NISSAN MOTOR CORPORATION IN U.S.A.
Post Office Box 191
Gardena, California 90248-0191
Telephone: (310) 532-3111

SERVICE BULLETIN

Classification:	Section:	Models:
EL93-027	Electrical System	All Models
Reference:		Date:
TECHNICAL BULLETIN NTB93-148		October 15, 1993

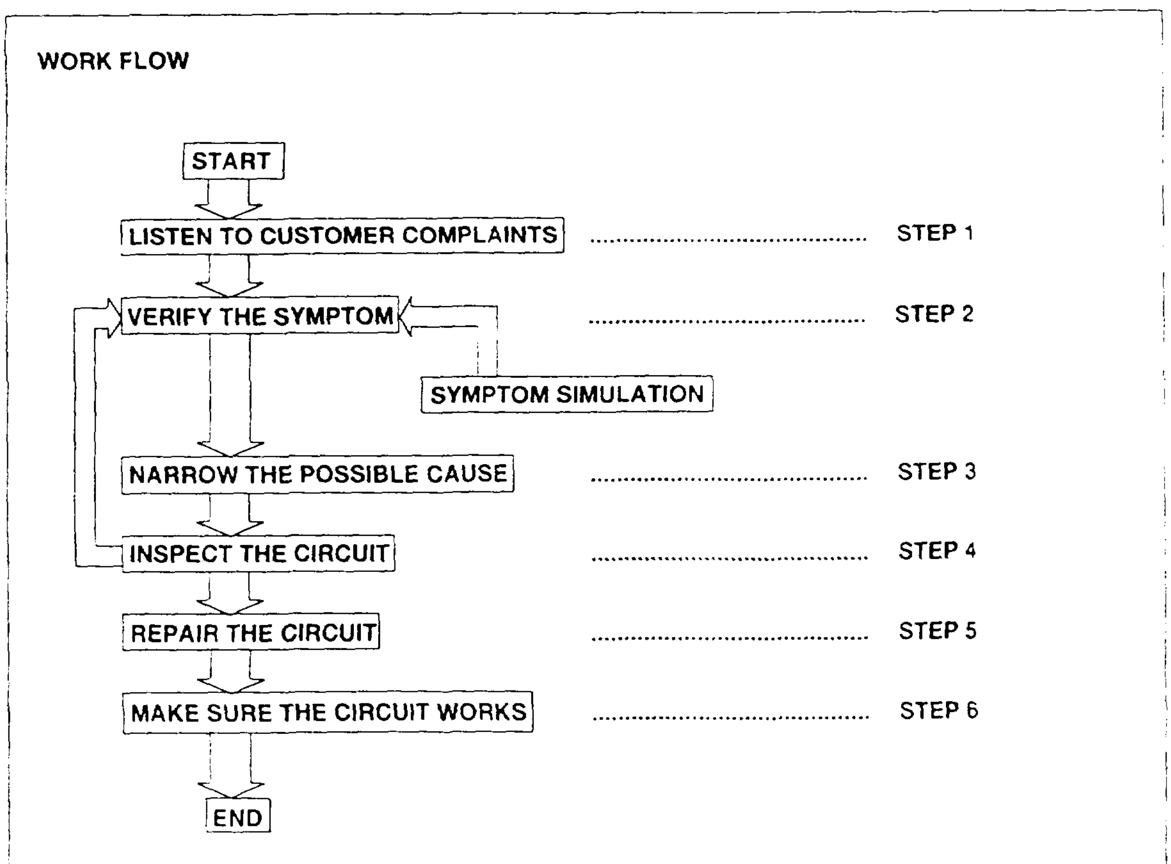
ELECTRICAL SYSTEM DIAGNOSIS

GENERAL INSPECTION PROCEDURE

In general, electrical systems are considered to be complex systems requiring a high level of technical knowledge. However, if you have a basic understanding of electrical systems and you understand their operation, you can approach a proper diagnosis and repair.

This is the first in a series of technical bulletins geared toward the diagnosis and repair of vehicle electrical systems.

How to Perform Trouble Diagnoses for Quick and Accurate Repair



TROUBLE DIAGNOSIS STEPS

The following chart shows the steps required to properly identify an electrical incident.
It is important to follow each step thoroughly.

STEP 1 Listening To The Customer.

Listening to the customer and documenting the conditions which exist when the problem occurs is critical to properly diagnosing an electrical incident.
You will need to understand the symptoms which caused the incident, to properly diagnose and/or to try to simulate the condition in the dealership.
It may also be important to determine if the car has had any accessories recently installed or if any service work (collision repair, etc.) has been recently performed.

STEP 2 Verify the parameters of the incident.

Whenever possible, you should operate the complete system to verify the customers comments.
Try to confirm the symptom(s) and under what conditions the incident occurs.

STEP 3 Get the proper diagnosis materials together.

Before beginning the diagnosis, make sure you have all of the necessary information.
Along with these Fix Tips you should have the Power Supply Routing information in the EL section of the appropriate service manual.
You should make sure you have a thorough understanding of how the system operates.
Based upon the customers comments and your knowledge of the circuit operation, you should be able to identify which component(s) could cause the incident.

STEP 4 Inspect the system.

Inspect the system to find the cause of the symptom.
Start the diagnosis by determining the location of the electrical units involved.
Inspect each component to verify that it is mechanically free to operate and that all connectors and harnesses are securely connected and properly routed.
Systematically check the circuits involved, using the Harness Layouts and Power Supply Routing in the service manual.
Determine which circuit is the cause of the incident and whether it is a wiring problem or a component problem.

STEP 5 Repair or replace.

Repair or replace the incident component or electrical circuit.

STEP 6 Verify the system works properly under all conditions.

Once you have repaired the circuit or replaced a component you need to operate the system in all modes and particularly under the circumstances which resulted in the customers initial complaint.

