SECTION 6D

ENGINE ELECTRICAL

CONTENTS

GENERAL DESCRIPTION OF SECTION 6D

The engine electrical systems includes the battery, ignition (primary and secondary), starter motor (and related wiring) and the generator (and related wiring).

Important

- Where a driveability complaint exists, or an ECM code is set, refer to SECTION 6E. Wiring diagrams, component locations and system checks are located in SECTION 8A.
- When a fault is traced to a particular component, refer to that component's section of the service manual.

SECTION 6D1—BATTERY

This section contains information on the maintenance, diagnosis, storage, charging and jump starting of automotive batteries. Battery cable and ground strap routing also appear in this section.

SECTION 6D2—CRANKING SYSTEM

This section contains information on the maintenance, diagnosis, service and specifications of the cranking circuit and starter motor.

SECTION 6D3—CHARGING SYSTEM

This section contains information on the maintenance, diagnosis, service and specifications of the charging circuit and generator. Generator drive belt routing and tension also appears in this section.

SECTION 6D4—IGNITION SYSTEM

This section contains information on the maintenance, diagnosis, service and specifications of the spark plugs, distributor and related components. Ignition timing is covered in SECTION 6E2.

SECTION 6D5—ENGINE WIRING

Engine wiring views are shown in this section. Refer to SECTION 8A for all other electrical wiring views. Engine electrical schematics are found in SECTION 6E2 and SECTION 8A.

SECTION 6D1

BATTERY

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in SECTION 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location View in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit or when a tool or equipment could easily come in contact with the "live" exposed electrical terminals, disconnect the negative (-) battery cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct sequence and tightening specifications. Following these instructions can help you avoid damage to parts and systems.

CONTENTS

GENERAL DESCRIPTION

BATTERY

Figures 1 and 2

The sealed battery is standard on all Geo Tracker models. The battery is completely sealed except for two small vent holes located on the side of the battery (Figure 1). These vent holes allow the small amount of gas produced in the battery to escape.

The battery has three major functions in the electrical system: first, it provides a source of energy for cranking the engine; second, it acts as a voltage stabilizer for the electrical system; and third, it can, for a limited time, provide energy when the electrical load exceeds the output of the generator.

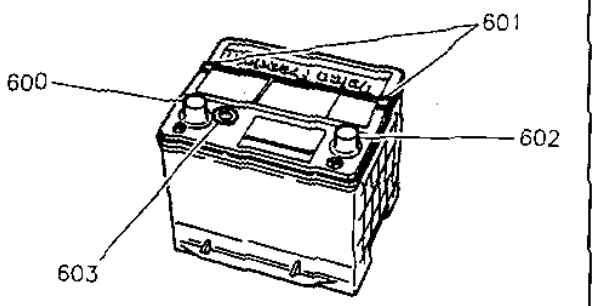
The battery specifications label contains information pertinent to the servicing of the battery, such as test ratings, recommended battery replacement part numbers and service precautions (Figure 2). Refer to "Battery Usage Chart" later in this section for additional information on battery use and original equipment replacement parts.

BATTERY RATINGS

A battery has two ratings: a reserve capacity rating at 27° C (80° F) which is an estimate of the time a fully charged battery will operate the vehicle with no generator operation; and a cold rating at -18° C (0° F) which indicates the cranking load capacity. Refer to "Battery Testing" later in this section for reserve capacity and cold cranking amperage tests.

Reserve Capacity

The reserve capacity is the maximum length of time (expressed in minutes) required for a fully charged battery to discharge to a terminal voltage of 10.5 volts-direct current (VDC). All batteries are rated at a constant temperature of 27° (80° F) and a constant current drain of 25 amperes. This current drain is about the same as operating a vehicle with the headlamps on with other minimal electrical loading (radio, etc.) and no generator output. The reserve capacity for the battery in this vehicle is 75 minutes.



600 NEGATIVE (−) BATTERY TERMINAL
601 VENT HOLES
602 POSITIVE (+) BATTERY TERMINAL
603 BUILT-IN HYDROMETER

EJT0016D1

Figure 1—Sealed Battery

Cold Cranking Amperage

The cold cranking amperage rating is the minimum amperage which must be maintained by the battery for 30 seconds while meeting a minimum voltage requirement of 7.2 VDC. All batteries are tested at -18°C (0°F). The cold cranking capacity of the battery in this vehicle is 500 amperes.

COMMON CAUSES OF BATTERY FAILURE

The battery is not designed to last indefinitely; however, with proper care, it will provide many years of service. If the battery performs satisfactorily during testing but fails to operate properly for no apparent reason, the following are some of the more important factors that may be the cause of the problem:

1. Vehicle accessories left on overnight or for an extended period of time without the generator operating.
2. Slow average driving speeds for short time periods.
3. The vehicle's electrical load is greater than the generator output, particularly with the addition of aftermarket electrical accessories.

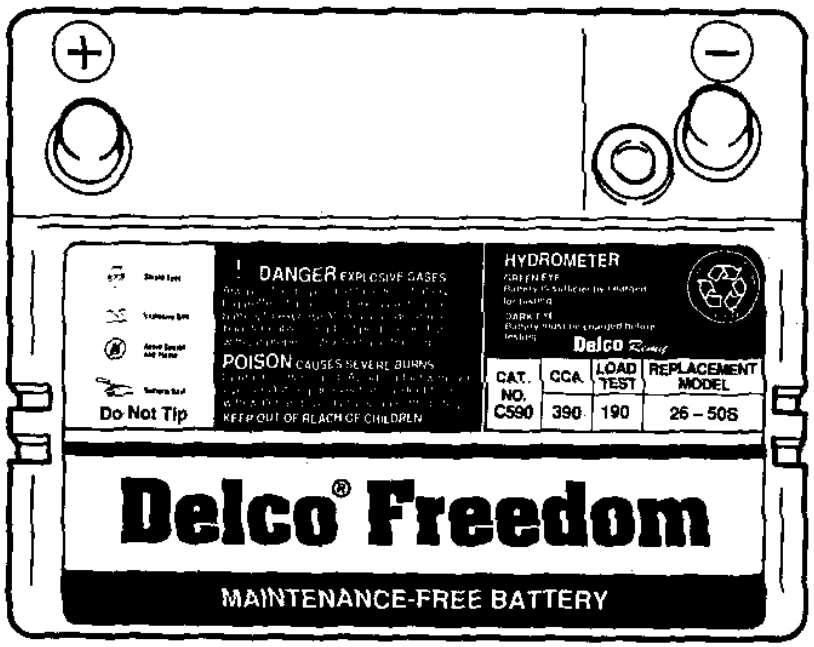


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Figure 2—Battery Specifications Label

4. Conditions in the charging system such as electrical shorts, slipping drive belt, faulty generator or voltage regulator. Refer to SECTION 6D3 and SECTION 8A for generator and charging system diagnosis.
5. Battery neglect and/or abuse, such as a loose battery retainer and hold down brackets or failure to maintain clean and tight battery connections.
6. Extended vehicle storage without proper battery protection. Refer to "Battery Protection During Vehicle Storage" later in this section for proper storage procedures.
7. New batteries received without proper charge.
8. Extended engine cranking due to poor engine mechanical conditions. Refer to SECTION 6 and SECTION 6A1 for engine diagnosis and repair procedures.
9. Incorrect interpretation of the built-in hydrometer. Refer to "Built-In Hydrometer" later in this section for proper hydrometer interpretation information.
10. Continued current draw on the battery through increased parasitic load. Refer to "Battery Electrical Drain" later in this section for parasitic load test procedures.
11. Mechanical conditions in the electrical system, such as shorted or pinched wires.

ELECTROLYTE FREEZING

The freezing point of electrolyte depends on its specific gravity. Since specific gravity depends on the state of charge, the battery should be protected against freezing by keeping it in a charged condition. If the electrolyte is frozen, the battery will need to be replaced.

CARRIER AND HOLD DOWN

The battery carrier and hold down bracket should be clean and free from corrosion before battery installation. The carrier should be in good condition with a minimal amount of corrosion so that it will hold the battery securely and keep it level.

Important

- Make certain that there are no parts or tools in the battery carrier before installing the battery.

To prevent the battery from shaking in its carrier, the hold down bracket nuts must be tightened to specification. Refer to "Battery Replacement" later in this section for proper battery, carrier and hold down bracket service.

BATTERY PROTECTION DURING VEHICLE STORAGE

The electrical devices (ECM, radio, etc.) used on the Geo Tracker cause a very small but continuous current drain on the battery. This condition is referred to as parasitic load drain. Vehicles that are not used for an extended period of time may develop extremely discharged and/or permanently damaged batteries resulting from parasitic load drain. To prevent parasitic load drain, follow the procedure outlined below:

1. For long term storage (six months or longer), the negative (-) battery cable should be disconnected.
2. For short term storage, the "TAIL DOME" and "CIGAR RADIO" fuses should be removed. This will deactivate the ECM and the radio memories.
3. Batteries should be recharged periodically (every 20 to 45 days) until the green dot is visible in the built-in hydrometer. Refer to "Battery Charging" later in this section for proper charging procedures.

Once the vehicle is returned to service, the radio station presets and the clock will have to be reset; refer to SECTION 9A.

BUILT-IN HYDROMETER

Figures 1 and 3

On the top of the battery is a built-in temperature compensated hydrometer (Figure 1). This hydrometer should be referred to during all diagnostic procedures involving the battery. When observing the hydrometer, make sure that the battery has a clean top. A light may be required in poorly lit areas.

Under normal operation, two indications can be observed (Figure 3):

1. GREEN DOT VISIBLE
   - Any green appearance should be interpreted as a "green dot." The green dot denotes that the battery is ready for testing.
2. DARK: GREEN DOT NOT VISIBLE
   - If there is no green visible in the hydrometer, the battery needs to be charged before testing; refer to "Battery Charging" later in this section. The charging and electrical systems should also be checked. Refer to SECTION 6D3 for charging system diagnosis and refer to SECTION 8A for general electrical system diagnosis.

Occasionally, a third condition may appear (Figure 3):

1. CLEAR OR LIGHT YELLOW
   - If the hydrometer appears clear or has a light yellow color, it indicates that the electrolyte fluid is below the bottom of the hydrometer and is too low for diagnosis. This may have been caused by excessive or prolonged charging, a broken case, excessive tipping or normal battery wearout. When a hydrometer is displaying either of these conditions the battery should be replaced (it cannot be charged); refer to "Battery Replacement" later in this section. The charging and electrical systems should also be checked. Refer to SECTION 6D3 for charging system diagnosis and refer to SECTION 8A for general electrical system diagnosis.

DIAGNOSIS

BATTERY TESTING

Figures 1, 3, 4 and 5

1. VISUAL INSPECTION—Check battery for obvious damage, such as a cracked or broken case or cover, that could permit loss of electrolyte.
   - If obvious damage is noted; replace the battery, determine the cause of damage and correct as necessary.
   - If no damage is noted, proceed to Step 2.

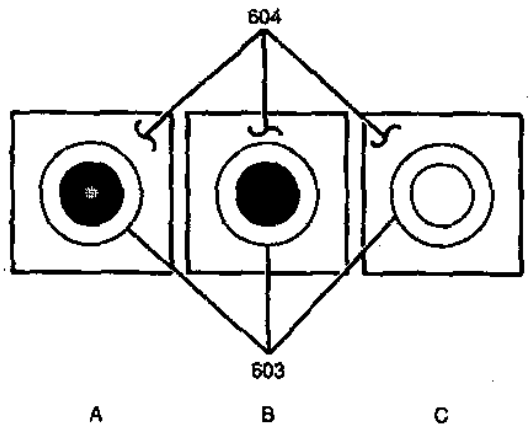

Figure 3—Built-In Hydrometer Indications

2. HYDROMETER CHECK—Check the state of the built-in hydrometer (Figure 1).
   - If a green dot is visible (Figure 3), proceed to Step 3.
   - If the hydrometer is dark (no green dot visible—Figure 3), charge the battery and proceed to Step 3. Refer to "Battery Charging" later in this section.
   - If the hydrometer is clear or has a light yellow color (Figure 3), the battery must be replaced. Refer to "Built-In Hydrometer" earlier in this section for additional details.
3. LOAD TEST

CAUTION: Wear a safety face shield when load testing a battery to prevent possible personal injury.

Important

- Do not load test a frozen battery.

Tool Required:
J 39200 Digital Multimeter

A. Connect a J 39200 and a battery load tester across the battery terminals (Figure 4).
B. Apply a 300 ampere load for 15 seconds to remove the surface charge from the battery.
C. Remove the load and wait 15 seconds to let the battery recover.
D. Apply 250 amperes to the battery.

Measure

- Battery voltage after 15 seconds.

E. Remove the load.
F. If the voltage does not drop below the minimum voltage listed in Figure 5, the battery is good and should be returned to service. (The battery temperature must be estimated by feel and by the temperature the battery had been exposed to for the preceding few hours.)
G. If the voltage drops below the minimum listed in Figure 5, replace the battery.

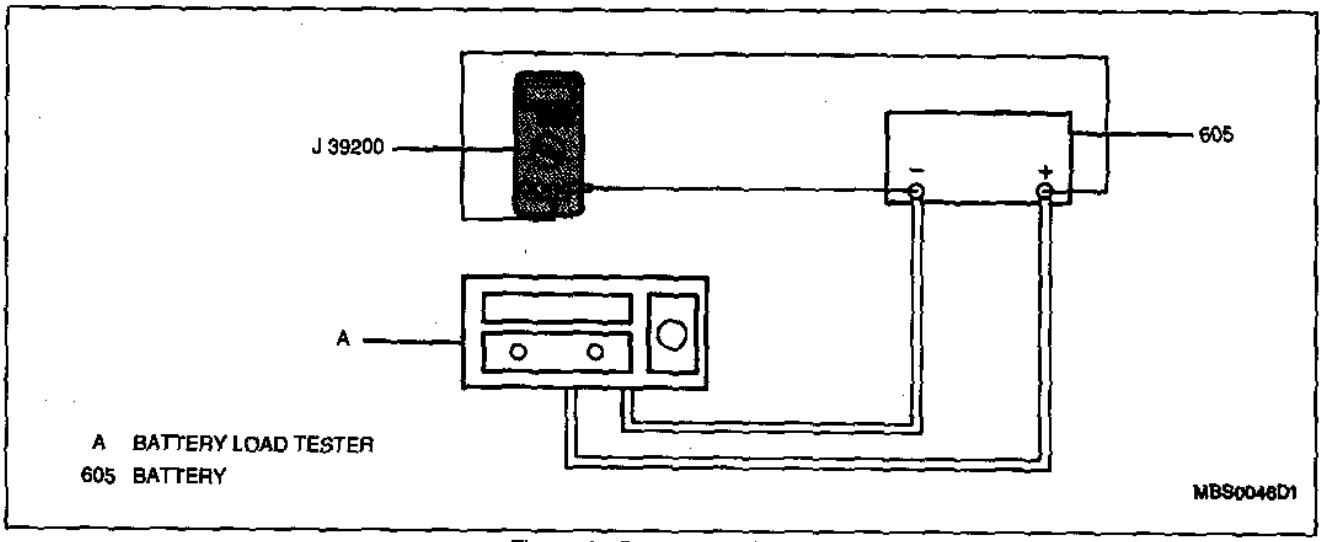

Figure 4—Batttery Load Test

BATTERY LOAD TEST VOLTAGE	
ESTIMATED TEMPERATURE	MINIMUM VOLTAGE
21°C (70°F)	9.6 VDC
10°C (50°F)	9.4 VDC
0°C (30°F)	9.1 VDC
-10°C (15°F)	8.8 VDC
-18°C (0°F)	8.5 VDC
Below -18°C (0°F)	8.0 VDC

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Figure 5—Battery Temperature vs. Voltage Drop

BATTERY ELECTRICAL DRAIN

If a vehicle exhibits a low or dead battery after an overnight set or discharges over a period of two or three days, the electrical system should be checked for an excessive electrical drain. This condition is referred to as parasitic load drain. To properly diagnose this condition, perform the "Parasitic Load Test."

Parasitic Load Test

Figures 6 and 7

Tool Required:
J 39200 Digital Multimeter

1. Turn the ignition to "LOCK."
2. Charge the battery to a full state of charge. Refer to "Battery Charging" later in this section.
3. Disconnect the negative (-) battery cable.
4. Connect an ammeter capable of carrying at least 20 amperes in series between the negative (-) battery terminal and the negative (-) battery cable (Figure 6).

Measure

- Parasitic load draw (in amperes) with all doors closed and the ignition switch in the "LOCK" position.

5. If a parasitic load drain over 0.5 amperes is present, isolate the electrical system, circuit or component at fault through the following procedure:
   A. Remove fuses one at a time. Refer to SECTION 8A for electrical system schematics, system diagnosis, component location views and wiring repair procedures. If a parasitic load drain over 0.5 amperes is still present, proceed to step B.
   B. Remove fusible links one at a time. Refer to SECTION 8A for electrical system schematics, system diagnosis and wiring repair procedures. If a parasitic load drain over 0.5 amperes is still present, proceed to step C.
   C. Check the starter motor, starter solenoid and related wiring for short circuits. Refer to SECTION 6D2 for starter motor and starter solenoid diagnosis and repair procedures. Refer to SECTION 8A for starter system wiring schematics and system diagnosis.

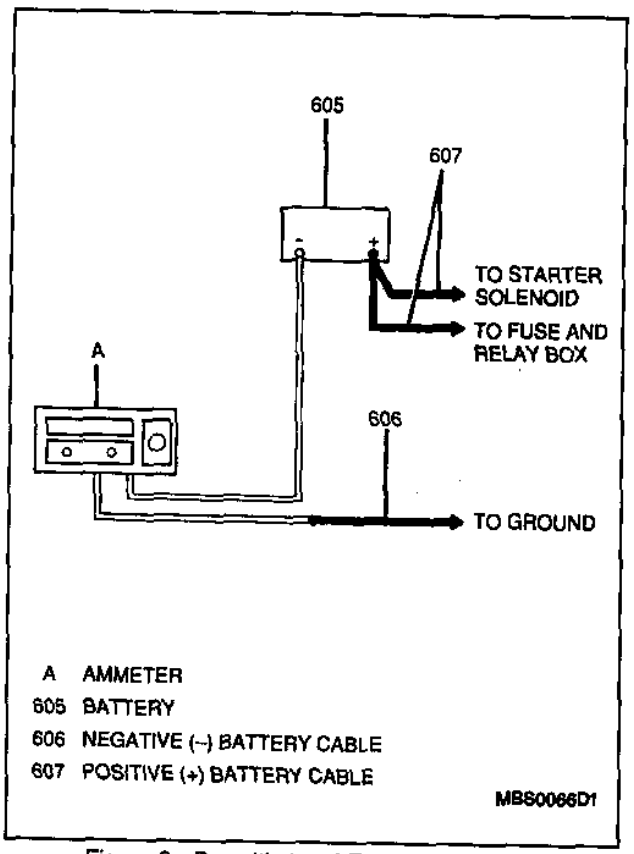


Figure 6—Parasitic Load Test with Ammeter

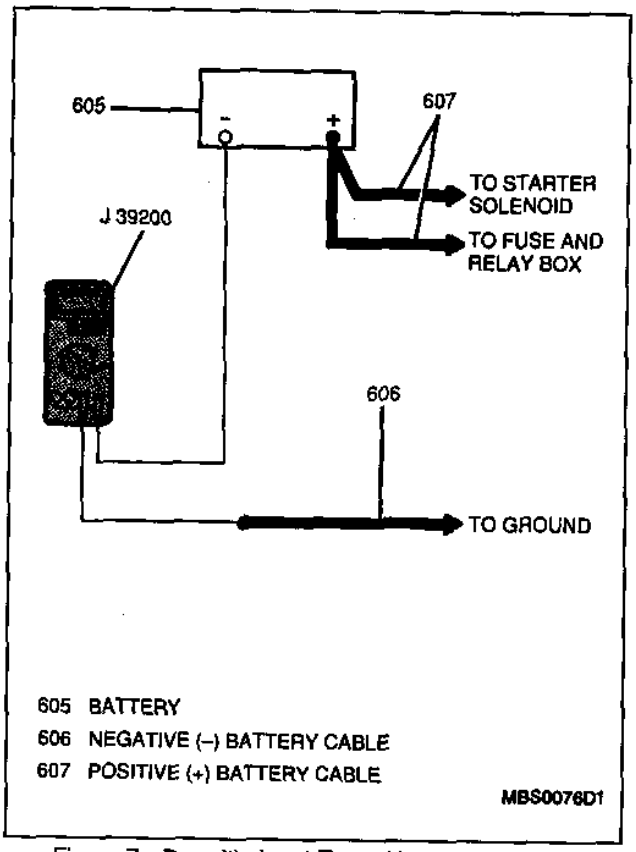


Figure 7—Parasitic Load Test with J 39200 Digital Multimeter

6. If a parasitic load drain less than 0.5 amperes is present, disconnect and remove the ammeter and connect a J 39200 between the negative (-) battery terminal and the negative (-) battery cable (Figure 7). Set the selector switch to Milliamp/Microamp Input Terminal scale.

NOTICE: To prevent possible damage to the J 39200, do not open any doors or operate any equipment that would draw more than 10 amperes. If the fuse opens, replace it with a 10 ampere fast opening fuse. Failure to use the proper fuse may result in damage to the J 39200.

Measure

- Parasitic load draw (in milliamperes) with all doors closed and the ignition switch in the "LOCK" position.

7. Normal parasitic load drain is 10 to 25 milliamperes. If the parasitic load drain is more than 25 milliamperes, isolate the electrical system, circuit or component at fault through the following procedure:
   A. Remove fuses one at a time. Refer to SECTION 8A for electrical system schematics, system diagnosis, component location views and wiring repair procedures. If a parasitic load drain over 25 milliamperes is still present, proceed to step B.
   B. Remove fusible links one at a time. Refer to SECTION 8A for electrical system schematics, system diagnosis and wiring repair procedures. If a parasitic load drain over 25 milliamperes is still present, proceed to step C.
   C. Check the starter motor, starter solenoid and related wiring for short circuits. Refer to SECTION 6D2 for starter motor and starter solenoid diagnosis and repair procedures. Refer to SECTION 8A for starter system wiring schematics and system diagnosis.

Important

- Repeat parasitic load test procedure after any electrical repair has been completed.

8. When the cause of the excessive parasitic load drain has been located and repaired, disconnect and remove the J 39200 and connect the negative (-) battery cable.

Tighten

- Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N.m (11 lb. ft.).

ON-VEHICLE SERVICE

BATTERY CHARGING

When it is necessary to charge the battery, the following conditions must be observed:

- Use a constant voltage power supply with an end charge voltage of 16.0 volts-direct current (VDC) and equipped with a voltmeter that is accurate within 1%.
- If more than one battery is to be charged, the batteries should be connected in parallel with each other; positive to positive (+ to +) and negative to negative (- to -).
- Ambient (surrounding) temperature should be 15 to 38°C (60 to 100°F). A battery that is extremely cold may not accept current for several hours after charging has begun.
- Charging area should be well ventilated.
- Do not charge battery if the built-in hydrometer is clear or light yellow. Replace the battery if this condition is discovered. Refer to "Built-In Hydrometer" earlier in this section for additional details.
- Do not charge the battery if the electrolytes are frozen.
- If the battery feels as hot as 52°C (125°F) or hotter, or if violent gassing or spewing of electrolyte through the vent holes occurs, discontinue charging or reduce the charging rate.

Charging Procedure

Figure 8

1. Batteries with a built-in hydrometer showing a green dot do not require charging unless they have just been discharged (by cranking the engine).

