Chapter 27
Automotive Wiring and Wire Repair

CHART 27.1
The list of relative conductivity of metals, showing silver to be the best.

CHART 27.2A
A teflon wire gauge (AWG) number and the actual conductor diameter in inches.
FIGURE 27.1 All lights and accessories ground to the body of the vehicle. Body ground wires such as this one are needed to conduct all of the current from these components back to the negative terminal of the battery. The body ground wire connects the body to the engine. Most battery negative cables attach to the engine.
Battery cables are designed to carry heavy starter current and are therefore usually 4 gauge or larger wires. Note that the battery has a thermal blanket covering to help protect the battery from high underhood temperatures. The wiring is also covered with plastic conduit called split-loom tubing.

FIGURE 27.3 A typical automotive fuse panel.

### CHART 27.5

<table>
<thead>
<tr>
<th>Normal Current in the Circuit (Ampere)</th>
<th>Fuse Rating (Ampere)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>24</td>
<td>30</td>
</tr>
</tbody>
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The fuse rating should be 20% higher than the maximum current in the circuit to provide the best protection for the wiring and the component being protected.
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CHART 27.6
Amperage Rating vs. Color chart:
- 4 amperes: Black, green
- 2 amperes: White
- 2.5 amperes: Purple
- 3 amperes: Red
- 4 amperes: Blue
- 5 amperes: Tan
- 6 amperes: Gray
- 7 amperes: Brown
- 8 amperes: Orange
- 10 amperes: Red
- 14 amperes: Black
- 15 amperes: Blue
- 20 amperes: Yellow
- 25 amperes: Natural
- 30 amperes: Green

The amperage rating and color codes of the blade fuse are standardized.

CHART 27.7
Mini fuse amperage rating and colors:
- 5 amperes: Tan
- 7.5 amperes: Brown
- 10 amperes: Red
- 15 amperes: Blue
- 20 amperes: Yellow
- 25 amperes: Natural
- 30 amperes: Green

CHART 27.8
Maxi fuse amperage rating and colors:
- 20 amperes: Yellow
- 30 amperes: Green
- 40 amperes: Amber
- 50 amperes: Red
- 60 amperes: Blue
- 70 amperes: Brown
- 80 amperes: Natural

The amperage rating and color codes of the maxi fuses are standardized.
FIGURE 27.4 Blade-type fuses can be tested through openings in the plastic at the tip of the fuse.

FIGURE 27.5 Three sizes of blade-type fuses: mini on the left, standard or ATO type in the center, and maxi on the right.

FIGURE 27.6 A comparison of the various types of protective devices used in most vehicles.
To test a fuse, use a test light to check for power at the power side of the fuse. The ignition switch and lights may have to be on before some fuses receive power. If the fuse is good, the test light should light on both sides (power side and load side) of the fuse.

Typical blade circuit breaker fits into the same space as a blade fuse. If excessive current flows through the bimetallic strip, it bends and opens the contacts and stops current flow. When the circuit breaker cools, the contacts close again, completing the electrical circuit.

Electrical symbols used to represent circuit breakers.
The normal operation of a PTC circuit protector such as in a power window motor circuit showing the many conducting paths. With normal current flow, the temperature of the PTC circuit protector remains normal. When current exceeds the amperage rating of the PTC circuit protection, the polymer elements that make up the electronic circuit protector increases in resistance. As shown, a high-resistance electrical path will exist even though the motor will stop operating as a result of the very low current flow through the very high resistance. The circuit protector will not reset or cool down until voltage is removed from the circuit.

PTC circuit protectors are used extensively in the power distribution center of this Chrysler vehicle.

Fusible links are usually located close to the battery and are usually attached to a junction block. This is to ensure that they are only 6 to 9 inches long and therefore that one fuse feeds each fusible link.
FIGURE 27.13 A 250 ampere-rated mega fuse used to protect the circuit from the alternator.

FIGURE 27.14 Some terminals have seals attached to help seal the electrical connections.

FIGURE 27.15 Separate a connector by opening the lock and pulling the two apart.
FIGURE 27.16 The secondary locks help retain the terminals in the connector.

FIGURE 27.17 Use a small removal tool, sometimes called a pick, to release terminals from the connector.

FIGURE 27.18 Always use rosin-core solder for electrical or electronic soldering. Also, use small-diameter solder for small soldering irons. Use large-diameter solder only for large-diameter (large-gauge) wires and higher-wattage soldering iron guns.
FIGURE 27.19 A butane-powered soldering tool. The cap has a built-in striker to ignite a converter in the tip of the tool. This handy soldering tool produces the equivalent of 60 watts of heat. It operates for about 1/2 hour on one charge from a commonly available butane refill dispenser.

FIGURE 27.20 Notice that to create a good crimp, the open part of the terminal is placed in the jaws of the crimping tool toward the anvil or the W-shape part.

FIGURE 27.21 All hand-crimped splices or terminals should be soldered to be assured of a good electrical connection.
FIGURE 27.22 A butane torch especially designed for use on heat shrink applies heat without an open flame, which could cause damage.

FIGURE 27.23 A typical crimp-and-seal connector. This type of connector is first lightly crimped to retain the wire of the wire and then it is heated. The tubing shrinks around the wire splice, and thermoplastic glue melts on the inside to provide an effective, weather-resistant seal.

FIGURE 27.24 Heating the crimp-and-seal connector melts the glue and forms an effective, weather-resistant seal.
FIGURE 27.25 Conduit that has a paint strip is constructed of plastics that can withstand high-underhood temperatures.

FIGURE 27.26 (a) Blue conduit is used to cover circuits that carry up to 42 volts. (b) Yellow conduit can also be used to cover 42 volt wiring.

FIGURE 27.27 Always follow the vehicle manufacturer’s instructions which include the use of high-voltage, high-voltage gloves when working on circuits that are covered in orange conduit.