

WIRING DIAGRAMS

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WIRING DIAGRAMS DESCRIPTION

The main wiring diagrams are laid out so that the diagram corresponds in position to the actual wiring in the vehicle. Therefore, the headlight circuitry is located on the left side of diagram and then progressing to the right is the engine, instrument panel, cab and taillight circuitry.

After the main diagrams are systems diagrams. These supplemental diagrams simplify the circuit tracing for the technician.

Circuits can also be traced by following the circuit numbers.

BASIC ELECTRICAL

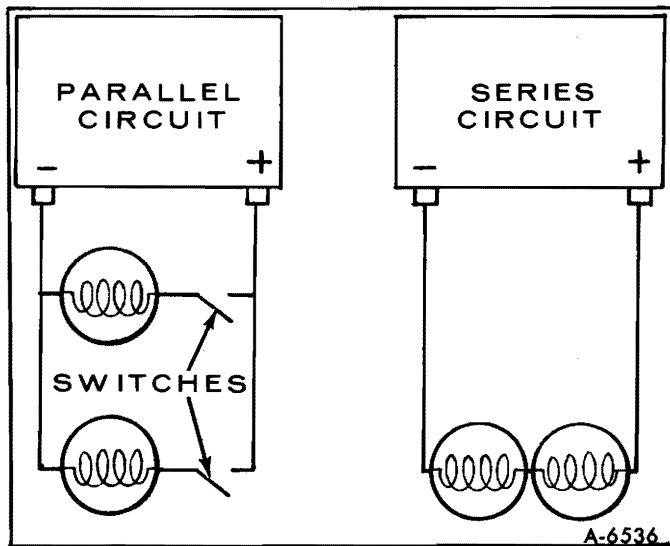


Figure 1—Basic Circuits

CIRCUITS

An electrical circuit starts from a supply of electricity, conducts the electricity back to the supply of electricity. There should be a device to open and close the circuit, and a protective device to open the circuit in case too much current flows in the circuit.

Electrical circuits can be set up as series circuits or parallel circuits. The circuits in trucks are usually parallel circuits.

SERIES CIRCUITS (Figure 1)

In series circuits, each electrical device is connected in the circuit so that the current can only go along one path as it flows from the power supply, around the circuit and back to the power supply.

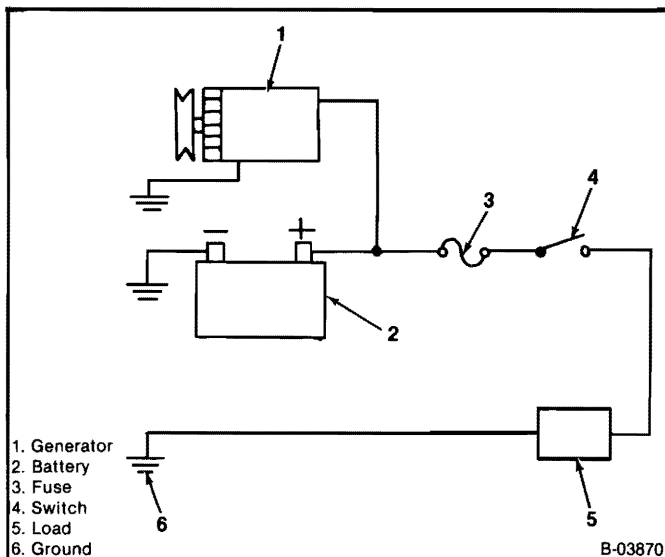


Figure 2—Circuit Components

PARALLEL CIRCUITS (Figure 1)

In parallel circuits, the electrical devices are connected by parallel wires that are joined at the start of the circuit. The current divides: part of it flows into one device, part into another.

With circuits in parallel, each circuit can be switched on and off by itself since each circuit receives electricity directly from the power supply.

CIRCUIT COMPONENTS (Figure 2)

The usual circuit path starts at the power supply which is the battery/generator system. Next in the circuit is the circuit protection component which can be a fusible link, a fuse, or a circuit breaker. Then the circuit goes to the circuit controller which can be a switch or a relay. From the circuit controller the circuit goes to the circuit load. The circuit load can be one light or many lights in parallel, an electric motor or a solenoid. After the electricity has passed through the load it must return to the power supply via the ground path. The ground path can be a wire in the harness or it could be through the load housing into the body or frame, thus returning the electricity to the power supply. The body and frame are connected by flexible ground straps.

