

# Engine Electrical

## Specifications

### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Auxiliary Battery Tray Retaining Bolt A	23 N·m	17 lb ft
Battery Retainer Hold Down Bolt	23 N·m	17 lb ft
Camshaft Position (CMP) Sensor Screws	2.2 N·m	20 lb in
Distributor Cap Screws	2.5 N·m	22 lb in
Distributor Clamp Bolt	25 N·m	18 lb ft
Distributor Rotor Screws	2 N·m	18 lb in
Generator BAT Terminal Nut	20 N·m	15 lb ft
Generator Bottom Bracket Bolt (5.0L, 5.7L)	50 N·m	37 lb ft
Generator Bottom Bracket Bolt (6.5 )	23 N·m	17 lb ft
Generator Bottom Bracket Bolt (7.4L)	25 N·m	18 lb ft
Generator Pulley Nut (CS-130D)	100 N·m	80 lb ft
Generator Pulley Nut (CS-144)	100 N·m	74 lb ft
Generator Top Bracket Bolt (4.3L, 5.0L, 5.7L, 6.5L)	25 N·m	18 lb ft
Generator Top Bracket Bolt (7.4L)	50 N·m	37 lb ft
Ignition Coil Hold Down Stud	11 N·m	8 lb ft
Ignition Coil Bolts (Vin J)	27 N·m	22 lb ft
Negative Battery Cable Terminal Nut	17 N·m	44 lb in
Positive Battery Terminal Nut	17 N·m	44 lb in
Battery Tray Mounting Bolt	25 N·m	22 lb in
Spark Plugs (New Cylinder Head)	30 N·m	22 lb ft
Spark Plugs (Used Cylinder Head)	20 N·m	15 lb ft
Starter Bracket Nut (Diesel)	8 N·m	71 lb in
Starter Brush Screws (MT-Series, Diesel)	1.5 N·m	13 lb in
Starter Brush Plate Screws (MT-Series, Diesel)	2.5 N·m	22 lb in
Starter Drive Housing Bolts (MT-Series, Diesel)	8.5 N·m	75 lb in
Starter Heat Shield Bolt (MT-Series, Diesel)	17 N·m	13 lb ft
Starter Motor Mounting Bolt (MT-Series, Diesel)	50 N·m	37 lb ft
Starter Motor Mounting Bolt (PG260-Series, Gas)	43 N·m	32 lb ft
Starter Shift Lever Nut (MT-Series, Diesel)	4.5 N·m	40 lb in
Starter Solenoid Clamp Screw	11 N·m	100 lb in
Starter Solenoid Field Lead Nut (SD-Series)	11 N·m	100 lb in
Starter Solenoid Motor Terminal Nut (MT-Series, Diesel)	11 N·m	100 lb in
Starter Solenoid Screws (MT-Series, Diesel)	2.8 N·m	25 lb in

**Battery Usage**

Engine Application	Option	OE Catalog	CCA Rating (Amperes)	RC Rating (Minutes)	Load Test (Amperes)	Replacement Catalog No.
4.3L (L35)	All	810	600	115	300	78A-72
5.0L (L30)	All	810	600	115	300	78-6Y
5.7L (L31)	base	810	600	115	300	78-6YR
5.7L (L31)	w/Z56	814	770	115	390	78-7Yr
6.5L (L56)	All	810	600	115	300	78-6YR
6.5L (L65)	base	810	600	115	300	78-6YR
6.5L (L65)	w/YF2	812	690	115	350	78-7YR
7.4L (L29)	All	810	600	115	300	78-6YR

**Battery Temperature vs Minimum Voltage**

Estimated Temperature °F	Estimated Temperature °C	Minimum Voltage
70 or above	21 or above	9.6
50	10	9.4
32	0	9.1
15	-10	8.8
0	-18	8.5
Below 0	Below -18	8.0

**Starter Motor Usage (Load Test @ 10 Volts 28-MT)**

Engine Type	Starter Type	Load Test @ 10 Volts AMPS Minimum	Load Test @ 10 Volts AMPS Maximum	Load Test @ 10 Volts RPM Minimum	Load Test @ 10 Volts RPM Maximum
Diesel Engine	28-MT	125 AMPS	190 AMPS	3,000 RPM	5,600 RPM

**Starter Motor Usage (Load Test @ 10 Volts Specs. PG-260)**

Engine Type	Starter Type	Load Test @ 10 Volts AMPS Minimum	Load Test @ 10 Volts AMPS Maximum	Load Test @ 10 Volts RPM Minimum	Load Test @ 10 Volts RPM Maximum
Gasoline Engine	PG260	47 AMPS	70 AMPS	6,500 RPM	11,000 RPM

**Generator Usage**

Generator Model	Engine	Option Code	Rated Output AMPS	Load Test Output AMPS
CS130D	5.0L, 5.7L, 6.5L	K60	100 A	70 A
CS130D	5.7L, 6.5L	K68	105 A	73 A
CS144	5.0L, 5.7L, 6.5L, 7.4L	KW2	124 A	86 A
CS144	5.7L, 6.5L, 7.4 L	KG9	140 A	98 A

**Spark Plug Wire Resistance****Tools Required**

*J 39200* Digital Multimeter

1. Disconnect both ends of each spark plug wire you are testing.  
Ensure that the wire terminals are clean before proceeding.
2. Use the *J 39200* on the high scale.

3. Connect an ohmmeter lead to each end of the wire.
4. Gently twist the wire while watching the ohmmeter reading.
5. If the ohmmeter reads above 30,000 ohms, no matter how long the wire is, or fluctuates from infinity to any value, replace the wire.

## GM SPO Group Numbers

Application	GM SPO Group Number
Battery Cable Bolt, Clip, Conduit, Cover, Module and Nut	2.343
Battery Hold-Down Bolt	2.334
Battery Hold-Down Retainer	2.335
Battery Insulator, Nut and Tray	2.333
Battery Negative and Engine Ground Cable and Strap	2.341
Battery Positive Block and Cable	2.342
Chassis Wiring Bolt, Cable, Harness and Wire	2.480
Distributor Bolt, Bracket, Connector, Heat Sink, Module, Ring, Seat, Sensor and Shield	2.383
Distributor Cap	2.367
Distributor Drive and Driver Gear Kit	2.374
Distributor Housing Bolt, Clamp and Gasket	2.363
Distributor Ignition	2.361
Distributor Rotor	2.382
Distributor Shaft, Switch Bolt	2.372
Engine Electrical Generator	2.275
Engine Wiring Harness and Wire	2.525
Generator Brush, Bolt Brush Kit	2.291
Generator Brush Spring	2.286
Generator Commutator End Bearing	2.298
Generator Connector, Cover, Insulator, Nut and Terminal	2.313
Generator Commutator End Frame	2.297
Generator Drive End Collar	2.307
Generator Fan and Pulley	2.274
Generator Field Stator	2.310
Generator Mounting Bolt, Brace, Bracket, Nut, Shield and Spacer	2.277
Generator Output Bolt, Bridge and Capacitor	2.319
Generator Rotor	2.279
Generator Rotor Shaft Washer and Nut	2.280
Generator Thru Bolt	2.316
Ignition Coil and Connector	2.170
Ignition Coil Mounting Bolt, Bracket and Stud	2.183
Spark Ignition Connector, Glow Plug and Spark Plug	2.270
Spark Plug or Coil Harness and Wire	2.240
Spark Plug Wire Kit	2.239
Spark Plug Wire Retainer, Shield and Support	2.251
Starter Motor	2.041
Starter Motor Armature	2.043
Starter Motor Bolt, Bracket, Nut, Shield and Shim	2.042
Starter Motor Brush	2.051
Starter Motor Brush Holder and Support	2.052
Starter Motor Brush Spring	2.053
Starter Motor Commutator end Bearing, Frame and Tube	2.067
Starter Motor Drive End Bearing and Bushing	2.083
Starter Motor Drive Housing, Shield and Support	2.085
Starter Motor Drive Plunger	2.113
Starter Motor Drive, Shaft and Stop	2.086
Starter Motor Drive Shaft Lever, Pin, Plug, Shaft, Spring and Wire	2.108
Starter Motor Frame	2.049

## GM SPO Group Numbers (cont'd)

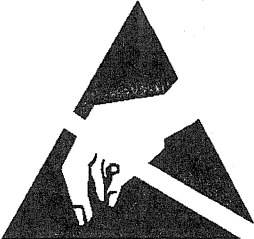
Application	GM SPO Group Number
Starter Motor Relay, Solenoid and Switch	2.100
Starter Motor Seal	2.070
Starter Motor Shoe Bolt	2.077
Starter Motor Solenoid Bolt, Clamp and Grommet	2.102
Starter Motor Thrust Collar, Retainer and Washer	2.063
Voltage Regulator	2.500

## Schematic and Routing Diagrams

## Engine Electrical Schematic References

Reference on Schematic	Section Number - Subsection Name
Ground Distribution Cell – 14	8–Wiring Systems
Instrument Cluster Cell – 81	8–Instrument Panel, Gauges and Console
Power Distribution Cell – 10	8–Wiring Systems

## Engine Electrical Schematic Icons

Icon	Icon Definition
 19384	Refer to <i>ESD Notice</i> In Cautions and Notices.



