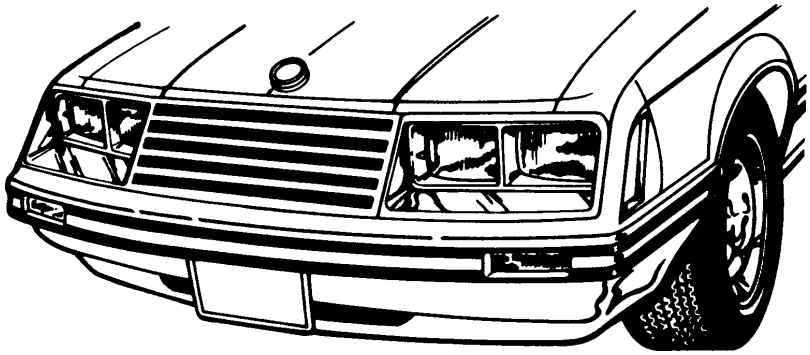
HOW - TO
WIRING & LIGHTING



Tool And Material Checklist

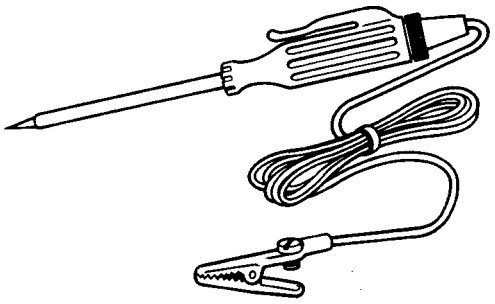
- ☐ Test Light
- ☐ Service Manual
- ☐ Penetrating Oil
- ☐ Long-Nose Pliers
- ☐ T-Square or Right Angle
- ☐ Screwdriver
- ☐ Black Electrical Tape
- ☐ Fuses
- ☐ Fuse Puller
- ☐ Cloth or Paper
- ☐ Wire Brush or Abrasive Paper
- ☐ Metal Clips or Nylon Wire Ties
- ☐ Rubber Grommets

Many important jobs related to your car's electrical system can be done easily and safely, if proper care is observed. With the exception of the headlights, most bulbs can be changed with little effort. The circuits that carry electrical current from the battery to the individual components are illustrated in detail in your car's service manual. Refer to these diagrams for specifics or to troubleshoot problems that cannot be corrected with the general information given in this booklet.

OPEN CIRCUITS

An open circuit is simply a switch that is off, a break in a wire, or a burned-out bulb. Open circuits are usually caused by breaks in the wiring, faulty connections, or mechanical failure in a switch or component. They cause components to fail, but they do not cause fuses to "blow." Use a test light to pinpoint an open circuit. For example, if the wipers fail to operate, proceed as follows:

1. Turn on the switch to the wiper accessory.
2. Attach the test light clamp to a good ground (some bare metal part of the car body, chassis or engine). To make sure the ground is good, touch the probe to a known hot source such as the battery or cigarette lighter socket.
3. After locating the fuse, touch the probe to one end of the fuse holder, then to the other. If it lights in both cases, the fuse is good. If is lights at one end only, replace the fuse.
4. If the fuse is not bad, touch the probe to the wires at the wiper switch. If the test light comes on, the wire between the fuse and the switch is unbroken.
5. Check the terminal and the wire that extends from the switch to the wiper. If there is current coming out of the switch to the wiper itself, the switch is good.
6. Check the mounting of the wiper by attaching the clamp of the probe to a hot wire and touching the probe to the housing or case of the wiper. If the ground is poor or nonexistent, the light will not work. If the light goes on, the ground is good and the problem is in the wiper motor itself. Check for current at the motor in the same manner to confirm the diagnosis.

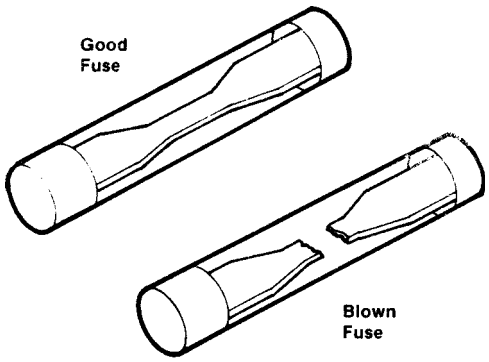


Typical test light

FUSES

Fuses act as safety valves for electricity by preventing damage caused by short circuits and overloads. If a short or overload causes the circuit's current drain to exceed the amp rating of the fuse, the fuse "blows" and switches the current to that circuit. All fuses are contained in the fuse block, which is located on the inside of the fire wall, usually on the driver's side. It is labeled with the name of the circuit(s) each fuse protects and, in most cases, the amp rating of the correct fuse.