FUSIBLE LINK

A fusible link is a section of wire that is usually four gage sizes smaller than the circuit it protects. A special insulation is used that swells when heated by the wire. Fusible links are usually found in the engine compartment harnesses. The function of the fusible link is to melt open when an overload occurs, thus preventing any damage to the circuit.

FUSES

The most common protector in the vehicle circuit is a fuse. A fuse consists of a fine wire or strip of metal, inside a glass tube or plastic housing. The strip melts and interrupts the flow of current in the circuit when there is an overload caused by an unwanted short or ground. The fuse is designed to melt before the wiring or electrical components in a circuit can be damaged. Naturally, the cause must be located and corrected before the fuse is replaced or the new fuse will also blow.

Since different circuits handle different amounts of current, fuses of various ratings are used. Fuses are rated in amperes. Be sure to replace a blown fuse with a fuse of the connecting rating.

CIRCUIT BREAKERS

Circuit breakers are another form of circuit protector. There are two types of circuit breakers; automatic reset and remote reset.

The automatic reset breaker opens when excess current heats a bimetallic strip, causing the strip to bend and open a set of contacts. Then the strip cools and

closes the contacts. So the circuit breaker opens and closes until the excess current condition is corrected or the circuit is disconnected from the power supply.

The remote reset circuit breaker has a heating wire wound around the bimetallic strip. When an excess current happens, the strip heats, bends, and opens the contacts. Then a small current flows through the heating wire, keeping the strip hot and the contacts open. This type of breaker will stay open until either the power supply is disconnected from the circuit or the breaker is removed from the circuit. Then the breaker can cool and reset.

CIRCUIT CONTROLLERS

Circuit controllers consist of switches or relays. Switches are usually operated by a mechanical means such as a hand or lever. Switches are usually at the beginning of a circuit but can be used to control a ground path. For example the light switch controlling the headlights is at the power end of the circuit while the door switch controlling the dome light completes the ground path.

Relays are remotely controlled switches. They are used in high current circuits and in circuits controlled by sensors.

Relays are designed so that a small current circuit will be able to control a large current circuit.

CIRCUIT LOADS

Circuit loads are the components that use most of the energy in the circuit. The energy converts to motion, light, or heat. Lights, motors, and engine heaters are the most common loads in the circuits.

WIRING HARNESS AND WIRES

Every wire is a specific size with colored or striped insulation that is indicated on the wiring diagrams. Insulation colors help to trace circuits and to make proper connections. Abbreviations and symbols used for indicating wire insulation colors and patterns are as follows:

BLK.:Black	ORGOrange
BRN.:Brown	PPLPurple
CH.:Check	TRTracer
CR:Cross	YELYellow
GRN:Green	//Parallel
NAT:Natural	WHTWhite
LT.:Light	BLUBlue
SGL:Single	STRStripe
ORN:Orange	PNKPink
GRA:Gray	DKDark

Some wires are grouped and taped together or encased in a split plastic casing. This grouping of wires is called a harness. For some purposes, it is more practical to use a single wire protected by a braided tubing called a loom.

Wiring harnesses are joined by using a multiple plug and receptacle connector block, or a terminal post chas-

sis junction block. In the instrument panel area plastic insulated blade-type connectors and screw-type terminals are used.

Each harness or wire must be held securely in place by clips or other holding devices to prevent chafing of the insulation.

WIRE SIZE

Wire size in a circuit is determined by the amount of current, the length of the circuit and the voltage drop allowed. Wire size is commonly specified using the American Wire Gage (AWG). This gage uses numbers that become smaller as the wire gets larger. Metric gage wire is being used more. The metric gage describes the wire size directly in cross section area measured in square millimeters.

WIRE SIZE CONVERSION TABLE

METRIC SIZE (mm) ²	AWG SIZE
0.22	24
0.5	20
0.8	18
1.0	16
2.0	14
3.0	12
5.0	10
8.0	8
13.0	6
19.0	4
32.0	2
40.0	1
50.0	0
62.0	00

CIRCUIT MALFUNCTIONS

There are three electrical conditions that can cause a nonworking circuit; and "Open Circuit," a "Short Circuit," and a "Ground Circuit."