## 6-736 Engine Electrical

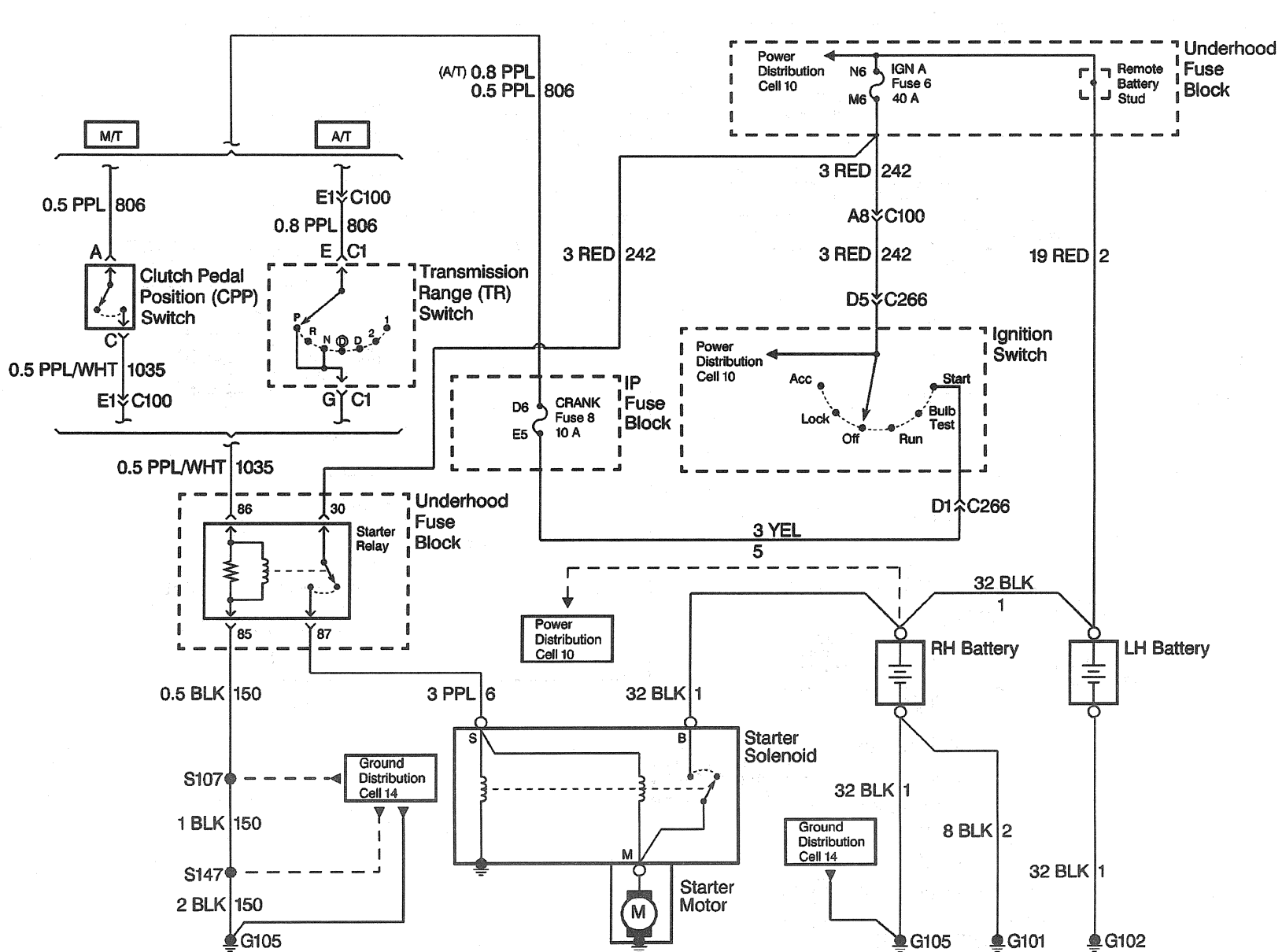


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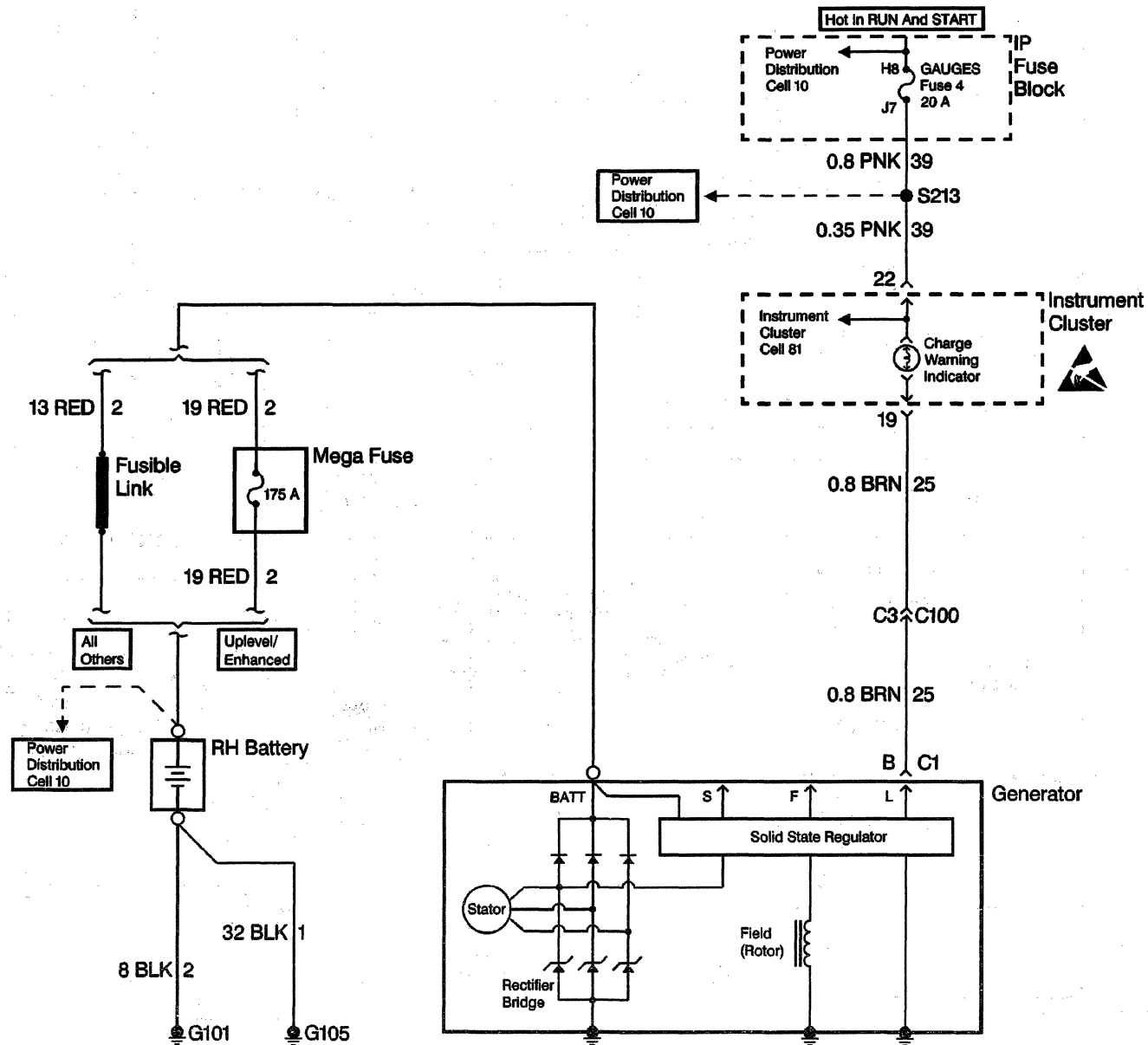
# Starting and Charging Schematics (Starter Controls (Diesel))