TROUBLE DIAGNOSIS STEPS (Cont'd)

STEP	DESCRIPTION
STEP 1	Get detailed information about the conditions and the environment when the incident occurred. The following are key pieces of information required to make a good analysis: **WHAT** Vehicle Model, Engine, Transmission and the System (i.e. Radio). **WHEN** Date, Time of Day, Weather Conditions, Frequency. **WHERE** Road Conditions, Altitude and Traffic Situation. **HOW** System Symptoms, Operating Conditions (Other Components Interaction). Service History and if any After Market Accessories have been installed.
STEP 2	Operate the system, road test if necessary. Verify the parameter of the incident. If the problem can not be duplicated refer to the Incident Simulation Tests below.
STEP 3	Get the proper diagnosis materials together including: Fix Tips POWER SUPPLY ROUTING System Operation Descriptions Applicable Service Manual Sections Identify where to begin diagnosis based upon your knowledge of the system operation and the customers comments.
STEP 4	Inspect the system for mechanical binding, loose connectors or wiring damage. Determine which circuits and components are involved and diagnose using the Power Supply Routing and Harness Layouts.
STEP 5	Repair or replace the incident circuit or component.
STEP 6	Operate the system in all modes. Verify the system works properly under all conditions. Make sure you have not inadvertently created a new incident during your diagnosis or repair steps.

INCIDENT SIMULATION TESTS

If the symptom is not present when the vehicle is brought in for service, it may be necessary for you to simulate the conditions and environment under which the incident occurred. Proceeding with a diagnosis when the vehicle is not displaying the symptom may lead the technician to a No Trouble Found Diagnosis. The following section illustrates ways to simulate the conditions/environments under which the owner experiences an electrical incident.

The section is broken into one of the six following topics:

1. Vehicle Vibration
2. Heat Sensitive
3. Freezing
4. Water Intrusion
5. Electrical Load
6. Cold or Hot Start Up

To properly simulate the condition under which the owner experiences the problem, it is important that you get a thorough description of the incident from the customer.

1. Vehicle Vibration

If the owner indicates the problem occurs or becomes worse while driving on a rough road or during periods when the engine is vibrating (idle with A/C on), you will want to check for a vibration related condition. Refer to the illustration below.

Connectors & Harness

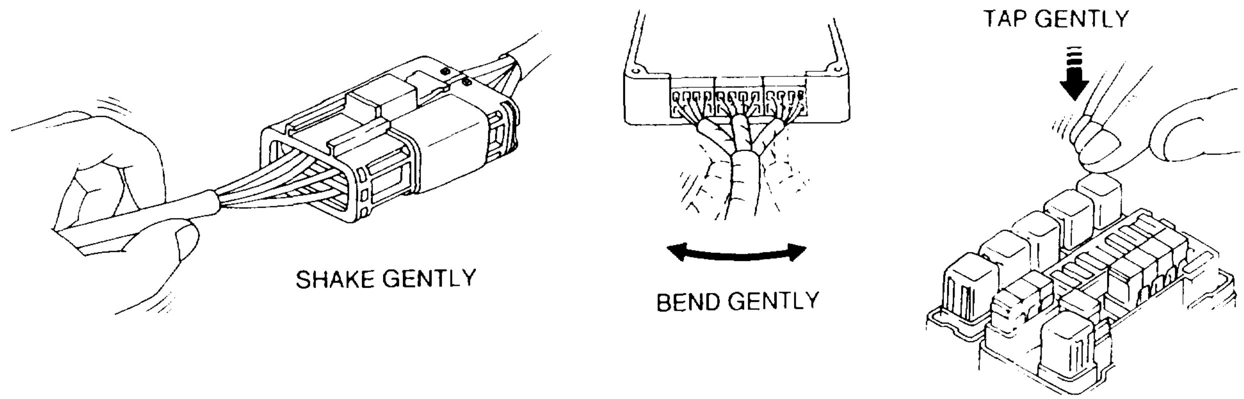
Determine which connectors and wiring harness would affect the electrical system you are inspecting. **Gently** shake each connector and harness while monitoring the system for the incident you are trying to duplicate. This test may indicate a loose or poor electrical connection.

HINT
Connectors can be exposed to moisture. It is possible to get a thin film of corrosion on the connector terminals. A visual inspection may not reveal this without disconnecting the connector. On intermittent incidents it is a good idea to disconnect, inspect and clean the terminals on related connectors in the system.

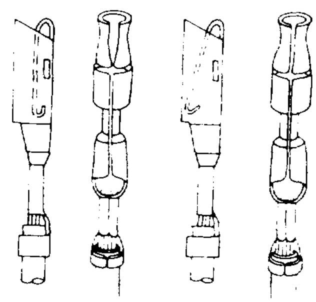
Sensors & Relays

Gently apply a slight vibration to sensors and relays in the system your inspecting.
This test may indicate a loose or poorly mounted sensor or relay.

VIBRATION TEST

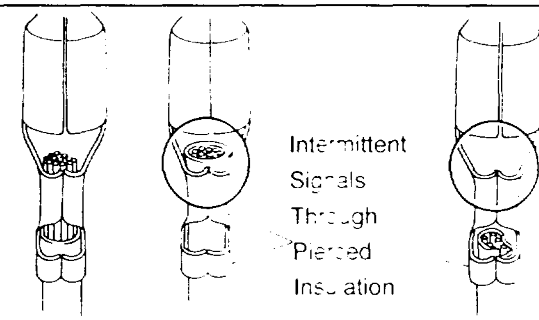


POSSIBLE CAUSE

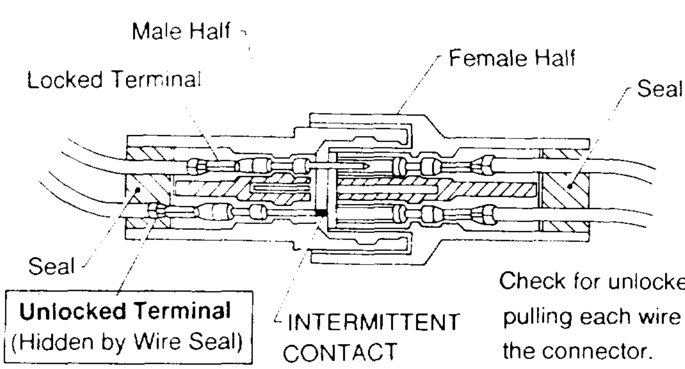


Any probe entering the terminal may enlarge the contact spring opening creating an intermittent signal.

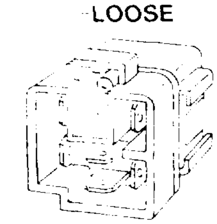
DEFORMED (ENLARGED) FEMALE TERMINALS



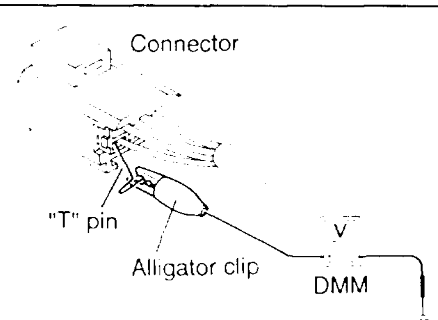
INCORRECT INSULATION STRIPPING



Check for unlocked terminals by pulling each wire at the end of the connector.