OPEN CIRCUIT

An open circuit occurs whenever there is a break in the circuit. The break can be corrosion at a connector, a wire broken off in a device, or a wire that burned open from too much current.

SHORT CIRCUIT

A short circuit happens when the current bypasses part of the normal circuit. This bypassing is usually caused by wires touching, salt water in or on a device such as a switch or a connector or solder melting and bridging conductors in a device.

GROUNDING CIRCUIT

A grounded circuit is like a short circuit but the current flows directly into a ground circuit that is not part of the original circuit. This may be caused by a wire rubbing against the frame or body. Sometimes a wire will break and fall against metal that is connected electrically to the ground side of the power supply. A grounded circuit may also be caused by deposits of oil, dirt and moisture around connections or terminals, which provide a good path to ground.

CIRCUIT DIAGNOSIS

A clear understanding of the circuit and a wiring diagram are needed for effective diagnosis. Use a logical sequence of testing to find the trouble. Use the diagnostic tools. After the trouble is fixed, make sure the circuit works correctly.

DIAGNOSTIC TOOLS

UNPOWERED TEST LIGHT

This tool consists of a 12 volt light with leads. The ends of the leads usually have alligator clamps, but various kinds of probes, terminal spades, and special connectors are used also.

The unpowered test light is used on an open circuit. One lead of the test light is grounded and the other lead is moved around the circuit to find the open. Depending on the physical layout of the circuit, sometimes it will be easier to start at the power supply and other times it is easier to start at the circuit load or ground circuit.

POWER TEST LIGHT

This light is a pencil shaped unit with a self contained battery, a 1.5 volt light bulb, a sharp probe and a ground lead fitted with an alligator clip.

This test light is used mainly for testing components that are disconnected from the vehicle power supply. The power test light is also useful for testing suspected high resistance points in a circuit such as connectors and ground circuits that are corroded or loose.

JUMPER

The jumper is usually a long wire with alligator clamps. A version of the jumper has a fuse holder in it with a 10 Amp fuse. This will prevent damaging the circuit if the jumper is connected in the wrong way.

The jumper is used to locate opens in a circuit. One end of the jumper is attached to a power source and then the other end is attached to the load in the circuit, i.e.; light, motor. If the load works, try "jumping" to circuit points that are progressively closer to the power supply. When the circuit load stops working, the open has been located.

The jumper is also used to test components in the circuit such as connectors, switches, and suspected high resistance points.

NOTICE: The following instruments: Ammeter, Voltmeter, and Ohmmeter, each have a particular application for trouble shooting electrical circuits.

When using an ammeter or voltmeter, and the valve being tested is unknown always use the highest scale first and work downward to a mid-scale reading whenever possible. This will avoid damage to the instrument.

Never use an ohmmeter in a power circuit, or as a substitute for a voltmeter or ammeter as damage to the instrument will result.

AMMETER

Disconnect the circuit from the power source before connecting the ammeter. The ammeter measures the amount of electrical current, amperes, moving through a conductor. The ammeter must be placed in series with the circuit being tested. Be sure that the ammeter's positive terminal is connected to the positive (battery) side of the circuit and its negative terminal to the negative (ground) side of the circuit (figure 3).

OHMMETER

The ohmmeter is an instrument designed to indicate resistance in ohms. It is used to test the condition of a unit disconnected from the circuit (figure 3).

Ohmmeter Calibration

When the ohmmeter probes are connected together, a circuit is completed causing the meter needle to deflect. The needle should read ZERO ohms, if it does not, rotate the CAL or ADJ knob to ZERO the needle.

When the probes are held apart, the needle moves to the maximum (infinite) resistance side of the scale.

The meter is now ready for use. Refer to figure 3 for a typical application of the ohmmeter.

VOLTMETER

The voltmeter (properly observed) will give the technician more information than the ammeter, ohmmeter and test light combined. Its application for troubleshooting here is to measure the electrical pressure (voltage) drop in a resistance circuit.

To use a voltmeter for troubleshooting an electrical problem, connect it in parallel with the existing circuit (figure 3). If the voltmeter is connected in series with the circuit being tested, the nature of the circuit would be changed and the reading would have no particular value or use. Connect the meter terminals according to polarity as shown in figure 3.