Engine

Engine Electrical 6-737

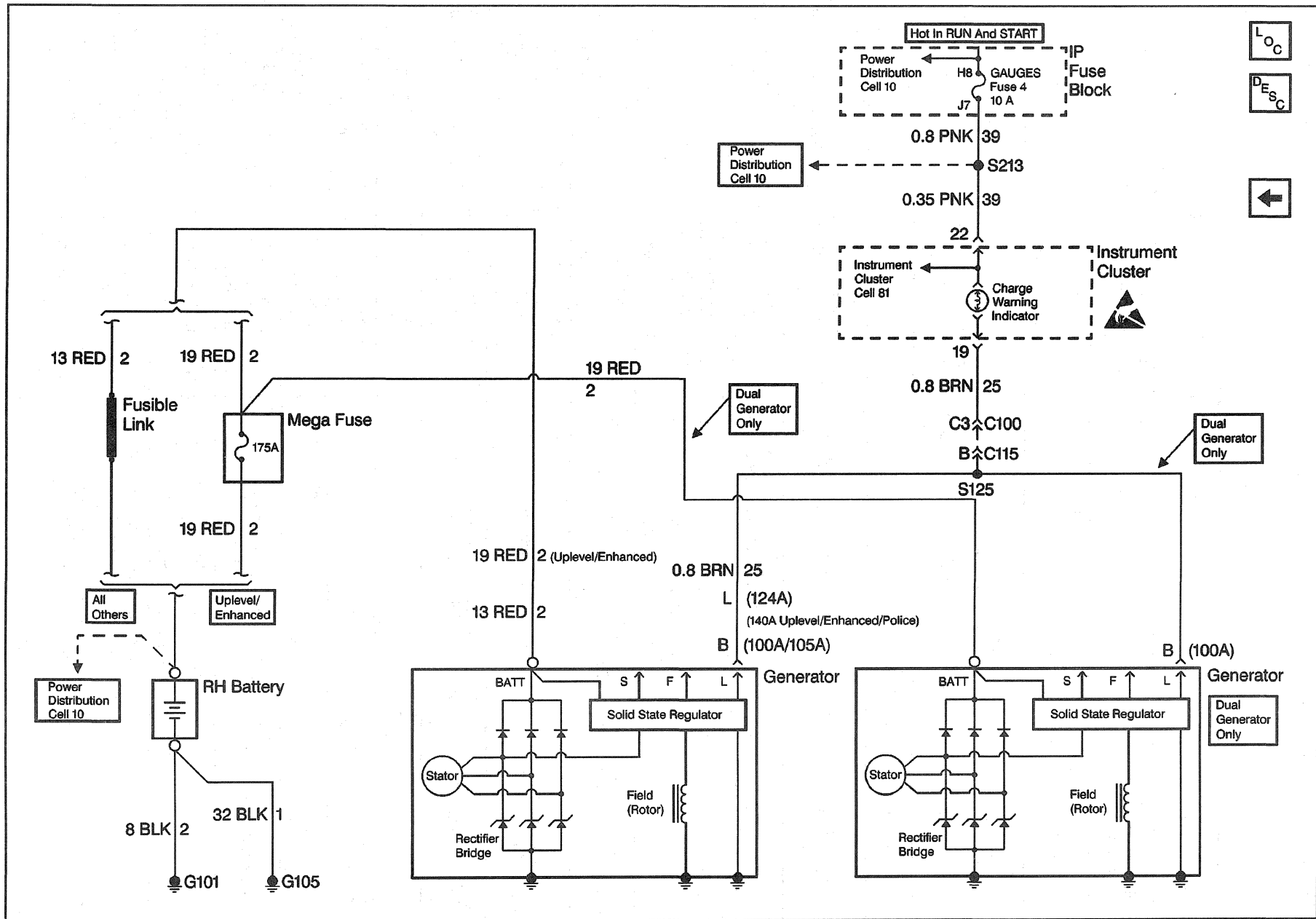


# Starting and Charging Schematics (Generator Controls (Gas))



362226

# Starting and Charging Schematics (Generator Controls (Diesel))



## Component Locator

## Engine Electrical Components

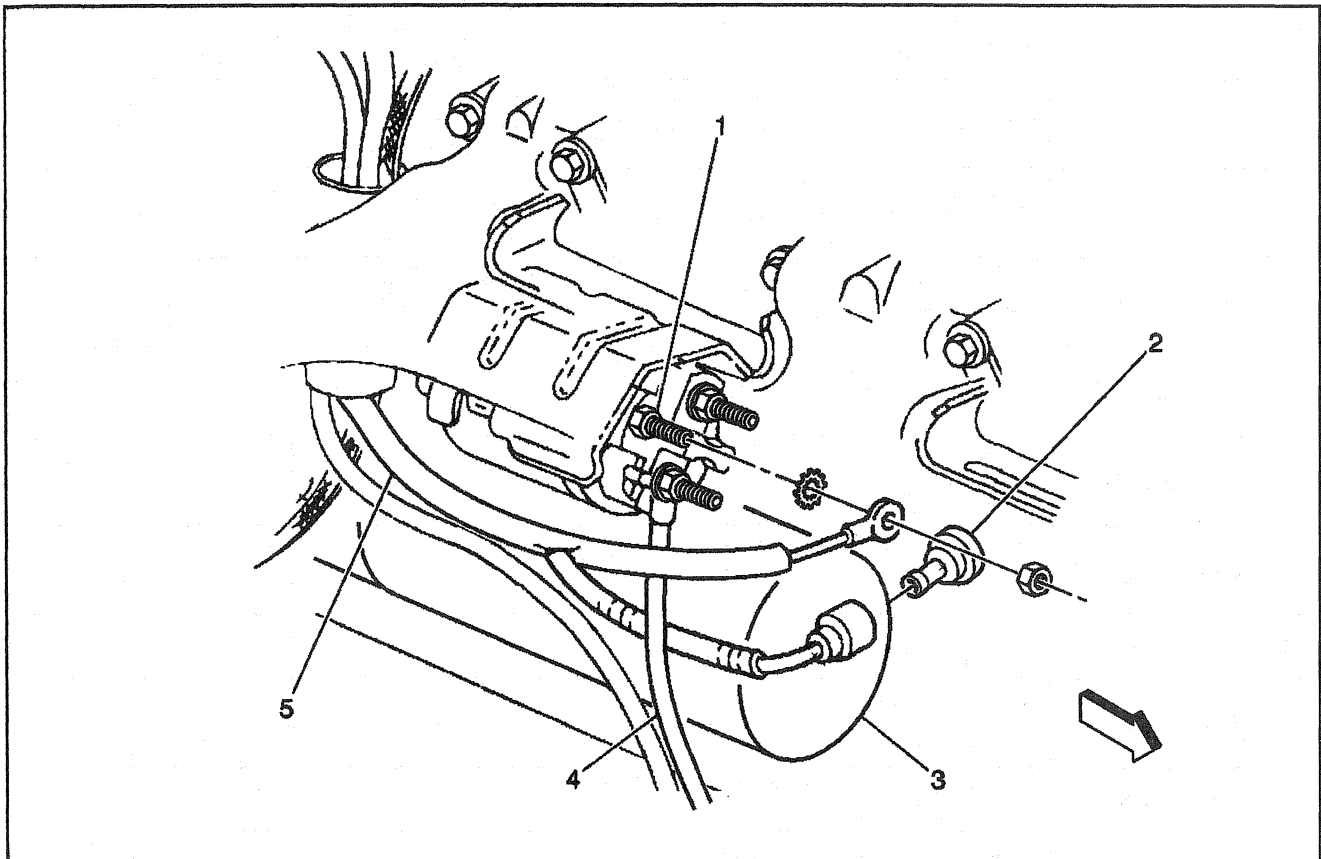
Name	Location	Locator View	Connector End View
Auxiliary Battery (Diesel)	In the left front side of the engine compartment	<i>Power and Grounding Component Views in Wiring Systems</i>	—
Battery, LH (w/Dual Battery Option)	In the left front of the engine compartment	<i>Power and Grounding Component Views in Wiring Systems</i>	—
Battery, RH	In the right front of the engine compartment	<i>Power and Grounding Component Views in Wiring Systems</i>	—
Clutch Pedal Position Switch	At top of Clutch Pedal	<i>Engine Electrical Component Views</i>	<i>Engine Electrical Connector End Views</i>
Fusible Link	Molded into the battery positive connector	<i>Power and Grounding Component Views in Wiring Systems</i>	—
Generator	LH Front of Engine	<i>Engine Electrical Component Views</i>	<i>Engine Electrical Connector End Views</i>
Ignition Switch	IP Steering Column, under Lock Cylinder	<i>Standard Wheel/Column Component Views in Steering Wheel and Column</i>	<i>Standard Wheel/Column Connector End Views in Steering Wheel and Column</i>
Instrument Cluster	On the upper left end of the IP, above the steering column	<i>Instrument Cluster Component Views in Instrument Panel and Console</i>	<i>Instrument Cluster Connector End Views in Instrument Panel and Console</i>
IP Fuse Block	To the left of the IP, near the left front door jamb switch	<i>Power and Grounding Component Views in Wiring Systems</i>	<i>Power and Grounding Connector End Views in Wiring Systems</i>
Mega Fuse Block	In the RF of the vehicle	<i>Power and Grounding Component Views in Wiring Systems</i>	<i>Power and Grounding Connector End Views in Wiring Systems</i>
Park/Neutral Position (PNP) Switch	At LH center of Transmission	<i>Automatic Transmission Electronic Component Views (Internal) in Automatic Transmission</i>	<i>Automatic Transmission Internal Connector End Views in Automatic Transmission</i>
Remote Battery Stud	Part of the Underhood Fuse Block, in the left rear side of the engine compartment, on the fender	<i>Power and Grounding Component Views in Wiring Systems</i>	<i>Power and Grounding Connector End Views in Wiring Systems</i>
Starter Motor	Lower RR of Engine	<i>Engine Electrical Component Views</i>	<i>Engine Electrical Connector End Views</i>
Starter Motor Solenoid	On Starter Motor	<i>Engine Electrical Component Views</i>	<i>Engine Electrical Connector End Views</i>
Starter Relay	In Underhood Fuse Block, LR of Engine Compartment, on Fender	<i>Engine Electrical Component Views</i>	<i>Engine Electrical Connector End Views</i>
Underhood Fuse Block	In the left rear side of the engine compartment, on the fender	<i>Power and Grounding Component Views in Wiring Systems</i>	<i>Power and Grounding Connector End Views in Wiring Systems</i>
C100	IP harness inline to the Engine harness, in the left rear side of the engine compartment, at the bulkhead	<i>Harness Routing Views in Wiring Systems</i>	<i>Inline Harness Connector End Views in Wiring Systems</i>
C115 (Diesel)	Engine harness, inline to the Alternator Jumper harness, top front center of the engine	<i>Harness Routing Views in Wiring Systems</i>	<i>Inline Harness Connector End Views in Wiring Systems</i>
C266	IP harness inline to steering column harness, to the left side of the steering column, near the bulkhead	<i>Harness Routing Views in Wiring Systems</i>	<i>Inline Harness Connector End Views in Wiring Systems</i>

