- White wire (Neutral) to SILVER screw
- Green wire (Ground) to GREEN screw

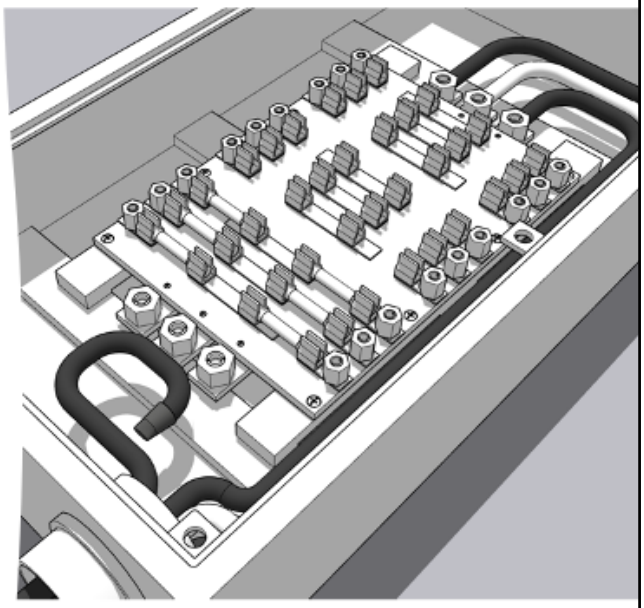


It is important that wiring be completed using a consistent pattern. Just like in your home, the Black Wire is the incoming HOT wire: the power source for the cable. The black wire should be connected using the brass screw. An easy way to remember this is “BB” meaning black-on-brass.

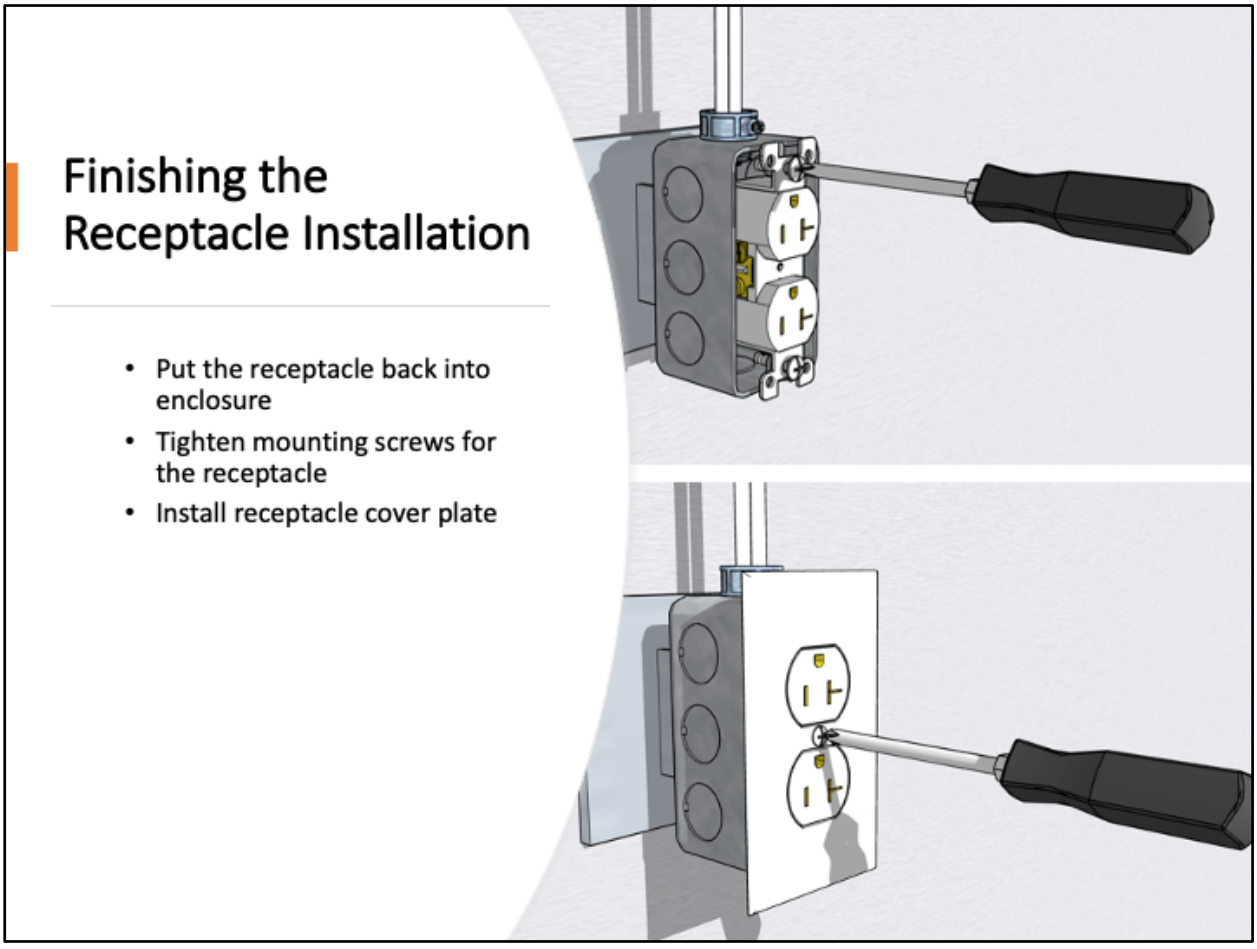
The White, or neutral wire, returns unused electrical power. The white wire should be connected to the silver screw. The ground wire is usually green or bare and should be connected to the green ground screw.