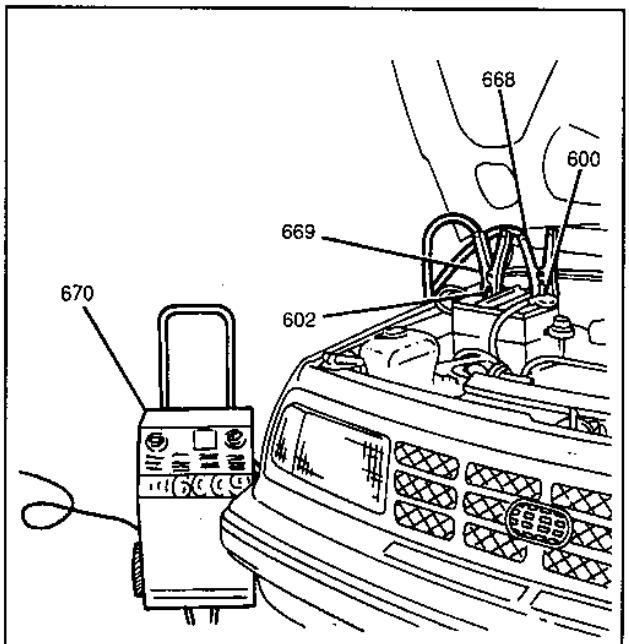


Figure 8—Battery Charging

2. Connect the battery charger cables to the positive (+) and negative (-) battery terminals (Figure 8). Make sure all charger cable-to-battery terminal connections are clean and tight.
3. Charge the battery using the charge setting for 12 VDC batteries that gives the highest charge rate to the battery. Refer to the battery charger manufacturer's instructions.

Important

- Do not use the charge settings for jump starting vehicles.

4. Charge the battery until the green dot appears in the hydrometer. Check the battery every half-hour. The battery may need to be tipped or shaken gently for the green dot to appear.
5. After charging, the battery should be tested. Refer to "Battery Testing" earlier in this section.

Charging Time Required

The time required to charge a battery will vary depending upon the following factors:

Size of battery —A completely discharged, large (heavy-duty) battery requires more than twice the recharging time as a completely discharged small (passenger car) battery.

Temperature —A longer time will be needed to charge any battery at -18°C (0°F) than at 27°C (80°F).When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first. The battery will accept a higher rate of current as it warms.

Charger capacity —A charger which can supply only 5 amperes will require a much longer charging period than a charger that can supply 30 amperes or more.

State-of-charge —A completely discharged battery requires more than twice as much charge as a half charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted by the battery is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will also increase.

Any battery discharged by parasitic load, and then allowed to stand in this condition for a period of time, may not accept charge readily. However, if recharged long enough, many batteries will return to a good usable condition.

If the battery remains in an extremely discharged condition for a prolonged period, it can become permanently damaged. This damage can be accelerated by low temperatures. Batteries which are extremely discharged can freeze at temperatures as high as -6°C (20°F)and be permanently damaged.

To prevent battery damage and recharge problems, vehicles which are not going to be in service within a 20 day period should have the battery negative (-) cable disconnected to remove the constant drain on the battery. If this is not possible, the battery should be recharged periodically every 20 to 45 days until the green dot is visible in the hydrometer or an open circuit voltage of 12.4 VDC is obtained.

Charging a Very Low or Completely Discharged Battery

The following procedure should be used to recharge a very low or completely discharged battery. Unless this procedure is properly followed, a perfectly good battery may be needlessly replaced.

Tool Required:
J 39200 Digital Multimeter

1. Measure voltage at battery terminals with a J 39200. If the battery voltage is below 11 VDC, the charge current will be very low and it could take some time before the battery accepts a current in excess of a few milliamperes. Such low current may not be detectable on some ammeters.
2. Set the battery charger on a high setting.
3. Some chargers feature polarity protection circuitry which prevents charging unless the charger leads are connected to the battery terminals correctly. A completely discharged battery may not have enough voltage to activate this circuitry, even though leads are connected properly, making it appear that the battery will not accept charging current. There-fore, follow the specific charger manufacturer's instructions explaining how to bypass the polarity protection circuitry, allowing the charger to charge a low-voltage battery.
4. Battery chargers vary in the amount of voltage and current they provide. The time required for a battery to accept measurable charger current at various voltages are as follows:
   - 16.0 VDC or more—up to 4 hours.
   - 14.0 to 15.9 VDC—up to 8 hours.
   - 13.9 VDC or less—up to 16 hours.
5. If the charge current is still not measurable at the end of the above charging times, the battery should be replaced.
6. If the charge current is measurable during the charging time, the battery is considered to be good and charging should be completed in the normal manner. Refer to "Battery Charging" earlier in this section.
7. It is important to remember that a completely discharged battery must be recharged for a sufficient number of ampere hours (AH) to restore it to a usable state. As a general rule, using the reserve capacity (RC) rating of the battery as the number of ampere hours of charge will usually bring the desired hydrometer indication (green dot) into view. The battery used in this vehicle is rated at 75 RC minutes, therefore, it would be completely recharged as follows:
   - 10 ampere charge for 7.5 hours (10 x 7.5) = 75 AH
   - 25 ampere charge for 3 hours (25 x 3) = 75 AH
8. Any battery recharged by this procedure should be load tested to establish serviceability. Refer to "Battery Testing" earlier in this section.

JUMP STARTING IN CASE OF EMERGENCY WITH AUXILIARY (BOOSTER) BATTERY

Figure 9

NOTICE: Do not push or tow this vehicle to "*push start*" the engine. Damage to the emission system and/or to other engine and vehicle parts may result.

Both the booster and discharged battery should be treated carefully when using jumper cables. Follow the procedure below, using caution not to generate any sparks.

CAUTION: Departure from these conditions or the procedure below could result in: (1) serious personal injury (particularly to eyes) or property damage from such causes as battery explosion, battery acid or electrical burns; and/or (2) damage to the electronic components of either vehicle. Never expose any battery to open flame or electric spark—batteries generate a gas which is flammable and explosive. Remove rings, watches and other jewelry. Wear approved eye protection. Do not allow battery fluid to contact eyes, skin, fabrics or painted surfaces—battery fluid is a corrosive acid. Flush any contacted area with water immediately and thoroughly. Be careful that metal tools or jumper cables do not contact the positive battery terminal (or metal in contact with it) or any other metal on the vehicle—a short circuit will occur.

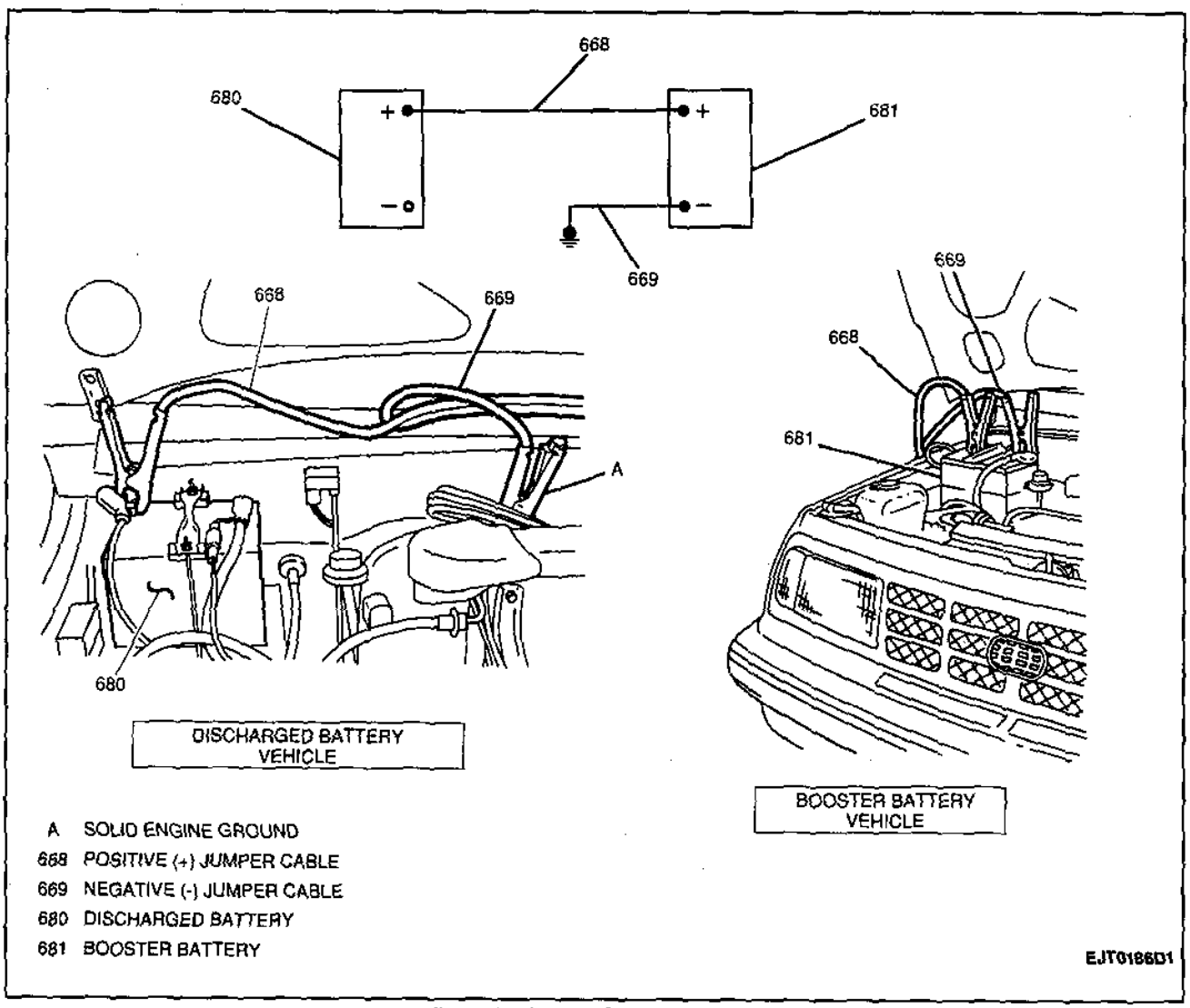


Figure 9—Jumper Cable Installation

1. Set the parking brake and place the manual selector lever (automatic transaxle models) into "P." Turn the ignition switch to "LOCK." Turn all electrical accessories and lamps off.
2. Check the state of the built-in hydrometer, refer to *"Built-In Hydrometer" earlier in this section.* If it is clear or a light yellow color, replace the battery.

NOTICE: When jump starting a vehicle with charging equipment, be sure that the charging equipment used is 12 volts and a negative ground. **Do not use 24 volt or positive ground charging equipment. Using such equipment can cause serious damage to the electrical system or electronic components on the vehicle.**

3. Attach one end of the positive (+) jumper cable to the positive (+) terminal of the booster battery and the other end (of the same cable) to the positive (+) terminal of the discharged battery (Figure 9)..

Important

- Do not permit vehicles to touch each other. This could cause a grounding effect and counteract the jump starting procedure.

4. Attach one end of the negative (-) jumper cable to the negative (-) terminal of the booster battery and the other end to a solid engine ground (such as the A/C compressor mounting bracket or generator mounting bracket) at least 457 mm (18-inches) from the discharged battery (Figure 9).

Important

- DO NOT CONNECT THE NEGATIVE (-) JUMPER CABLE DIRECTLY TO THE NEGATIVE (-) TERMINAL OF THE DISCHARGED BATTERY.

5. Start the engine of the vehicle with the booster battery. Turn off all electrical accessories and lamps.
6. Start the engine of the vehicle with the discharged battery.
7. Disconnect and remove the negative (-) jumper cable from the solid engine ground and from the negative (-) terminal of the booster battery.
8. Disconnect and remove the positive (+) jumper cable from the positive (+) terminal of the then discharged battery and from the positive (+) terminal of the booster battery.

BATTERY REPLACEMENT

Figure 10

Remove or Disconnect

1. Negative (-) battery cable from negative (-) battery terminal (Figure 10).
2. Positive (+) battery cable from positive (+) battery terminal.
3. Two nuts and battery retainer from hold down brackets.
4. Battery from vehicle.

Install or Connect

1. Battery into vehicle; position into carrier.
2. Battery retainer to hold down brackets; secure with two nuts.

Tighten

- Battery hold down bracket nuts to 8 N.m (71 lb. in.).

3. Positive (+) battery cable to positive (+) battery terminal.
4. Negative (-) battery cable to negative (-) battery terminal.

Tighten

- Battery cable-to-battery terminal retainers to 15 N.m (11 lb. ft.).

Battery Carrier and Hold Down Brackets

Figure 10

Remove or Disconnect

1. Negative (-) battery cable from negative (-) battery terminal (Figure 10).

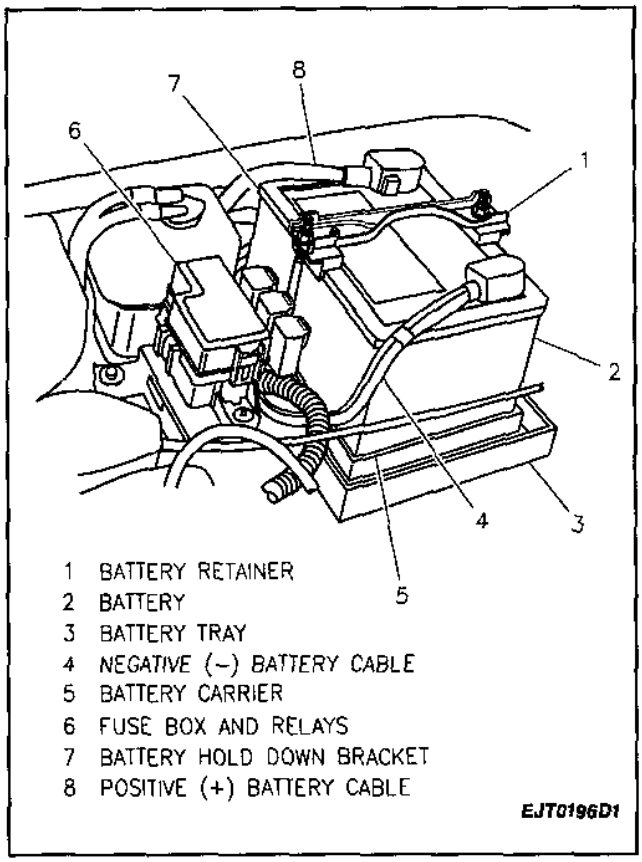


Figure 10—Battery, Cables, Carrier and Hold Down Brackets

2. Positive (+) battery cable from positive (+) battery terminal.
3. Two nuts and battery retainer from hold down brackets.
4. Battery from vehicle.
5. Battery hold down brackets from strut tower and bulkhead.
6. Carrier from vehicle.

Install or Connect

1. Carrier into vehicle.
2. Battery hold down brackets to strut tower and bulkhead.
3. Battery into vehicle; position into carrier.
4. Battery retainer to hold down brackets; secure with two nuts.

Tighten

- Battery hold down bracket nuts to 8 N.m (71 lb. in.).

5. Positive (+) battery cable to positive (+) battery terminal.
6. Negative (-) battery cable to negative (-) battery terminal.

Tighten

- Battery cable-to-battery terminal retainers to 15 N.m (11 lb. ft.).

BATTERY CABLE REPLACEMENT AND ROUTING

Important

- Whenever battery cables are being replaced, always be certain to use a replacement cable that is the same type, size and length. Some positive (+) cables have additional feed wires attached to them and some negative (-) cables have additional ground leads attached. Always be certain to route the replacement battery cable in exactly the same manner as the original cable.

Negative (-) Battery Cable

Figure 10

Remove or Disconnect

1. Battery from vehicle. Refer to "Battery Replacement" earlier in this section.
2. Ground bolt and negative (-) battery cable from body (Figure 10).
3. Ground bolt and cable from starter motor housing.
4. Cable from harness retainer near starter motor and remove cable from vehicle.

Install or Connect

1. Position negative (-) battery cable into vehicle.
2. Cable to starter motor housing; secure with ground bolt.

Tighten

- Ground bolt to 23 N.m (17 lb. ft.).

3. Cable to body; secure with ground bolt.

Tighten

- Body ground bolt to 14 N.m (124 lb. in.).

4. Route cable and secure in harness retainer near starter motor.
5. Battery into vehicle. Refer to "Battery Replacement" earlier in this section.

Positive (+) Battery Cable

Figure 10

Remove or Disconnect

1. Battery from vehicle. Refer to "Battery Replacement" earlier in this section.
2. Fuse box cover.
3. Two bolts and positive (+) battery cable from fuse box (Figure 10).
4. Retaining nut and cable from starter solenoid.
5. Retaining nut and cable from generator.
6. Cable from harness retainers and remove cable from vehicle.

Install or Connect

1. Position positive (+) battery cable into vehicle.
2. Cable to generator; secure with retaining nut.

Tighten

- Positive (+) battery cable-to-generator retaining nut to 8 N.m (71 lb. in.).

3. Cable to starter solenoid; secure with retaining nut.

Tighten

- Positive (+) battery cable-to-starter solenoid retaining nut to 7 N.m (62 lb. in.).

4. Cable to fuse box; secure with one bolt.

Tighten

- Fuse box bolt to 10 N.m (89 lb. in.).

5. Fuse box cover.
6. Route cable and secure with harness retainers.
7. Battery into vehicle. Refer to "Battery Replacement" earlier in this section.

GROUND STRAPS

This vehicle does not use additional ground straps. All additional ground paths are through engine and transmission grounding brackets.

SPECIFICATIONS

FASTENER TORQUES

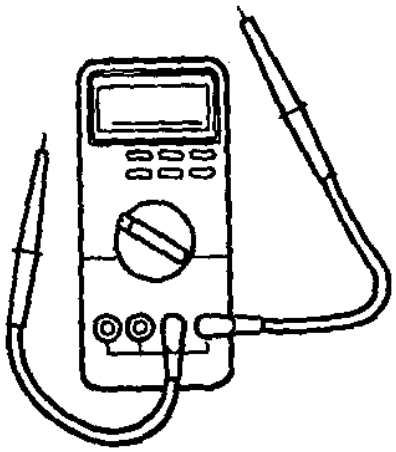
Battery Hold Down Bracket Nuts ..... 8 N.m (71 lb. in.)
Battery Cable-to-Battery Terminal Retainers ..... 15 N.m (11 lb. ft.)
Ground Bolt ..... 23 N.m (17 lb. ft.)
Body Ground Bolt ..... 14 N.m (124 lb. in.)
Fuse Box Bolt ..... 10 N.m (89 lb. in.)
Generator Retaining Nut ..... 8 N.m (71 lb. in.)

BATTERY USAGE CHART				
REPLACEMENT MODEL	CATALOG NUMBER	TEST LOAD AMPERES	COLD CRANKING AMPERES	RESERVE CAPACITY MINUTES
26-60S	C900	250	500	75

T5482

SPECIAL TOOLS

[1]
J 39200



[1] DIGITAL MULTIMETER

MBS0136D1

SECTION 6D2

CRANKING SYSTEM

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in SECTION 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location View in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the negative (-) battery cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct sequence and tightening specifications. Following these instructions can help you avoid damage to parts and systems.

CONTENTS

GENERAL DESCRIPTION

CRANKING CIRCUIT

Figure 1

The cranking circuit consists of the battery, starter motor, ignition switch and all related electrical wiring (Figure 1). This section will cover the starter motor. Refer to SECTION 8A for electrical schematics and diagnostic procedures.

STARTER MOTOR

Figure 2

The starter solenoid windings are energized when the ignition switch is turned to the "START" position and the clutch pedal position (CPP) switch (manual transmission) or the transaxle range switch switch (automatic transmission) is closed. (In manual transmission equipped vehicles, the clutch pedal must be fully depressed to activate the clutch pedal position switch.) The resulting plunger and shift lever movement causes the drive pinion to engage the engine flywheel ring gear and the starter solenoid contacts to close.

With the contacts closed, the starter solenoid provides a closed circuit between the positive (+) battery terminal and the starter motor. The circuit is complete and cranking occurs as soon as the starter solenoid contacts are closed (the starter motor is permanently grounded to the engine block). When the engine starts, the clutch and drive assembly is designed to overrun and protect the armature from excessive speed until the ignition switch is released from the "START" position. After the ignition switch is released from the "START" position, a return spring in the solenoid assembly forces the starter solenoid contacts open, breaking the circuit between

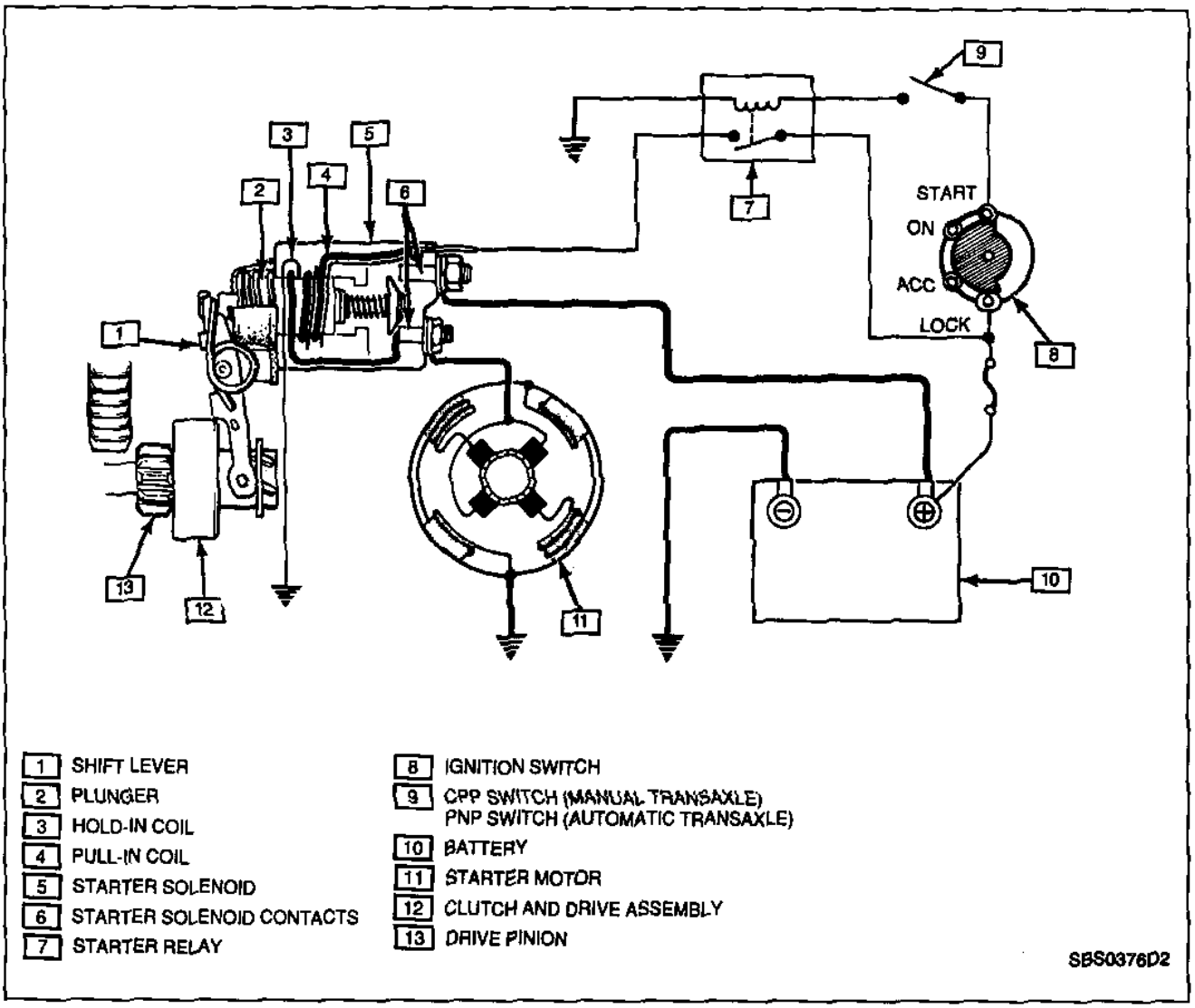


Figure 1—Cranking Circuit

the battery and the starter motor, and disengaging the clutch and drive assembly (Figure 2). The ignition switch should be released immediately upon engine start-up to prevent prolonged overrun.