TERMINAL NOT PROPERLY SEATED

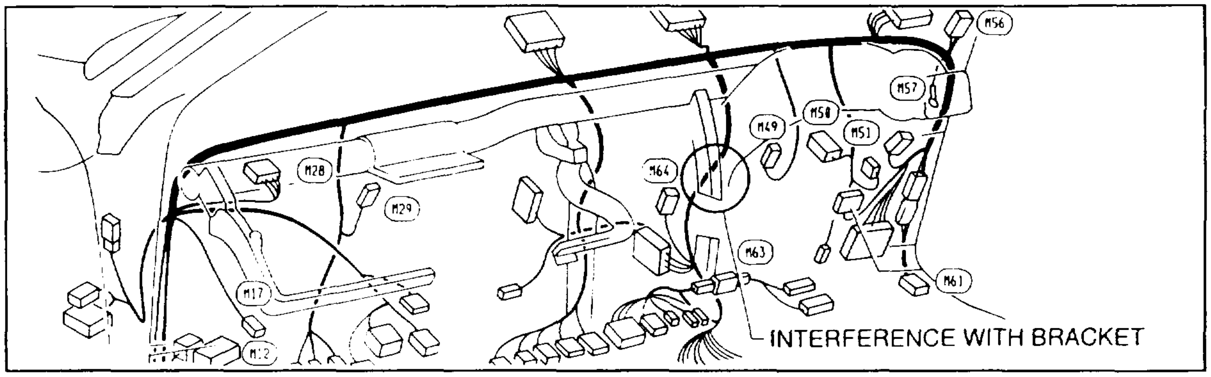


When probing a connector it is possible to enlarge the contact spring opening. Refer to figure. If this occurs it may create an intermittent signal in the circuit. When probing a connector, use care not to enlarge the opening. If the probe of the Digital Multimeter (DMM) you are using will not fit into the connector cavity, you can back probe the connector with a "T" pin to create an extension. Most DMM's have accessory alligator clips which slide over the probe to allow clipping the "T" pin for a better contact. Refer to figure. If you have any difficulty probing a terminal, inspect the terminal to ensure you have not accidentally opened the contact spring or pulled a wire loose.

INCIDENT SIMULATION TESTS (Cont'd)

Behind The Instrument Panel

Improperly routed or improperly clamped harness can become pinched during accessory installation. Vehicle vibration can aggravate a harness which is routed along a bracket or near a screw behind or below the dash.

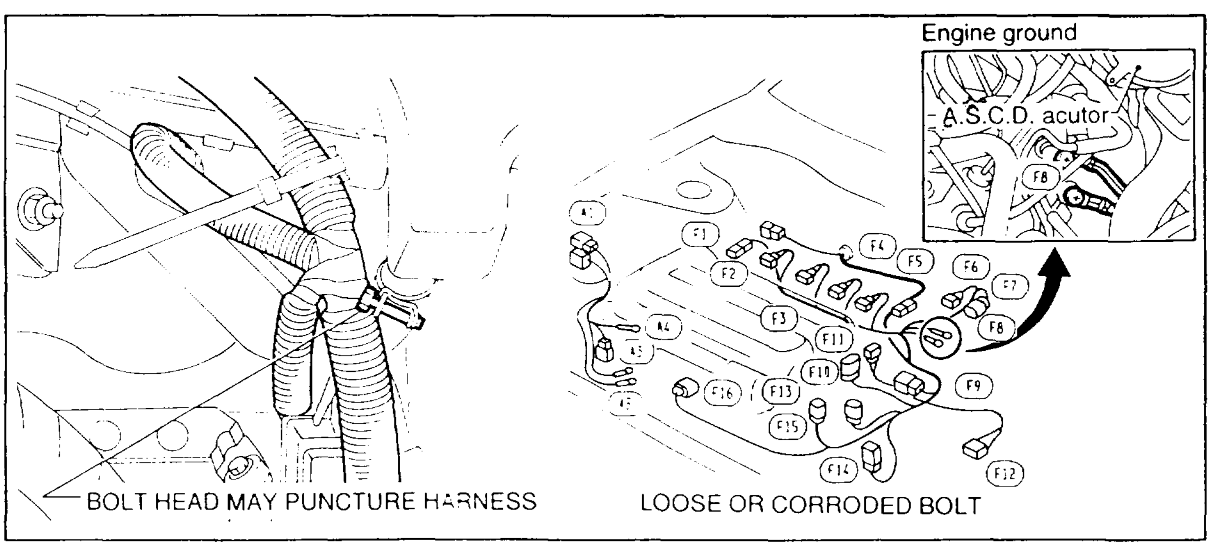


Engine Compartment

There are several reasons a vehicle or engine vibration could cause an electrical complaint. Some of the things to check for are:

A. Connectors which are inaccessible for diagnosis probing.
B. Connectors which may not fully be seated.
C. Wiring harness which are not long enough and are being stressed during engine vibrations or rocking.
D. Wires laying across brackets or moving components.
E. Loose dirty or corroded ground wires.
F. Wires routed too close to hot components.

To inspect components underhood, start by verifying the integrity of ground connections. (Refer to the GROUND INSPECTION described later.) Once you have assured the system is properly grounded check for loose connections by **gently shaking** the wiring or component as previously explained. Using the wiring diagrams in the service manual, inspect the wiring for continuity.



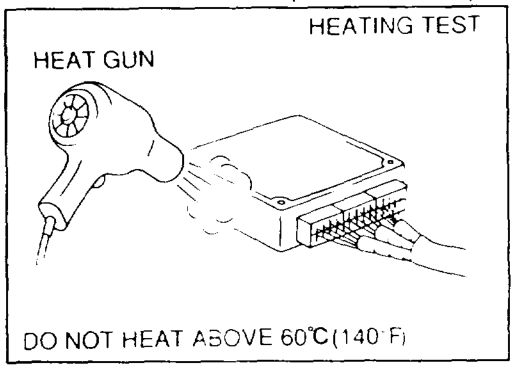
INCIDENT SIMULATION TESTS (Cont'd)

Under Seating Area's

If a harness is not clamped properly or has too much slack, vehicle vibration could cause the wiring to become pinched by seat components such as slide guides. If the wiring runs under seating areas inspect wiring routing for possible damage or pinching.

