Electrical Switches

Installing or Replacing Electric Switches

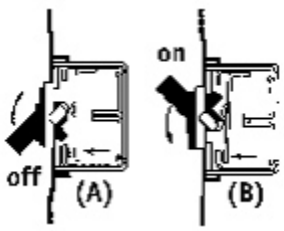
Follow these tips and instructions on how to replace or install electric switches to save you time and effort. Before beginning any electrical repairs, turn off the power at your service panel, fuse box or breaker box. If you know which fuse or breaker controls the circuit you will be working on, remove that fuse or trip that breaker. If there is any doubt, you can remove the main fuse or trip the main breaker.
CAUTION: Tripping the main breaker or removing the main fuse will usually shut off all power to the house. Take the time to read the directions thoroughly to help ensure a satisfactory job.

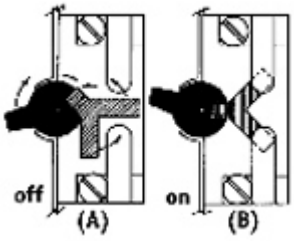
TOOL AND MATERIAL CHECKLIST	
Screwdriver	Two-Wire Feed Cable
Three-Wire Feed Cable	Side-Cutting Pliers
Wirenuts or Scew-on Connectors	Outlet Boxes
Knife for Stripping Wire	Cable Connectors
Toggle Switches	Keyhole Saw
Pigtails	Three-Way Switches
Insulating Tape	Cable Straps
Hand Cleaner	

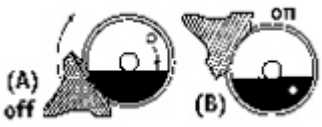
Step 1

THREE BASIC TYPES OF WALL SWITCHES

- **Toggle Switch**
  The popular toggle switch has an arrow-shaped armature that floats between the contact points when the switch is in the off position (see part A, first image below). This armature comes in contact with both terminals when the switch is flipped to the on position (see part B), thus providing a continuous flow of electrical current to the light or appliance.
- **Mercury Switch**
  The mercury switch has a small hollow cylinder, partially filled with mercury (see second image below). In the off position, the small contact point is above the mercury level (see part A). When flipped to the on position, the contact point is immersed in mercury (see part B). This establishes contact between the two terminals and provides power to the light or appliance.
- **Silent Switch**
  The silent switch has a steel spring armature that is pressed away from the bottom terminal when the switch is turned off (see part A, third image below). Flipping the switch lever to the on position moves the steel spring back against the contact point (see part B), thus establishing contact in the circuit.



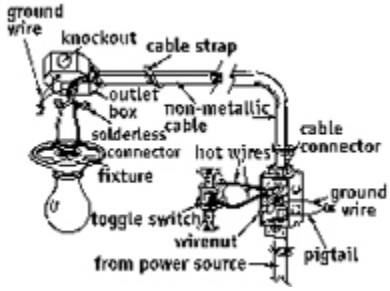


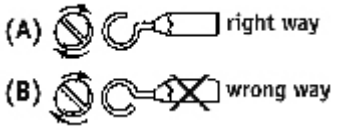


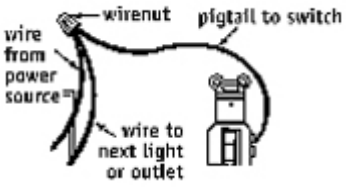
Step 2

INSTALLING THE SINGLE-POLE TOGGLE SWITCH

- The simplest switch system - the single-pole toggle switch - is illustrated in this image. The ordinary single-pole toggle switch provides a means for breaking or feeding electrical current to a light, appliance, etc.
- The single-pole toggle switch has two brass terminal screws. One wire (usually the black) is cut, then is connected to the two brass terminals. The other wire (white) is uninterrupted from the power source to the light or fixture.
- When connecting a wire to the terminal screw of a switch, always turn the loop on the end of the wire in the same direction as the screw threads, as shown in part A of this image. If the loop is turned in the opposite direction (part B), tightening the screw will loosen the loop.
- If the wire connects to the terminal screw and then runs on, cut and strip the wire on both sides of the cut. Using a 6" piece of wire with both ends stripped (sometimes called a pigtail) and a wirenut, fasten the three wires together. Connect the pigtail to the terminal, as in the first image below.
- Use wirenuts or screw-on connectors to save time and effort when you must make a splice in any electrical wire (see second image below). Always cover any soldered connection with insulating tape. If soldered sections are rough, apply an extra layer of tape. Insulate the wire an additional inch or two beyond the soldered connection in each direction.
- White wires should generally be attached to light colored terminal screws such as silver. Black wires should generally be attached to dark colored screws such as brass colored. If the terminal screws are the same color, either wire can generally be attached to either terminal. Green terminal screws are for grounding wires.