DIAGNOSIS

Before removing any unit in the cranking circuit for repair, perform the diagnostic procedures in SECTION 8A-30 and also check the following items:

Battery: To determine the condition of the battery, follow the testing procedures outlined in SECTION 6D1.

Wiring: Inspect for wiring damage. Inspect the connections to the starter motor, the starter solenoid, the ignition switch, the battery, and all related ground points.

Starter Solenoid and Ignition Switch: Inspect these components to determine their serviceability.

Starter Motor: If the battery, wiring and switches are in satisfactory condition and the engine is functioning properly, remove and test the starter motor. Refer to "Starter Replacement" later in this section. Perform starter assembly performance tests. Refer to "Starter Assembly Performance Testing" later in this section.

STARTER ASSEMBLY PERFORMANCE TESTING

Figures 3 through 5

NOTICE: These tests should be limited to 5 seconds each to avoid damaging the starter solenoid.

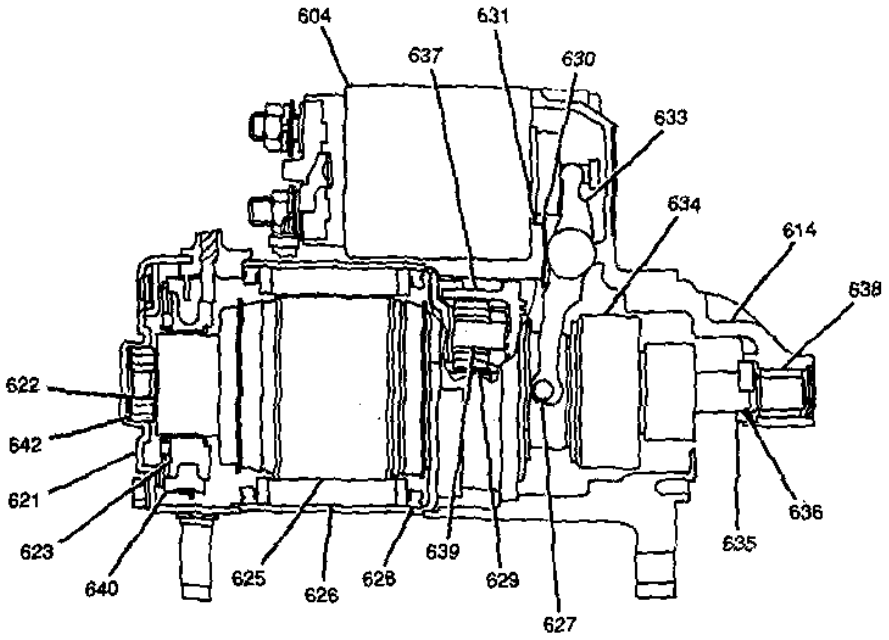
Remove or Disconnect

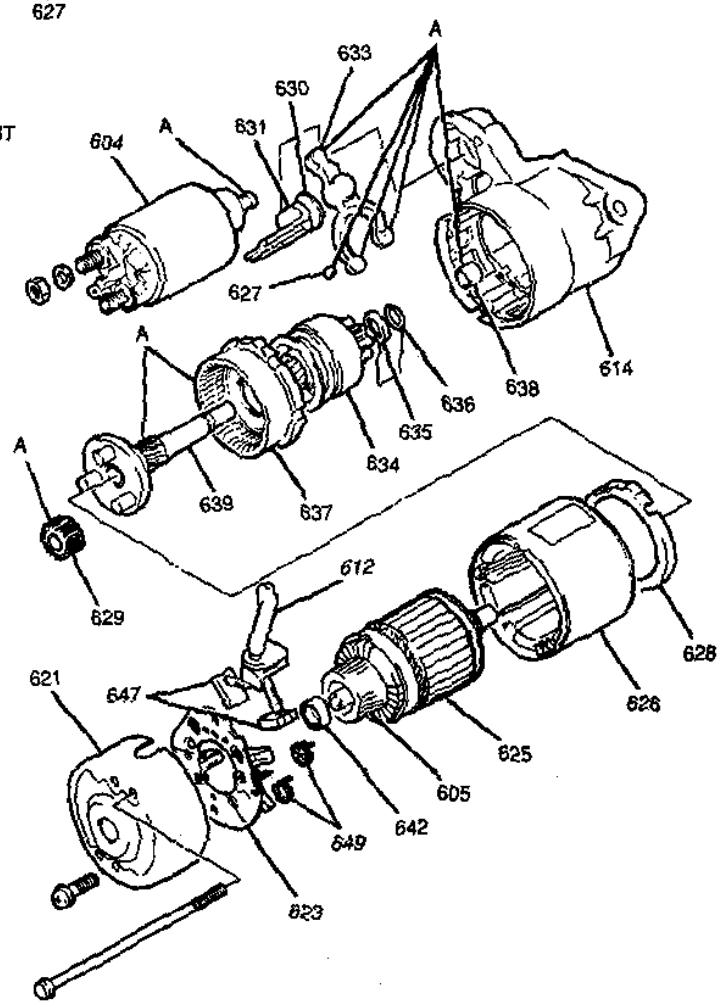
- Starter motor assembly. Refer to "Starter Replacement" later in this section.

Pull-In Test

Remove or Disconnect

- Field coil lead wire from solenoid terminal (Figure 3).





A *LIGHTLY GREASE WITH LUBRIPLATE LUBRICANT GM P/N 1050109, OR EQUIVALENT*

604 STARTER SOLENOID
605 COMMUTATOR END
612 FIELD COIL LEAD WIRE
614 DRIVE HOUSING
621 COMMUTATOR END HOUSING
622 SPRING WASHER
623 BRUSH HOLDER
625 ARMATURE
626 STARTER MOTOR YOKE
627 ARMATURE BEARING
628 IDLE GEAR RETAINER
629 *IDLE GEARS (3)*
630 PINION DRIVE LEVER PLATE
631 *PINION DRIVE LEVER SEAL*
633 PINION DRIVE LEVER
634 OVERRUNNING CLUTCH
635 OVERRUNNING CLUTCH STOP RING
636 OVERRUNNING CLUTCH RETAINING RING
637 INTERNAL GEAR ASSEMBLY
638 GEAR SHAFT ASSEMBLY BUSHING
639 MOTOR GEAR SHAFT
640 STARTER MOTOR BRUSH
642 ARMATURE BUSHING
643 PINION GEAR
647 BRUSHES
649 BRUSH SPRINGS

EJS0028D2

Figure 2—Starter Motor

Install or Connect

- Test leads from battery to starter motor assembly (Figure 3).

Inspect

- That the pinion extends quickly and completely to the energized position.
- If the pinion movement is satisfactory, proceed to the "Hold-In Test" later in this section.
- If the pinion movement is not satisfactory, replace the starter solenoid. Refer to "Solenoid Replacement" later in this section.

Hold-In Test

Remove or Disconnect

- Negative (-) test lead from field coil lead wire solenoid terminal (Figure 4).

Inspect

- Check that the pinion remains completely in the energized position.
- If the pinion remains in the energized position, proceed to the "Pinion Return Test" later in this section.
- If the pinion does not remain completely energized, replace the starter solenoid. Refer to "Solenoid Replacement" later in this section.

Pinion Return Test

Remove or Disconnect

- Negative (-) lead from starter motor assembly (Figure 5).

Inspect

- That the pinion returns quickly and completely to the de-energized position.
- If the pinion returns quickly and completely, proceed to the "No-Load Test" later in this section.
- If the pinion does not return to the de-energized position, the cause is most likely a faulty starter solenoid return spring, requiring replacement of the starter solenoid. Refer to "Solenoid Replacement" later in this section and retest. If after solenoid replacement, the pinion does not return satisfactorily to the de-energized position, proceed to "Starter Disassembly" and "Cleaning, Inspection and Testing" later in this section for further inspection procedures.

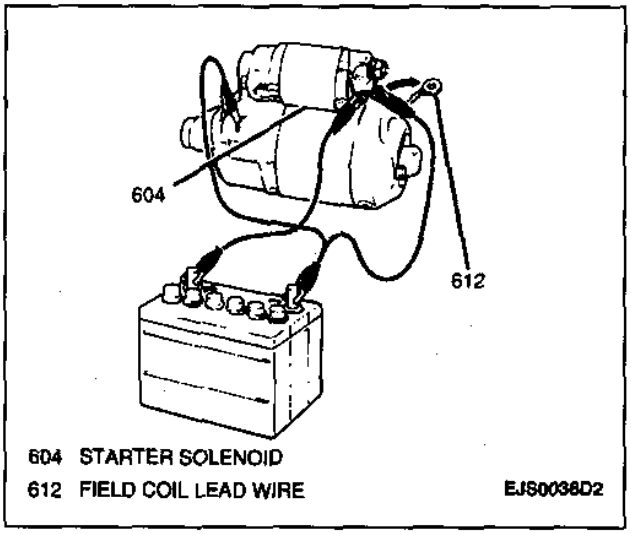


Figure 3—Pull-In Test

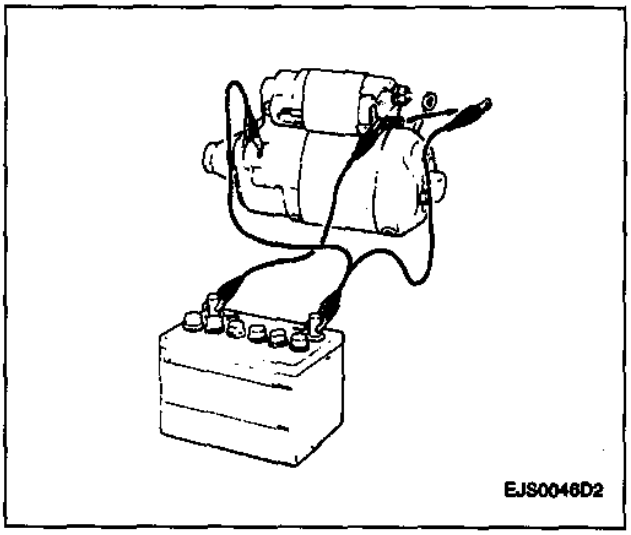


Figure 4—Hold-In Test

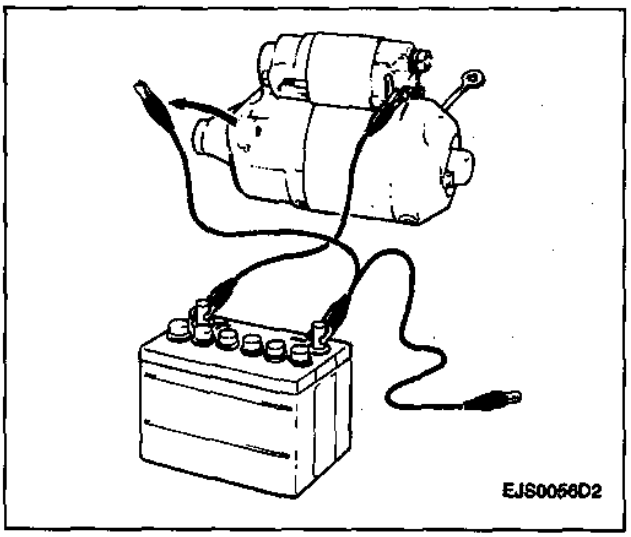


Figure 5—Pinion Return Test

ON-VEHICLE SERVICE

STARTER REPLACEMENT

Remove or Disconnect

1. Negative (-) battery cable from negative (-) battery terminal.
2. Retaining nut and positive (+) battery cable from starter solenoid.
3. Starter solenoid electrical connector.
4. One nut, upper mounting bolt and negative (-) battery cable from starter motor assembly.
5. Lower mounting nut and starter motor assembly from vehicle.

Install or Connect

1. Starter motor assembly to vehicle; secure with lower mounting nut.

Tighten

- Starter motor assembly lower mounting nut to 30 N.m (22 lb. ft.).

2. Negative (-) battery cable to starter motor assembly; secure with upper mounting bolt and retaining nut.

Tighten

- Starter motor assembly upper mounting bolt and retaining nut to 30 N.m (22 lb. ft.).

3. Positive (+) battery cable to starter solenoid; secure with one nut.

Tighten

- Starter solenoid nut to 15 N.m (11 lb. ft.).

4. Starter solenoid electrical connector.
5. Negative (-) battery cable to negative (-) battery terminal.

Tighten

- Negative (-) battery cable-to-negative (-) battery terminal retainer to15 N.m (11 lb. ft.).

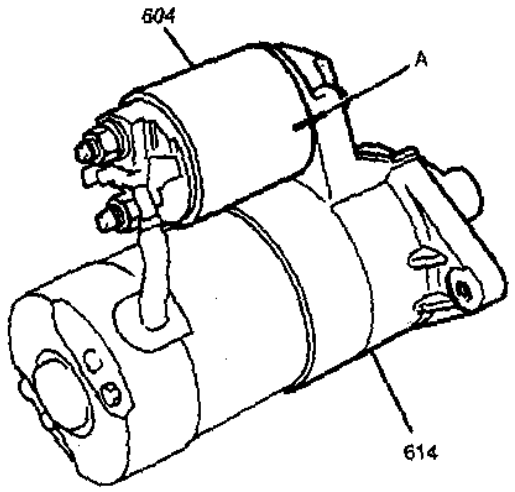
UNIT REPAIR

SOLENOID REPLACEMENT

Figures 6 through 10

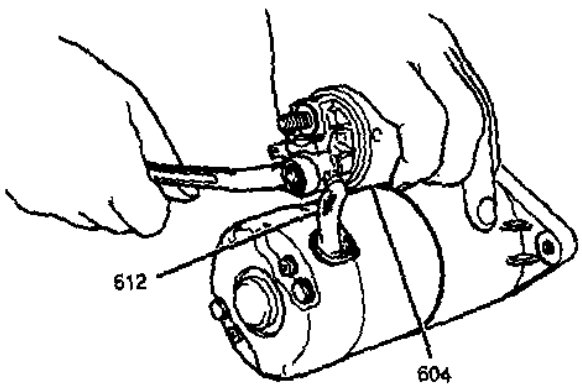
Important

- Scribe matchmarks on the solenoid and drive housing to ensure proper solenoid installation (Figure 6).



A SOLENOID-TO-DRIVE HOUSING MATCHMARK
604 STARTER SOLENOID
614 DRIVE HOUSING EJS0066D2

Figure 6—Solenoid-to-Drive Housing Matchmark



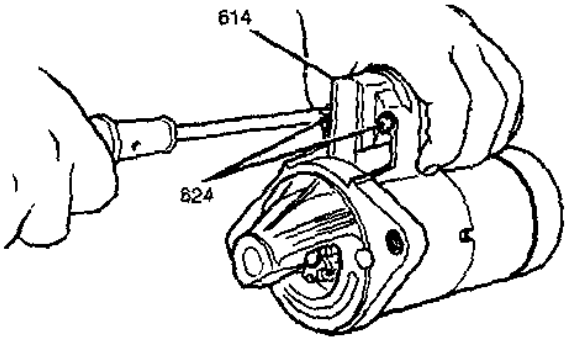
604 STARTER SOLENOID
612 FIELD COIL LEAD WIRE EJS0078D2

Figure 7—Removing Field Coil Lead Wire From Starter Solenoid

Remove or Disconnect

1. Retaining nut and field coil lead wire from starter solenoid (Figure 7).
2. Two solenoid attaching screws and starter solenoid from drive housing (Figure 8).

NOTICE: Do not disassemble the starter solenoid. If it is found to be defective, replace the solenoid.



614 DRIVE HOUSING
624 SOLENOID-TO-STARTER MOTOR ATTACHING SCREWS
EJS0086D2

Figure 8—Removing Starter Solenoid From Drive Housing

Inspect

- Plunger joint and spring for wear; replace as necessary (Figure 9).

Install or Connect

1. Lightly grease solenoid plunger with Lubriplate lubricant GM P/N 1050109, or equivalent.
2. Solenoid to drive housing aligning solenoid-to-drive housing matchmarks; secure with two screws (Figure 10).
3. Field coil lead wire to starter solenoid; secure with one nut.

Tighten

- Field coil lead wire nut to 15 N.m (11 lb. ft.).

NO-LOAD TEST

Figure 11

Install or Connect

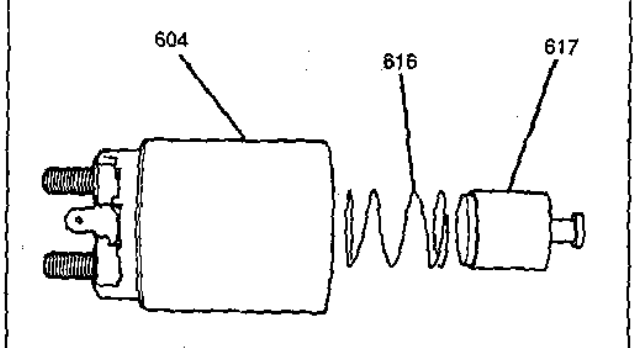
- Test leads from battery and ammeter to starter motor assembly (Figure 11).

Inspect

- That the starter motor runs smoothly and that the pinion extends quickly and completely.

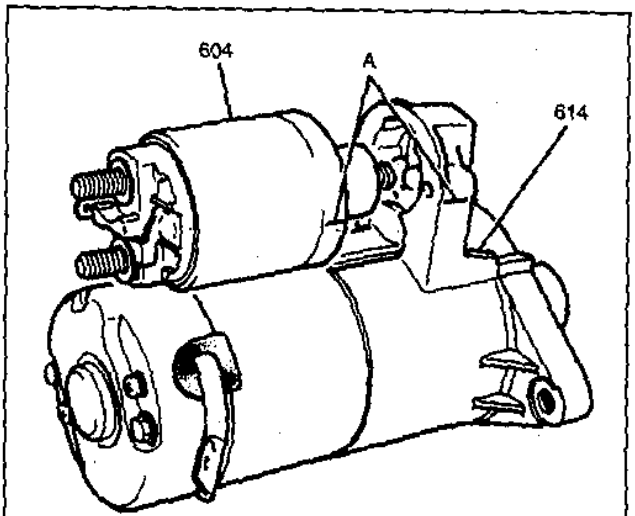
Measure

1. Starter motor current draw. Standard starter motor current draw at 11 volts is:
   - Manual transmission equipped vehicles - No more than 50 amperes.
   - Automatic transmission equipped vehicles - No more than 90 amperes.



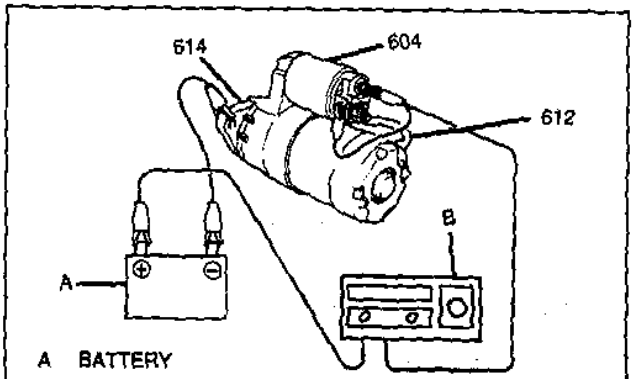
604 STARTER SOLENOID
616 SPRING
617 PLUNGER
EJS0096D2

Figure 9—Solenoid Assembly



A SOLENOID-TO-DRIVE HOUSING MATCHMARK
604 STARTER SOLENOID
614 DRIVE HOUSING
EJS0106D2

Figure 10—Installing Solenoid



A BATTERY
B AMMETER
604 STARTER SOLENOID
612 FIELD COIL LEAD WIRE
614 DRIVE HOUSING
EJS0116D2

Figure 11—No-Load Test

Evaluation

1. Low free speed and high current draw indicates:
   - Too much friction - tight, dirty or worn bushings, bent armature shaft allowing armature to drag.
   - Shorted armature. This can be further checked on a growler after disassembly.
   - Grounded armature or fields. Check further after disassembly.
2. Failure to operate and high current draw indicates:
   - A direct ground in the terminal or fields.
   - "Frozen" bearings.
3. Failure to operate and low or no current draw indicates:
   - Open solenoid windings.
   - Open field circuit. This can be checked after disassembly by inspecting internal connections.
   - Open armature coils. Inspect the commutator for badly burned bars after disassembly.
   - Broken brush springs, worn brushes, high insulation between the commutator bars or other causes which could prevent good contact between the brushes and commutator.
4. Low no-load speed and low current draw indicates:
   - High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under fault number 3.
5. High free speed and high current draw indicate shorted fields. If shorted fields are suspected, replace the field coil assembly. Also check for shorted armature using a growler.
6. Rated current draw and no-load speed indicate normal condition of starter motor assembly; reinstall starter motor assembly onto vehicle.

Install or Connect

1. Field coil lead wire to starter solenoid; secure with one nut.

Tighten

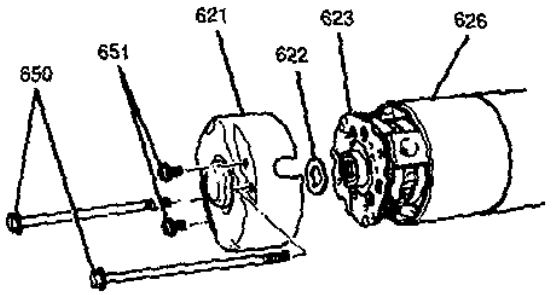
   - Field coil lead wire nut to 15 N·m (11 lb. ft.).
2. Starter motor assembly onto vehicle. Refer to "Starter Replacement" earlier in this section.

STARTER DISASSEMBLY

Figures 12 through 19

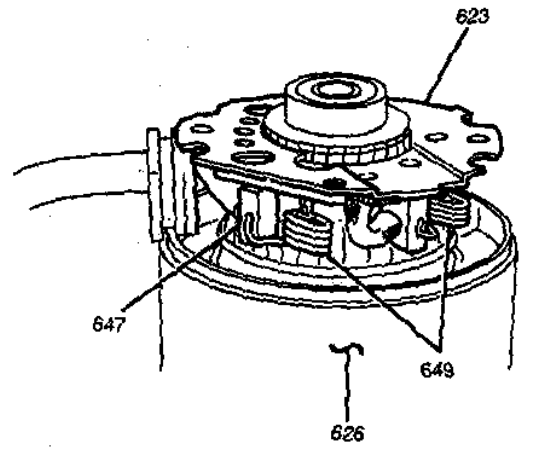
Remove or Disconnect

1. Starter solenoid from starter assembly. Refer to "Solenoid Replacement" earlier in this section.
2. Two bolts, two screws and commutator end housing from drive housing (Figure 12).
3. Brush holder and brushes from commutator end of armature (Figure 13).
4. Armature and starter motor yoke from drive housing (Figure 14).



621 COMMUTATOR END HOUSING
622 SPRING WASHER
623 BRUSH HOLDER
626 STARTER MOTOR YOKE
650 COMMUTATOR END HOUSING BOLTS
651 COMMUTATOR END HOUSING SCREWS EJS0128D2

Figure 12—Removing Commutator End Housing

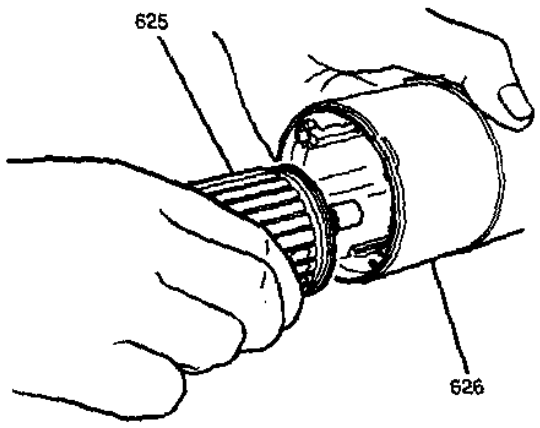


623 BRUSH HOLDER
626 STARTER MOTOR YOKE
647 BRUSHES
649 BRUSH SPRINGS EJS0138D2

Figure 13—Removing Brush holder and Brushes

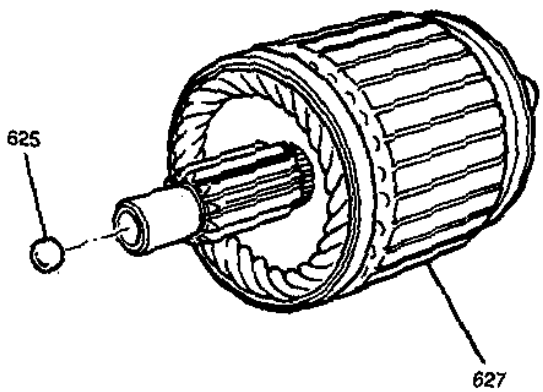
NOTICE: If the armature bearing comes out during the removal procedure, apply grease to it and reinsert (Figure 15).

