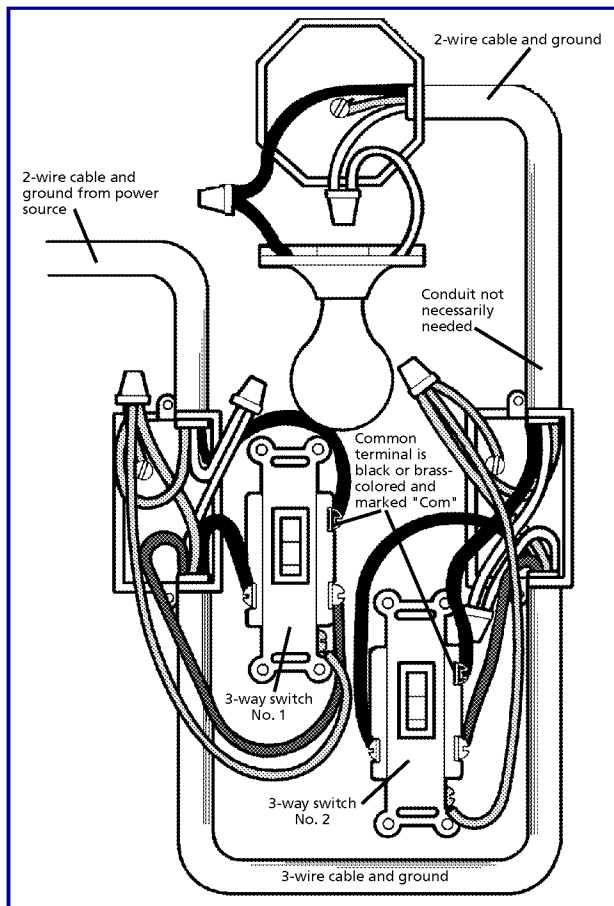




## HOW-TO BOOKLET #3004 THREE-WAY SWITCHES



### FIXTURE CONTROLLED BY TWO SWITCHES: POWER THROUGH A SWITCH BOX

Two three-way switches control one light with the electric power coming through the first switch, flowing to the second switch, and then to the light fixture. The bare ground wire goes through both switch boxes and the ceiling light box and it is connected at all junctions, except the light, with a pigtail (short piece of wire) and wire nut. The hot wire in the drawing is black and is connected to the COM terminal. The neutral wire is white. Track each with a finger to its conclusion at the light fixture to ensure proper connection. Be aware that some light fixtures have a ground connection.



### TOOL & MATERIAL CHECKLIST

- No. 12/3 Cable (No. 14/2 in Canada)
- Wire Connectors
- Outlet Boxes
- Lineman's Pliers
- Tape Measure
- Electrician's Tape
- Switch Boxes
- Needlenose Pliers
- Wire Strippers
- Screw Driver
- Three-Way Switches

*Read this Entire How-To Booklet for Specific Tools and Materials Not Noted in the Basics Listed Above.*





Three-way switches control lights and receptacles from two points: for example, a light in a hallway that can be operated from the first floor and second floor. Or, a light in a garage that can be turned on/off from the garage and the kitchen or pantry or living room.

Three-way switches require a three-wire cable: the power wire, the neutral wire, and the traveler or switch wire.

**NOTE:** The shadings of the wires in the illustrations represent actual color. See color key.

The cable should also have a ground wire, or a total of four wires in the cable. The system also requires three-way switches. The switches are wider than regular single-pole switches and they have three terminal screws on the side (sometimes back) of the switch housing. Two terminals will be on one side of the switch housing; one terminal on the other side.

### COLOR KEY FOR ILLUSTRATIONS

-  White = White Wires (Neutral)
-  100% Black = Black Wires (Hot)
-  60% Black = Red Wires (Traveller or Switch)
-  10% Black = Green Wires (Ground)

Four-way switches have four terminals. This switch works in combination with two three-way switches to control electricity to lights and receptacles from three locations. All of the four terminals are brass colored. They support hot conductors (traveler wires), which receive and transfer electricity from each of the three-way switches. The toggle on a four-way switch is NOT marked “OFF” and “ON”. These markings are the only way to tell the difference between it and a double-pole switch, which is labeled “OFF” and “ON”.