The dash mounted voltmeter (in the vehicle) should also be observed for monitoring proper operation of the generator battery cranking motor, and cranking circuit.

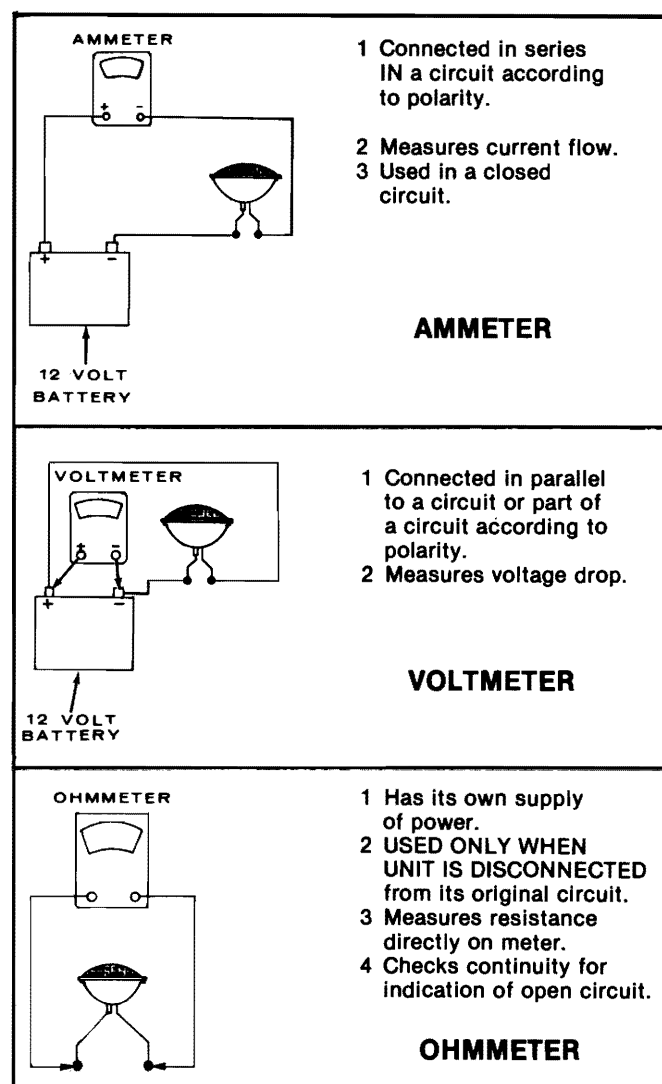


Figure 3—Basic Meters and Connections

In this application, battery voltage drop can be monitored while the engine is cranking; and after the engine is running, generator output voltage can be monitored. This can be a valuable first step prior to diagnosing other electrical problems.

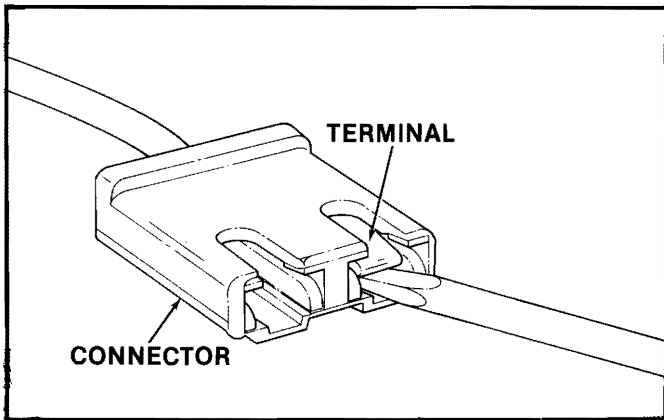


Figure 4—Removing Terminals from Connector

CIRCUIT MAINTENANCE AND REPAIR

MAINTENANCE AND REPAIR

All electrical connections must be kept clean and tight. Loose or corroded connections may cause a discharge battery, difficult starting, dim lights, and possible damage to the generator and regulator. Wires must be replaced if insulation becomes burned, cracked, or deteriorated.

To splice a wire or repair one that is frayed or broken, always use rosin flux solder to bond the splice and insulating tape to cover all splices or bare wires.

When replacing wires, it is important that the correct size wire be used as shown on applicable wiring diagrams or parts book. Each harness or wire must be held securely in place to prevent chafing or damage to the insulation due to vibration.