2. Heat Sensitive

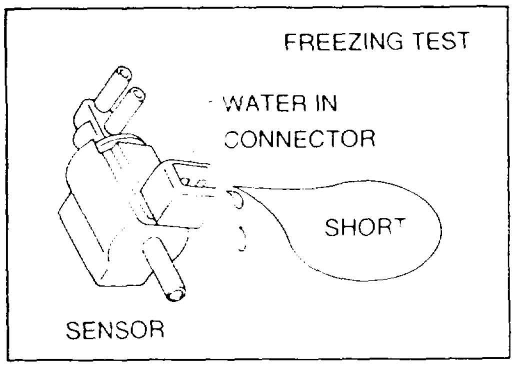
If owner indicates the problem occurs during hot weather or after the car has sat for a short period of time, you will want to check for a heat sensitive condition.



To determine if an electrical component is heat sensitive, heat the component with a heat gun or equivalent.
Do not heat components above 60 degrees Celsius (140 Fahrenheit). If the incident occurs while heating the unit you will need to replace the component or make sure it is properly insulated from the heat source.

3. Freezing

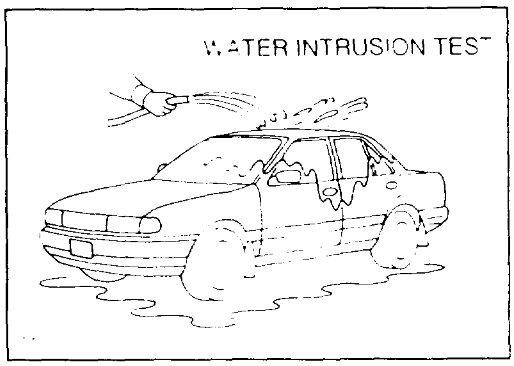
If the customer indicates the incident goes away after the car warms up (winter time) the cause could be related to water freezing somewhere in the wiring/electrical system.



There are two methods to check for this. The first is to arrange for the owner to leave his car over night. Make sure it will get cold enough to demonstrate his complaint. Leave the car parked outside overnight. In the morning, be prepared to do a quick and thorough diagnosis of those electrical components which could be affected.

The second method to diagnose for a freezing component is to put the suspect component into a freezer long enough for any water to freeze. If reinstalling the part into the car results in the incident reoccurring you will need to repair or replace that component.

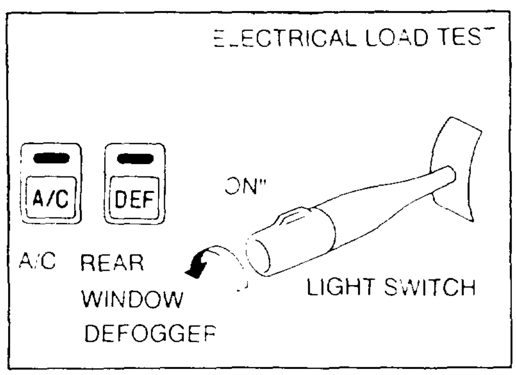
4. Water Intrusion



If the incident only occurs during high humidity or rainy/snowy periods, it could be caused by water intrusion on an electrical part. This can be simulated by soaking the car or running it through a car wash.
Do not spray water directly on any electrical components.

5. Electrical Load

If the incident appears to be electrical load sensitive, perform diagnosis while all accessories are turned on including, A/C, rear defog, radio, fog lamps, etc.



6. Cold or Hot Start Up

On some occasions an electrical incident may only occur when the car is started cold or when the car is restarted (hot) shortly after being turned off. In these cases you may have to keep the car overnight to make a proper diagnosis.

TESTING CIRCUITS

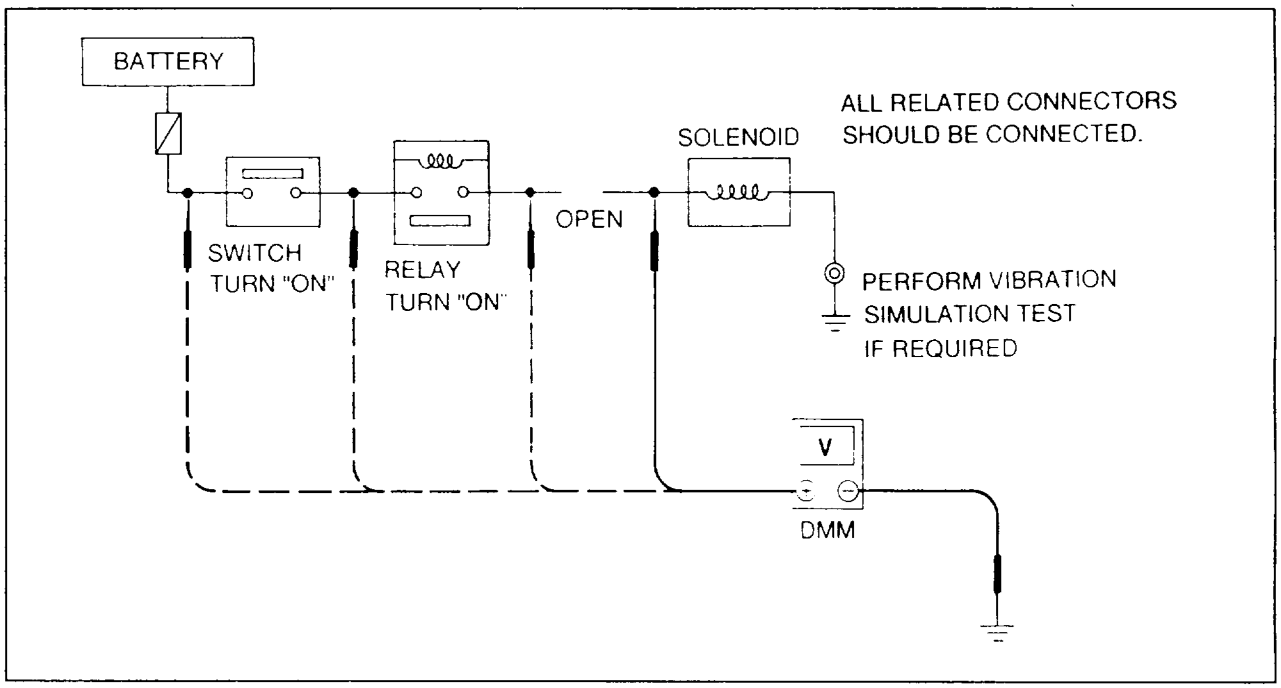
In general testing electrical circuits is an easy task if it is approached in a logical and organized method. Before beginning it is important that you have all available information related to the system you are going to test. You should also have a thorough understanding of how the system operates so that you use the appropriate test procedure and equipment.