Spare Conductors

- Keep the spare conductors separate from the active conductors
- Insert the sleeves and heat shrink or electrical tape on spares



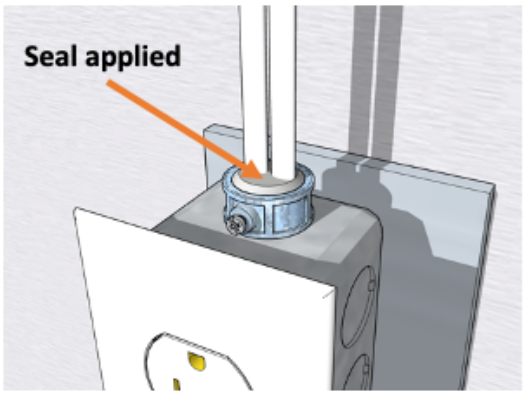
Cables may sometimes have more than one hot cable in the same insulation jacket. It is important that the extra conductor is completely insulated using sleeves and heat shrink or electrical tape to prevent accidental power transmission which could cause injury or damage equipment. After separating and inserting the spare conductor, push it back out of the way of other wiring.



After connecting and tightening all wires to the receptacle, put the receptacle back into the enclosure. As you do this, be careful not to bind the wires in the back, meaning that they are trapped or clamped down. Tighten the receptacle in place and then install the receptacle cover plate.

Seal the Receptacle Installation

- Use Duct Seal to close all receptacle box openings through which water could enter
- Apply evenly, ensure that all openings are closed, especially where the cable enters and at the cable entrance connector
- If the cable is pointing up, apply to top and the sides

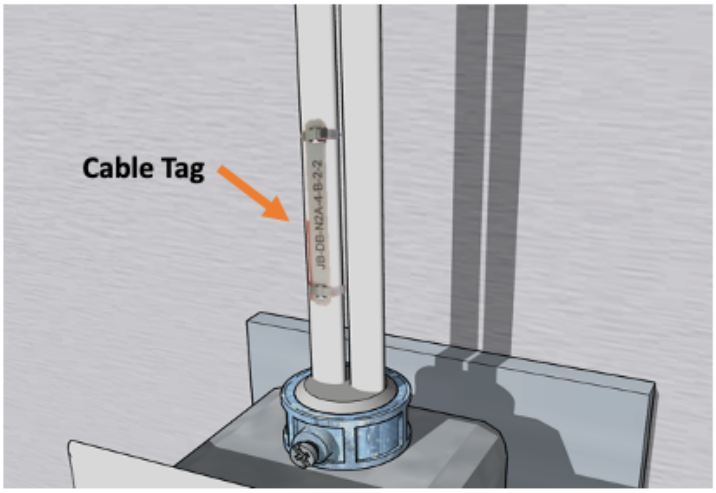


It would be easy for many receptacles on a ship to splashed by water. Because of this, any openings in the receptacle must be sealed to prevent water from entering. This is done using Duct Seal. Sometimes, Duct Seal may be called “Fire Stop.”