It is advisable to use No. 12 wire for residential, indoor wiring. No. 14 wire is acceptable if the circuit is protected at 15 amperes. (Canadian code requires the use of No. 14 wire for interior application.) Local and provincial codes should be checked before starting any wiring project. Most codes dictate that all wire connections must be placed inside a switch, receptacle or junction box. If wires going to switches and fixtures are going to be exposed to dampness, use wire designated for damp locations. Be sure to obtain any required electrical permits before beginning work.

### ESTIMATING WIRE NEEDED

The information and illustrations in this booklet are based on the use of non-metallic, sheathed cable (often called by the brand name Romex).

To figure materials needed: measure the distance between the new switch and the power source. Add an extra foot for every connection you will make along the line. Then, to provide a margin for error, add 20% more.

For example, if you measure 12 feet of cable between a new switch and existing fixture, add another 2 feet for the two connections, making the total 14 feet. Then add 20%, about 3 feet, to the total. To do this job, you would need 17 feet of cable.

### WORKING WITH WIRE

To make wire connections, the wire must be pulled through boxes at least 6 inches, cut, and then striped of insulation. Here is the procedure to follow:

- 1 Cut the cable to the proper length using line-man’s pliers or a hacksaw.
- 2 With a sharp knife or slitting tool, slit the outer sheathing being very careful not to cut the insulation covering the wires inside the cable. If possible, lay the cable on a flat, firm surface to slit it properly. You may also use a cable ripper.
- 3 Peel back the sheathing and trim it square.
- 4 With wire strippers, put single wires in the proper size groove in the handle (12 for No. 12 gauge wire). Twist the stripper or rotate it 360 degrees, sliding the insulation off the wire as it breaks loose under the cutting blades. Remove 3/4 to 1 inch of insulation.
- 5 Splice wires together and top with a wire nut. See How-To Booklet #3005, “Wires & Wiring” for more details.

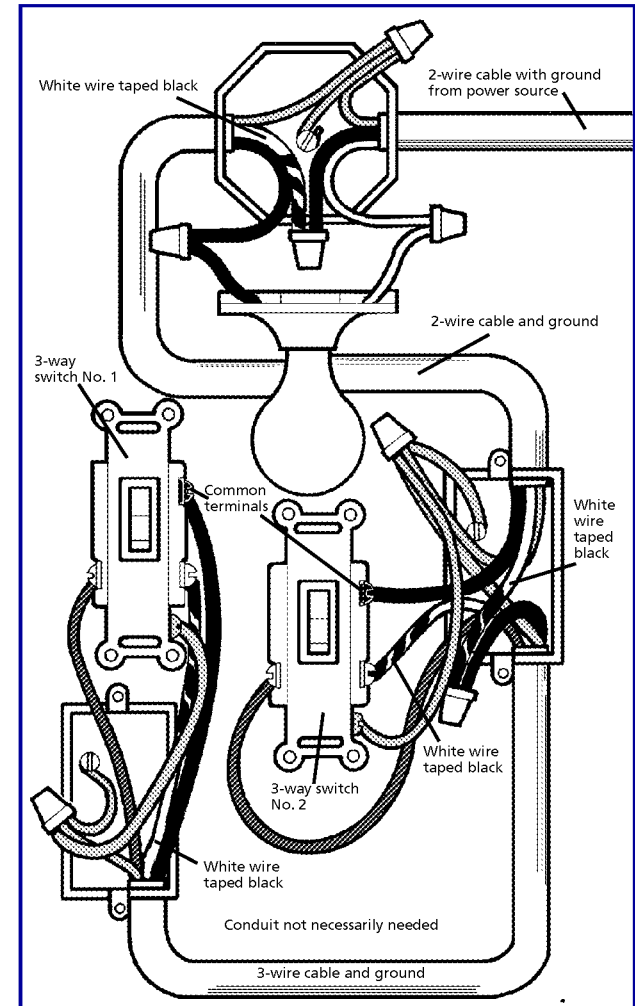
### ADDING NEW WIRING

This involves pulling wires through studs and rafters in back of the wallcovering (plaster, gypsum wallboard). You will need a hand brace, a drill with a long electrician’s bit, a coil of electrician’s fish tape and lots of patience.