While testing electrical components, if the incident is reported as intermittent, it may be necessary to gently shake the wiring harness or electrical component to simulate vehicle vibrations.

DIAGNOSTIC TOOLS AND EQUIPMENT

A Digital Multimeter DMM (10 megaohm input impedance) can safely be used to diagnose and test most vehicle systems.

Test lights are not recommended due to the possibility of inadvertently tapping into a computer or air bag circuit and causing damage.



Before attempting to diagnose a circuit for an open or a short, it is important that you:

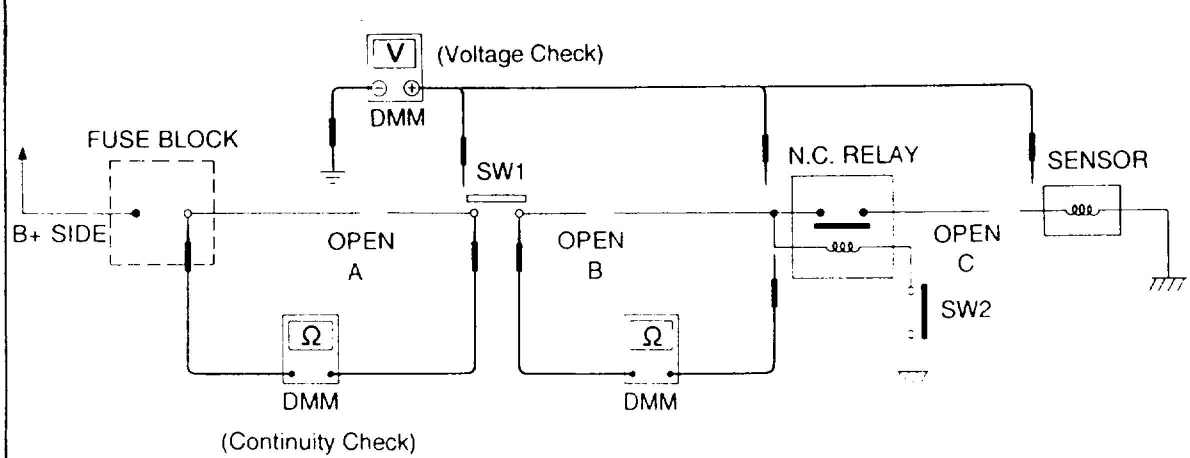
1. Have the proper reference material available.
   - Power Supply Routings
   - Applicable Service Manual sections
   - Fix Tips
2. Understand how the system works.
3. Have a good understanding of what condition you are diagnosing
   - Situation when the problem occurs (weather, loads, etc.)
   - What systems interact with the one you are diagnosing
   - Is it intermittent or a consistent problem
4. Have proper equipment to perform the diagnosis such as a digital voltmeter, alligator clips, and probe leads.

TESTING CIRCUITS (Cont'd)

TESTING FOR OPENS IN THE CIRCUIT

Before you begin to diagnose and test the system, you should rough sketch a schematic of the system. This will help you to logically walk through the diagnosis process. Drawing the sketch will also reinforce your working knowledge of the system. Refer to the attached drawing for sample schematics.

INSPECTION FOR OPENS



Continuity Check Method

The continuity check is used to find an open in the circuit. The Digital Multimeter (DMM) set on the resistance function will indicate an open circuit as over limit (OL, no beep tone or no ohms symbol). Make sure to always start with the DMM at the highest resistance level.

To help in understanding the diagnosis of open circuits please refer to the attached diagram.

1. Disconnect the battery negative cable.
2. Start at one end of the circuit and work your way to the other end. (At the fuse block in this example)
3. Connect 1 probe of the DMM to the fuse block terminal on the load side.
4. Connect the other probe to the fuse block (power) side of sw1. Little or no resistance will indicate that portion of the circuit has good continuity. If there were an open in the circuit, the DMM would indicate an over limit or infinite resistance condition. (point A)
5. Connect the probes between sw1 and the relay. Little or no resistance will indicate that portion of the circuit has good continuity. If there were an open in the circuit, the DMM would indicate an over limit or infinite resistance condition. (point B)
6. Connect the probes between the relay and the sensor. Little or no resistance will indicate that portion of the circuit has good continuity. If there were an open in the circuit, tne DMM would indicate an over limit or infinite resistance condition. (point C)

Any circuit can be diagnosed using the approach in the above example.

TESTING CIRCUITS (Cont'd)

Voltage Check Method

To help in understanding the diagnosis of open circuits please refer to the previous diagram.

In any powered circuit, an open can be found by methodically checking the system for the presence of voltage. This is done by switching the DMM to the voltage function.

1. Connect one probe of the DMM to a known good ground.
2. Begin probing at one end of the circuit and work your way to the other end.

3. With sw1 open, probe at sw1 to check for voltage.

voltage; open is further down the circuit than sw1.
no voltage; open is between fuse block and sw1 (point A).

4. Close sw1 and probe at relay.

voltage; open is further down the circuit than the relay.
no voltage; open is between sw1 and relay (point B).