Never replace a wire with one of a smaller size or replace a fusible link with a wire of a larger size.

WIRING CONNECTOR

TERMINAL REPLACEMENT (Figures 4, 5, 6, and 7)

Either blade-type or twin lock-type connectors are

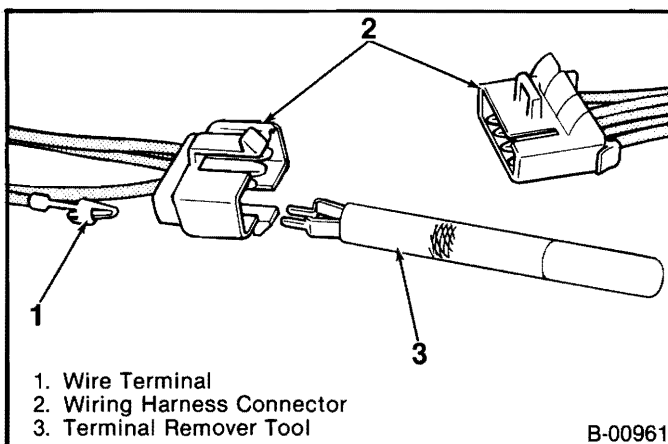


Figure 5—Replacing Twin Lock Connector Terminal

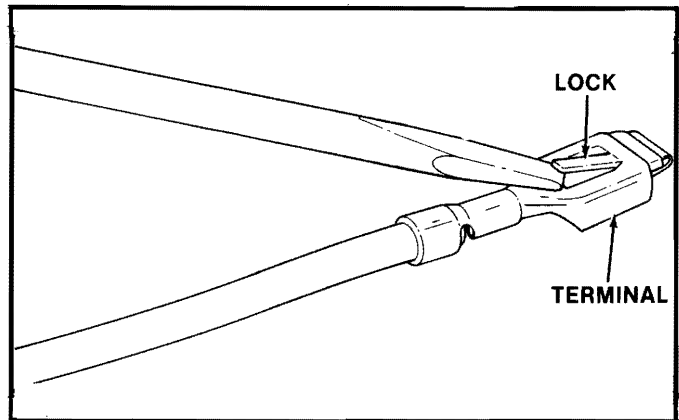


Figure 6—Resetting Lock Tang

used in the wiring harness connectors or in single or multiple wiring connectors.

Mating ends of the blade-type and twin lock-type connectors are secured by tang locks which must be disengaged to separate the connector.

Some connectors are positive locking, self-rejecting type which are located in various places throughout the vehicle.

The self-stripping connector consists of a plastic insulator with a hinge cover through which the wires are inserted. A U-type spring pressure connector is then pressed through the wire insulation to complete the connection.

Terminal Removal

1. In removing the blade type terminal from the connector, disengage the connector lock tangs and separate. Insert a thin bladed instrument under the mating end of the connector terminal and pry on the terminal as shown in figure 4. Be careful not to damage the connector. Pull the wire and terminal from the connector.

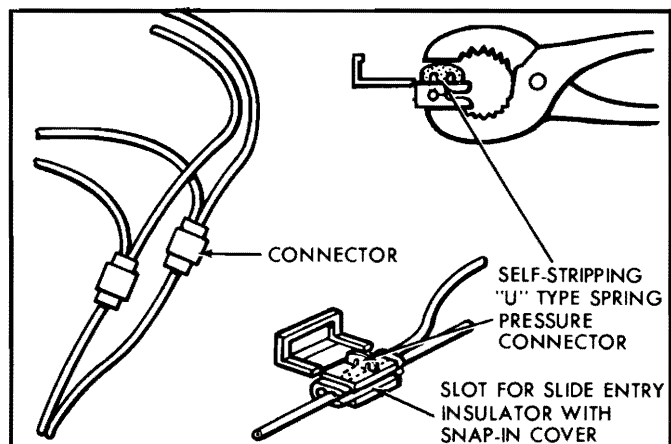


Figure 7—Self-Stripping Connector Installation

2. To remove a twin lock-type terminal from connector, disengage the lock tangs and separate connector. Terminal Remover J-22727 or equivalent as shown in figure 5, to disengage terminal locks from the connector. Pull the wire and terminal from the cable connector.