## Engine Electrical Components (cont'd)

Name	Location	Locator View	Connector End View
G101	On the sheet metal at the right front wheelhousing	<i>Power and Grounding Component Views in Wiring Systems</i>	—
G102 (Diesel)	On the left front side of the intake manifold	<i>Power and Grounding Component Views in Wiring Systems</i>	—
G105 (Gas)	On the right front side of the engine block	<i>Power and Grounding Component Views in Wiring Systems</i>	—
G105 (Diesel)	Right Rear of the cylinder head, cylinder #7 intake bolt	<i>Power and Grounding Component Views in Wiring Systems</i>	—
S107 (5.0L, 5.7L)	Engine harness, approx. 20 cm (8 in) from EGR valve breakout, toward taillamp harness breakout	—	—
S107 (6.5L, HD)	Engine harness, approx. 40 cm (15 in) from EBCM breakout, toward Transmission harness breakout	—	—
S107 (7.4L)	Engine harness, approx. 18 cm (7 in) from EBCM breakout, toward the EGR harness breakout	—	—
S125 (Dual Generator)	Alternator Jumper harness, approx. 18 cm (7 in) from the RH Generator	—	—
S147 (Gas)	Engine harness, approx. 5 cm (2 in) from EGR valve breakout, toward taillamp harness breakout	—	—
S147 (Diesel)	Engine harness, approx. 4 cm (1.5 in) from starter motor solenoid breakout	—	—
S213	IP harness, approx. 4 cm (1.5 in) from steering column harness breakout, towards the DLC	—	—