5. Idle gear retainer and idle gears from gear shaft assembly (Figure 16).
6. Pinion drive lever seal and plate from drive housing (Figure 17).
7. Motor gear shaft assembly with pinion drive lever from drive housing (Figure 18).
8. Overrunning clutch retaining ring, stop ring and overrunning clutch from motor gear shaft (Figure 19).



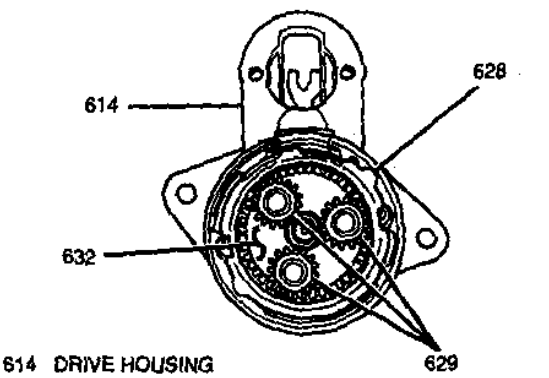
625 ARMATURE
626 STARTER MOTOR YOKE EJS0146D2

Figure 14—Removing Armature and Starter Motor Yoke



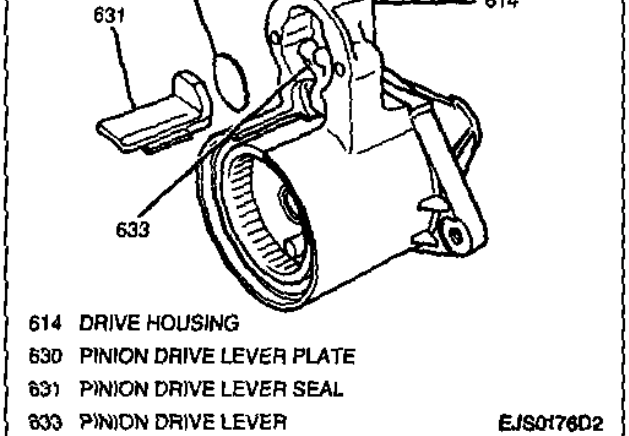
625 ARMATURE
627 ARMATURE BEARING EJS0156D2

Figure 15—Armature Bearing



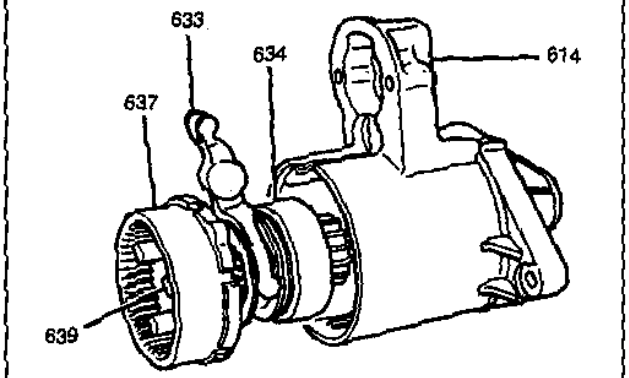
614 DRIVE HOUSING
628 IDLE GEAR RETAINER
629 IDLE GEARS (3)
632 GEAR SHAFT ASSEMBLY EJS0166D2

Figure 16—Removing Idle Gear Retainer and Idle Gears



614 DRIVE HOUSING
630 PINION DRIVE LEVER PLATE
631 PINION DRIVE LEVER SEAL
633 PINION DRIVE LEVER EJS0176D2

Figure 17—Removing Pinion Drive Lever Seal and Plate



614 DRIVE HOUSING
633 PINION DRIVE LEVER
634 OVERRUNNING CLUTCH
637 INTERNAL GEAR ASSEMBLY
639 MOTOR GEAR SHAFT EJS0186D2

Figure 18—Removing Motor Gear Shaft Assembly

CLEANING, INSPECTION AND TESTING

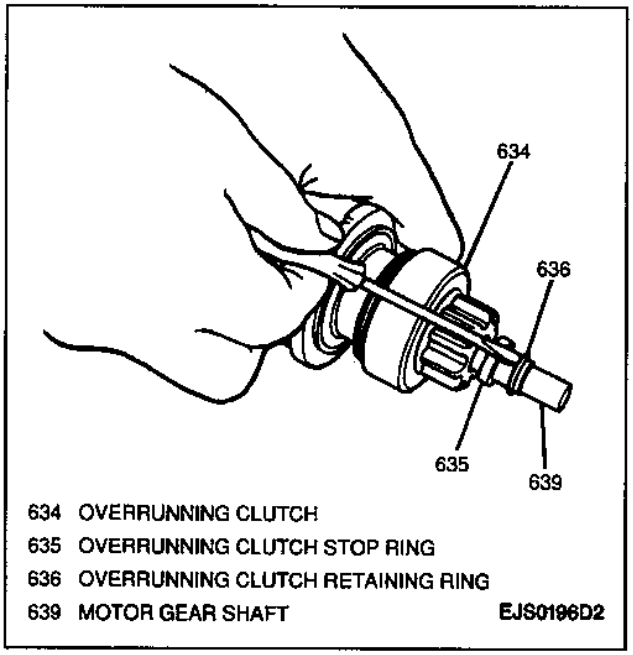
Figures 20 through 35

Tools Required:
J 544-01 Tension Scale
J 8001 Dial Indicator
J 26900-13 Magnetic Base
J 26900-5 Vernier Caliper
J 39200 Digital Multimeter

Clean

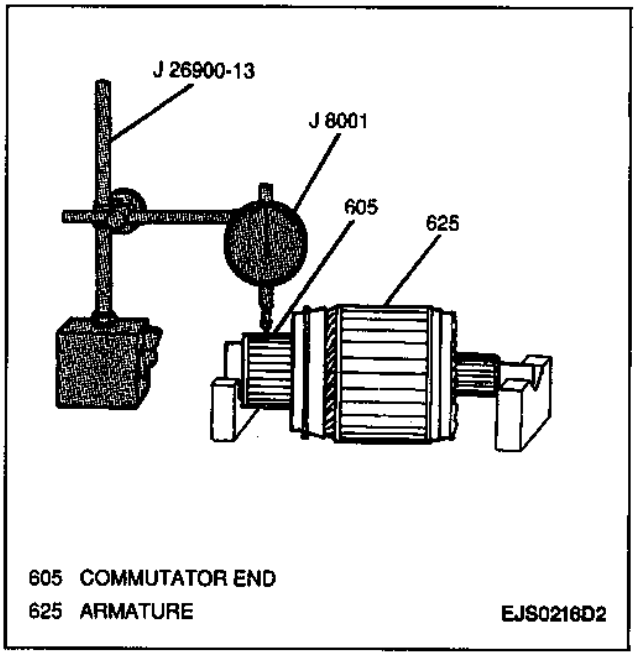
- All starter motor parts.

NOTICE: Do not use grease dissolving solvents for cleaning. Such solvents will dissolve the grease packed in the overrunning clutch and may damage the armature and field coil insulation.



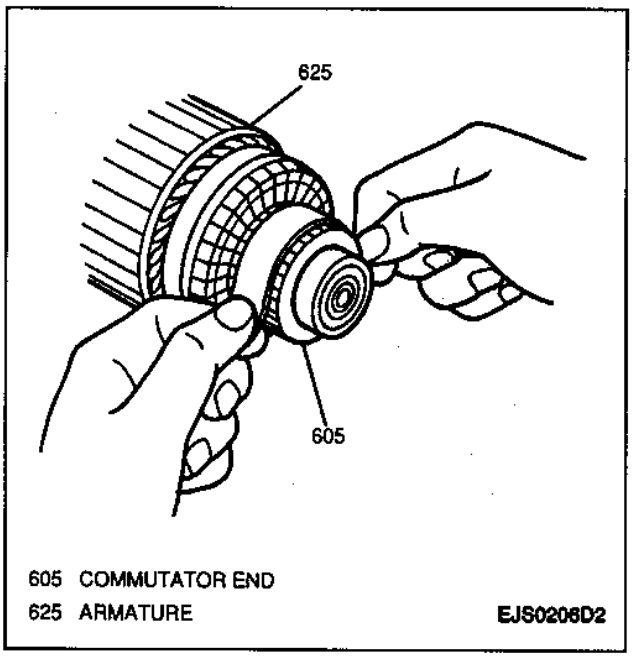
634 OVERRUNNING CLUTCH
635 OVERRUNNING CLUTCH STOP RING
636 OVERRUNNING CLUTCH RETAINING RING
639 MOTOR GEAR SHAFT EJS0196D2

Figure 19—Removing Overrunning Clutch



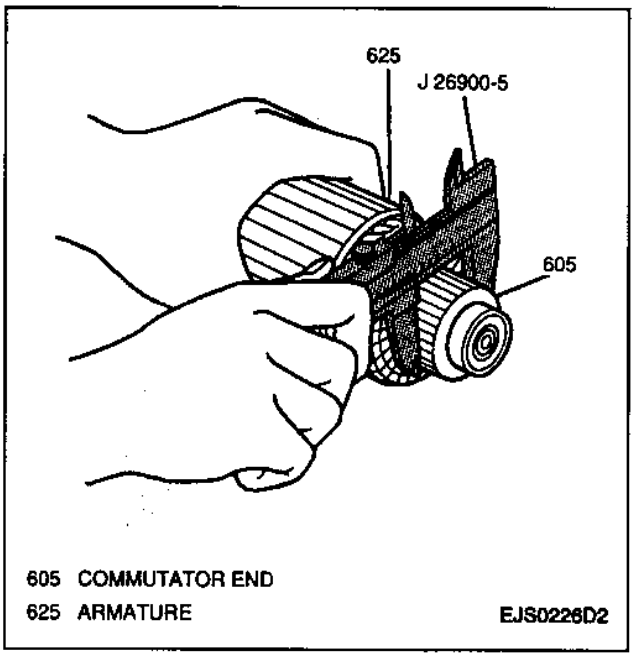
605 COMMUTATOR END
625 ARMATURE EJS0216D2

Figure 21—Measuring Commutator Run-Out



605 COMMUTATOR END
625 ARMATURE EJS0206D2

Figure 20—Cleaning Commutator



605 COMMUTATOR END
625 ARMATURE EJS0226D2

Figure 22—Measuring Commutator Wear

- Remove dirt and burn marks from the commutator end of the armature by sanding with a #300 or #400 grit sandpaper (Figure 20). Wipe parts with a clean shop cloth.

Measure

1. Place the armature onto a pair of "V-blocks." Using a J 8001 with a J 26900-13, measure commutator run-out (Figure 21). Standard commutator run-out is 0.05 mm (0.002-inch) or less. If run-out exceeds 0.40 mm (0.016-inch), replace the armature.
2. Commutator wear using a J 26900-5 to measure the outside diameter of the commutator (Figure 22). Standard commutator outside diameter is 29.4 mm (1.157-inches). If the outside diameter is less than 28.8 mm (1.134-inches), replace the armature.
3. Commutator insulation depth (Figure 23). Standard commutator insulation depth is 0.5 to 0.8 mm (0.020 to 0.031-inch). If insulation depth is less than 0.2 mm (0.008-inch), replace the armature.
4. Resistance between armature core and commutator using a J 39200 (Figure 24). If resistance is 5.0 ohms or less, the armature is grounded and must be replaced.

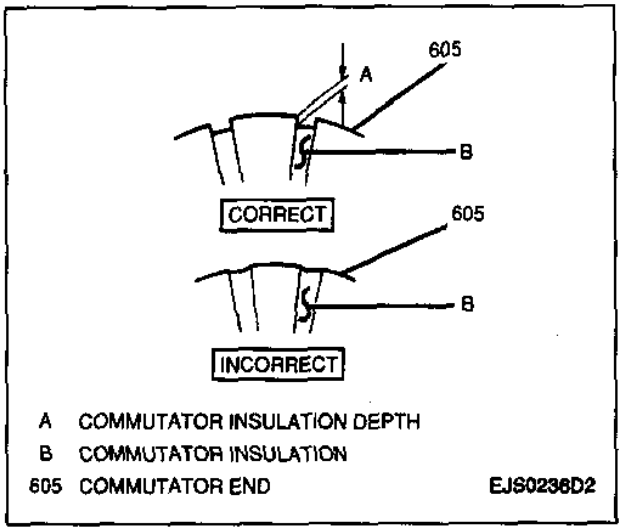


Figure 23—Measure Commutator Insulation Depth

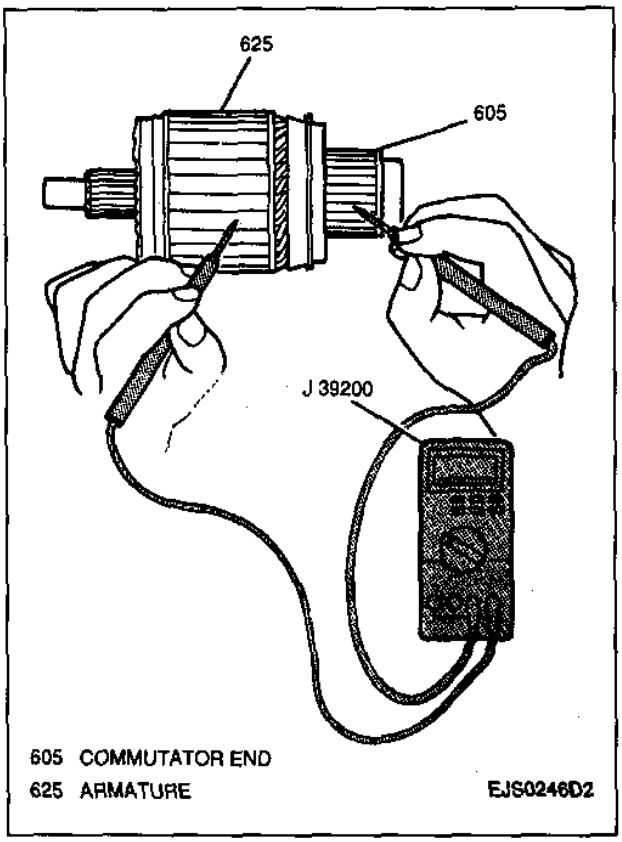


Figure 24—Measuring Armature Core-to-Commutator Resistance

5. Resistance between commutator segments using the J 39200 (Figure 25). If resistance is not 5.0 ohms or less at any test point, there is an open circuit in the commutator and the armature must be replaced.
6. Brush length using the J 26900-5 (Figure 26). Standard brush length is 17.5 mm (0.67-inch). If brush length is less than 12.0 mm (0.47-inch), replace the brush.
7. Resistance between positive brush holder and negative brush holder using the J 39200 (Figure 27). If the resistance is 5.0 ohms or less, the brush holder is grounded and must be replaced.
8. Brush spring tension using a J 544-01 (Figure 28). Standard tension is 1.9 kg (4.19 lbs.). If brush spring tension is less than 0.7 kg (1.54 lbs.), the brush spring must be replaced.
9. Starter solenoid pull-in coil resistance between terminal "S" and terminal "M" using the J 39200 (Figure 29). If resistance is not 5.0 ohms or less, the pull-in coil is open and the starter solenoid must be replaced.

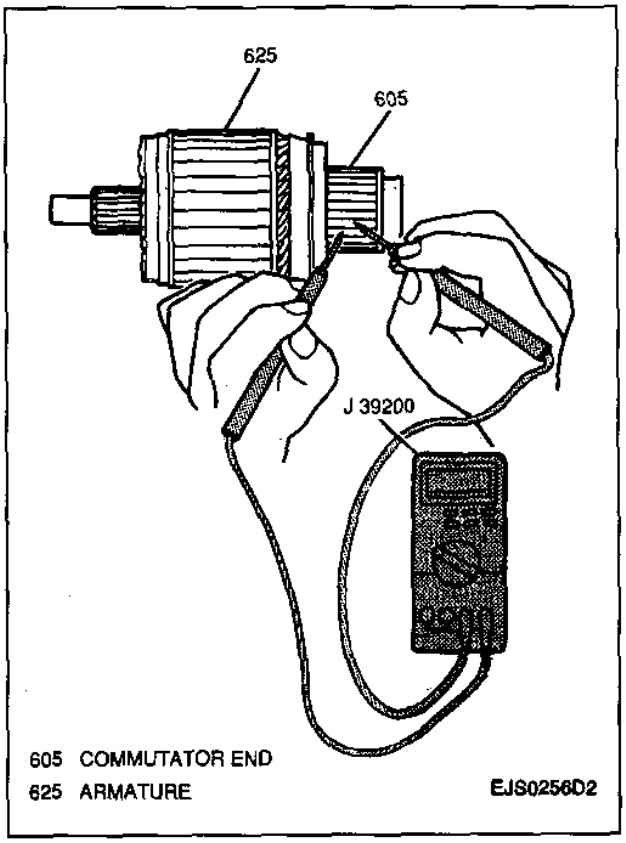


Figure 25—Measuring Commutator Resistance

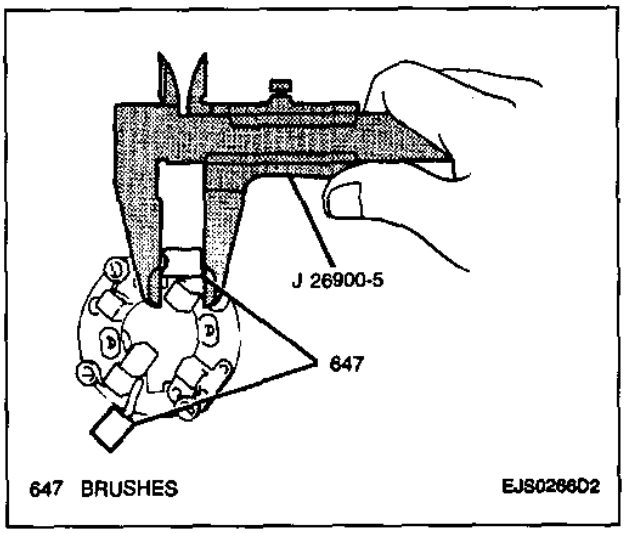


Figure 26—Measuring Brush Length

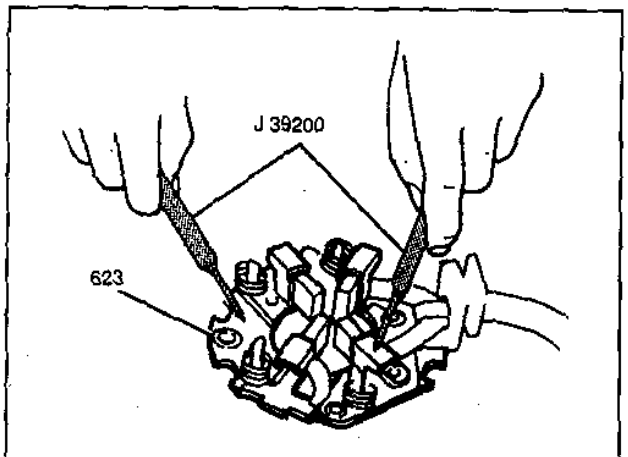


Figure 27—Measuring Brush Holder Resistance

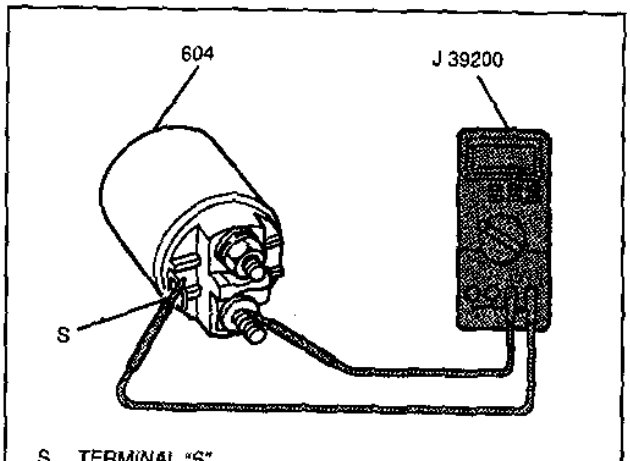


Figure 30—Measuring Starter Solenoid Hold-In Coil Resistance

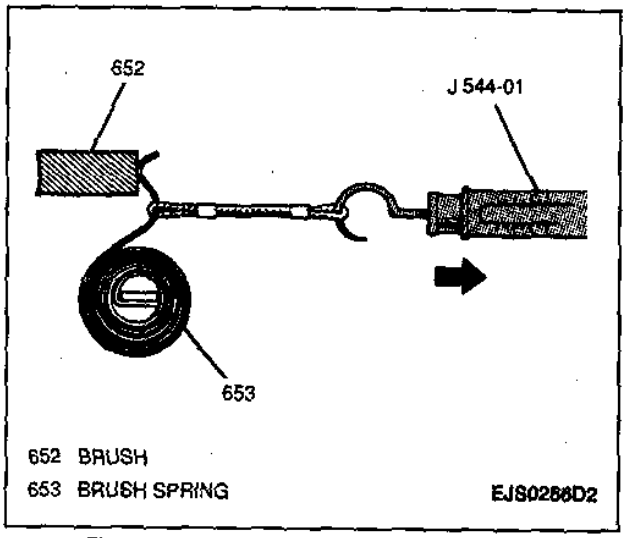


Figure 28—Measuring Brush Spring Tension

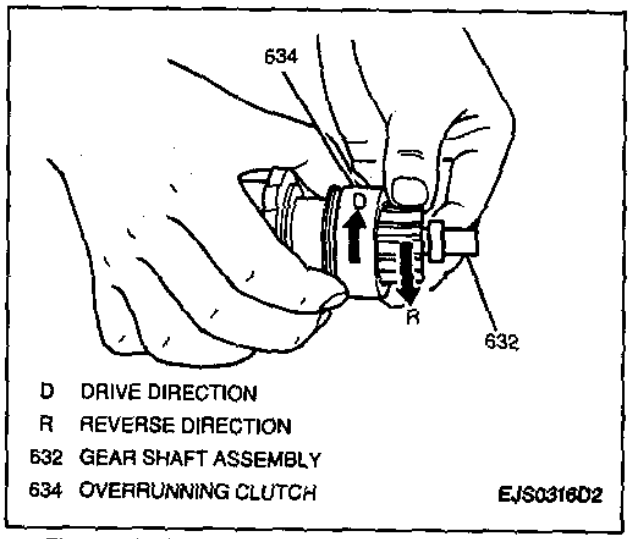


Figure 31—Inspecting Overrunning Clutch Operation

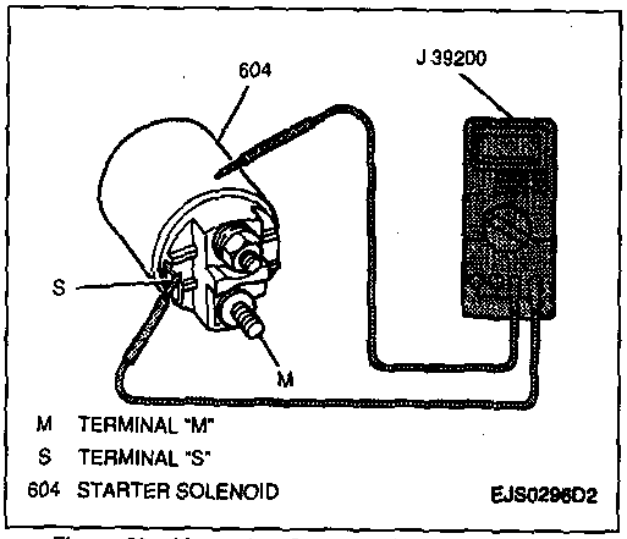
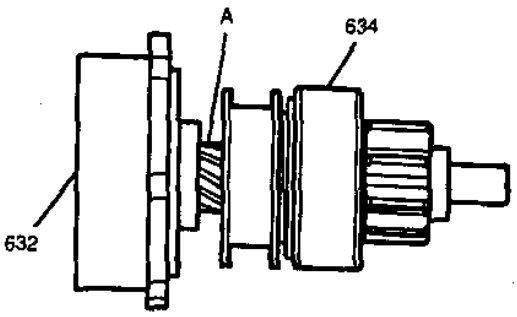


Figure 29—Measuring Starter Solenoid Pull-In Coil Resistance

10. Starter solenoid hold-in coil resistance between terminal "S" and the solenoid case using the J 39200 (Figure 30). If resistance is not 5.0 ohms or less, the hold-in coil is open and the starter solenoid must be replaced.