Terminal Installation (Blade Type)

1. If blade type terminals are reused, pry out the lock tang on the terminal clip to assure a firm connection when the terminals are inserted (figure 6).
2. Push the terminal into the connector until the lock tangs are seated.
3. Check tang retention by gently pulling on the connector wire.

Weather-Pack Connectors

Special connectors known as Weather-Pack connectors (figure 8) require a special tool J-28742 for servicing. This special tool is required to remove the pin and sleeve terminals. If removal is attempted with an ordinary pick, there is a good chance that the terminal will be bent or deformed. Unlike standard blade-type terminals, these terminals cannot be straightened once they are bent.

Make sure that the connectors are properly seated and all of the sealing rings in place when connecting the leads. The hinge-type flap provides a backup, or secondary locking feature for the terminals. They are used to improve the connector reliability by retaining the terminals if the small terminal lock tangs are not positioned properly.

Molded-on-connectors require complete replacement of the connection. This means splicing a new connector assembly into the harness. Environmental connections cannot be replaced with standard connections. Instructions are provided with the Weather-Pack connector and terminal packages.

With the low current and voltage levels found in some circuits, it is important that the best possible bond at all wire splices be made by soldering the splices as shown in (figure 9).

Use care when probing the connections or replacing terminals in them, it is possible to short between opposite terminals. If this happens to the wrong terminal pair, it is possible that damage may be done to certain components. Always use jumper wires between connectors for circuit checking. Never probe through the Weather-Pack seals.

When diagnosing for possible open circuits, it is often difficult to locate them by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may correct the open circuit condition. This should always be considered when an open circuit is indicated while troubleshooting. Intermittent problems may also be caused by oxidized or loose connections.