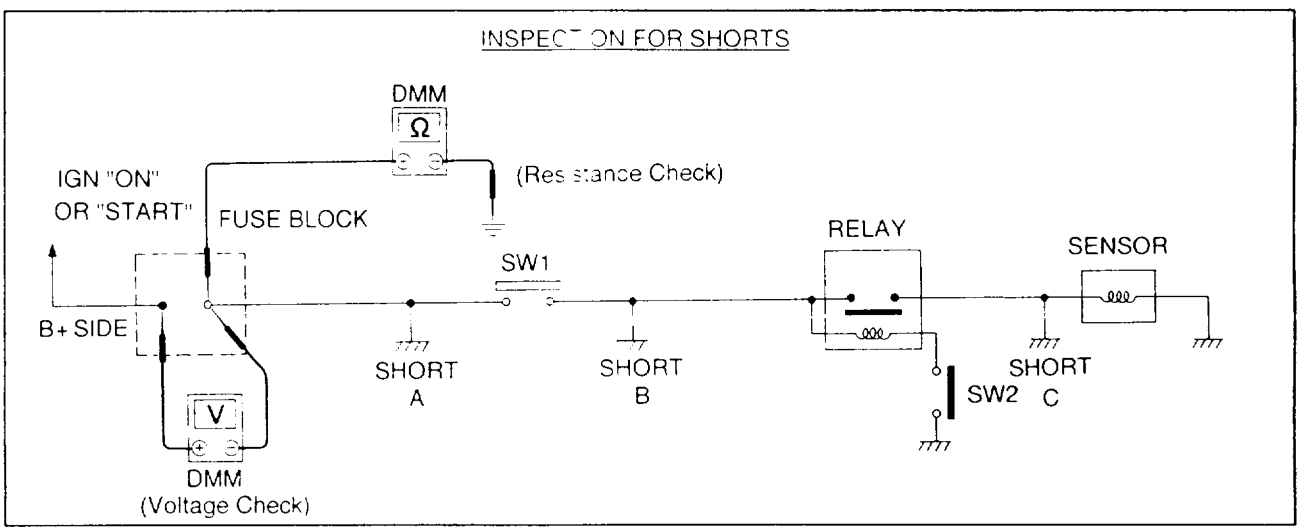
5. Close the relay and probe at the sensor.

voltage; open is further down the circuit than the sensor.
no voltage; open is between relay and sensor (point C).

Any powered circuit can be diagnosed using the approach in the above example.

TESTING FOR SHORTS IN THE CIRCUIT

To simplify the discussion of shorts in the system please refer to the schematic.



Resistance Check method

1. Disconnect the battery negative cable and remove the blown fuse.

2. Disconnect all loads (sw1 open, relay disconnected and sensor disconnected) powered through the fuse.

3. Connect one probe of the ohm meter to the load side of the fuse terminal and the other probe to a known good ground.

4. With sw1 open, check for continuity.

continuity; short is between fuse terminal and sw1 (point A).
no continuity; short is further down the circuit than sw1.

TESTING CIRCUITS (Cont'd)

5. With sw1 closed, relay disconnected and probes at the load side of fuse terminal and ground check for continuity.

   continuity; short is between sw1 and the relay (point B).
   no continuity; short is further down the circuit than the relay.

6. With sw1 closed, relay contacts jumped with jumper wire and probes at the load side of fuse terminal and ground check for continuity.

   continuity; short is between relay and sensor (point C).
   no continuity; check sensor, retrace steps.

Voltage Check Method

1. Remove the blown fuse and disconnect all loads (i.e. sw1 open, relay disconnected and sensor disconnected) powered through the fuse.

2. Turn the ignition key to the ON or START position and verify battery voltage at the B+side of the fuse terminal (one lead on the B+terminal side of the fuse block and one lead on a known good ground).

3. With sw1 open and the DMM leads across both fuse terminals, check for voltage.

   voltage; short is between fuse block and sw1 (point A).
   no voltage; short is further down the circuit than sw1.

4. With sw1 closed, relay and sensor disconnected and the DMM leads across both fuse terminals, check for voltage.

   voltage; short is between sw1 and the relay (point B).
   no voltage; short is further down the circuit than the relay.

5. With sw1 closed, relay contacts jumped with fused jumper wire check for voltage.

   voltage; short is down the circuit of the relay or between the relay and the disconnected sensor (point C).
   no voltage; retrace steps and check power to fuse block.

GROUND INSPECTION

Ground connections are very important to the proper operation of electrical and electronic circuits. Ground connections are often exposed to moisture, dirt and other corrosive elements. The corrosion (rust) can become an unwanted resistance. This resistance can change the way a circuit operates.

Electronically controlled circuits are very sensitive to proper grounding. A loose or corroded ground can drastically alter an electronically controlled circuit. These circuits generally operate in the 5 volt range. The components in these circuits can be seriously affected by a voltage change as low as one tenth (0.1V) of a volt.
A poor or corroded ground can easily affect the circuit by that amount. Even when the ground connection looks clean, there can be a thin film of rust on the surface.
When inspecting a ground connection follow these rules:

1. Remove the ground bolt screw or clip.
2. Inspect all mating surfaces for tarnish, dirt, rust, etc.
3. Clean as required to assure good contact.
4. Reinstall bolt or screw securely.
5. Inspect for "add-on" accessories which may be interfering with the ground circuit.
6. If several wires are crimped into one ground eyelet terminal, check for proper crimps. Make sure all of the wires are clean, securely fastened and providing a good ground path. If multiple wires are cased in one eyelet make sure one or more of the ground wires does not have excess wire insulation.

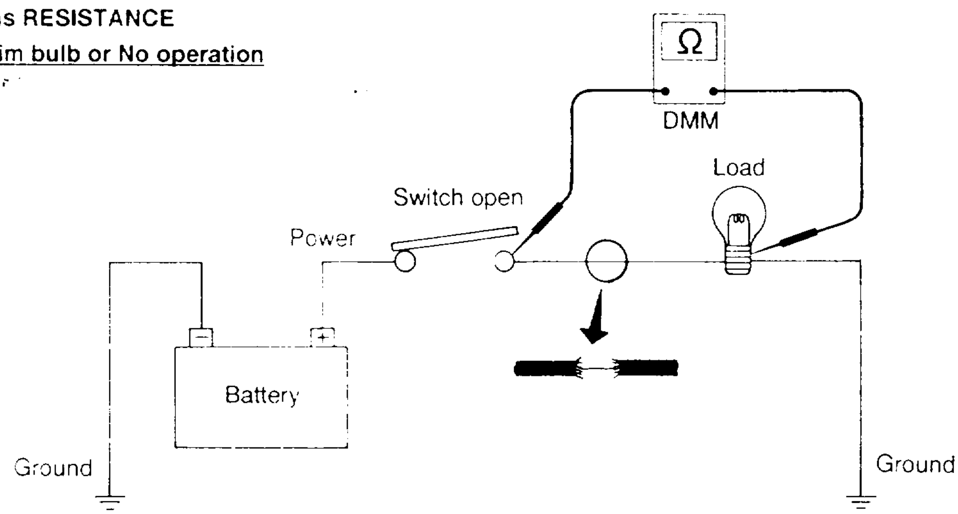
VOLTAGE DROP TESTS

Voltage Drop Tests are often used to find components or circuits which have excessive resistance. A voltage drop in a circuit is caused by a resistance when the circuit is in operation.
Part of the available voltage is used by the resistance. When there is excessive resistance less voltage is available for other loads (lights, motors, etc.) in the circuit. Since each resistance in a circuit uses voltage, a voltmeter can be used to isolate problems.