When a blown fuse is detected, either visually or by test light, replace it with a new one *of the same amp rating.* If this new fuse blows, check for a short or a temporary overload. For example, if the wipers are turned on while the blades are frozen to the glass, a temporary overload can result. If you don't have a fuse puller to remove blown fuses, use half of a hinged clothespin. Be careful – glass fuses can break easily.



Identifying a blown fuse

SHORT CIRCUITS

A short circuit occurs when electricity finds a "short cut" from positive to negative; it is the result of a bare spot on the wire contacting part of the metal car body. The windings in electric motors can also short. Short circuits are hazardous because they create sparks, burned wires, and blown fuses. They are more difficult to locate with a test light than open circuits.

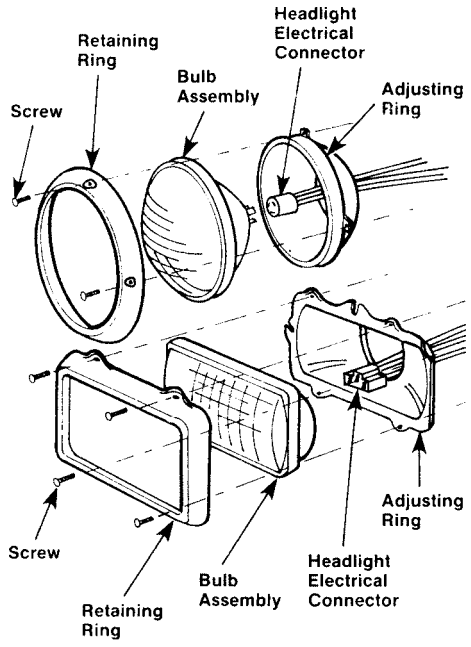
1. Disconnect the suspected circuit at all points where it is joined by connectors (you'll need the wiring diagram for this).

2. Attach the clamp of the tester to the hot side of that circuit's fuse and touch the probe to the other side of the blown fuse. If the light goes on, the short is between the fuse and the first disconnected connector.

3. If the light doesn't go on, connect the first connector and touch the probe to the fuse holders again. If the light goes on, the short is between the first and second connector.

4. If the light again does not go on, repeat the process until the section of the wire with the short is isolates.

HEADLIGHTS



Parts of a typical headlight

Two-light systems have one headlight on each side, each of which has a high-beam and a low-beam filament. Four-light systems have two lights on each side; two of them should be lit for low beam and all four for high beam.

To replace a burned-out headlight:

1. Remove the trim ring or headlight bezel.

2. Remove the three screws (four on rectangular lights) from the retaining ring. If difficult to remove, apply penetrating oil.

NOTE: Do not disturb the two adjusting screws (the screws with springs under them). This will throw off the headlight adjustment.

3. With the retaining ring off, pull the headlight out.

4. Remove the plug-in socket at the back of the light. Test the headlight for current to make sure the beam was the problem.

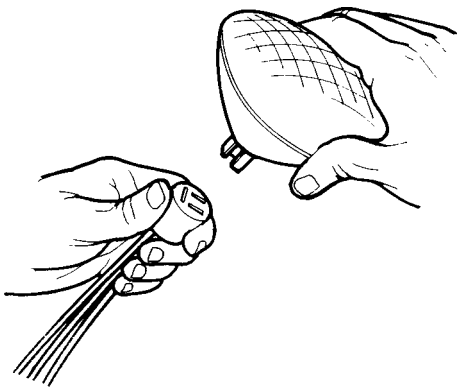
5. Install the plug on the new headlight, making sure that the prongs on the light and those on the socket are properly aligned.

6. Install the retaining ring, making sure that the light is properly aligned before tightening the retaining ring screws. The headlight has locating lugs around the back of the glass that fit in the notches of the adjusting house.