## Engine Electrical Component Views

## Starter Wiring (Gas)



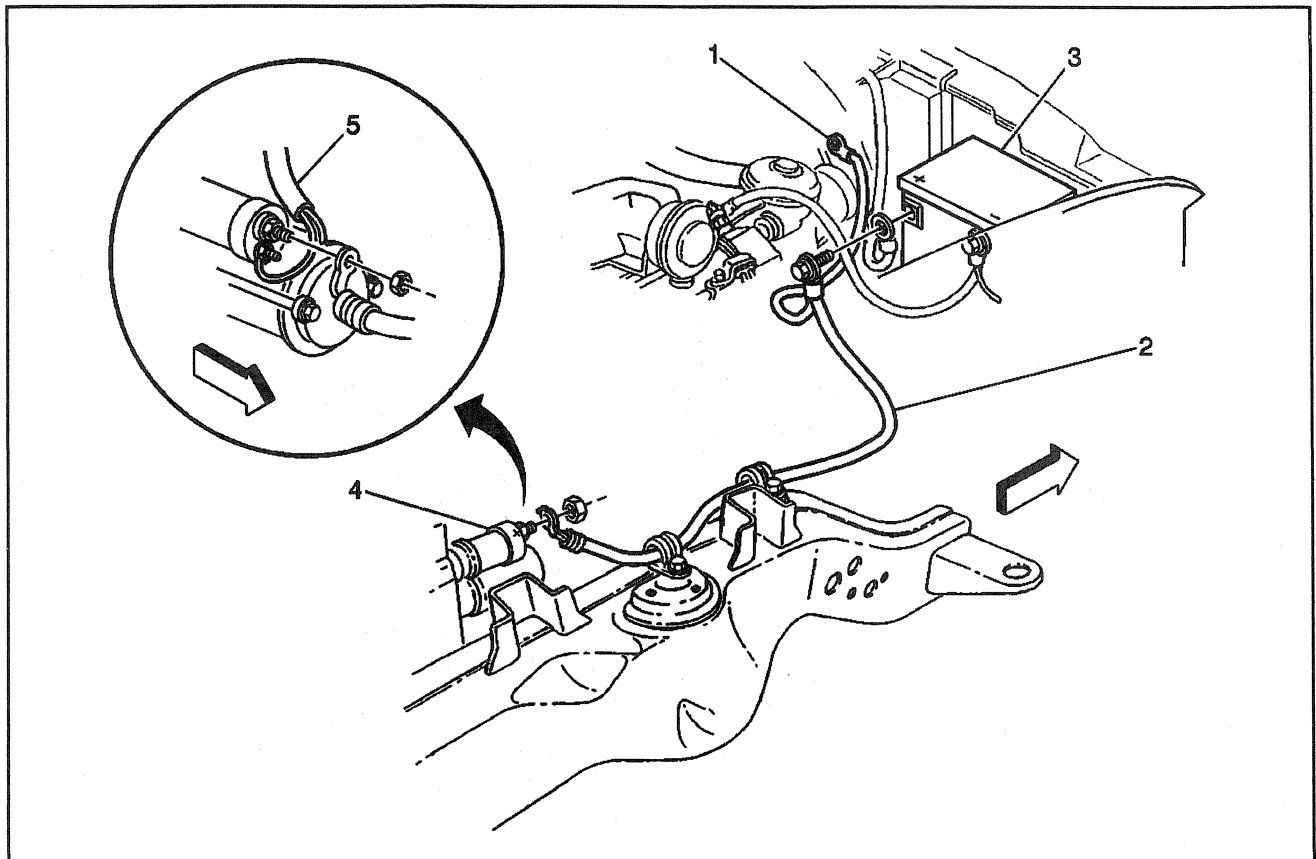
391545

## Legend

- (1) Starter Solenoid
- (2) Knock Sensor
- (3) Starter Motor

- (4) Positive Battery Cable
- (5) Engine Wiring Harness

## Starter Support Wiring (Diesel)



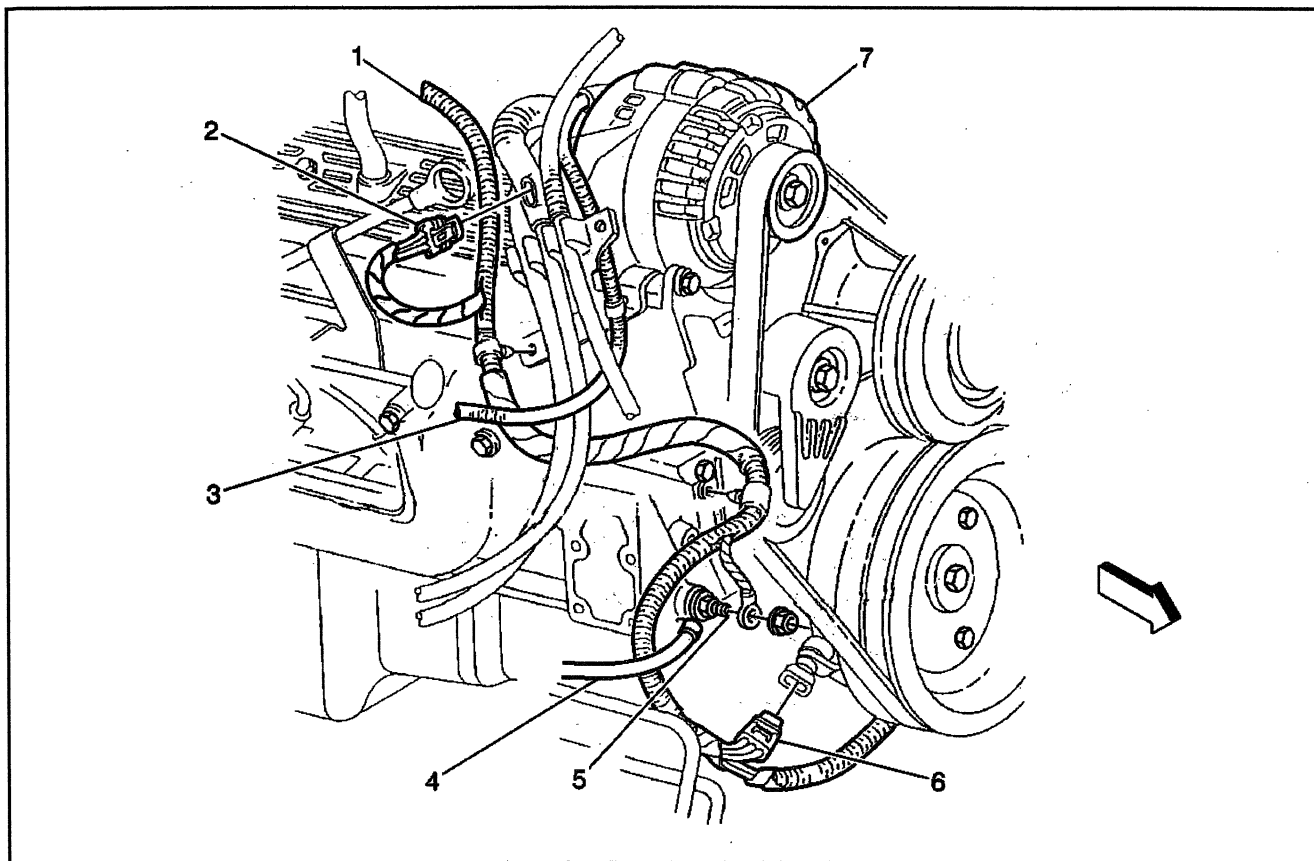
391546

## Legend

- |                            |                           |
|----------------------------|---------------------------|
| (1) Generator Cable        | (4) Starter Solenoid      |
| (2) Positive Battery Cable | (5) Engine Wiring Harness |
| (3) Battery, RH            |                           |



## Generator Support Wiring

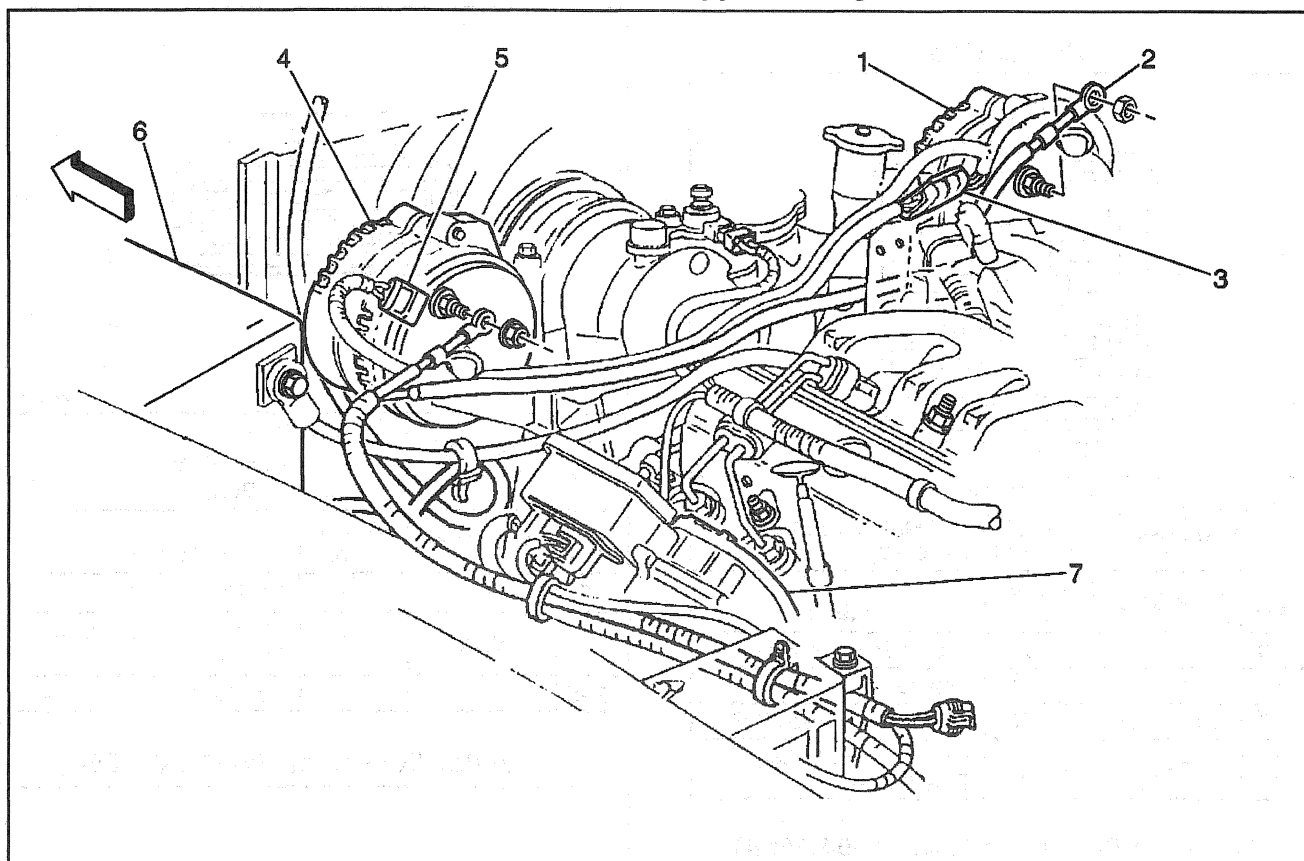


391537

## Legend

- |                            |                                |
|----------------------------|--------------------------------|
| (1) Engine Wiring Harness  | (5) G105                       |
| (2) Generator Connector    | (6) Crankshaft Position Sensor |
| (3) Generator Wiring       | (7) Generator                  |
| (4) Negative Battery Cable |                                |

## Dual Generator Support Wiring



391542

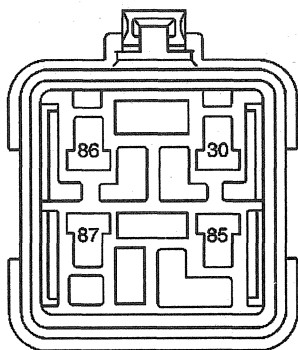
## Legend

- (1) Generator, RH
- (2) Generator Cable
- (3) C115
- (4) Generator, LH

- (5) Generator Connector, LH
- (6) Battery, LH
- (7) Electronic Brake Control Module (EBCM)