A voltage drop across closed contacts can indicate excessive resistance. This can cause the circuit to operate incorrectly. Remember a switch is not a load. During diagnosis, use a voltmeter to measure the voltage drop across each switch contact while the circuit is in operation.

Check the wire in the illustration. If an ohmmeter is used to measure resistance (circuit off), the single strand of wire still making contact would give a reading of 0 ohms. This would indicate a good circuit. When the circuit operates, this single strand of wire is not able to carry the current. The single strand will have a high resistance to the current. Using the voltmeter this will be picked up as a slight voltage drop.

0 (zero) Ohms RESISTANCE
Symptom: Dim bulb or No operation



Unwanted high resistance can be caused by many factors as illustrated below:

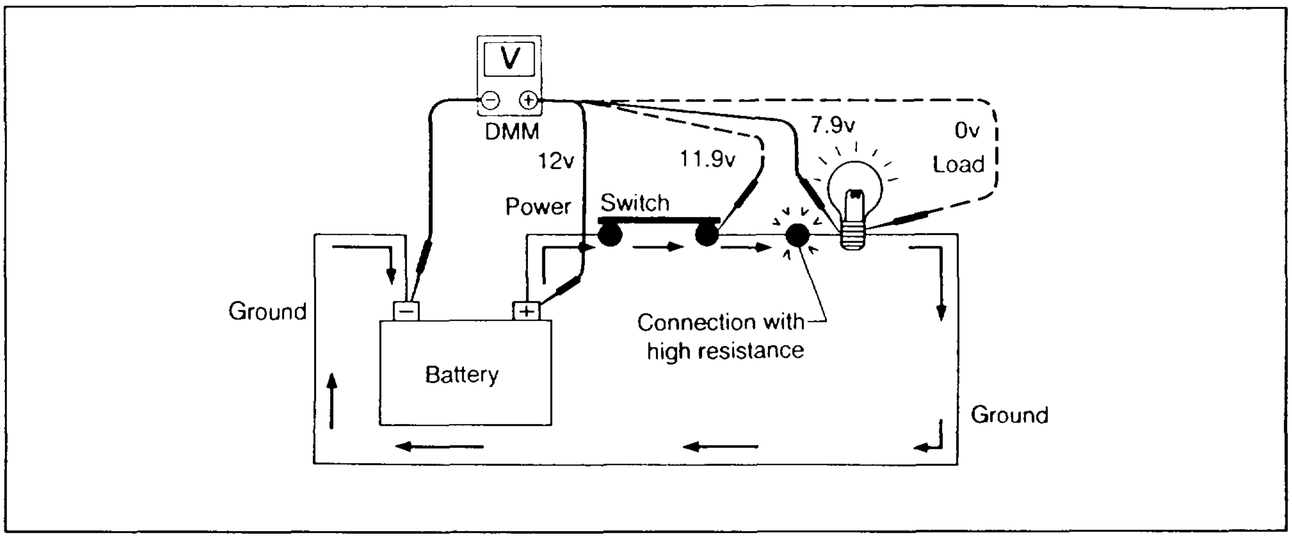
Undersized Wiring (single strand example)
Corrosion On Switch Contacts
Loose Wire Connections Or Splices.

If repairs are needed always use wire that is of the same or larger gauge.

Measuring Voltage Drop Accumulated Method

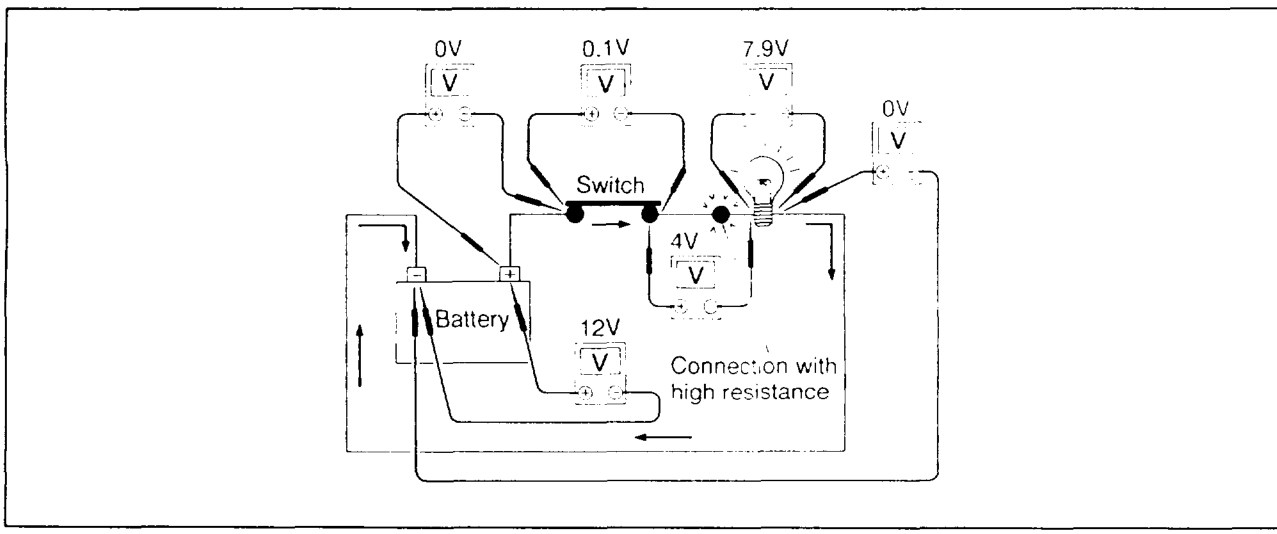
1. Connect the voltmeter across the connector or part of the circuit you want to check. The positive lead of the voltmeter should be closer to power and the negative lead closer to ground.
2. Operate the circuit
3. The voltmeter will indicate how many volts are being used to "push" current through that part of the circuit.

Note in the illustration that there is an excessive 4.1 volt drop between the battery and the bulb.