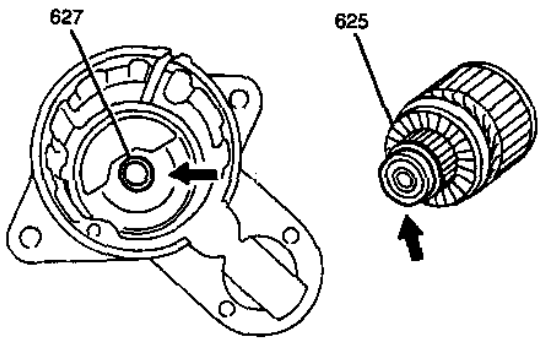
Inspect

1. Pinion drive lever for wear; replace as necessary.
2. Overrunning clutch for wear, damage or other abnormal conditions. Check that the clutch locks when turned in the drive direction and rotates smoothly in the reverse direction (Figure 31). Replace as necessary.
3. Overrunning clutch spline teeth for wear or damage; replace as necessary (Figure 32).
4. Armature bushing and bearing for wear and damage; replace as necessary (Figure 33).
5. Starter solenoid plunger by pressing the plunger in and releasing it (Figure 34). If the plunger does not return to its original position quickly, the starter solenoid must be replaced.



A OVERRUNNING CLUTCH SPLINE TEETH
632 GEAR SHAFT ASSEMBLY
634 OVERRUNNING CLUTCH EJS0326D2

Figure 32—Inspecting Overrunning Clutch Spline Teeth



625 ARMATURE
627 ARMATURE BEARING EJS0336D2

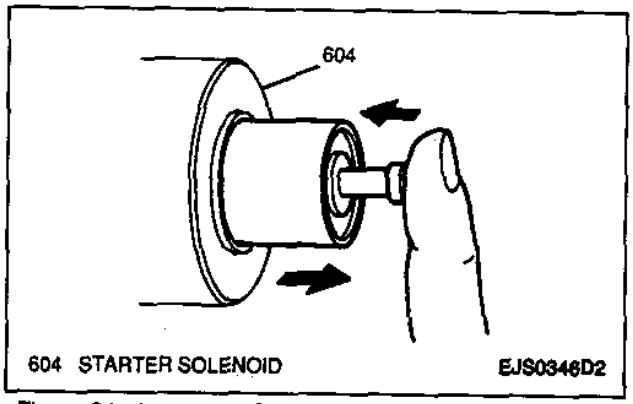
Figure 33—Inspecting Armature Bushing and Bearing

6. Internal gear assembly and idle gears for wear, damage or other abnormal conditions; replace as necessary (Figure 35).
7. Check the brush springs for corrosion or damage. Also check the brush holder and the insulation on the positive plates for wear. Replace components as needed.

STARTER ASSEMBLY

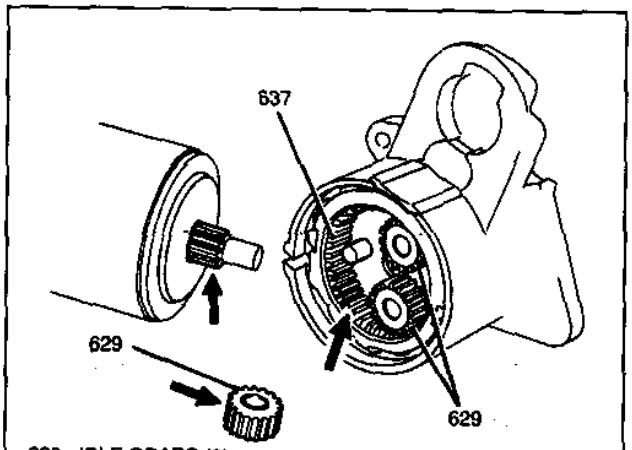
Install or Connect

1. Overrunning clutch to shaft; secure with new stop ring and retaining ring.
2. Motor gear shaft assembly and pinion drive lever to drive housing.
3. Pinion drive lever plate and seal to drive housing.
4. Idle gears and idle gear retainer to gear shaft assembly.



604 STARTER SOLENOID EJS0346D2

Figure 34—Inspecting Starter Solenoid Plunger Operation



629 IDLE GEARS (3)
637 INTERNAL GEAR ASSEMBLY EJS0356D2

Figure 35—Inspecting Internal Gear Assembly and Idle Gears

NOTICE: If the armature bearing comes out during removal, apply grease to it and reinsert (Figure 15).

5. Apply a light coating of Lubriplate lubricant GM P/N 1050109, or equivalent, to front and rear armature bearings.
6. Armature and starter motor yoke to drive housing.
7. Brushes, brush holder and spring washer to commutator end of armature, applying a light coating of Lubriplate lubricant GM P/N 1050109, or equivalent, to holder commutator end connection points.
8. Commutator end housing to drive housing; secure with two bolts and two screws.

Tighten

- Commutator end housing bolts to 30 N.m (22 lb. ft.).

9. Starter solenoid to starter motor assembly. Refer to "Solenoid Replacement" earlier in this section.

SPECIFICATIONS

FASTENER TORQUES

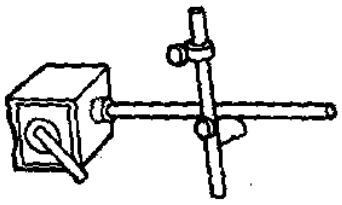
Starter Motor Assembly Lower Mounting Nut	30 N.m (22 lb. ft.)
Starter Motor Assembly Upper Mounting Bolt and Retaining Nut	30 N.m (22 lb. ft.)
Starter Solenoid Nut	15 N.m (11 lb. ft.)
Negative (-) Battery Cable-to-Negative (-) Battery Terminal Retainer	15 N.m (11 lb. ft.)
Field Coil Lead Wire Nut	15 N.m (11 lb. ft.)
Commutator End Housing Bolts	30 N.m (22 lb. ft.)

STARTER MOTOR USAGE

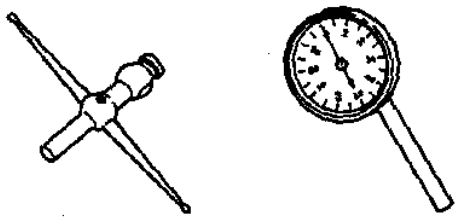
Voltage	12 volts
Output:	
Manual Transmission	1.2 kwatts
Automatic Transmission	1.4 kwatts
Rating	30 seconds
Direction of Rotation	Clockwise (as viewed from pinion)
Number of Pinion Teeth	9
Starter Solenoid Operating Voltage	8 volts min.
Starter Motor Current Draw	
No-Load:	
Manual Transmission	50 amps at 11 volts
Automatic Transmission	90 amps at 11 volts
Load:	
Manual Transmission (9.1 N.m /80.5 lb. in. of torque)	300 amps at 7.7 volts
Automatic Transmission (10.4 N.m /92 lb. in. of torque)	300 amps at 7.7 volts
Locked Rotor	
Manual Transmission (18.6 N.m /13.8 lb. ft.)	780 amps at 4 volts
Automatic Transmission (25.5 N.m /18.8 lb. ft.)	980 amps at 4 volts
Commutator Run-Out	
Standard	0.05 mm (0.002 in.)
Limit (Maximum)	0.40 mm (0.016 in.)
Commutator Outside Diameter	
Standard	29.4 mm (1.157 in.)
Limit (Minimum)	28.8 mm (1.134 in.)
Commutator Insulation Depth	
Standard	0.50-0.80 mm (0.020-0.031 in.)
Limit (Minimum)	0.20 mm (0.47 in.)
Brush Length	
Standard	17.5 mm (0.69 in.)
Limit (Minimum)	12.0 mm (0.47 in.)
Brush Spring Tension	
Standard	1.9 kg (4.19 lbs.)
Limit (Minimum)	0.7 kg (1.54 lbs.)

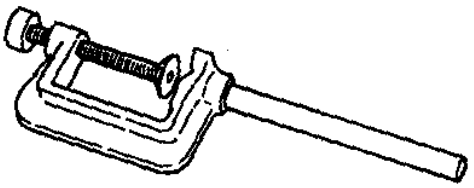
SPECIAL TOOLS

1
J 26900-13

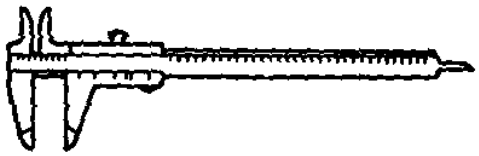


4
J 6001

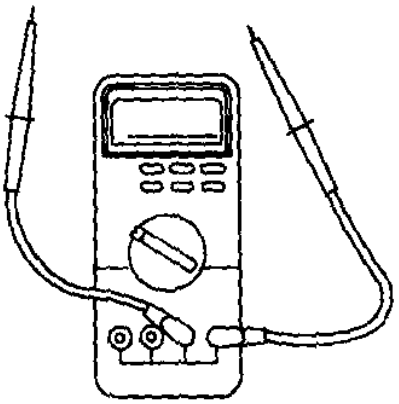




2
J 26900-5



5
J 39200



3
J 544-01

1 MAGNETIC BASE
2 VERNIER CALIPER
3 STEERING WHEEL TENSION SCALE
4 DIAL INDICATOR
5 DIGITAL MULTIMETER

EJS0366D2

SECTION 6D3

CHARGING SYSTEM

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in SECTION 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location View in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the negative (-) battery cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

CONTENTS

GENERAL DESCRIPTION

GENERATOR

All Geo Tracker models utilize an internal regulator charging system. The integrated circuit (IC) regulator is a solid state unit that is mounted inside the generator to the rear end frame. All regulator components are enclosed in a solid mold to protect them from heat and corrosive elements.

The generator rotor bearings contain enough grease to eliminate the need for periodic lubrication. Two brushes carry current through two slip rings to the field coil mounted on the rotor. Stator windings are assembled inside a laminated core that form part of the generator drive end frame. A rectifier bridge that contains 6 diodes is connected to stator windings. These diodes electrically change stator AC voltage into DC voltage. This DC voltage is then transmitted to the generator output terminal. Two neutral diodes are utilized to smooth out voltage fluctuations caused by varying generator speeds. A capacitor (condenser), mounted in the regulator, protects the rectifier bridge and neutral diodes. This capacitor also suppresses radio interference noise.

DIAGNOSIS

CAUTION: Never disconnect either battery terminal while the engine is running. Battery disconnection during engine operation will result in damage to electrical components.

FAULTY INDICATOR LAMP OPERATION

Check the charge indicator for normal operation. Refer to SECTION 8A-30. If the indicator is operating normally, proceed to the "Undercharged Battery" procedure in this section.

UNDERCHARGED BATTERY

Figure 1

Tool Required:
J 39200 Digital Multimeter

An undercharged battery is usually characterized by slow cranking or by a dark battery hydrometer. If this condition exists, check the following items for a cause:

1. Determine that the undercharged condition has not been caused by leaving accessories on for extended periods without charging the battery.
2. Check the drive belt for proper tension. Refer to "Generator Replacement" procedure later in this section.
3. If battery fault is suspected, refer to SECTION 6D1.
4. Inspect the wiring for faults. Check that all connections are clean and tight. Also check that all bulkhead connectors are tight and undamaged. Battery cable connections at the battery, starter and engine ground points should also be checked.
5. With all accessories turned off, connect a J 39200 across the battery. Run the engine at a moderate speed and check the voltage, taking into account the temperature the generator is exposed to during the test. As the temperature of the regulator case in the generator increases, the voltage output will decrease (Figure 1). The standard regulator voltage setting is 14.2 to 14.8 volts at 25°C (77°F). The minimum operating voltage should be 13.5 volts. If the voltage is at 13.5 volts or more, proceed to Step 6. If the voltage is less than 13.5 volts, remove the generator. Refer to "Generator Replacement" later in this section.
6. If Steps 1 through 5 have not produced satisfactory results, perform the following generator test:
   A. Disconnect the negative (-) battery cable.
   B. Remove the rubber protector, nut and generator battery terminal wire.
   C. Connect an ammeter between the generator and the disconnected wire. Connect the ammeter black lead to the wire and the ammeter red lead to the generator battery terminal.
   D. Connect a J 39200 between the generator battery terminal and chassis ground.
   E. Start and run engine at 2000 RPM. Turn all accessories and high-beam headlamps on. Turn the blower to HIGH. Ground the generator F terminal with a screwdriver.
   F. Adjust engine speed to obtain the maximum current output.
   G. If the current output is within 10 amperes of the maximum rating and the voltage reading is 13.5 to 16.0 volts, the generator is not faulty and is not the cause of an undercharged battery condition. Refer to "Generator Usage Chart" later in this section. If the current output is not within 10 amperes of the maximum rating, or the voltage reading is less than 13.5 volts, remove the generator. Refer to "Generator Replacement" later in this section.

OVERCHARGED BATTERY

1. Refer to SECTION 6D1 to determine the battery's condition.
2. If an obvious overcharge condition exists (as evidenced by spewing of electrolyte), check the field windings of the generator for shorts to grounds. If the field winding is faulty, replace the rotor and retest the generator for proper voltage output. Refer to "Disassembly, Test and Reassembly" later in this section.

VOLTAGE REGULATOR TEST

On-Vehicle

Tool Required:
J 39200 Digital Multimeter

1. Connect a fast charger and a J 39200 digital multimeter to the battery.
2. Turn the ignition switch to the "ON" position and slowly increase the charge rate. The charge indicator in the vehicle will begin to dim when the voltage setting is reached. The indicator should dim somewhere between 13.5 and 16.0 volts. If the test results are unsatisfactory, replace the voltage regulator. Refer to "Disassembly, Test and Reassembly" later in this section.

Off-Vehicle

Figure 1

Tool Required:
J 39200 Digital Multimeter

1. Remove the generator. Refer to "Generator Replacement" later in this section.
2. Remove the voltage regulator from the generator. Refer to "Disassembly, Test and Reassembly" later in this section.
3. Connect a J 39200 and a fast charger to a fully charged 12-volt battery.
4. Connect the voltage regulator battery terminal to the positive (+) battery terminal.
5. Connect a non-powered test lamp across the voltage regulator rotor terminals. If the test lamp lights, proceed to Step 6. If the test lamp does not light replace the voltage regulator. Refer to "Disassembly, Test and Reassembly" later in this section.

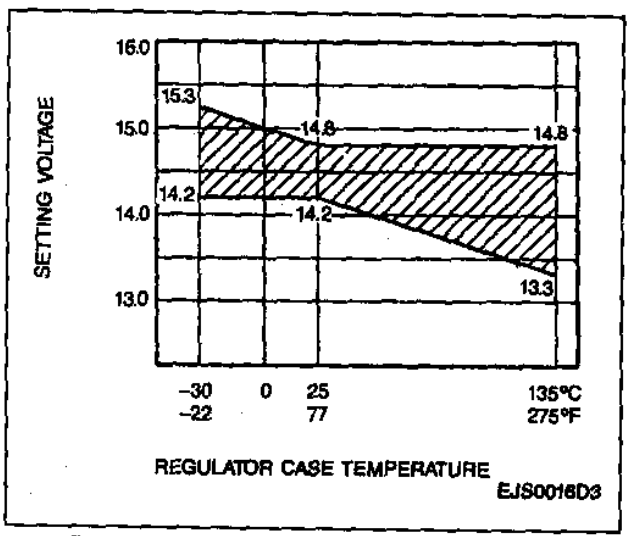


Figure 1—Regulator Setting Voltage -Voltage vs. Temperature

6. Turn the fast charger on. Observe the J 39200. The test lamp will begin to dim as the voltage regulator voltage setting is reached. The test lamp should go out at 13.5 to 16.0 volts. If the test results are satisfactory the voltage regulator is serviceable and should be reinstalled on the vehicle. If the test results are unsatisfactory, replace the voltage regulator. Refer to "Disassembly, Test and Reassembly" later in this section.

The test lamp is connected into the circuit exactly as the rotor would be when the regulator is inside the generator. The regulator interrupts the current to the test lamp when the regulator voltage setting is reached. Again, this voltage will vary slightly with temperature variations.

NOISY GENERATOR

Noise from a generator may be caused by a loose drive pulley, loose mounting bolts, worn or dirty bearings, or a defective stator. A high frequency whine (or magnetic noise) that is heard at full output is normal and should not be considered a generator failure.

ON-VEHICLE SERVICE

GENERATOR REPLACEMENT

Figures 2 and 3

Remove or Disconnect

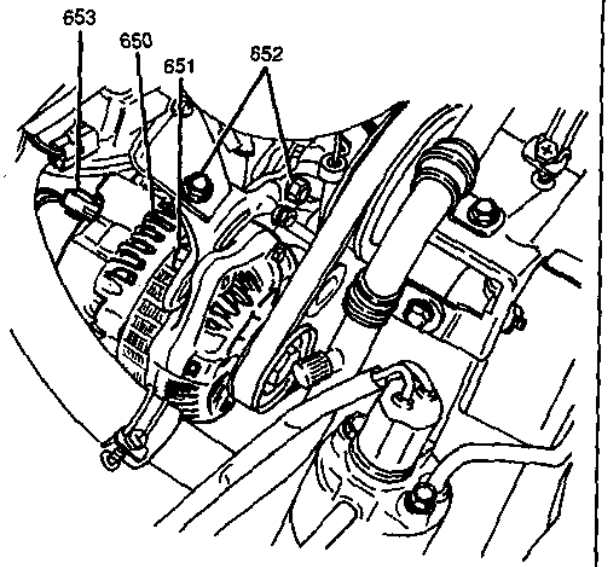
1. Negative (-) battery cable from negative (-) battery terminal.

CAUTION: Failure to observe Step 1 may result in a serious personal injury. If a tool is shorted at the generator lead, the tool will become hot enough to cause a serious burn.

2. Slide evaporative emission (EVAP) canister from mounting bracket at inner fender.
3. Loosen two lower generator pivot mounting bolts.
4. Drive belt adjusting bolt from mounting bracket and drive belt from vehicle.
5. Generator electrical connector from back of generator (Figure 2).
6. Rubber protector, nut and generator battery terminal wire from generator battery terminal.
7. Two upper generator mounting bracket bolts (Figure 2).
8. Two lower generator pivot mounting bolts and generator from vehicle.

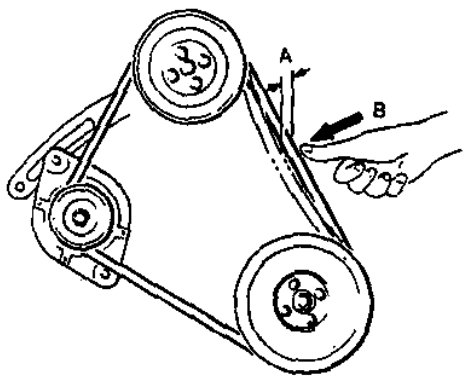
Install or Connect

1. Generator to vehicle; secure with two lower generator pivot mounting bolts. Do not tighten fully.
2. Two upper generator mounting bracket bolts.



650 GENERATOR
651 DRIVE BELT ADJUSTING BOLT
652 GENERATOR MOUNTING BRACKET BOLTS
653 GENERATOR ELECTRICAL CONNECTOR
EJS0026D3

Figure 2—Removing Generator



A USED BELT: 6–8 mm (0.24–0.31")
NEW BELT: 5–7 mm (0.20–0.27")
B 10 kg (22 lbs.)
EJS0036D3

Figure 3—Drive Belt Tension

Tighten

- Generator upper mounting bracket bolts to 27 N·m (20 lb. ft.).

3. Drive belt adjusting bolt to upper mounting bracket. Do not tighten fully.
4. Drive belt to generator pulley.

Adjust

- Drive belt to obtain a 6 to 8 mm (0.24 to 0.31-inch) deflection with 10 kg (22 lbs.) pressure exerted when reinstalling a used belt (Figure 3).
- Drive belt to obtain a 5 to 7 mm (0.20 to 0.27-inch) deflection with 10 kg (22 lbs.) pressure exerted when reinstalling a new belt (Figure 3).

Tighten

- Drive belt adjusting bolt to 33 N.m (24 lb. ft.).
- Generator lower pivot mounting bolts to 33 N.m (24 lb. ft.).

5. Generator electrical connector to back of the generator.
6. Generator battery terminal wire; secure with one nut.

Tighten

- Generator battery terminal retaining nut to 10 N.m (89 lb. in.).

7. Reposition rubber protector over generator battery terminal.
8. EVAP canister to mounting bracket at inner fender.
9. Negative (-) battery cable to negative (-) battery terminal.

Tighten

- Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N.m (11 lb. ft.).

UNIT REPAIR

DISASSEMBLY, TEST AND REASSEMBLY

Figures 4 through 23

Remove or Disconnect

Tool Required:
J 22912-01 Bearing Remover

1. Scribe matchmarks on the front and rear housing to ensure proper assembly (Figure 5).
2. Four generator housing bolts from front housing (Figure 6).
3. Using a flat-bladed tool, gently pry off the front housing (with drive pulley and rotor) from the stator coil and rear housing (Figure 7).
4. Place the front housing and rotor into a vise, facing the drive pulley up.