## Engine Electrical Connector End Views

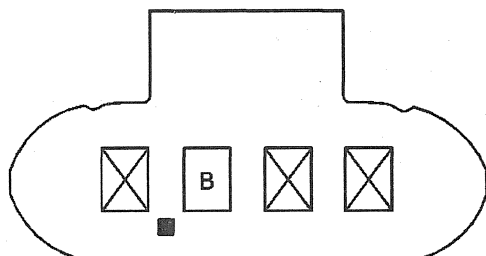
Starter Relay



306606

Connector Part Information		<ul style="list-style-type: none"> <li>• 12129716</li> <li>• CONN 4F M/P 280 FLXLK SLD (MD GRY)</li> </ul>	
Pin	Wire Color	Circuit No.	Function
30	PPL	6	Starter Solenoid Feed
85	BLK	150	Ground
86	PPL/WHT	1035	Starter Relay Feed Coil
87	RED	242	Fuse Output - Battery Type II Fuse

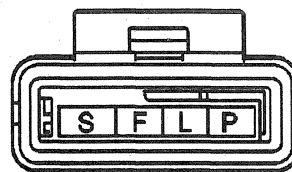
Generator Connector (Gas) (100A/105A)



306607

Connector Part Information		<ul style="list-style-type: none"> <li>• 12186566</li> <li>• ASM 1F M/P 150 Sealed (BLK)</li> </ul>	
Pin	Wire Color	Circuit No.	Function
B	BRN	25	Charge Indicator Lamp Output

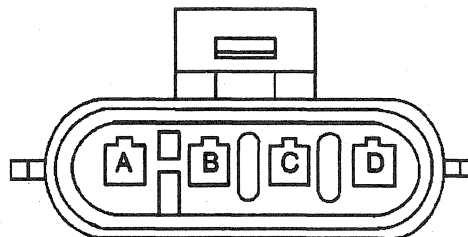
Generator Connector (Gas) (124A/140A)



226995

Connector Part Information		<ul style="list-style-type: none"> <li>• 12124898</li> <li>• ASM Conn 4F M/P Sealed (BLK)</li> </ul>	
Pin	Wire Color	Circuit No.	Function
F	—	—	Not Used
L	BRN	25	Charge Indicator Lamp Output
P-S	—	—	Not Used

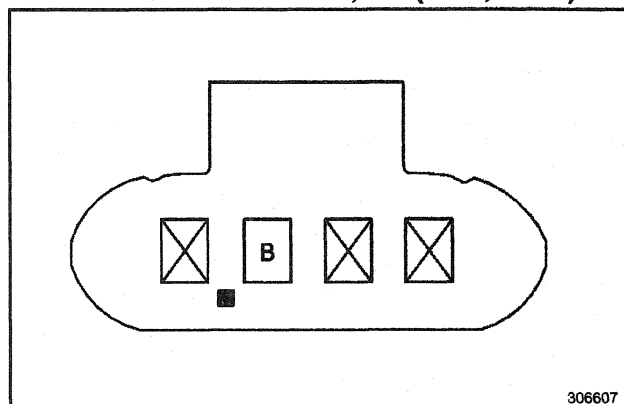
Generator Connector, RH (Dual, 100A)



62443

Connector Part Information		<ul style="list-style-type: none"> <li>• 12047950</li> <li>• ASM Conn 4F M/P 150 (BLK)</li> </ul>	
Pin	Wire Color	Circuit No.	Function
A	WHT	121	Tachometer Signal
B	BRN	25	Charge Indicator Lamp Output
C-D	—	—	Not Used

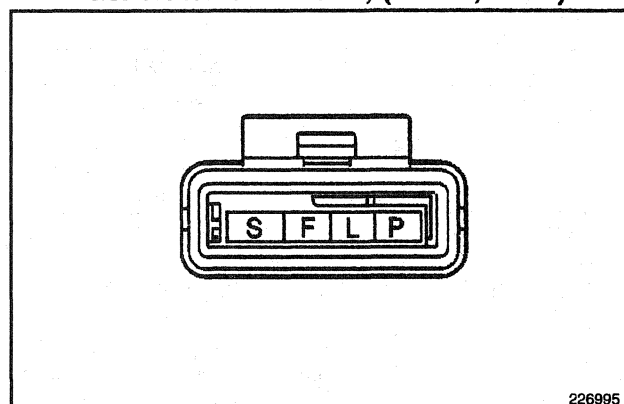
## Generator Connector, LH (Dual, 100A)



306607

Connector Part Information		<ul style="list-style-type: none"> <li>• 12047950</li> <li>• ASM Conn 4F M/P 150 (BLK)</li> </ul>	
Pin	Wire Color	Circuit No.	Function
A	—	—	Not Used
B	BRN	25	Charge Indicator Lamp Output
C-D	—	—	Not Used

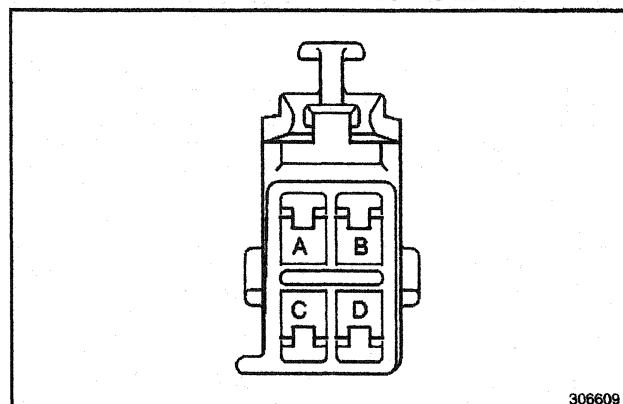
## Generator Connector, (Diesel, 140A)



226995

Connector Part Information		<ul style="list-style-type: none"> <li>• 12124898</li> <li>• ASM Conn 4F M/P Sealed (BLK)</li> </ul>	
Pin	Wire Color	Circuit No.	Function
F	—	—	Not Used
L	WHT	121	Tachometer Signal
P	BRN	25	Charge Indicator Lamp Output
S	—	—	Not Used

## Clutch Pedal Position Switch



306609

Connector Part Information		<ul style="list-style-type: none"> <li>• 12129136</li> <li>• CONN 4F M/P 280 FLXLK (BLK)</li> </ul>	
Pin	Wire Color	Circuit No.	Function
A	PPL	806	Fuse Output - Crank - Type III Fuse
B	PPL	420	Stop Lamp Switch Output
C	PPL/WHT	1035	Starter Relay Feed - Coil
D	BRN/WHT	379	Cruise Control Clutch Pedal Position Switch Output

## Diagnostic Information and Procedures

## Charging System Check

Step	Action	Normal Result(s)	Abnormal Result(s)*
1	Move the ignition switch from the OFF position to the RUN position.	Battery indicator lamp turns ON, voltmeter gauge reads between 12-14 volts.	<ul style="list-style-type: none"> <li>• Refer to <i>Charge Indicator Inoperative</i>.</li> <li>• Refer to <i>Volt Gauge Inaccurate or Inoperative</i>.</li> </ul>
2	Move the Ignition Switch to the START position and then release.	The engine starts, the voltage gauge reads between 13-16 volts, the battery indicator lamp turns OFF.	Refer to <i>Charge Indicator Always On</i> .
3	Run the engine at idle while observing the voltmeter gauge and the battery indicator lamp.	Voltmeter gage holds steady between 13-16 volts and the battery indicator lamp is OFF.	Refer to <i>Generator Not Operating Properly</i> .
4	1. Turn on the following electrical components: <ul style="list-style-type: none"> <li>• Headlamps</li> <li>• Rear defogger</li> <li>• Heater blower motor to HI</li> </ul> 2. Increase the engine speed to 2500 RPM for 2 minutes and observe the voltmeter gage.	Voltmeter gauge holds steady between 13-16 volts and the battery indicator lamp is OFF.	Refer to <i>Generator Not Operating Properly</i> .

\* Refer to the appropriate symptom diagnostic table for the applicable abnormal result.