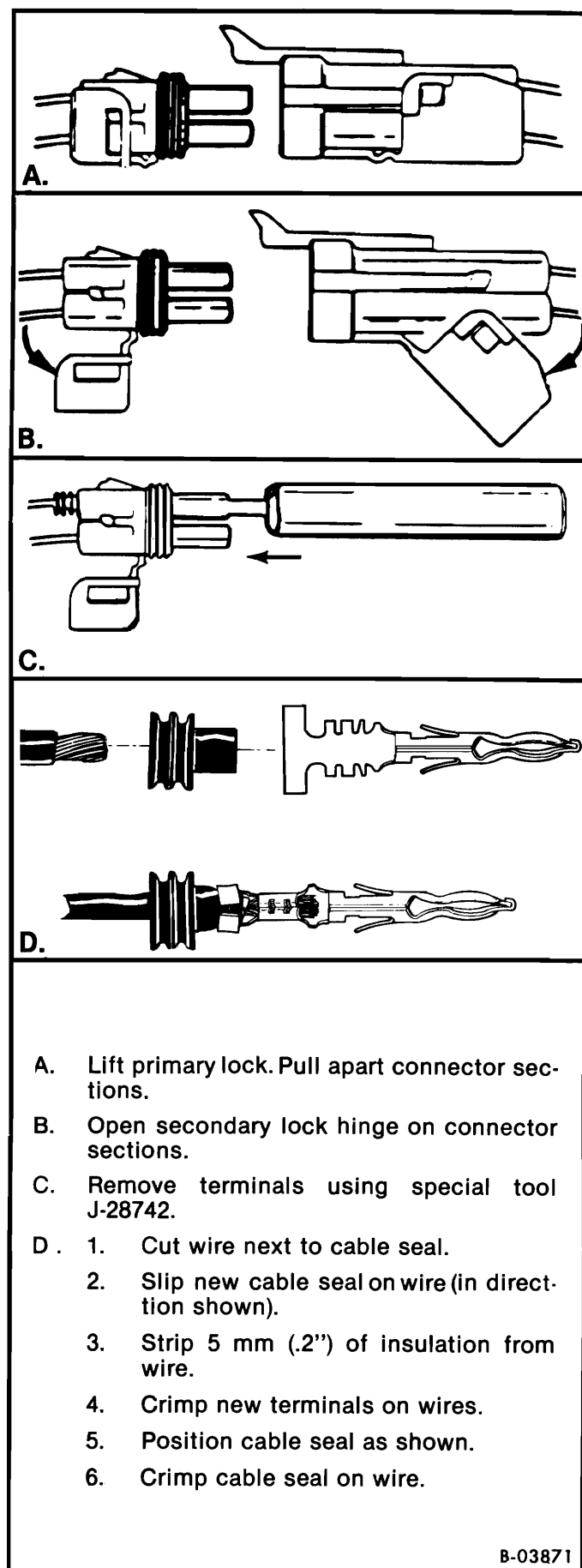
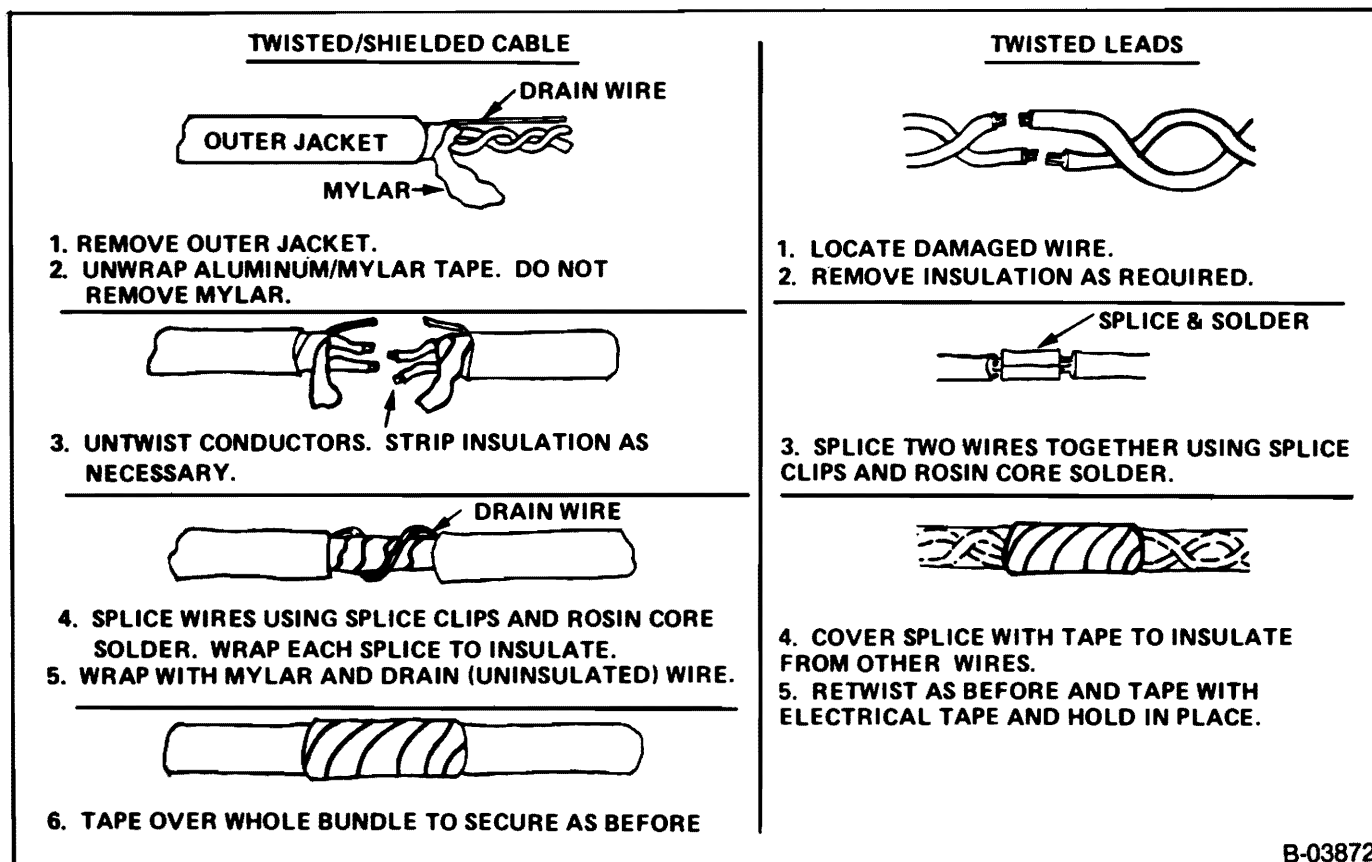


Figure 8—Weather-Pack Terminals



B-03872

Figure 9—Wiring Repair