In wiring three-way switches, the power wire is connected to the COMMON terminal, usually marked “COM” (C in drawings). The location of this common terminal may vary according to the manufacturer of the switch. Check the switch. If not marked, the common terminal may be color coded black or brass.

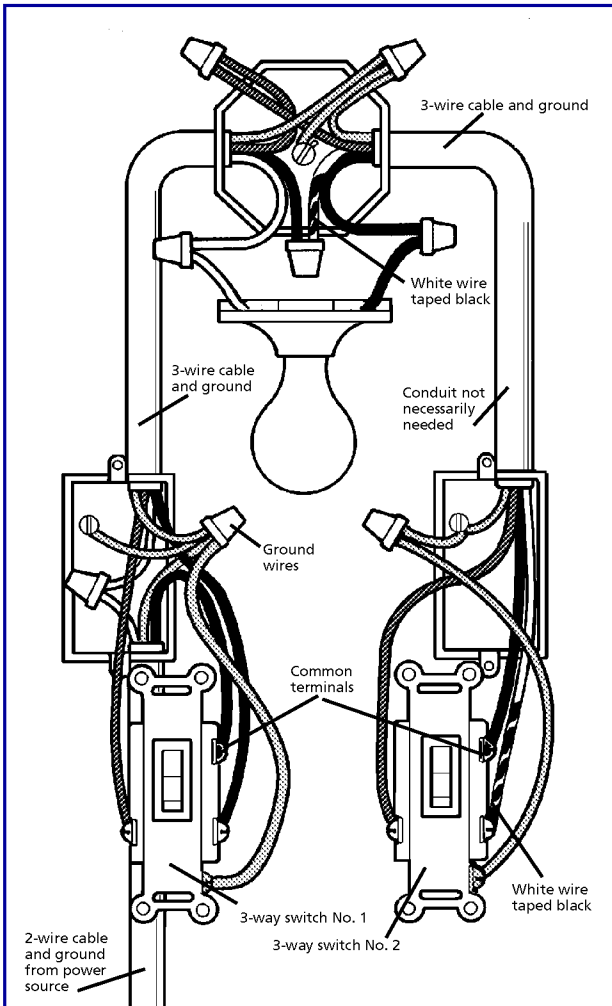
In the following illustrations, track each wire with a finger or pencil to its conclusion at the fixture. This way, you will ensure all connections are made properly.

**CAUTION: When working with electricity, always turn off the power at the main service (fuse or circuit breaker) panel before you start working. Be sure the circuit is completely dead!**