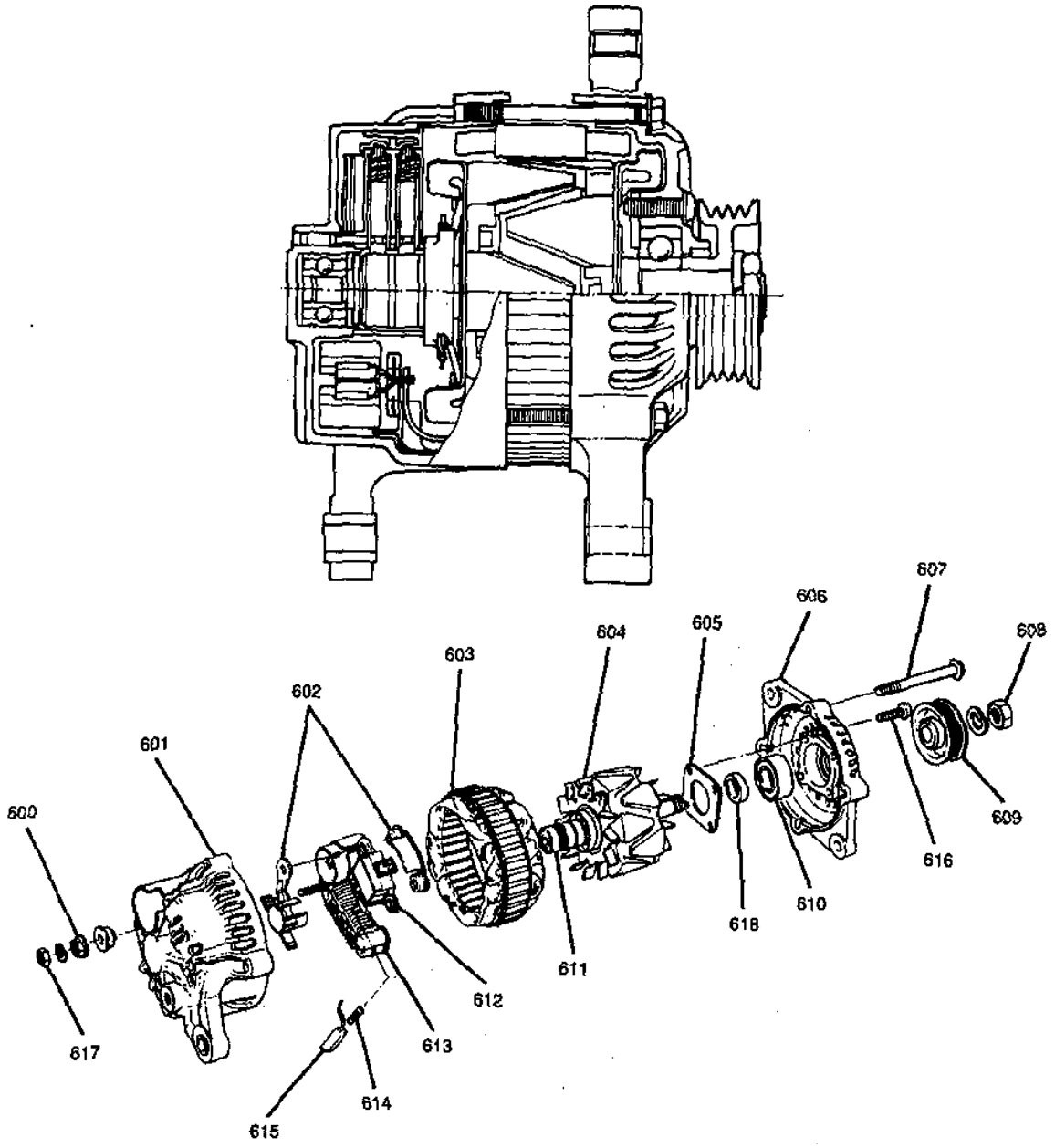
NOTICE: To prevent damage to the rotor, place clean shop cloths between the rotor and vise.

5. Drive pulley retaining nut.
6. Drive pulley washer and drive pulley from rotor.
7. Front housing and rotor from vise.
8. Rotor and spacer from front housing.
9. Four screws, front bearing retainer and front bearing from front housing (Figure 8).
10. Rear bearing from rotor using a J 22912-01 and a press (Figure 9).
11. Battery terminal retaining nut from rear housing (Figure 10).
12. Stator leads from rectifier using a soldering iron.
13. Four retaining screws and stator from rear housing (Figure 11).
14. One nut and rectifier from rear housing.
15. Regulator and brush holder from rear housing.
16. Brush holder from regulator.
17. Brushes from regulator (Figure 12).
    A. Remove brush lead wire cover.
    B. Using a soldering iron, heat and disconnect brush lead wires from regulator terminals.
    C. Remove brushes and brush springs from regulator.

Measure

Tools Required:
J 39200 Digital Multimeter
J 26900-5 Vernier Caliper

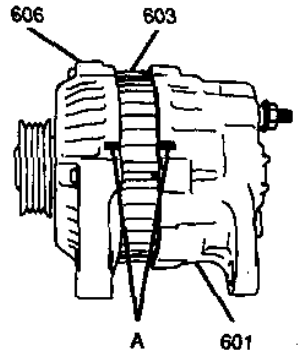
1. Resistance between the rotor slip rings using a J 39200 (Figure 13). If resistance is greater than 3.5 ohms, replace the rotor.
2. Resistance between the rotor slip ring and the rotor using the J 39200 (Figure 14). If resistance is less than 5 ohms, replace the rotor.
3. Resistance between all stator leads using the J 39200 (Figure 15). If resistance is greater than 5 ohms for any measurement, replace the stator.
4. Resistance between all stator leads and the stator core using the J 39200 (Figure 16). If resistance is less than 5 ohms, replace the stator.
5. Length of each brush using a J 26900-5. Standard brush length is 16 mm (0.63-inch) (Figure 17). If the length is more than 2 mm (0.08-inch) from the standard length, replace the brush.
6. Resistance between rectifier upper body and each diode lead using the J 39200 (Figure 18). Reverse the probes and measure resistance again. If resistance is not less than 5 ohms in one measurement and greater than 5 ohms in the other measurement, replace the rectifier.
7. Resistance between rectifier lower body and each diode lead using the J 39200 (Figure 19). Reverse the probes and measure resistance again. If resistance is not less than 5 ohms in one measurement and greater than 5 ohms in the other measurement, replace the rectifier.



600 BATTERY TERMINAL RETAINING NUT
601 REAR HOUSING
602 BRUSH HOLDER
603 STATOR
604 ROTOR
605 FRONT BEARING RETAINER
606 FRONT HOUSING
607 GENERATOR HOUSING BOLT (4)
608 DRIVE PULLEY RETAINING NUT
609 DRIVE PULLEY
610 FRONT BEARING
611 REAR BEARING
612 REGULATOR
613 RECTIFIER
614 BRUSH SPRING (2)
615 BRUSH (2)
616 FRONT BEARING RETAINING SCREW (4)
617 "BAT" TERMINAL RETAINING NUT
618 FRONT BEARING SPACER

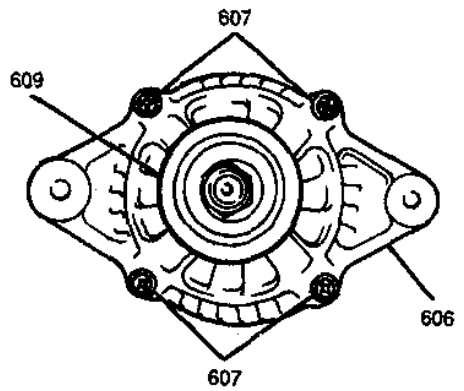
EJS0046D3

Figure 4—Generator Assembly



A GENERATOR HOUSING MATCHMARKS
601 REAR HOUSING
603 STATOR
606 FRONT HOUSING
EJS0056D3

Figure 5—Generator Housing Matchmarks



606 FRONT HOUSING
607 GENERATOR HOUSING BOLTS
609 DRIVE PULLEY
EJS0066D3

Figure 6—Generator Housing Bolts

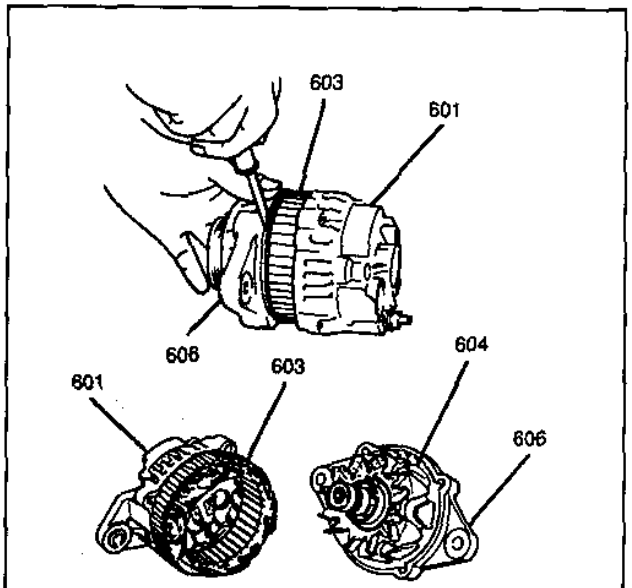
8. Resistance between both leads of each rectifier diode trio using the J 39200 (Figure 20). Reverse the probes and measure resistance again. If resistance is not less than 5 ohms in one measurement and greater than 5 ohms in the other measurement, replace the rectifier.
9. Condenser capacity using a digital capacitor meter (Figure 21). If condenser capacity is not 0.5°F, replace the rectifier.

Inspect

- Rotor slip rings for roughness or scoring. If slip rings are rough or scored, replace the rotor.

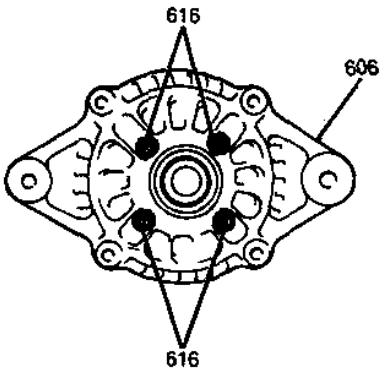
Install or Connect

1. Brushes to regulator (Figure 22).
   A. Install brush springs and brushes to regulator so that the label on each brush is 2 to 3 mm (0.008 to 0.012-inch) from the rectifier.
   B. Solder brush lead wires to regulator terminals.
   C. Install brush lead wire cover.



601 REAR HOUSING
603 STATOR
604 ROTOR
606 FRONT HOUSING
EJS0076D3

Figure 7—Removing Front Housing (With Drive Pulley and Rotor)



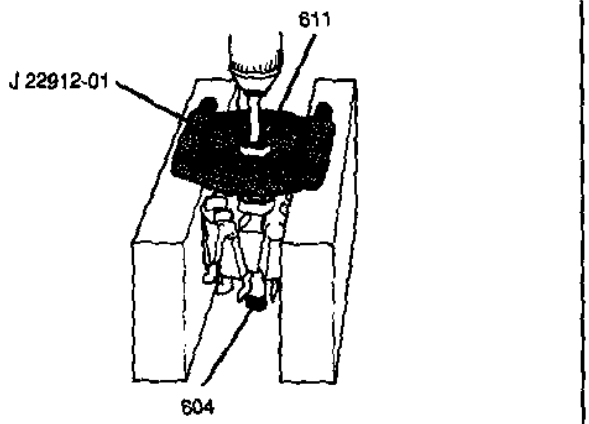
606 FRONT HOUSING
616 FRONT BEARING RETAINER SCREWS
EJS0086D3

Figure 8—Front Bearing Retainer Screws

2. Brush holder to regulator.
3. Regulator and brush holder to rear housing.
4. Remove hole plug from rear housing.
5. Support brushes with a wire inserted through the hole in the rear housing (Figure 23).
6. Rectifier to rear housing; secure with one nut.

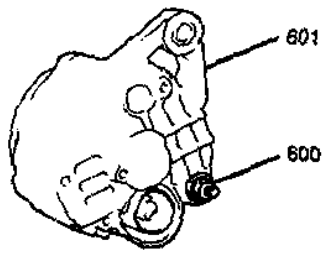
Tighten

- Generator rectifier nut to 33 N.m (24 lb. ft.).



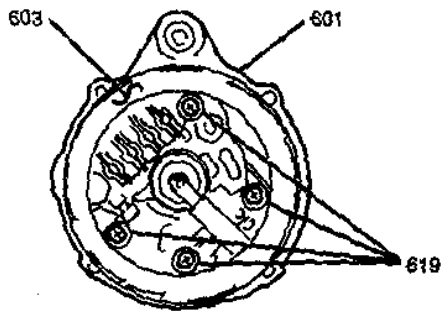
604 ROTOR
611 REAR BEARING EJS0096D3

Figure 9—Removing Rear Bearing



600 BATTERY TERMINAL RETAINING NUT
601 REAR HOUSING EJS0106D3

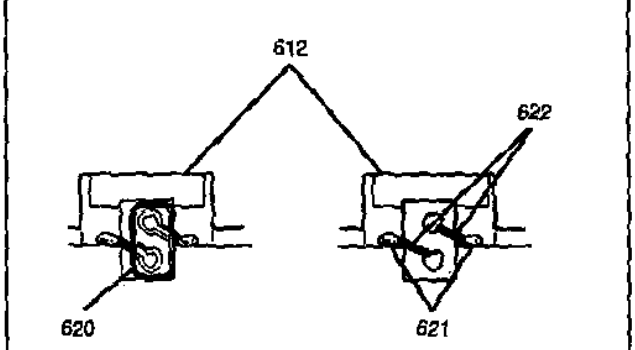
Figure 10—Battery Terminal Retaining Nut



601 REAR HOUSING
603 STATOR
619 STATOR RETAINING SCREWS EJS0116D3

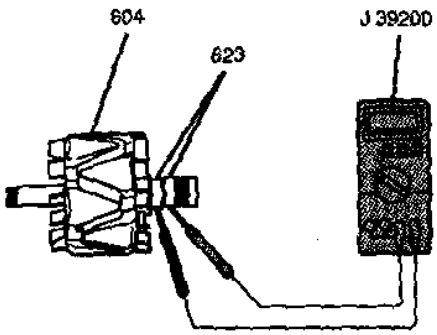
Figure 11—Stator Retaining Screws

7. Stator to rear housing; secure with four retaining screws.
8. Solder stator leads to rectifier.
9. Battery terminal retaining nut to rear housing.



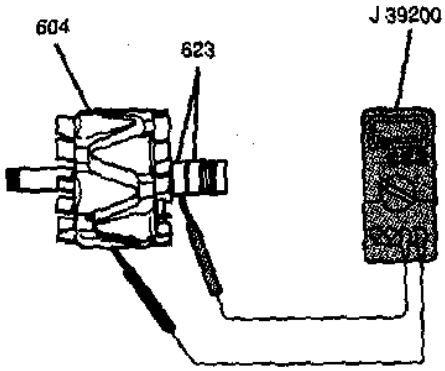
612 REGULATOR
620 BRUSH LEAD WIRE COVER
621 REGULATOR TERMINALS
622 BRUSH LEAD WIRES EJS0126D3

Figure 12—Removing Brushes From Regulator



604 ROTOR
623 ROTOR SLIP RINGS EJS0136D3

Figure 13—Measuring Rotor Slip Ring Resistance



604 ROTOR
623 ROTOR SLIP RINGS EJS0146D3

Figure 14—Measuring Rotor Slip Ring to Rotor Resistance

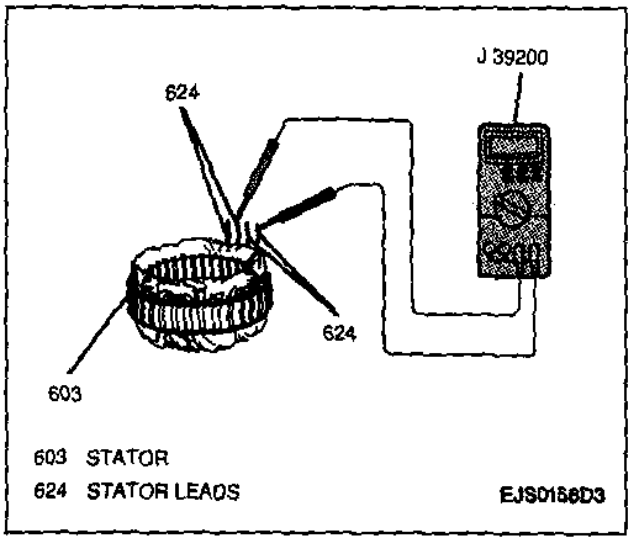


Figure 15—Measuring Stator Lead Resistance

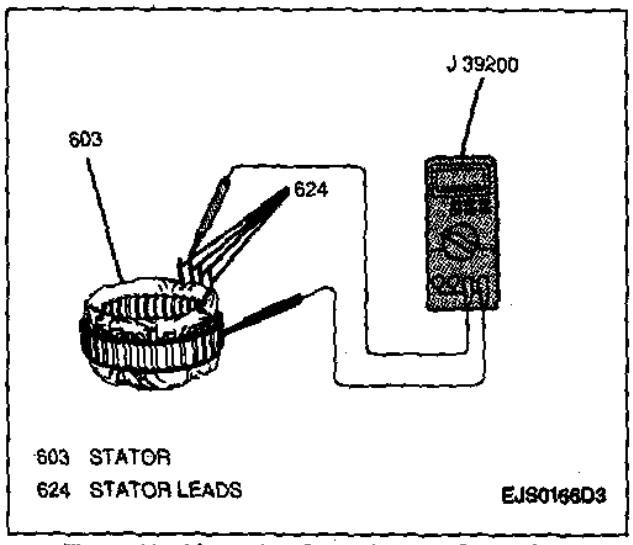


Figure 16—Measuring Stator Lead-to-Stator Core *Resistance*

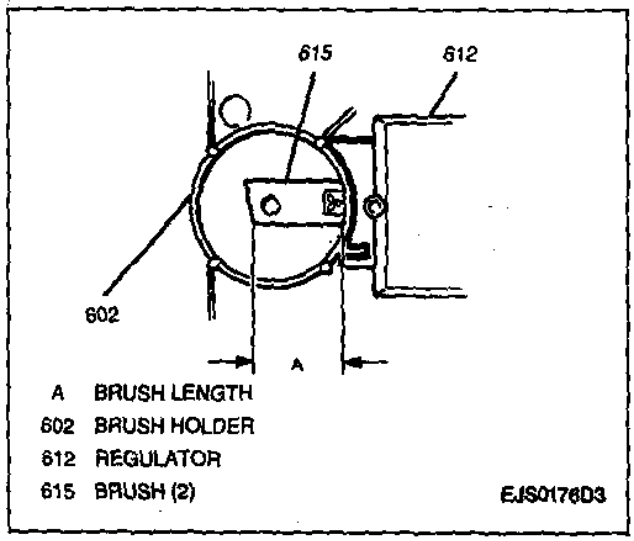


Figure 17—Measuring Brush Length

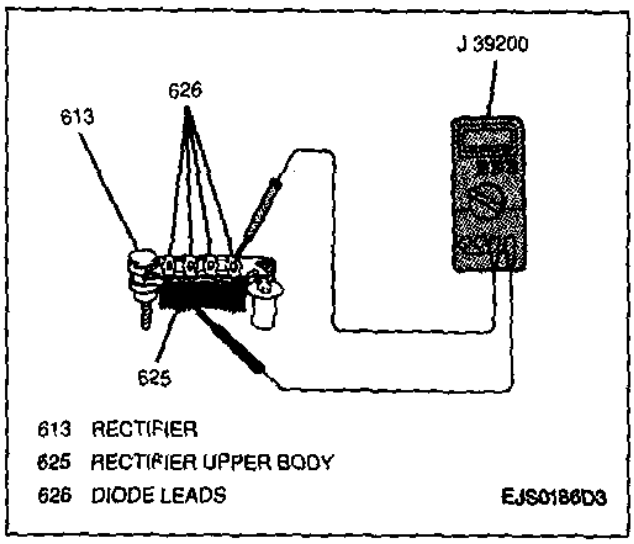


Figure 18—Measuring Rectifier Upper Body-to-Diode Lead Resistance

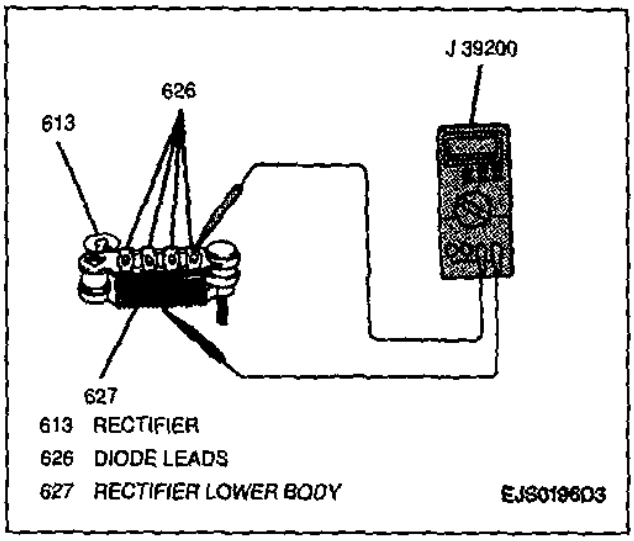


Figure 19—Measuring Rectifier Lower Body-to-Diode Lead Resistance

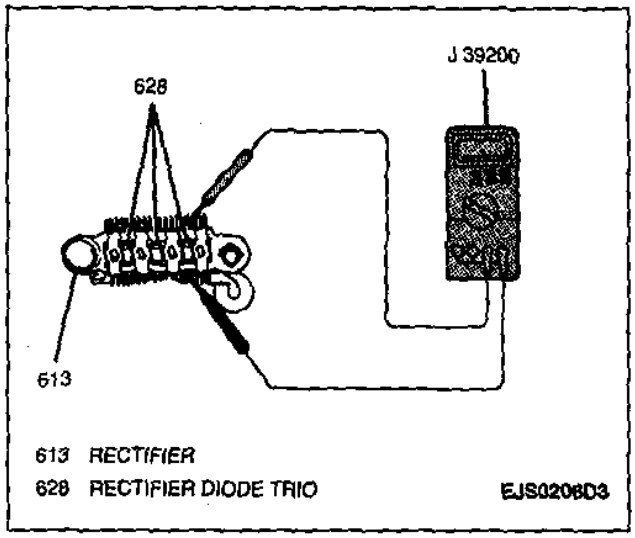
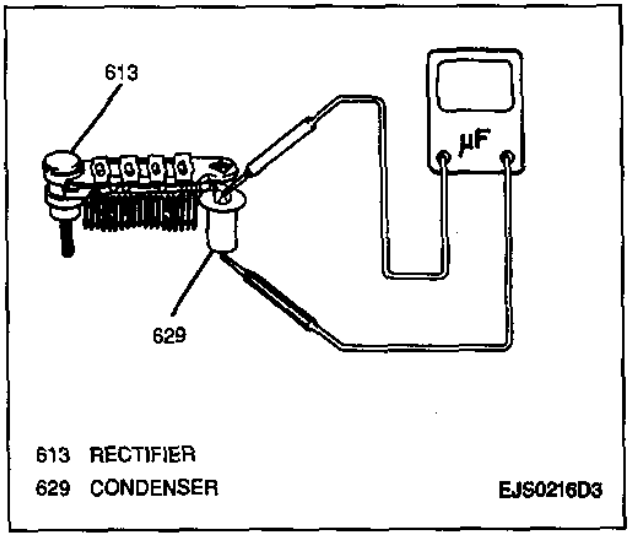
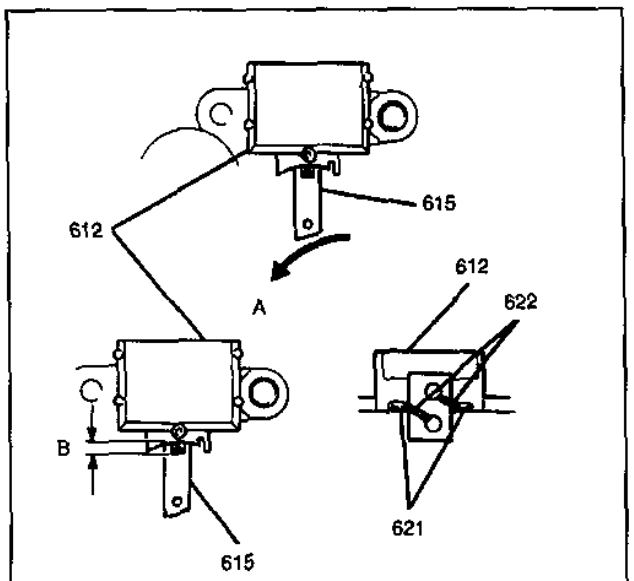


Figure 20—Rectifier Diode Trio Resistance



613 RECTIFIER
629 CONDENSER EJS0216D3

Figure 21—Measuring Condenser Capacity



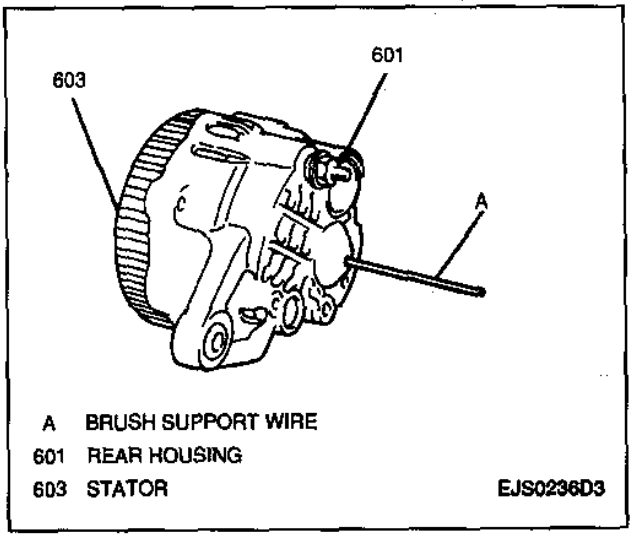
A ROTOR ROTATION DIRECTION
B 2-3 mm (0.008-0.012")
612 REGULATOR
615 BRUSH (2)
621 REGULATOR TERMINALS
622 BRUSH LEAD WIRES EJS0226D3

Figure 22—Installing Brushes to Regulator

Tighten

- Battery terminal retaining nut to 10 N.m (89 lb. in.).