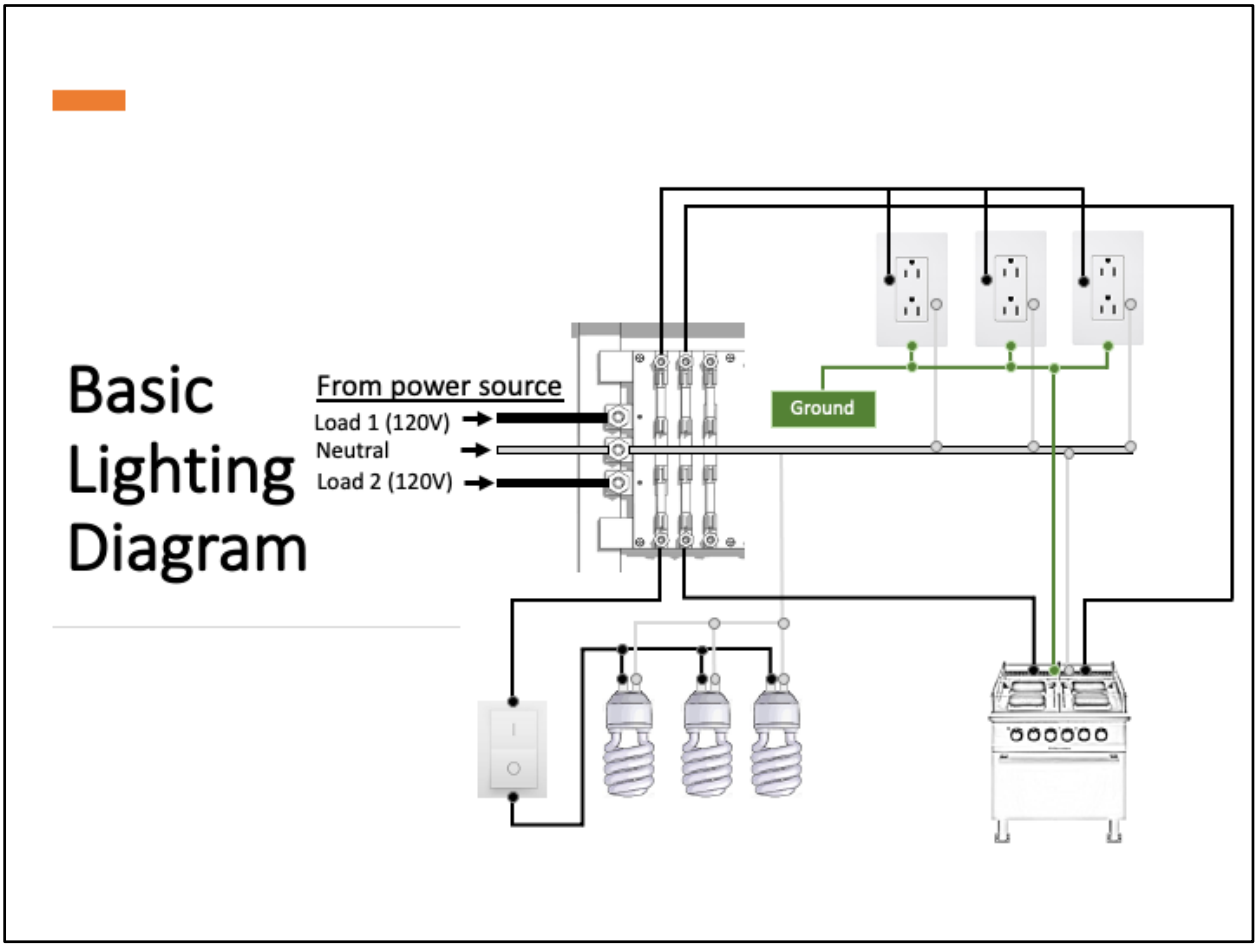
While wearing protective gloves, mold an appropriate amount of duct seal and press it into any openings, ensuring that all spaces around the cable entry and the cable entrance connector are closed. IF the cable is pointed up, apply duct seal to the top and to the sides to ensure that there are no openings for water entry.

Permanent Cable Tags

- If a receptacle has 2 cables, tag only the power side (supply) and not the load side (the rest of the receptacles on the same string)



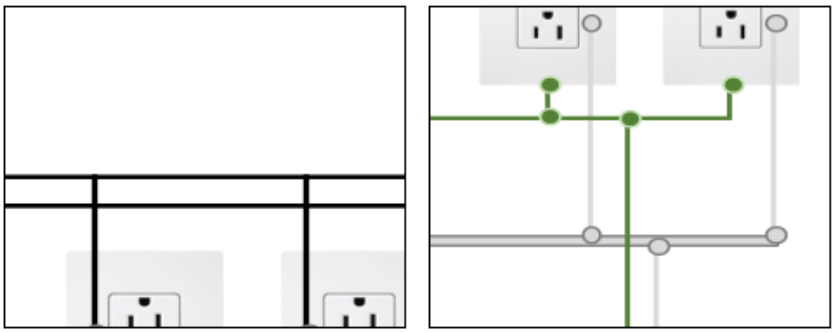
After completing the cable installation and sealing the receptacle, install the permanent cable tag. Permanent tags are usually made of metal and identify the cable to make future work easier. Permanent tags are REQUIRED. Tags should be installed near the point of penetration with the labeling visible. If a receptacle has both a supply cable and a load cable, install a permanent cable tag only on the supply side. Load cables, which provide power to downstream equipment, are tagged at the next entry point.