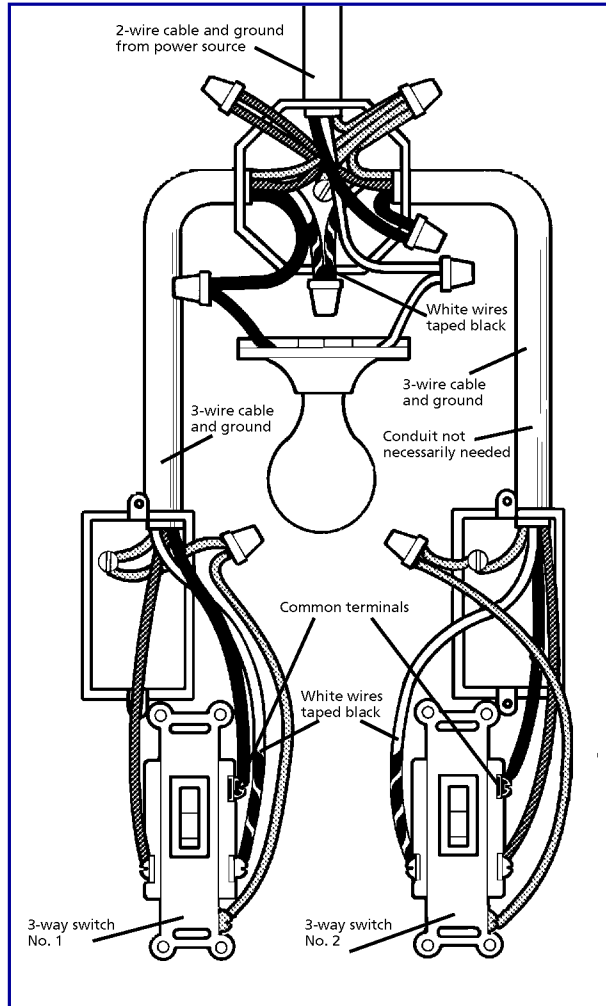
### FIXTURE CONTROLLED BY TWO SWITCHES: POWER THROUGH FIXTURE BOX

Two three-way switches control one light with the electric power coming through the light on a two wire cable. In order to code the white wire, which is used as a power wire from the light fixture through the switches, black electrician’s tape is wrapped around the wire in the boxes. This way, if you or someone else goes into the boxes for repairs, the white wire taped black will indicate a hot wire. Even when taped black, the white wire may never be used to bring power to the fixture terminal. The traveler (switch) wire runs just between the two switches, not the light. Note connections of the ground wire throughout.



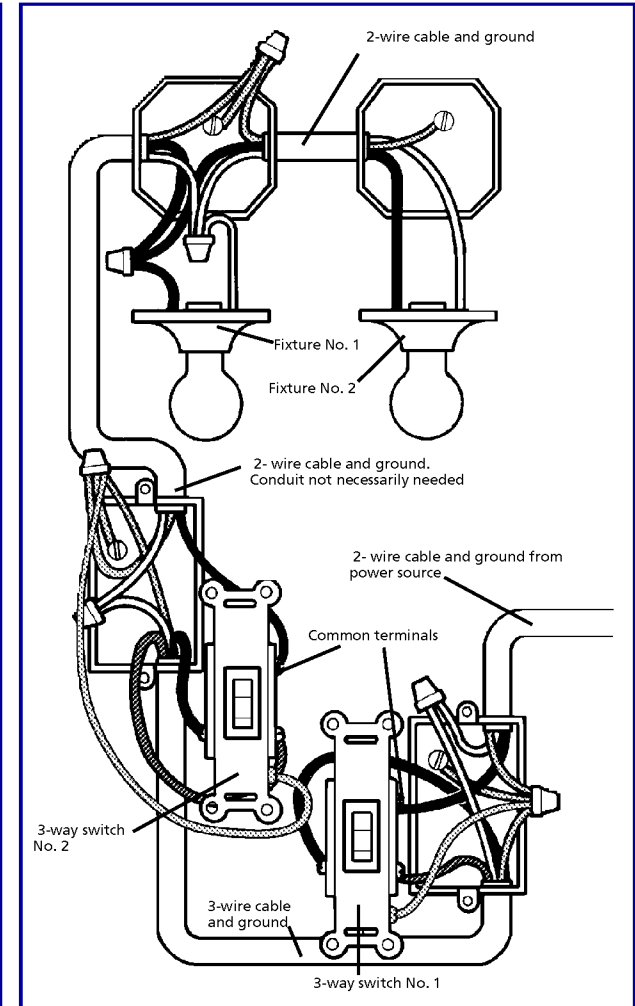
### FIXTURE BETWEEN TWO THREE-WAY SWITCHES: POWER THROUGH SWITCH

This light is controlled by two three-way switches with the light between the switches and the power first going through a switch, then to the light, and onto the second three-way switch. The ground wire is pigtailed with a wire nut at the switch boxes and the ceiling box. Grounding screws often are furnished with boxes and are green. Note that the traveler wire goes through the light ceiling box and that the white wire is taped black between the fixture and second switch.