10. Rear bearing to rotor.
11. Front bearing and front bearing retainer to front housing; secure with four screws.
12. Rotor with spacer to front housing.
13. Place the front housing and rotor into a vise, facing the drive pulley end up.



A BRUSH SUPPORT WIRE
601 REAR HOUSING
603 STATOR EJS0236D3

Figure 23—Supporting Brushes With Wire

NOTICE: To prevent damage to the rotor, place clean shop cloths between the rotor and vise.

14. Drive pulley and drive pulley washer to rotor; secure with retaining nut.

Tighten

- Drive pulley retaining nut to 65 N.m (48 lb. ft.).

15. Remove the front housing and rotor from the vise.
16. Using a heat gun, heat the rear housing to approximately 50 to 60° C (122 to 140° F).
17. Front housing (with drive pulley and rotor) to stator coil and rear housing, aligning generator housing matchmarks; secure with four generator housing bolts.

Tighten

- Generator housing bolts to 30 N.m (22 lb. ft.).

18. Remove the brush support wire and install the hole plug into the rear housing.

Inspect

- Make sure that the rotor rotates smoothly by turning the drive pulley.

SPECIFICATIONS

FASTENER TORQUES

Generator Lower Pivot Mounting Bolts	33 N·m (24 lb. ft.)
Generator Upper Mounting Bracket Bolts	27 N·m (20 lb. ft.)
Drive Pulley Retaining Nut	65 N·m (48 lb. ft.)
Generator Housing Bolts	17 N·m (10 lb. ft.)
Drive Belt Adjusting Bolt	33 N·m (24 lb. ft.)
Battery Terminal Retaining Nut	10 N·m (89 lb. in.)
Negative (-) Battery Cable-to-Negative Battery Terminal Retainer	15 N·m (11 lb. ft.)
Generator Rectifier Nut	33 N·m (24 lb. ft.)

GENERATOR USAGE CHART

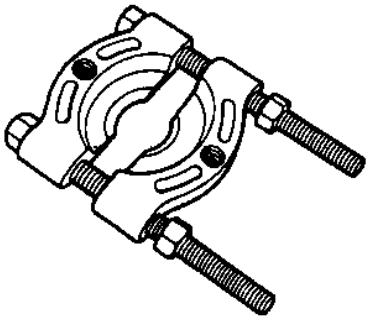
Normal Operating Voltage	12 Volts
Maximum Generator Output	55 amps
Polarity	Negative (-) Ground
No-Load Generator Speed	1100 rpm
Regulator Voltage	14.7 - 15.0 Volts
Direction of Rotation	Clockwise as viewed from pulley side
Maximum Generator Speed	18,000 rpm
Temperature Range	30 to 90°C (-22 to 194°F)
Brush Length Standard	16 mm (0.63 in.)
Limit (Minimum)	2 mm (0.08 in.)
Condenser Capacity	0.5 uF

DRIVE BELT TENSION

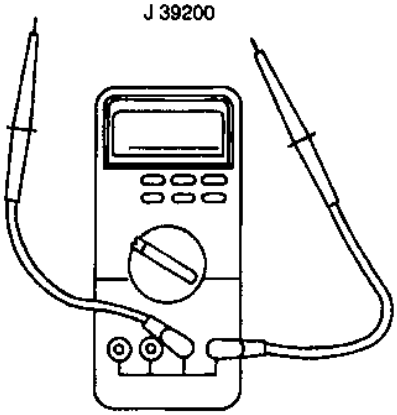
Drive Belt Deflection (New Belt)	5-7 mm (0.20-0.27 in.) 10 Kg (22 lbs.)
Drive Belt Deflection (Used Belt)	6-8 mm (0.24-0.31 in.) 10 Kg (22 lbs.)

SPECIAL TOOLS

1
J 22912-01



3
J 39200



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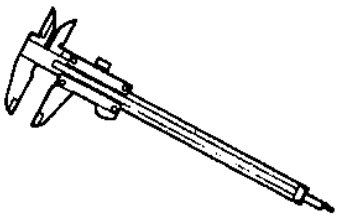
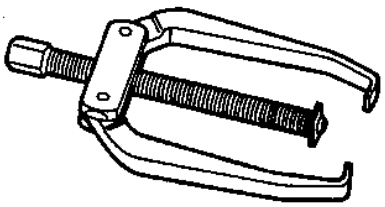


4
J 28509-A



5
J 38276

1 BEARING REMOVER
2 VERNIER CALIPER
3 DIGITAL MULTIMETER
4 PULLER
5 PULLER ADAPTER

EJS0246D3

SECTION 6D4

IGNITION SYSTEM

CAUTION: This vehicle is equipped with a Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR component and wiring Locations View in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury or otherwise unneeded SIR repairs.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct sequence and tightening specifications. Following these instructions can help you avoid damage to parts and systems.

CONTENTS

GENERAL DESCRIPTION

The ignition circuit consists of the battery, distributor, ignition switch, igniter, spark plugs and primary and secondary wiring. This vehicle uses an ignition control (IC) system which is monitored and controlled by the engine control module (ECM).

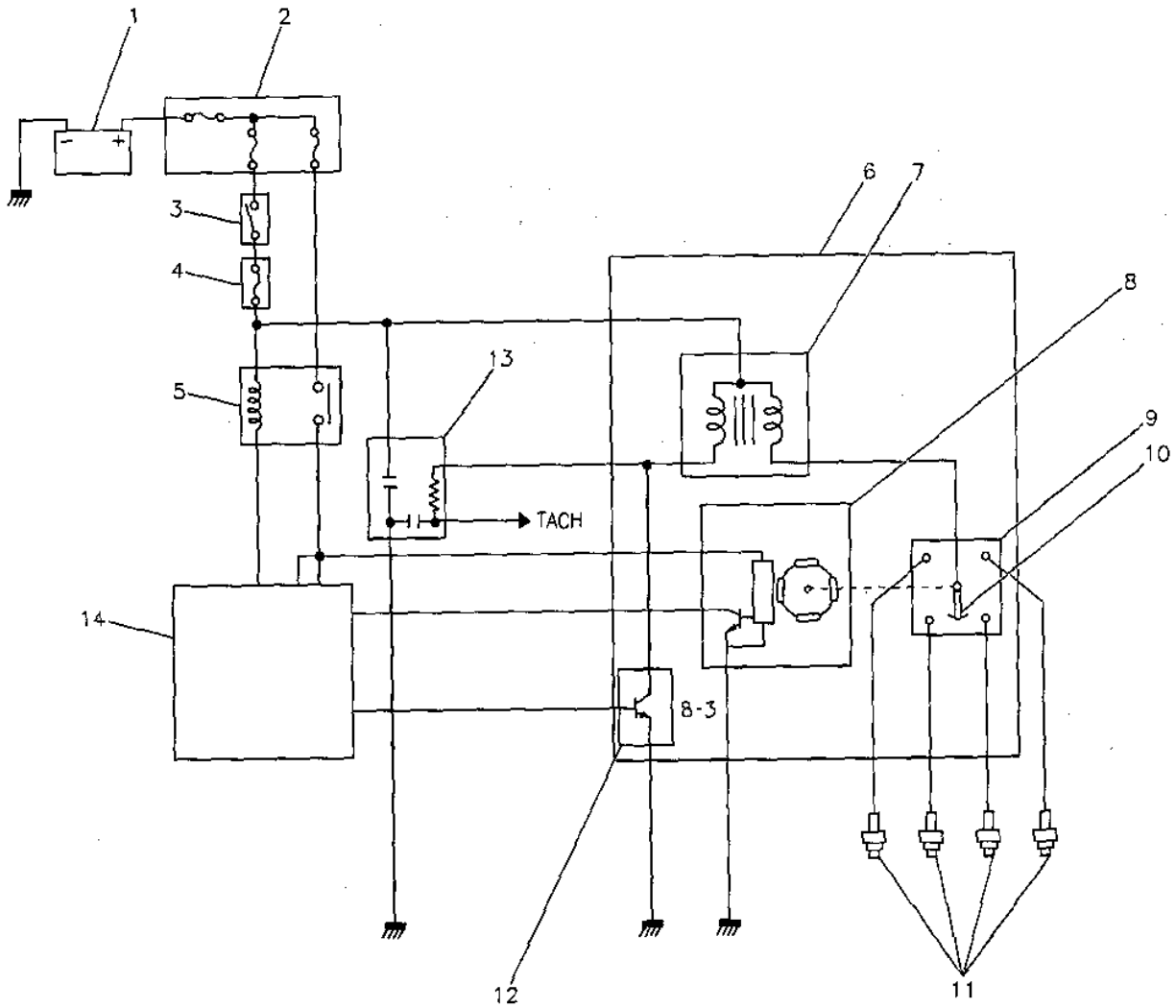
DISTRIBUTOR IGNITION SYSTEM

Figure 1

The distributor used within the ignition system consists of a signal generator (signal rotor and camshaft position [CMP] sensor) and rotor. All spark timing changes in the distributor are performed electronically by the ECM. The ECM monitors information from various engine sensors, computes desired spark timing, and signals the distributor to change the timing accordingly. No vacuum or mechanical advance mechanisms are used. The ignition system also includes a noise suppressor filter to eliminate ignition sound. The noise suppressor filter also provides the tachometer (if equipped) with an ignition signal.

SECONDARY WIRING

The spark plug wiring used with the ignition system withstands high temperatures and provides an excellent insulator for the high voltages produced by the ignition system. The spark plug boot forms a tight seal on the spark plug. The boot should always be twisted one-half turn before removing the spark plug wire.



1	BATTERY	8	CAMSHAFT POSITION SENSOR (CMP)
2	MAIN FUSE	9	DISTRIBUTOR CAP
3	IGNITION SWITCH	10	DISTRIBUTOR ROTOR
4	FUSE BOX	11	SPARK PLUGS
5	MAIN RELAY	12	IGNITER
6	DISTRIBUTOR	13	NOISE SUPPRESSOR
7	IGNITION COIL	14	ENGINE CONTROL MODULE (ECM)

EJT0016D4

Figure 1—Ignition Control (IC) System

SPARK PLUGS

Figure 2

This vehicle should be serviced with NGK Type BPR5ES or Nippondenso Type NGK Type BKR6E, Nippondenso Type K20PR-U or AC Type FR2LS spark plugs. The spark plug gap should be set to 0.71 mm (0.028-inch).

Normal service is assumed to be a mixture of idling, slow-speed and high-speed driving. Occasional or intermittent highway driving is needed for good spark plug performance. The higher combustion temperatures generated during highway driving burn away any deposits of carbon or oxides that have built up from frequent idling or continual stop-and-go driving. Spark plugs are protected by an insulating nipple made of special heat-resistant material, which covers the spark plug terminal and extends downward over a portion of the plug insulator. These nipples prevent flash-over which causes engine misfire. Do not mistake corona discharge for flash-over, or a shorted insulator. Corona discharge is a steady blue light appearing around the insulator, just above the shell crimp. It is the visible evidence of a high-tension field and has no effect on ignition performance.

Spark plugs must operate within certain temperature limits if they are to provide the performance and service life expected. The spark plug selected for an engine is based on the normal engine service and may not perform satisfactorily under other than normal operating conditions. For almost exclusively city driving, a spark plug one step higher in heat range might deliver longer service life than the spark plug recommended. Conversely, a spark plug one step colder will perform better for heavy loads or continual high-speed driving.

There are three rules to follow when selecting spark plugs for an engine in good condition:

1. Choose a spark plug within the specified heat range.
2. If spark plug overheating occurs, select a spark plug that is one heat range lower than the specified heat range.
3. If fouling is a problem, select a spark plug that is one heat range higher then the specified heat range.

IGNITION SWITCH

The ignition switch is located on the right side of the steering column below the steering wheel. The electrical and mechanical portions of the switch work in conjunction with each other. For more information regarding the ignition switch and the key and lock cylinder, refer to SECTIONS 3F4.

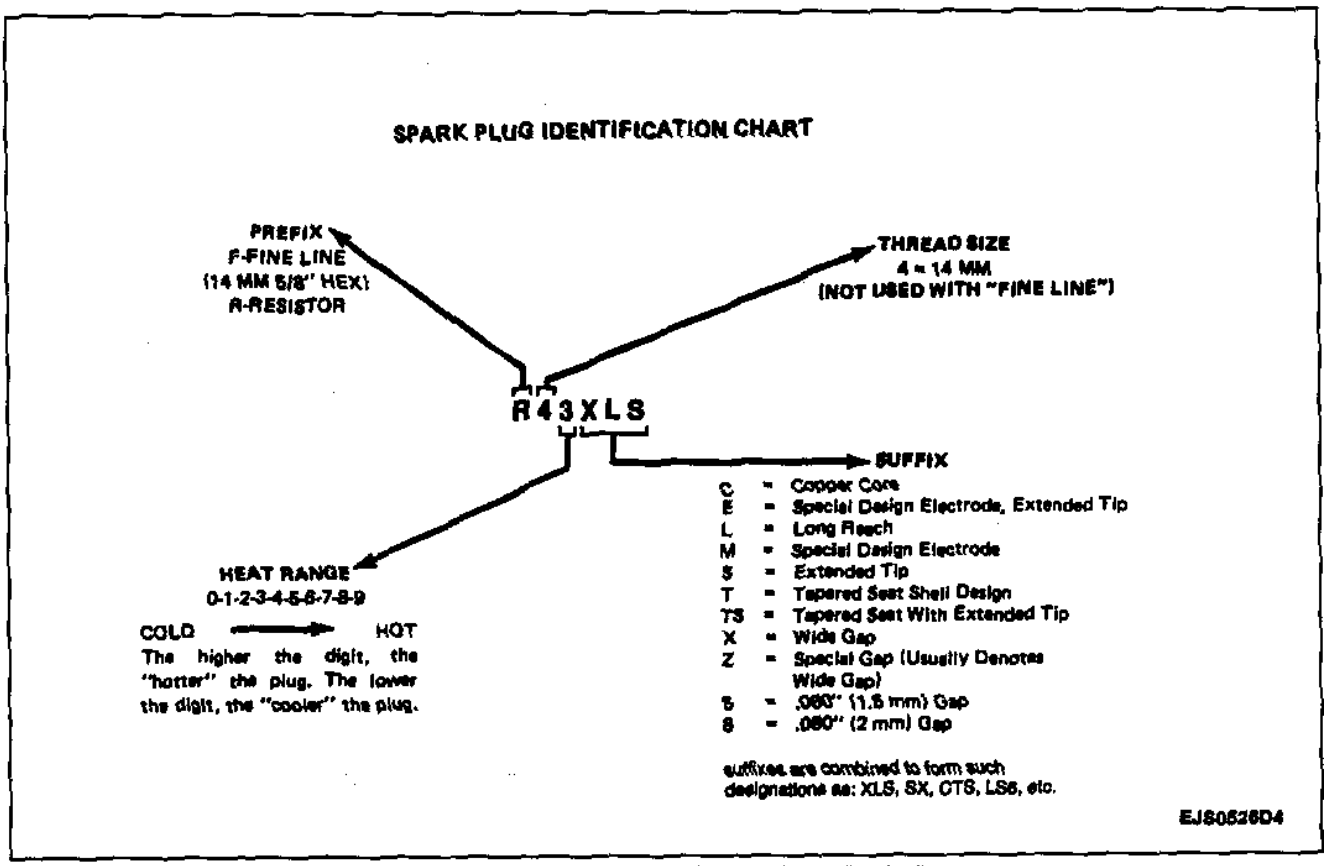


Figure 2—Spark Plug Identification Chart (Typical)

DIAGNOSIS

IGNITION SYSTEM

Refer to SECTION 6E for ignition control (IC) system diagnostic procedures.

SPARK PLUGS

Figure 3

Worn or dirty spark plugs provide satisfactory performance at idle speed, but under more demanding operating conditions, they will frequently misfire. Conditions such as poor fuel economy, power loss, loss of speed, hard starting and generally poor engine performance may be the result of misfiring spark plugs. Spark plugs may misfire due to carbon fouling, an excessive air gap, a broken insulator, bridged electrodes or a damaged spark plug wire and/or boot.

Fouled spark plugs are indicated by black carbon deposits on electrodes. These black deposits are usually the result of slow-speed driving and short runs in which sufficient operating temperature is seldom achieved. Carbon deposits will also result because of worn pistons, rings, faulty ignition, over-rich air/fuel mixture and the incorrect spark plug heat range.

Carbon deposits on the spark plug insulator tip may become conductive and cause the high-voltage arc to track along the tip to some point where it arcs to join the spark plug shell. This arc ignites the air/fuel mixture later than normal which, in effect, retards ignition timing. Heavy carbon deposits may be conductive to the extent that the arc path now becomes a shunt path to the spark plug shell. This condition prevents the high voltage from arcing and igniting the air/fuel mixture. Once arc tracking occurs, the spark plug may be permanently damaged and must be replaced.

Excessive gap wear on plugs of low mileage usually indicates the engine is operating at higher speeds than those for which the engine was designed or that the spark plug's heat range is too high. Electrode wear may also be the result of spark plug overheating caused by combustion gases leaking past the threads. Electrode wear can become excessive to the point that the high voltage no longer arcs across the electrodes.

Broken or cracked insulators are usually the result of improper installation. Broken lower insulators often result from improper gapping and are usually visible immediately. When gapping a spark plug, always make the gap adjustment by bending the ground (side) electrode. Spark plugs with broken insulators must always be replaced.

Damaged spark plug wires and/or boots cause a similar condition to that of a cracked insulator. The high-voltage arc flashes through the wire or boot and grounds on the spark plug shell or the engine.

Spark plugs are protected by an insulating boot comprised of heat-resistant material which covers the spark plug terminal and extends downward over a portion of the spark plug insulator. These boots prevent the flash-over that causes engine misfiring.

Corona discharge, a steady blue light, may repel dust particles and leave a clear ring on the insulator just above the shell. It is important not to mistake corona discharge as evidence that combustion gases have blown between the shell and the insulator. Corona discharge is the visible evidence of a high-tension field and has no effect on ignition system performance.

ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

1. When making compression checks, disconnect the distributor electrical connector.
2. Periodic lubrication of the distributor is not required.
3. The material used to construct the secondary (spark plug) wiring is very soft. This allows the wiring to withstand more heat and carry a higher voltage than traditional wiring; however, the wire is more susceptible to scuffing and damage. The secondary wires must be routed correctly to prevent chafing or cutting. When removing a secondary wire from a spark plug, a distributor , twist the boot one-half turn and pull on the boot only.

SECONDARY WIRING REPLACEMENT

Figure 4

Remove or Disconnect

1. Negative (-) battery cable.
2. Secondary (spark plug) wire(s) from wire retainers.
3. Secondary (spark plug) wire(s) from spark plugs (Figure 4).
4. Secondary (spark plug) wire(s) from distributor cap.

Important

- Note wire placement to cap and routing to engine so as to maintain correct firing order and proper clearances to engine parts that could cause damage to wiring.

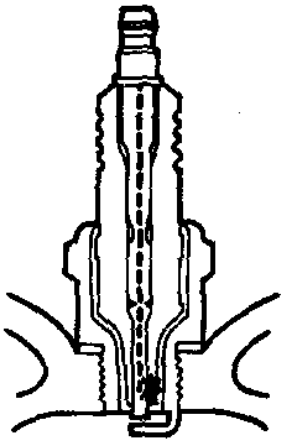
Install or Connect

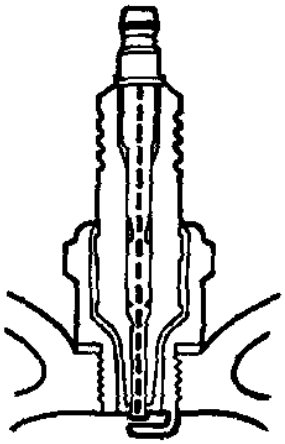
1. Secondary (spark plug) wire(s) to distributor cap.
2. Secondary (spark plug) wire(s) to spark plugs.
3. Reposition secondary (spark plug) wires and insert into secondary wire retainers.
4. Negative (-) battery cable.

Tighten

- Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N.m (11 lb. ft.).

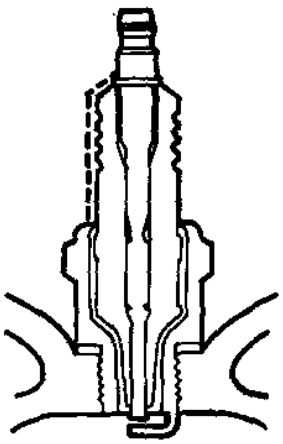
Tracking Arc
High voltage arcs between a fouling deposit on the insulator tip and spark plug shell. This ignites the fuel/air mixture at some point along the insulator tip, retarding the ignition timing which causes a power and fuel loss.

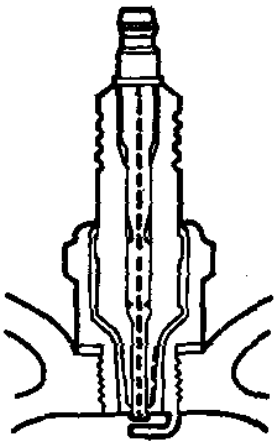




Wide Gap
Spark plug electrodes are worn so that the high voltage charge cannot arc across the electrodes. Improper gapping of electrodes on new or "cleaned" spark plugs could cause a similar condition. Fuel remains unburned and a power loss results.

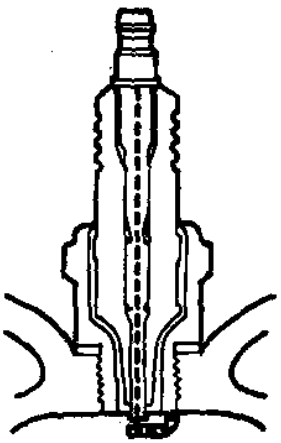
Flashover
A damaged spark plug boot, along with dirt and moisture, could permit the high voltage charge to short over the insulator to the spark plug shell or the engine. AC's buttress insulator design helps prevent high voltage flashover.

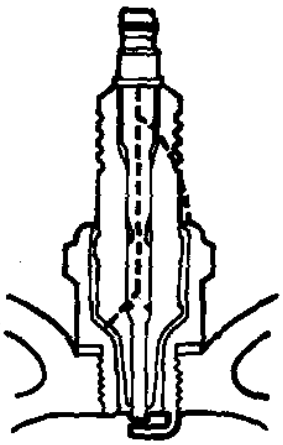




Fouled Spark Plug
Deposits that have formed on the insulator tip may become conductive and provide a "shunt" path to the shell. This prevents the high voltage from arcing between the electrodes. A power and fuel loss is the result.

Bridged Electrodes
Fouling deposits between the electrodes "ground out" the high voltage needed to fire the spark plug. The arc between the electrodes does not occur and the fuel air mixture is not ignited. This causes a power loss and exhausting of raw fuel.





Cracked Insulator
A crack in the spark plug insulator could cause the high voltage charge to "ground out." Here, the spark does not jump the electrode gap and the fuel air mixture is not ignited. This causes a power loss and raw fuel is exhausted.