7. Replace the trim ring or decorative panel.

ADJUSTING HEADLIGHTS

1. Consult your service manual for the correct tire pressure and how much gasoline should be in the tank, both of which affect the height and angle of the headlight beam.



2. Use a T-square or right angle to draw a perpendicular line through the center of a large board or one of your garage doors.

3. Draw a horizontal line at the same height from the base of the board or door as the center of the headlights are from the ground. Draw two lines if your car has headlights one over the other one on each side.

4. Measure the distance from each headlight center to the center of the car.

5. On the diagram, measure and mark this distance along the horizontal from the center perpendicular line.

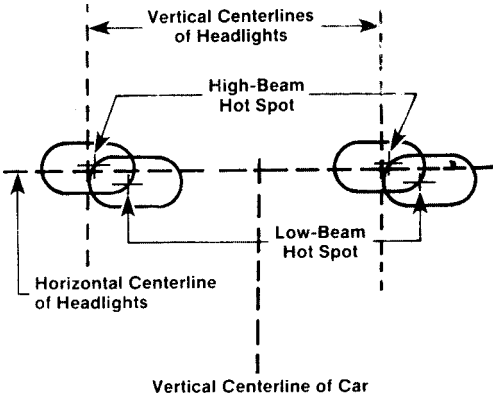


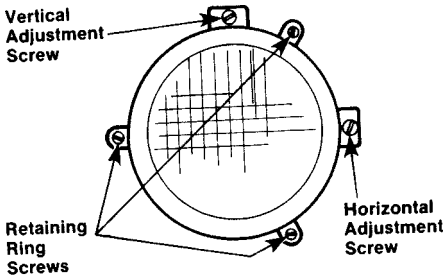
Diagram for adjusting headlights

6. Draw vertical lines through these marks. If your car has two side-by-side headlights on each side, you will need a total of four vertical lines.

7. Position the front of the car exactly 25' from and parallel to the diagram, with the car's center pointed exactly at the vertical centerline on the diagram.

8. After dark, switch the headlights on high beam and cover all but one with cloth or paper.

9. Make the adjustment by using the horizontal and vertical adjustment screws. The bright center (or hot spot) is 2" below the intersection of the horizontal and vertical centerlines on the diagram, corresponding to that headlight.



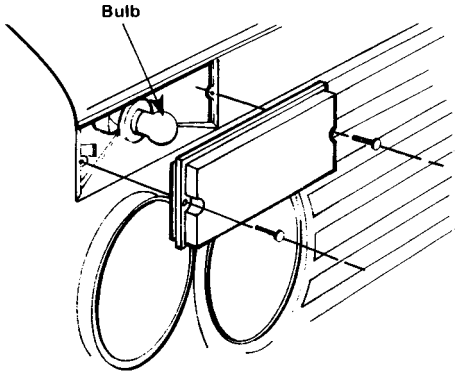
Headlight adjustment screws

10. Repeat for all headlights, then switch to low beam.

11. On four-headlight cars, adjust the low-beam headlights so that the hot spot is 2" to the right of the vertical headlight centerlines, with the top of the hot spot just touching the horizontal line.On two-headlight cars, this should be automatically corrected if the high beam was adjusted properly.

EXTERIOR BULBS

Gain access to exterior bulbs by removing the screws that retain the lens, then the lens itself. Many exterior bulbs must be removed from the back of the light housing, usually from the inside of the trunk or under the fender. With rear-access housing, remove the socket itself by turning it 1/4 turn counterclockwise and pulling it out of the housing. The rest of the bulb removal procedure is the same for either front or rear access.



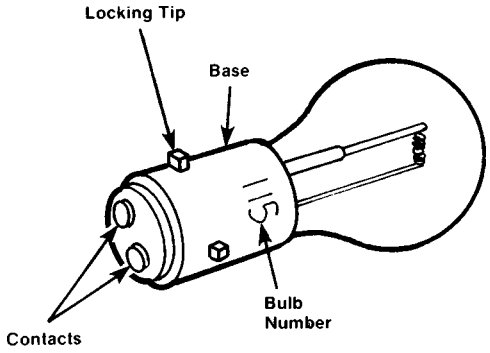
Exterior bulb replacement

1. Gently grasp the globe and push it down into the socket, turning it counterclockwise 1/4 turn until it stops. If the bulb will not turn, use penetrating oil.