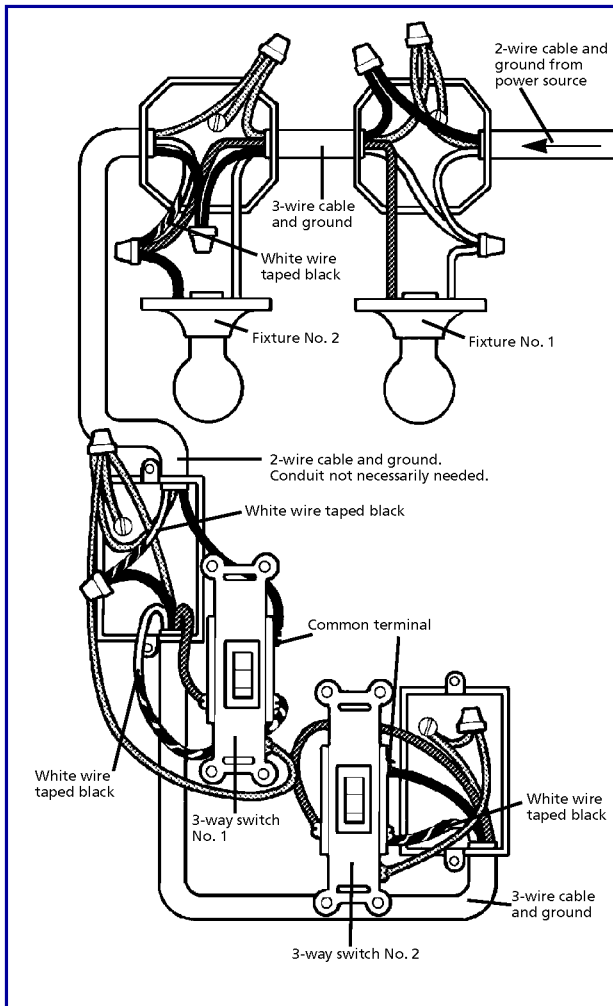
### FIXTURE BETWEEN TWO THREE-WAY SWITCHES: POWER THROUGH LIGHT

This light is between switches with the power source coming from the light. Three-wire cable with a ground wire is used for this connection. The power is routed first through the light ceiling box and then flows to the switches. Note how white neutral wire from the power source is connected directly to the light fixture. The black or hot wire is routed to a switch and then is fed back through the connections via a white wire taped with black electrician's tape indicate that it is hot. The traveler wires are connected at the fixture box.



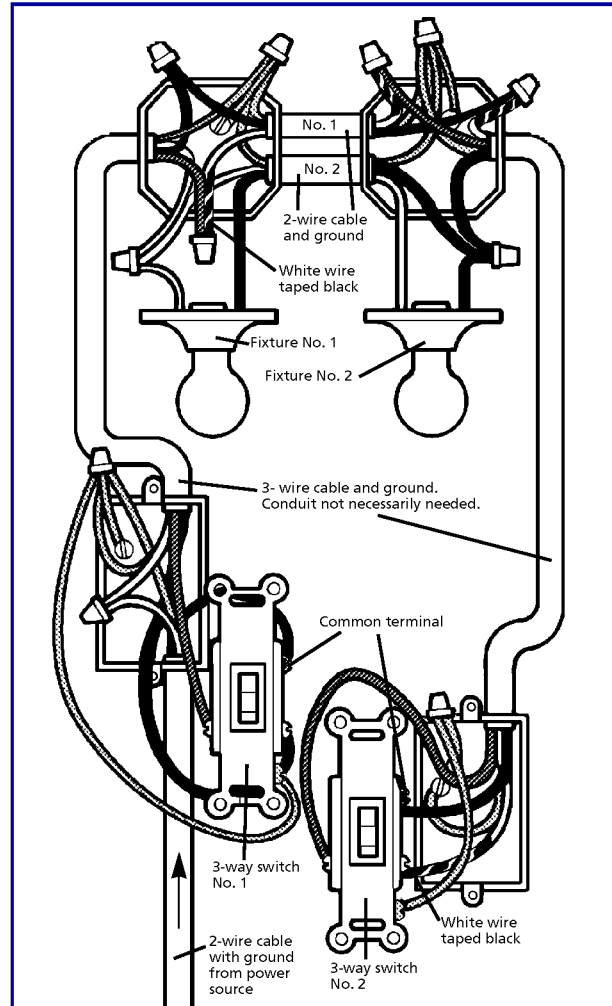
### END-OF-RUN LIGHTS CONTROLLED BY TWO THREE-WAY SWITCHES

These end-of-run lights are controlled by two three-way switches with a two-wire cable power source coming through the first three-way switch. Note how the white or neutral wire goes completely through the connection system with pigtail connections at both switches and the first light box. Only two-wire cable with ground is needed for the boxes at the lights. Traveler wires (red) connect the three-way switches without going further in the system.