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Figure 3—Spark Plug Diagnosis

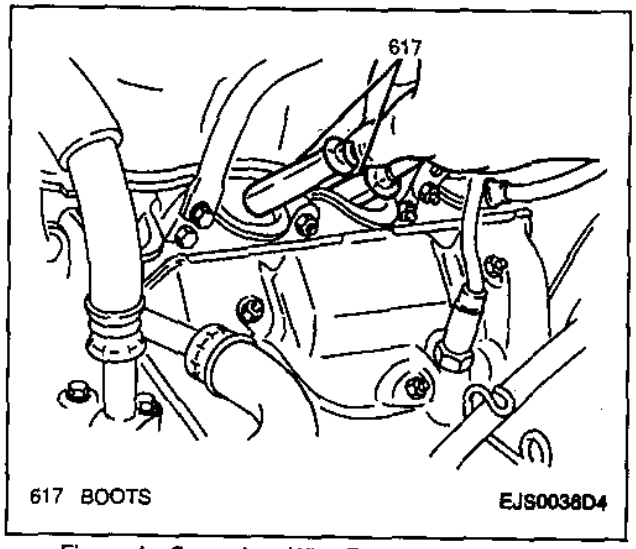


Figure 4—Secondary Wire Replacement (Typical)

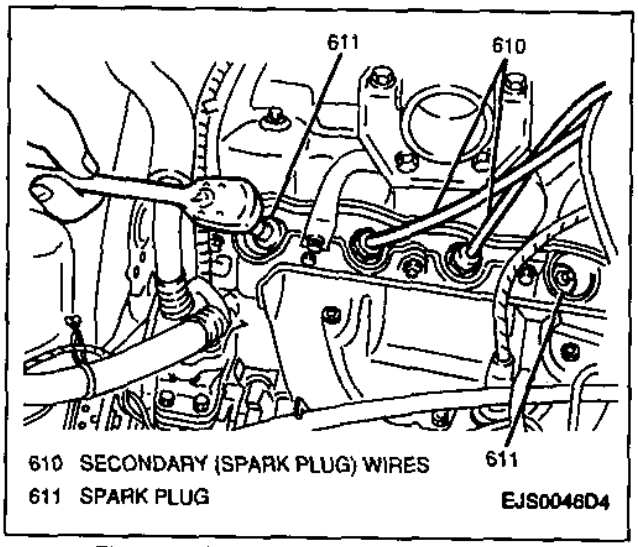


Figure 5—Removing Spark Plugs (Typical)

SPARK PLUG REPLACEMENT

Figures 5 and 6

NOTICE: This engine is equipped with an aluminum cylinder head. Allow the engine to cool before removing spark plugs. Removing the spark plugs from an engine at operating temperature may damage the spark plug threads in the cylinder head. Also be sure to clean any dirt or debris from around spark plug holes prior to removing spark plugs.

Remove or Disconnect

1. Negative (-) battery cable.
2. Secondary (spark plug) wire(s) from spark plug(s).
3. Spark plug(s) from cylinder head (Figure 5).

Inspect

- Spark plug(s) for electrode wear, carbon deposits and insulator damage. Refer to "Spark Plugs" earlier in this section.

Install or Connect

Important

- Use NGK Type BKR6E, Nippondenso Type K20PR-U or AC Type FR2LS spark plugs.
- Set spark plug gap to 0.71 mm (0.028-inch) (Figure 6).

1. Spark plug(s) to cylinder head.

Tighten

- Spark plug to 28 N.m (21 lb. ft.).

2. Secondary (spark plug) wire(s) to spark plug(s).
3. Negative (-) battery cable.

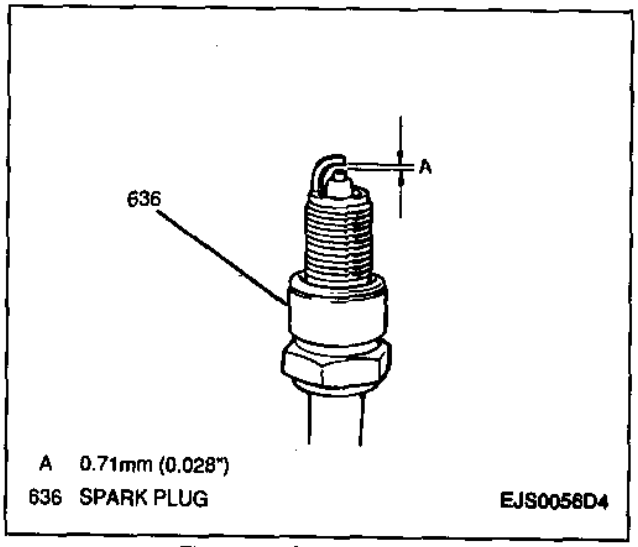


Figure 6—Spark Plug Gap

Tighten

- Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N.m (11 lb. ft.).

NOISE SUPPRESSOR FILTER

Figure 7

Remove or Disconnect

1. Negative (-) battery cable.
2. Noise suppressor filter from bulkhead (Figure 7).
3. Electrical tape and noise suppressor filter from main harness.
4. Noise suppressor filter electrical connector.

Install or Connect

1. Noise suppressor filter electrical connector.
2. Noise suppressor filter to main harness; secure with electrical tape.
3. Noise suppressor filter to bulkhead.
4. Negative (-) battery cable.

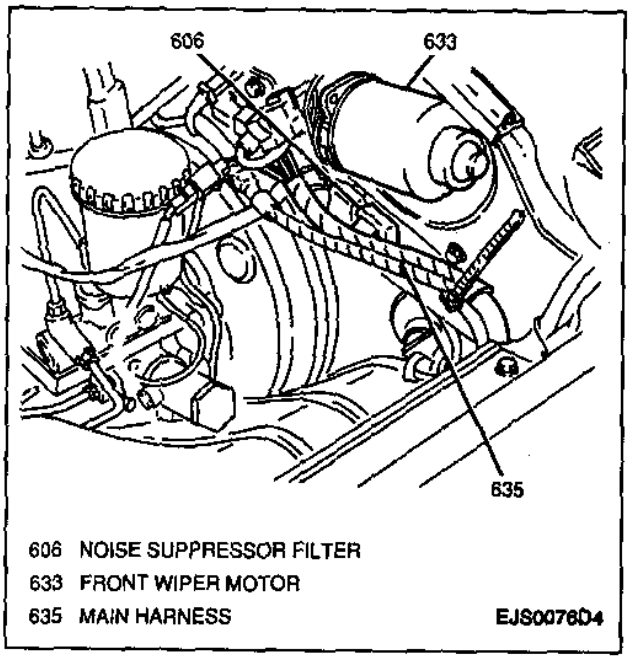


Figure 7—Noise Suppressor Filter

Tighten

- Negative (-) battery cable-to-negative (-) battery terminal retainer to 15 N.m (11 lb. ft.).

DISTRIBUTOR REPLACEMENT

Figure 8

Remove or Disconnect

1. Negative (-) battery cable.
2. Distributor electrical connector (Figure 8).
3. Two screws and distributor cap from distributor (Figure 8).
4. Mark the distributor housing position on the cylinder head.
5. Distributor flange bolt and distributor housing from cylinder head (Figure 8).
6. Mark the distributor coupling position on the distributor housing.

Inspect

- Distributor cap and rotor for cracks, terminal corrosion and wear; replace as necessary.

Install or Connect

1. Distributor housing to cylinder head. Match the marks made on the cylinder head and distributor housing during removal. Also match the distributor coupling and housing alignment marks.
2. Distributor flange bolt. Do not tighten fully.

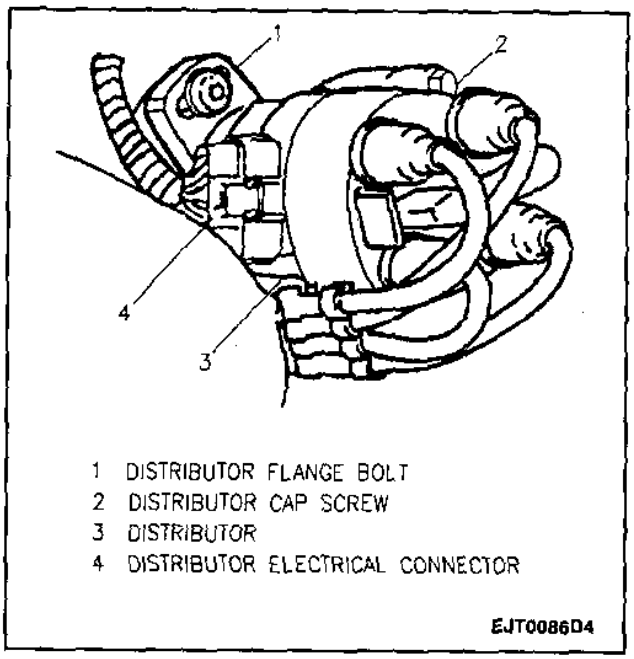


Figure 8—Distributor Flange Bolt

3. Distributor cap to distributor; secure with two screws.
4. Distributor electrical connector.
5. Negative (-) battery cable.

Tighten

- Negative (-) battery cable-to negative (-) battery terminal retainer to 15 N.m (11 lb. ft.).

6. Set ignition timing. Refer to SECTION 6E3.

IF DISTRIBUTOR POSITION WAS LOST

Tool Required:
J 39313 Spark Plug Port Adapter

If the engine was accidentally cranked after the distributor was removed, the following procedure can be used to properly position the distributor.

1. Crank the engine until the number one cylinder is at top dead center (TDC) on its compression stroke.

This can be accomplished by the following:

A. Remove the fuel pump relay.
B. Remove the number one spark plug. Refer to "Spark Plug Replacement" earlier in this section.
C. Install a J 39313 and a compression gage into the spark plug cavity.
D. Crank the engine and observe the compression gage. The TDC of the cylinder's compression stroke occurs when the compression reading is highest.

2. Align the timing mark on the crankshaft pulley to the zero (0) position on the timing indicator.
3. Position the rotor to the number one cylinder position on the distributor cap.
4. Install the distributor. Refer to "Distributor Replacement" earlier in this section.
5. Remove the J 39313 and the compression gage.
6. Install the number one spark plug.

Tighten

- Spark plug to 28 N.m (21 lb. ft.).

7. Install fuel pump relay.
8. Set ignition timing. Refer to SECTION 6E3.

IGNITION COIL REPLACEMENT

The ignition coil is nonserviceable, for ignition coil replacement refer to DISTRIBUTOR REPLACEMENT earlier in this section.

IGNITER

The igniter is nonserviceable, for igniter replacement refer to DISTRIBUTOR REPLACEMENT earlier in this section.

IGNITION TIMING

For ignition timing procedures, refer to SECTION 6E3.

UNIT REPAIR

Figure 9

The distributor housing assembly components are not serviced separately; service is by the replacement of the housing assembly as a complete unit (Figure 9).

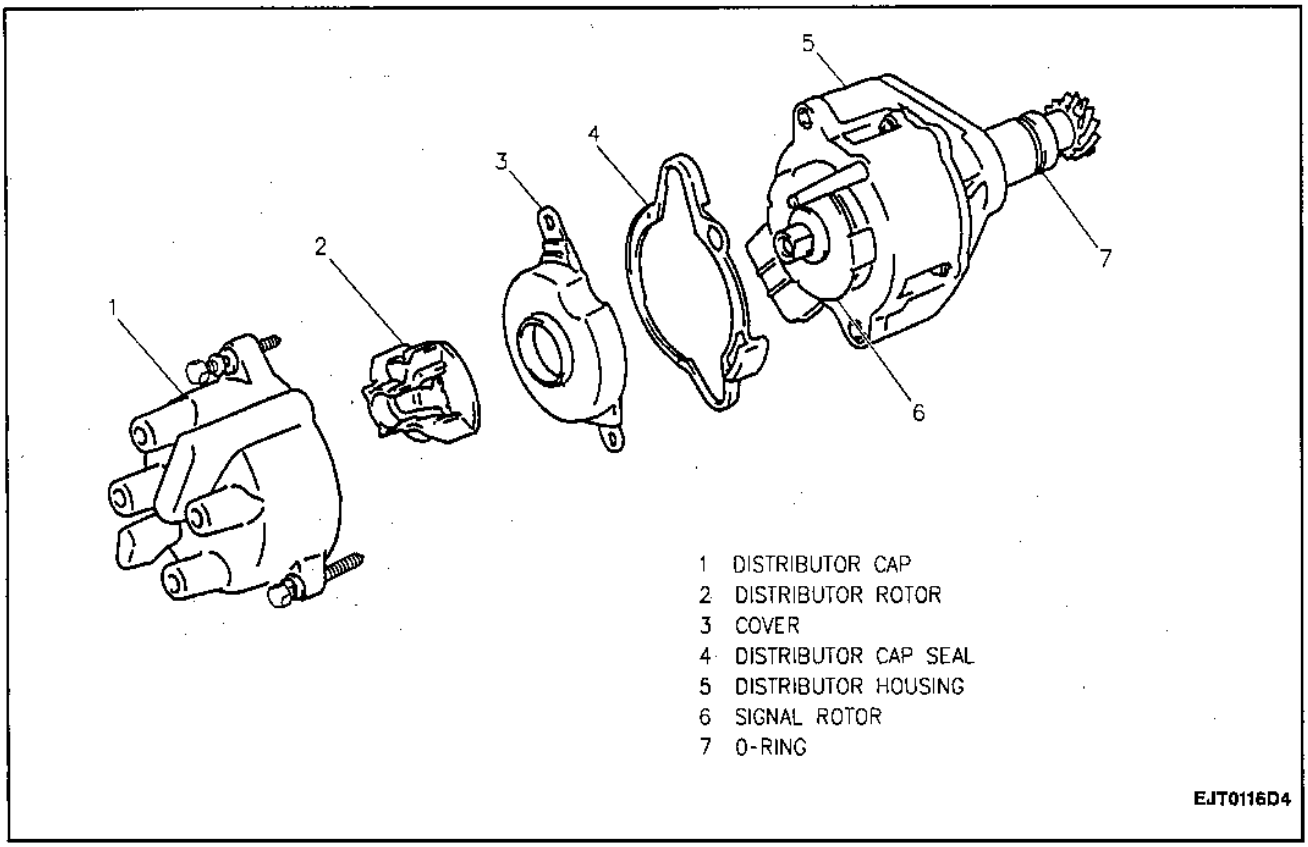


Figure 9—Distributor

SPECIFICATIONS

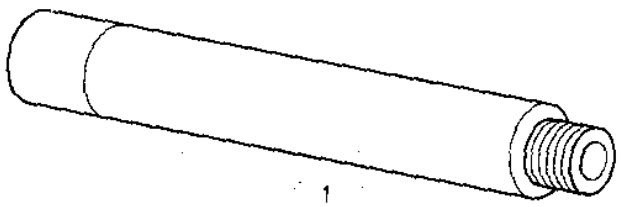
FASTENER TORQUES

Spark Plugs	28 N.m (21 lb. ft.)
Distributor Flange Bolt	20 N.m (15 lb. ft.)
Negative (-) Battery Cable-to-Negative (-) Battery Terminal Retainer	15 N.m (11 lb. ft.)

IGNITION SYSTEM

Spark Plug Type NGK	BKR6E
Nippondenso	K20PR-U
AC	FR2LS
Spark Plug Gap	0.71 mm (0.028 in.)

SPECIAL TOOLS



J 39313

1 SPARK PLUG PORT ADAPTER

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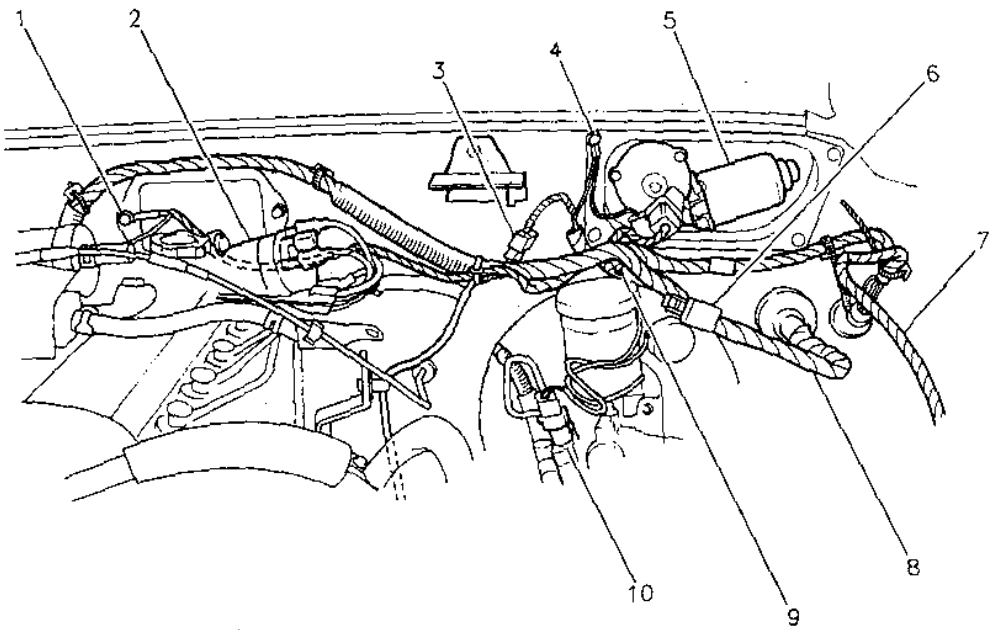
SECTION 6D5

ENGINE WIRING

CAUTION: This vehicle is equipped with a Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR component and wiring Locations View in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury or otherwise unneeded SIR repairs.

CONTENTS



1 GROUND–G101
2 DISTRIBUTOR
3 HEATED OXYGEN SENSOR CONNECTOR (H02S1)
4 GROUND–G108
5 FRONT WIPER MOTOR
6 MAIN HARNESS
7 ENGINE HARNESS
8 NOISE SUPPRESSOR FILTER
9 TO BRAKE FLUID LEVEL SWITCH
10 BRAKE FLUID PRESSURE DIFFERENTIAL SWITCH

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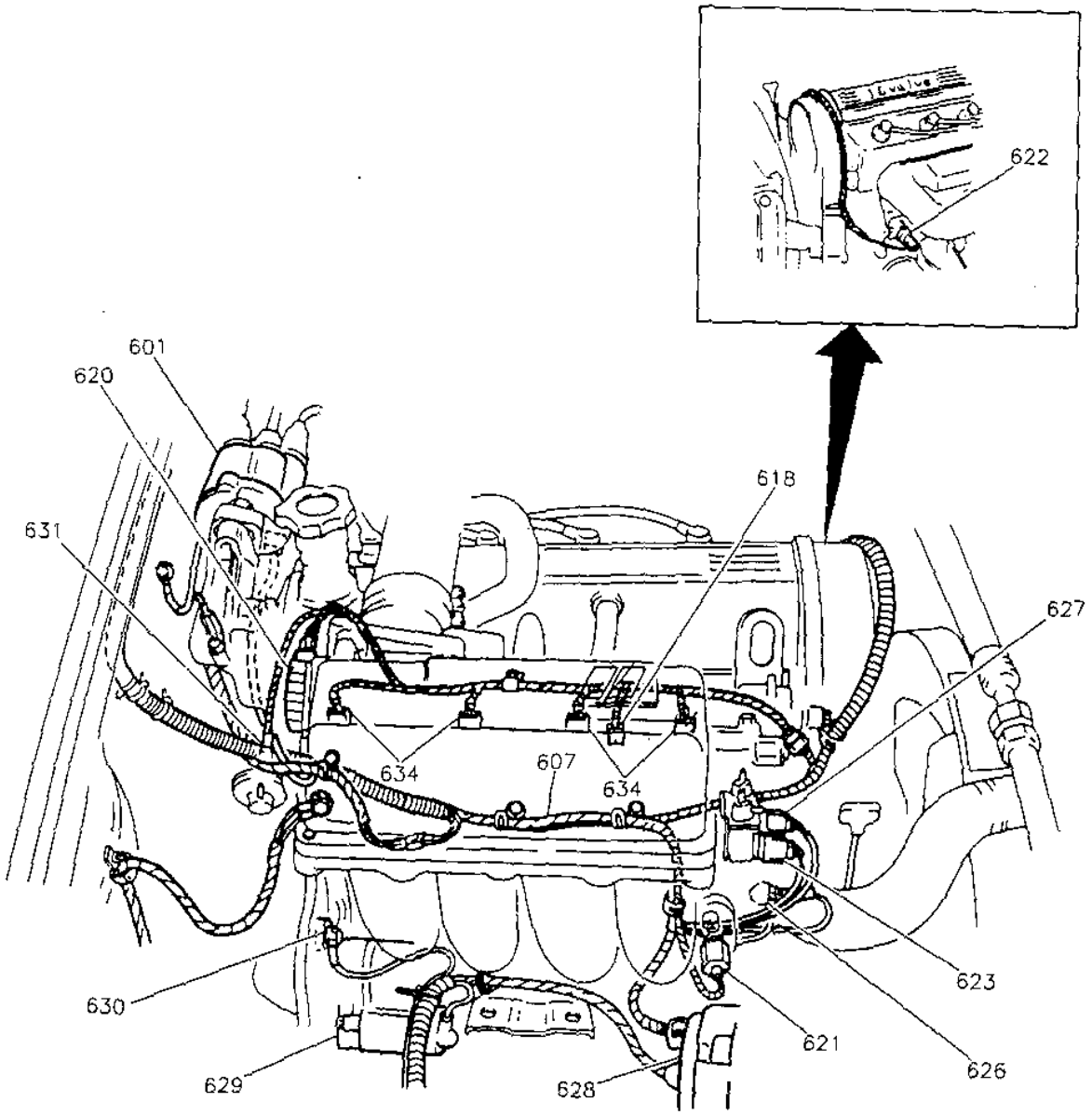
Figure 1—Engine Wiring—Bulkhead



601 DISTRIBUTOR
607 ENGINE HARNESS
618 IDLE AIR CONTROL (IAC) VALVE
620 THROTTLE POSITION (TP) SENSOR
621 ENGINE COOLANT TEMPERATURE (ECT) SENSOR
622 OIL PRESSURE SWITCH
623 EXHAUST GAS RECIRCULATION SOLENOID VACUUM (EGR SV) VALVE (BROWN VALVE)/EGR BYPASS VALVE (BLUE VALVE)
626 ENGINE COOLANT TEMPERATURE (ECT) SENDING UNIT
627 EVAPORATIVE CANISTER PURGE VALVE
628 GENERATOR
629 STARTER SOLENOID
630 GROUND-G103
631 EXHAUST GAS RECIRCULATION (EGR) TEMPERATURE SENSOR
634 FUEL INJECTORS

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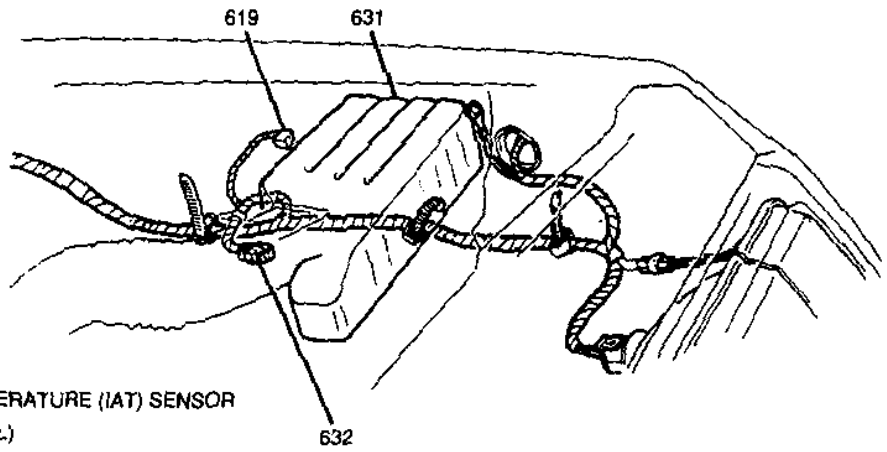
Figure 2—Engine Wiring—Engine



619 INTAKE AIR TEMPERATURE (IAT) SENSOR
631 AIR CLEANER (ACL)
632 MASS AIRFLOW (MAF) SENSOR

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Figure 3—Engine Wiring—LH Engine Compartment