Measuring Voltage Drop – Step By Step

The Step by Step method is most useful in isolating excessive drops in low voltage systems, such as those in "Computer Controlled Systems".
Circuits in the "Computer Controlled Systems" operate on very low amperage. Any variation in resistance in the system due to poor connections, improper installation, improper wire gauge or corrosion can adversely affect the systems operation.
A step by step voltage drop test can be used to identify a component or wire which is operating under too much resistance.



1. Connect the voltmeter as described above, starting at the battery and working your way around the circuit.

2. An unusually large voltage drop will indicate a component or wire that needs to be repaired. As you can see in the illustration above, the poor connection causes a 4 volt drop.

The chart that follows illustrates some maximum allowable voltage drops. These values are given as a guideline, the exact value for each component may vary.

COMPONENT	VOLTAGE DROP
Wire	negligible < .001 volts
Ground Connections	Approx. 0.1 volts
Switch Contacts	Approx. 0.3 volts
Starter Solenoids	Approx. 0.5 volts

PROPER DIAGNOSTIC PROCEDURES TO AVOID DAMAGING OTHER COMPONENTS

In the process of diagnosing electrical incidents you may be required to remove components, disconnect connectors and inspect parts.

Test equipment

When working with any test equipment, be careful to follow all manufacturers directions and warnings. Improper use of test equipment can result in damage to either your test equipment or vehicle electrical components.

SERVICE PRECAUTIONS

When working on a vehicle's electrical system you need to use care. The following guidelines will help you prevent new problems while diagnosing an electrical incident.

Removing Components

When removing components (such as an engine) which have electrical connectors, disconnect all of the connectors prior to attempting to take the component out of the car. Stretching the connector harness can cause wiring to pull loose and may create a short or open circuit as well as a possible intermittent condition.

Installing Components

When reinstalling components, wait until the component is back in the vehicle before reattaching connectors. Once the component is back in the car, check to verify that the wires and harness are properly positioned in the vehicle. Check the male and female connectors to verify there is no water, grease, dirt, etc. in the connector. Assure that the harness will not be damaged by any brackets or finishing screws. Reconnect the connector. Make sure the connector has an appropriate amount of slack to accommodate any component motion without having unnecessary slack. Secure the harness as required to prevent possible damage to the harness itself.

Disconnecting Connectors

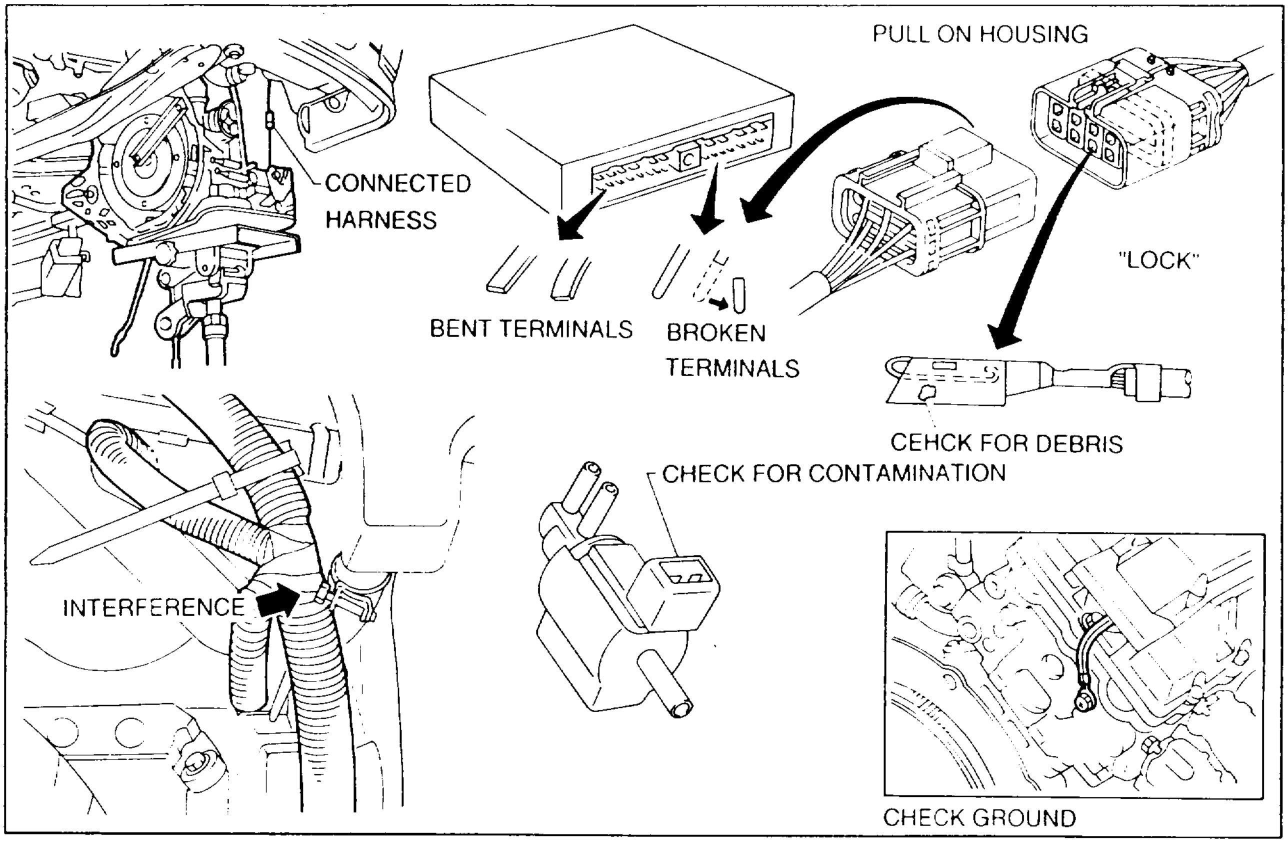
Disconnect the connectors by releasing any locking tabs and pulling on the connector housings. **Never** disconnect a connector by pulling on the harness or wires.

Connecting Harnesses

Before connecting the harness connectors, inspect the housings to make sure there is no water, grease, dirt, etc. in the housing which may interfere with the proper operation of the connector or componment.

Align the male and female halves to prevent bending or breaking terminals.

Make sure the connectors are fully seated when connected. Visually verify that the connector has seated and is locked into place.



EXAMPLES OF COMMON ELECTRICAL INCIDENTS