## Starting System Check

Step	Action	Normal Result(s)	Abnormal Result(s)*
1	Visually inspect the battery hydrometer for green eye.	Battery hydrometer displays a green eye.	Refer to <i>Battery Hydrometer Displays Yellow Dot</i> .
2	Perform the Battery Terminal Check. Refer to Battery Terminal Check.	Battery cables are clean and tightly connected.	Battery cable(s) are loose. Refer to <i>Fastener Tightening Specifications</i> .
3	Move the ignition switch from the OFF position to the START position and release.	Starter motor pinion gear engages the flywheel without noise, the engine starts, the pinion gear disengages from the flywheel without noise.	<ul style="list-style-type: none"> <li>• Refer to <i>Starter Solenoid Does Not Click</i>.</li> <li>• Refer to <i>Starter Solenoid Clicks, Engine Does Not Crank</i>.</li> <li>• Refer to <i>Engine Cranks/Cranks Slowly, but Does Not Start</i>.</li> <li>• Refer to <i>Starter Motor Noise Diagnosis</i>.</li> </ul>

\* Refer to the appropriate symptom diagnostic table for the applicable abnormal result.

## Battery Common Causes of Failure

The battery will not last indefinitely. With proper care, the battery will provide many years of service.

- When the battery tests well, but fails to perform satisfactorily, inspect for the following conditions:
  - A vehicle accessory is left on overnight.
  - Long periods of slow driving or short trips that do not allow sufficient time to recharge the battery.
  - The electrical load on the vehicle is greater than the generator output. This can happen when aftermarket equipment is added.

- Check the charging system for the following conditions:
  - Poor ground connections
  - Electrical shorts
  - A slipping drive belt
  - A faulty generator
- Check for the following that results from a poorly maintained battery:
  - Corrosion on the battery terminals
  - Loose battery cable clamps
  - Operating the vehicle with a loose battery hold down
- Check the exterior for damage to the battery case.

## Battery Check

Step	Action	Normal Result(s)	Abnormal Result(s)*
<p><b>Caution: Batteries produce explosive gasses. Batteries contain corrosive acid. Batteries supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury while working near a battery:</b></p> <ul style="list-style-type: none"> <li>• Always shield your eyes.</li> <li>• Avoid leaning over the battery whenever possible.</li> <li>• Do not expose the battery to open flames or sparks.</li> <li>• Do not allow battery acid to contact the eyes or the skin.               <ul style="list-style-type: none"> <li>– Flush any contacted areas with water immediately and thoroughly.</li> <li>– Get medical help.</li> </ul> </li> </ul>			
1	1. Inspect the following areas for battery acid: <ul style="list-style-type: none"> <li>• The battery case</li> <li>• The battery tray</li> <li>• The area around and underneath the battery tray</li> </ul> 2. Inspect the battery for a cracked, broken, or damaged case.	<ul style="list-style-type: none"> <li>• The battery case, the battery tray, and the surrounding area are dry.</li> <li>• The battery is not cracked, broken, or damaged.</li> </ul>	Refer to <i>Battery Replacement</i> .
2	Compare the Cold Cranking Amperage (CCA) and the Reserve Capacity (RC) of the battery or the Original Equipment (OE) specification. Refer to <i>Battery Usage</i> .	The ratings of the vehicle battery meet or exceed the CCA and the RC of the original equipment specification.	Refer to <i>Battery Replacement</i> .
3	Inspect the battery hydrometer for a green dot.	The battery hydrometer displays a green dot.	<ul style="list-style-type: none"> <li>• If the battery hydrometer has a dark dot (no green dot visible), test the condition of the battery. Refer to <i>Battery Not Operating Properly</i>.</li> <li>• If the battery hydrometer has a yellow dot, check the battery for low electrolyte. Refer to <i>Battery Hydrometer Displays Yellow Dot</i>.</li> </ul>
4	Turn the ignition key to START and check to see if the engine cranks normally and starts.	The engine cranks normally and starts.	<ul style="list-style-type: none"> <li>• Engine does not crank or cranks slowly, refer to <i>Battery Not Operating Properly</i>.</li> <li>• Engine cranks normally but does not start, refer to <i>Engine Cranks but Does Not Run</i> in Engine Controls.</li> <li>• Engine starts but does not start overnight or after a couple of days, refer to <i>Charging System Check</i> and <i>Battery (Parasitic) Load Test</i>.</li> </ul>
5	1. Inspect the battery for proper installation and retention in the battery tray. 2. Inspect the battery terminals for clean and tight connections.	<ul style="list-style-type: none"> <li>• The battery is firmly held in place in the tray and the hold-down bolt is properly tightened.</li> <li>• The battery terminals are clean and tight.</li> </ul>	<ul style="list-style-type: none"> <li>• Install the battery in the battery tray correctly. Refer to <i>Battery Replacement</i>.</li> <li>• Refer to <i>Battery Terminal Check</i>.</li> </ul>
* Refer to the appropriate symptom diagnostic table for the applicable abnormal result.			

## Battery Hydrometer Displays Yellow Dot

Step	Action	Value(s)	Yes	No
<b>Caution: Refer to Batteries Produce Explosive Gasses Caution in Cautions and Notices.</b>				
1	Was the Battery Check performed?	—	Go to Step 2	Go to Battery Check
2	Tap the hydrometer lightly on top with the handle of a small screwdriver to dislodge any air bubbles inside the battery. Is the hydrometer dot still yellow?	—	Go to Step 4	Go to Step 3
3	Does the hydrometer display a green or dark dot?	—	Hydrometer OK	Go to Step 4
4	Replace the battery. Refer to <i>Battery Replacement</i> in Engine Electrical. Did you complete the replacement?	—	Go to Step 5	—
5	Visually inspect the hydrometer in the new battery. Does the hydrometer display a green dot?	—	Go to Step 11	Go to Step 6
6	Does the hydrometer display a yellow dot?	—	Go to Step 7	Go to Step 9
7	Tap the hydrometer lightly on top with the handle of a small screwdriver to dislodge any air bubbles inside the battery. Is the hydrometer dot still yellow?	—	Go to Step 4	Go to Step 8
8	Does the hydrometer display a green dot?	—	Go to Step 11	Go to Step 9
9	Does the hydrometer display a dark dot?	—	Go to Step 10	—
10	Charge the battery. Refer to <i>Battery Charging</i> in Engine Electrical. Was the battery recharged?	—	Go to Step 11	—
11	Check the charging system for proper operation. Refer to <i>Charging System Check</i> in Engine Electrical. Is the charging system OK?	—	Hydrometer OK	—

## Battery Not Operating Properly

**Caution:** Batteries produce explosive gases, contain corrosive acid, and supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury when working near a battery:

- Always shield your eyes and avoid leaning over the battery whenever possible.
- Do not expose the battery to open flames or sparks.
- Do not allow the battery electrolyte to contact the eyes or the skin. Flush immediately and thoroughly any contacted areas with water and get medical help.
- Follow each step of the jump starting procedure in order.
- Treat both the booster and the discharged batteries carefully when using the jumper cables.

**Important:** The battery test using the J 42000 Battery Tester requires correct connections to the battery terminals. A failure to obtain the correct connections during the test may result in replacing the battery unnecessarily. Adhere to the following instructions in order to avoid an incorrect diagnosis due to poor connections:

- When testing the vehicle with the battery cables still connected, rock the J 42000 clips back and forth on the terminal bolt in order to cut through any coating or oxidation that may be present on the bolt.

Even new bolts contain a protective coating that may insulate or cause a resistance in the test circuit.

- If it is uncertain that correct connections can be made to the battery terminal bolts in the vehicle, perform the following steps:
  1. Disconnect the battery cables.
  2. Install the test adapters on the terminals.
  3. Follow the instructions for testing the battery outside of the vehicle.

- If a REPLACE BATTERY result is obtained for a battery tested in the vehicle with the battery cables connected, perform the following steps:

1. Disconnect the battery cables.
2. Install the approved adapters.
3. Follow the instructions for testing the battery outside of the vehicle.
4. Replace the battery only if the second test shows a REPLACE BATTERY result.

For warranty purposes, use the test code from the second test.

- Use the approved terminal adapters.

Do not use any common bolts or a combination of bolts, nut, and washers as adapters when testing the battery.

Use the test adapters that are provided with the J 42000 tester or GM part number 12303040 terminal adapters. If the adapters that are provided with the J 42000 tester require replacement, only use adapters with the GM part number 12303040. Any other adapters may not contact the correct areas of the battery terminal, causing resistance that may result in an invalid battery test result.

- In order to test the top terminal, threaded stud batteries outside of the vehicle, use GM part number 12303040 adapters.

Do not connect the tester to the plain threaded terminals.

**Important:** For warranty purposes, always place the test code displayed by the tester on the repair order. The number is a unique identifier that describes the test data for a particular battery at a particular time.

While the test code may occasionally repeat when retesting the same battery, it is more likely that a different code will result each time the battery is tested.