2. Lift out the bulb. If it is broken, you will need long-nose pliers to grasp the base, push, turn, and pull it out.

3. Reverse the procedure for installation. If the bulb will not turn after pushing it down, take it out, turn it 180°, and reinsert it.

4. With the rear-access light, install the socket



Parts of a light bulb

in the housing and test the light. There is no need to do this with the front-access light because the socket is fixed to the ground.

5. If the bulb does not light and it is definitely good, wiggle the bulb in its socket. If it lights, clean off any corrosion at the base or side of the socket with a small wire brush or abrasive paper.

6. If the contact at the bottom of the socket is corroded beyond correction, a replacement contact with attached wire can be purchased. This is called a pigtail assembly and is available with one or two contacts.

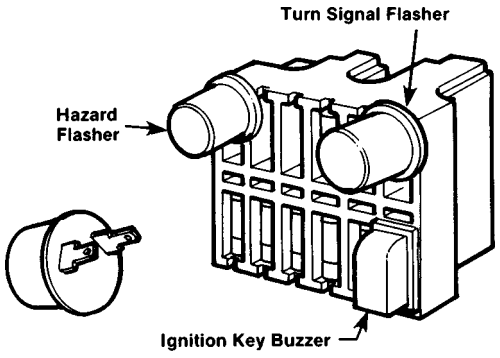
7. If corrosion is not the problem, check the grounding of the socket.

8. If properly grounded, check for an open circuit in the hot wire.

FLASHERS

Most cars have two small can-shaped or box-shaped units that make a tick-tick sound when the turn signals or hazard warning lights are activated. These flashers are usually mounted under the dash on the driver's side; they can also be mounted to the fuse block or taped to a wiring harness. A test light can be used to determine which flasher is used for the turn signals and which is used for the hazard warning lights. An easier way is to turn on both the directionals and the hazards; this will activate both flasher units. By removing one of the flashers, you will disable one of the circuits and thus find out which flasher operates which system.

If your turn signals fail to operate and the fuse is good, the flasher has probably failed. Occasionally, the flasher will not flash as fast as it once did, or it will flash faster; this is also cause for replacement. (If it flashes too fast or too slowly, check for a burned-out bulb first.) A flasher features two or three prongs that plug into a socket. Just pull the prongs out of the socket and replace with a new flasher. Flashers are designed to operate a specific number of bulbs of a specific candlepower (brightness). If the candlepower of the turn signal bulbs is changed, or if additional bulbs are used (if you hook up a trailer, for instance), a heavy-duty flasher must be used. This will fit your socket without modifications.



Flasher installation

ACCESSORIES

When adding accessories (radios, driving lights, clocks, etc.), there are several procedures to follow to ensure a safe and trouble-free installation.

1. Be sure you use wire of the proper gauge. The installation instructions received with the accessory will specify this, as well as the proper amp rating of the fuse. While some people use knives or razor blades to strip insulated wires, the use of wire stripping pliers is recommended. This tool strips any standard gauge wire quickly and accurately. The tip of the jaws is a wire cutter, and immediately behind the cutter the jaws are hollowed out for crimping.

2. Be sure the new circuit is fused. Some fuse panels already have a fuse labeled "additional accessories"; use this if possible. Others have additional holders where circuits can be added. If one of these is not available, an in-line fuse and fuse holder can be purchased. Check your fuse panel for a spade terminal that is vacant, and use the test light

to see if it is hot. For accessories that you want controlled by the key, do the test with the key in both the on and off positions. Attach the in-line fuse to this spade terminal and position the fuse holder so that it is accessible. Attach your wire from the other end of the fuse holder to your accessory (or to the switch, if one is used).

3. Be sure all connections are mechanically and electrically sound. Solderless insulated terminals and connectors are commonly used in most automotive applications.

4. Be sure that the wiring is routed in a safe and protected manner. Do not permit it to come in contact with moving parts. Either tape it to an existing wire or purchase metal clips or nylon wire ties to fasten it to a solid surface. If you must drill a hole for the wire to pass through, protect the wire with a rubber grommet in the hole, or make several wraps of tape around the wire where it passes through the hole.