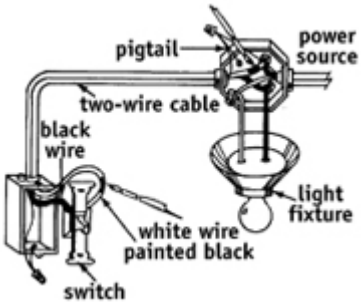






Step 3

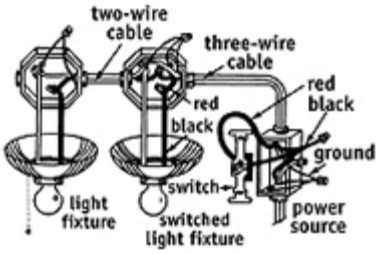
INSTALLING SWITCH OUTSIDE MAIN WIRING RUN



- Use an ordinary toggle switch for installations outside the main wiring run. Shut off all current at the main service panel. At the light fixture, connect the black wire from the switch to the black wire from the light fixture. Connect the white wire from the switch to the black wire from the power source (see image).
- CAUTION: Anytime it is necessary to connect a white and black wire together, take the time to paint the white wire black at both ends to indicate that the white wire is attached to a power source. Connect the white wire from the light fixture to the white wire from the power source.
- At the light switch, connect the black wire to one terminal and the white wire to the other. Remember, a green screw is always for the ground wire.

Step 4

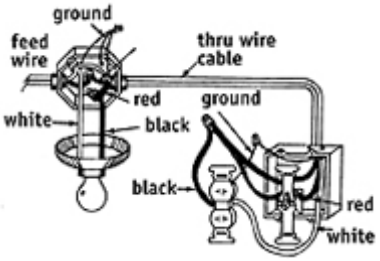
INSTALLING IN-LINE SWITCH FOR CONTROL OF ONE LIGHT



- Shut off all current at the main service panel. A third wire (red, see image) must be added to the power cable for this switch arrangement. The red wire serves as a black wire from the switch to the light or outlet which is to be controlled.
- Study the diagram carefully. You will note that the white wire feeds continuously from the power source to all fixtures. The black wire is pigtailed on one terminal of the switch, while the red wire attaches to the other terminal. The black wire then runs continuously through to the light or outlet which is not controlled, while the red wire runs from the switch terminal to connect with the black wire on the controlled light or outlet.
- This arrangement allows the switch to control the first light or outlet while power continues uninterrupted to the second fixture.

Step 5

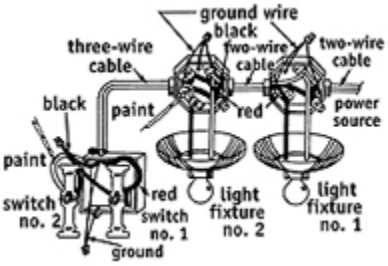
INSTALLING SWITCH AND CONVENIENCE OUTLET IN SAME BOX



- Shut off all current at the main service panel. At the double-switch box (see image), connect a pigtail to the brass terminal on the outlet and another pigtail to either of the terminals on the switch. Wirenut these two pigtails and the black wire from the light fixture together. Connect the white wire from the light fixture to the silver terminal on the outlet. Connect the red wire from the light fixture to the other terminal on the switch.
- At the light fixture, wirenut the white wires from the power source, the light fixture and the switch together. Wirenut the black wires from the power source and the switch together. Wirenut the red wire from the switch and the black wire from the light fixture together.