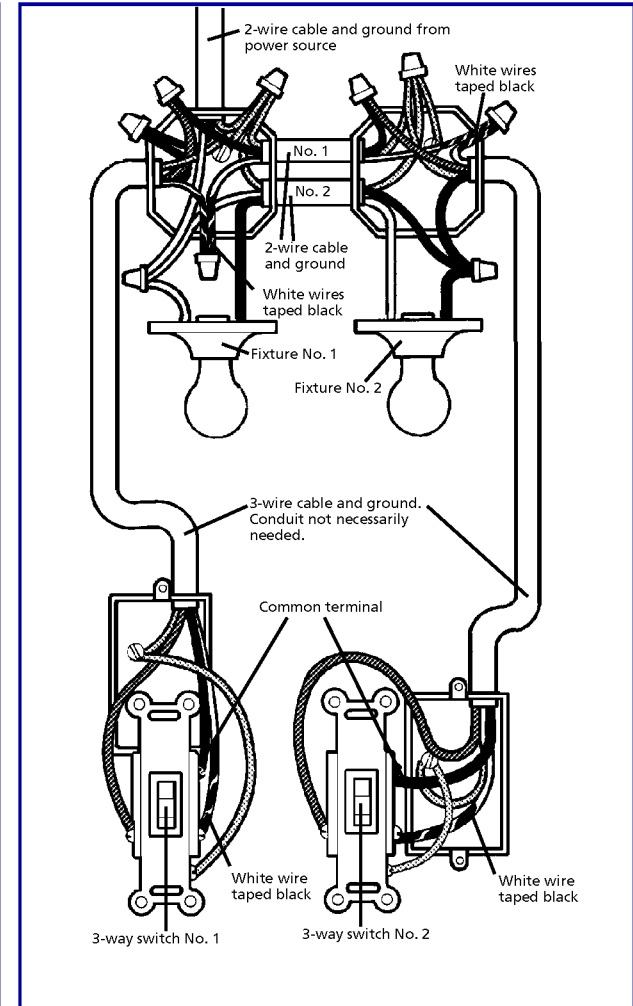
### TWO THREE-WAY SWITCHES CONTROL TWO LIGHTS: POWER THROUGH LIGHT

End-wired lights are controlled with two three-way switches with power routed through the light boxes to two-wire cable to the two switches. Note how power is connected at lights: white wire taped with black electrician's tape from the nearest switch to a traveler wire that connects the second or end light, then pigtailed to the brass fixture terminal. All wire is utilized this way without waste. Both the white wire taped black and the traveler wire (red) indicate hot wires, if switches/lights are ever reworked.



### TWO LIGHTS BETWEEN TWO THREE-WAY SWITCHES: POWER THROUGH SWITCH

These lights between switches with the electrical power coming through a switch. Second switch is an end-wired or end-of-the-run switch. Both three-wire and two-wire cable with ground is used. Note how the traveler wire is connected in the light ceiling boxes: with a length of neutral wire taped black to indicate a hot wire. The ground wire is pigtailed throughout. Neutral wire bypasses first three-way switch. Note double cable hookup between lights to handle the multiple wires.



### END-WIRED SWITCHES: POWER THROUGH FIXTURE BOX

Power through the lights to three-way switches has two-wire cable and ground between the light boxes and three-wire cable and ground at the switches. White or neutral wire taped with black electrician's tape is used as black power wire to make connections throughout. Grounding wires are pigtailed to the light fixture boxes, and the switch box terminals. The switches operate both lights, but the wiring ensures that if one bulb should burn out, the other will still work.