This diagram shows a basic hook-up plan for lighting or receptacles. Note that cable colors should be labeled to identify the hot and neutral cables. Lines that show a filled-in circle where cables cross indicate that the cables are connected at that point. Lines that cross with no circle shown indicate cables cross at that point but are not connected.

Switches are shown with “swing arms” to identify where wires would be connected when closed.

Conductors



Conductors Crossing

Conductors Connected

Lines that show a filled-in circle where cables cross indicate that the cables are connected at that point. Lines that cross with no circle shown indicate cables cross at that point but are not connected.

Wire Nuts

- Wire nuts are used to connect conductors in circuits from 120 volts to 450 volts
- Most often used in lighting and receptacle systems powering small appliances or motors
- Do not use wire nuts in communications, fire control, or other electronics systems
- Choose the correct size wire nut for the wires joined

Wire nuts are used to connect conductors. They can be used in circuits from 120 volts all the way to 450 volt circuits but are most often used in lighting systems or small appliances and motors.

Wire nuts are selected to match the size of the wires being joined. Wires are sized using the AWG or American Wire Guide system. Contrary to what you might think, larger gauge numbers indicate smaller wire diameter sizes.

This is because the system used was developed in the mid-1800s and was developed on the difficulty of drawing the wires in plans. Smaller wire required more detail and thus when diagrams were created, more passes from older printing machines were required. Thus, 14-gauge wire actually has a larger diameter than 16-gauge wire!

Wire Nut Connection

- Determine the correct wire nut size to use
- Strip the conductor insulation to proper length
  - Red ½-inch
  - Blue ¾-inch
- Hold stripped conductors with the ends even
- Insert conductors into the wire nut
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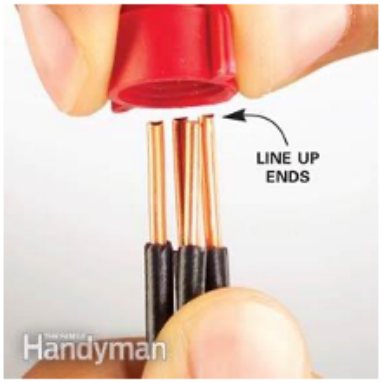
DO NOT TWIST conductors together before inserting into wire nut!

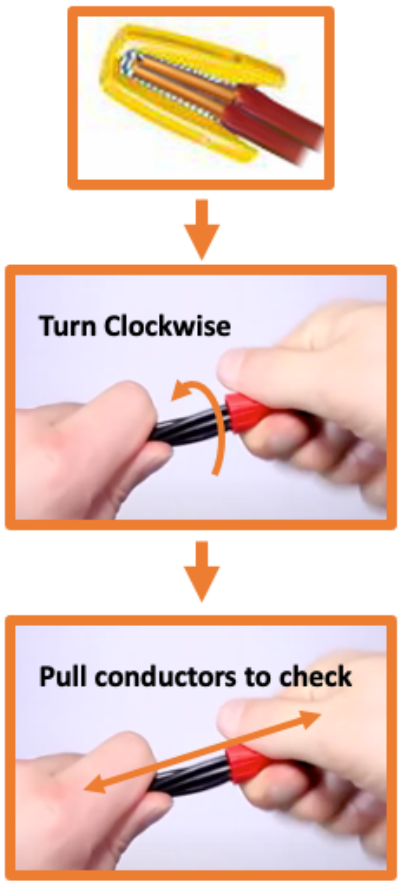


After you've selected the correct size wire nut, strip the wires to the appropriate length.

While firmly holding the wires side by side, push them into the wire nut. Do NOT twist the wires together before pushing them into the wire nut.

Wire Nut Connection

- Hold wires firmly, push and twist the wire nut onto the bundle until it is tight
- Check the connection by holding the wire nut and pulling on **each** conductor individually



When the wires are inserted, twist the wire nut onto the wires until it is tight.

While holding the wire nut, pull on each wire individually to ensure that it is secured and will not come out.