Step 6

INSTALLING TWO PARALLEL SWITCHES FOR CONTROL OF TWO SEPARATE LIGHTS

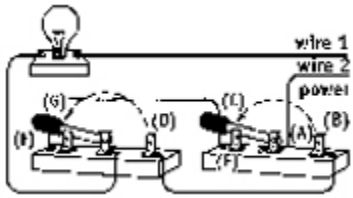


- Shut off all current at the main service panel. At the switch box, attach a pigtail to one of the terminals on switch 1 (see image). Connect a second pigtail to one of the terminals on switch 2. Wirenut these two pigtails and the black wire from the light fixture together. Connect the red wire from the light fixture to the other terminal on switch 1. Connect the white wire from the light fixture to the other terminal on switch 2. Be sure to paint the white wire black.
- At light fixture 1, wirenut the black wire from the power source and the black wire leading to light fixture 2 together. Wirenut the white wires from the power source, light fixture 1 and light fixture 2 together. Wirenut the black wire from light fixture 1 and the red wire to light fixture 2 together.
- At light fixture 2, wirenut the black wires from light fixture 1 and the switches together. Wirenut the white wires from light fixture 1 and light fixture 2 together. Wirenut the red wires from switch 1 and light fixture 1 together. Wirenut the white wire from switch 2 and the black wire from light fixture 2 together. Be sure to paint the white wire black.

Step 7

HOW A THREE-WAY SWITCH WORKS

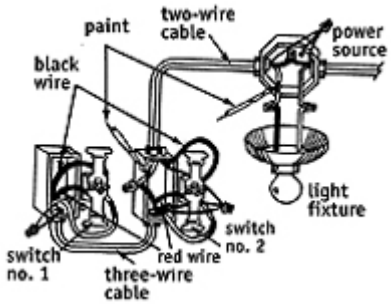
- This illustration uses open-knife switches to demonstrate how a three-way switch works. Wire No. 1 feeds directly from the power source to the light fixture. However, power must be fed through two wires for the light to function. The flow of power through wire No. 2 is continued or broken by the two switches, as illustrated.
- Power through wire No. 2 reaches the first switch at the center or common terminal (A). If the knife-switch handle were in position (B), the current would flow through to terminal (D). However, this arrangement would not provide a continuous power flow since the knife switch, as illustrated, is at position (G). The light bulb would not be illuminated.



- Since the first switch is at position (C), the current flows directly through terminal (E) to terminal (F), then through handle (G) to turn on the light. Note that when either handle is placed in the opposite position, the circuit is broken and the light is not illuminated.
- Note also that if you swing either handle to the opposite position, the current flow is made continuous and the light goes on again. Obviously, knife switches are not used in an electrical installation. They are used here simply to illustrate what happens inside an ordinary three-way switch when it is installed.

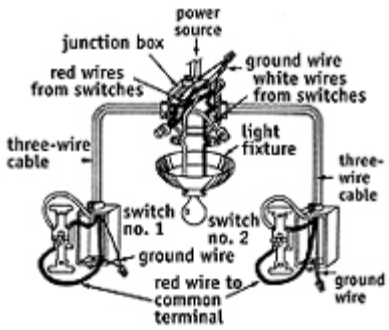
Step 8

THREE-WAY SWITCHES FOR LIGHT CONTROL BEYOND SWITCHES



- Shut off all current at the main service panel. At the light fixture, wirenut the white wires from the power source and the light fixture together (see image). Wirenut the black wires from the power source and the switches together. Wirenut the black wire from the light fixture and the white wire from the switches together. Paint the end of the white wire black.
- At switch 1, locate the terminal on the three-way switch that is marked as common and attach the red wire. Attach the black wire to either of the two remaining terminals. Attach the white wire to the last terminal.
- At switch 2, locate the terminal on the three-way switch that is marked as common and attach the red wire. Attach the white wire from switch 1 to either of the two remaining terminals. Paint the end of the wire black. Attach the black wire from the light fixture to the last terminal. Wire the black wire from switch 1 and the white wire from the light fixture together. Paint the end of the white wire black.

Step 9



THREE-WAY SWITCHES FOR LIGHT CONTROL BETWEEN SWITCHES

- Shut off all current at the main service panel. At switch 1, find the terminal marked as common and attach the red wire (see image). Attach the white wire to either of the two remaining terminals. Attach the black wire to the last terminal.
- At switch 2, find the terminal marked as common and attach the red wire. Attach the white wire to either of the two remaining terminals. Attach the black wire to the last terminal.
- At the light fixture, wirenut the two red wires from the switches together. Wirenut the two white wires from the switches together. Wirenut the black wires from the power source and switch 1 together. Wirenut the white wires from the power source and the light fixture together. Wirenut the black wires from the light fixture and switch 2 together.