## Battery Not Operating Properly

Step	Action	Value(s)	Yes	No
1	Has the Battery Check been performed?	—	Go to Step 2	Go to Battery Check
2	Is the battery in the vehicle, with the battery cables connected?	—	Go to Step 4	Go to Step 3
3	1. Lightly wire brush the lead faces of both battery terminals. 2. Install the terminal adapters to both of the terminals. Are the adapters installed?	—	Go to Step 6	—
4	Ensure that the battery terminals are clean, tight, and in good condition. Refer <i>Battery Terminal Check</i> . Are the terminal connections OK?	—	Go to Step 5	—
5	1. Turn the ignition switch to the OFF position. 2. Turn the electrical loads and all accessory lights to the OFF position. Are all of the electrical loads and accessory lights OFF?	—	Go to Step 6	—



## Battery Not Operating Properly (cont'd)

Step	Action	Value(s)	Yes	No
6	<p><b>Important:</b> When testing the battery in the vehicle, connect the tester directly to the cable bolts. Do not connect either of the tester clamps to a remote terminal, such as a junction block or a jump start terminal. The use of a remote terminal will cause invalid test results.</p> <ol style="list-style-type: none"> <li>1. Connect the red clamp on the J 42000 to the adapter or the cable bolt on the battery positive terminal.</li> <li>2. Connect the black clamp on the tester to the adapter or cable bolt on the battery negative terminal.</li> <li>3. Rock both of the tester clamps back and forth in order to cut through to the bare metal.</li> </ol> <p>The message GM MICRO 410 should appear for a short time on the tester display, and then change to SELECT TEST.</p> <p>Does the display read SELECT TEST?</p>	—	Go to Step 10	Go to Step 7
7	Does a CHECK CONNECTION message appear on the J 42000 display?	—	Go to Step 8	Go to Step 9
8	<p>Inspect the tester connections to the battery terminal adapters or cable bolts for the following conditions:</p> <ul style="list-style-type: none"> <li>• Both sides of each tester clamp must make the correct contact.</li> <li>• Ensure that the red clamp is connected to the positive post and the black clamp is connected to the negative post.</li> <li>• If the adapters or the bolts appear corroded, rock the clamps back and forth in order to ensure a correct connection.</li> </ul> <p>Use a wire brush in order to clean the adapters or cable bolts, if needed.</p> <p>Does the tester display now read SELECT TEST?</p>	—	Go to Step 17	Go to Step 12
9	<p>Use a J 39200 DMM in order to test the battery voltage with the J 42000 tester connected.</p> <p>Is the voltage at or below the specified value?</p>	5.5 V	Go to Step 25	Go to Step 29
10	<p>Use the scroll keys on the J 42000 tester in order to select either IN-VEHICLE or OUT-OF-VEHICLE testing, depending on the following conditions:</p> <ul style="list-style-type: none"> <li>• Use IN-VEHICLE testing if the battery cables are connected to the battery.</li> <li>• Use OUT-OF-VEHICLE testing if the battery cables are disconnected and the terminal adapters are installed.</li> </ul> <p>Was IN-VEHICLE testing selected?</p>	—	Go to Step 11	Go to Step 12
11	<p>The display on the tester will show ALWAYS TEST AT BATTERY TERMINAL, and then change to SELECT RATING.</p> <p>Does the display read SELECT RATING?</p>	—	Go to Step 13	Go to Step 37
12	<p>For OUT-OF-VEHICLE testing, the display on the tester will show USE TERMINAL ADAPTERS, and then change to SELECT RATING.</p> <p>Does the tester display read SELECT RATING?</p>	—	Go to Step 13	Go to Step 37

## Battery Not Operating Properly (cont'd)

Step	Action	Value(s)	Yes	No
13	<b>Important:</b> Refer to the <i>Battery Usage</i> for the correct rating for the vehicle's OE battery. If a battery with a lower CCA rating has been installed in the vehicle, the battery may not perform properly during the use of the vehicle even if the battery passes the test using the J 42000 tester. 1. Use the scroll keys on the J 42000 tester in order to select the CCA rating on the battery label. 2. Press the ENTER key on the tester. TESTING will appear briefly on the display, followed by the results of the test. Are the results of the test displayed?	—	Go to Step 14	—
14	Does GOOD BATTERY appear on the J 42000 display?	—	Go to Step 22	Go to Step 15
15	Does GOOD-RECHARGE appear on the display?	—	Go to Step 25	Go to Step 16
16	Does CHARGE & RETEST appear on the display?	—	Go to Step 29	Go to Step 17
17	Does REPLACE BATTERY appear on the display?	—	Go to Step 26	Go to Step 18
18	Does BAD CELL-REPLACE appear on the display?	—	Go to Step 28	Go to Step 19
19	Does SURFACE CHARGE DETECTED appear on the display?	—	Go to Step 30	Go to Step 20
20	Does SELECT TEMP appear on the display?	—	Go to Step 33	Go to Step 21
21	Does SYSTEM NOISE-CHECK LOADS, alternating with RETESTING, appear on the display?	—	Go to Step 34	Go to Step 37
22	1. Press the CODE button on the J 42000. 2. For warranty purposes, write the displayed code on the repair order. Is the green dot visible in the battery's hydrometer?	—	Go to Step 24	Go to Step 23
23	Charge the battery. Refer to <i>Battery Charging</i> . Is the green dot visible in the hydrometer?	—	Go to Step 24	Go to Step 39
24	The battery is OK. Install the battery. Refer to <i>Battery Replacement</i> . Is the action complete?	—	System OK	—
25	1. Press the CODE button on the J 42000. 2. For warranty purposes, write the displayed code on the repair order. 3. Charge the battery. Refer to <i>Battery Charging</i> . Is the green dot visible in the hydrometer?	—	Go to Step 24	—
26	Was the battery tested in the vehicle with the battery cables still attached?	—	Go to Step 27	Go to Step 28
27	<b>Caution:</b> Refer to <i>Ignition OFF When Disconnecting Battery Notice</i> . <b>Notice:</b> Refer to <i>Battery Disconnect Caution</i> . 1. Turn the ignition key to the OFF position. 2. Disconnect the battery negative cable. 3. Disconnect the battery positive cable. Are the actions complete?	—	Go to Step 3	—
28	1. Press the CODE button on the J 42000. 2. For warranty purpose, write the displayed code on the repair order. 3. Replace the battery. Refer to <i>Battery Replacement</i> . Is the action complete?	—	Go to Step 2	—
29	1. Press the CODE button on the J 42000. 2. For warranty purpose, write the displayed code on the repair order. 3. Charge the battery. Refer to <i>Battery Charging</i> . Is the green dot visible in the battery hydrometer?	—	Go to Step 2	—

## Battery Not Operating Properly (cont'd)

Step	Action	Value(s)	Yes	No
30	<p><b>Important:</b> Surface charge removal is only necessary when the tester detects that a surface charge may affect the results of the test. The tester will not complete the testing sequence until the surface charge is removed.</p> <p>Follow the tester prompts in order to remove the surface charge by turning the vehicle's headlights ON and OFF. If the sequence is followed properly, the tester will automatically complete the test. If the sequence is not followed properly, the tester will display the message DISCONNECT AND RETEST.</p> <p>Does the DISCONNECT AND RETEST message appear?</p>	—	Go to Step 31	Go to Step 32
31	<p>Disconnect the tester from the battery terminals.</p> <p>Is the action complete?</p>	—	Go to Step 2	—
32	<p>The tester will display the word RETESTING and show the CCA rating that was selected for the test. If the test is successfully completed, the test results will be displayed.</p> <p>Do the test results appear on the display?</p>	—	Go to Step 14	Go to Step 36
33	<p><b>Important:</b> Temperature compensation is only necessary when the tester detects that the battery temperature may affect the results of the test.</p> <ol style="list-style-type: none"> <li>1. Use the scroll keys in order to indicate whether the internal temperature of the battery is above or below 0°C (32°F). Use the temperature of the battery to which the battery has been exposed for the past several hours in order to estimate the temperature.</li> <li>2. Push the ENTER key.</li> </ol> <p>The tester will briefly display the RETESTING message and the CCA rating selected for the test. The test results will then show on the display.</p> <p>Do the test results show on the display?</p>	—	Go to Step 14	Go to Step 37
34	<p>The tester detects that a vehicle electrical load is not present (such as a light is on or the ignition key is not in the OFF position).</p> <p>Turn OFF all of the system electrical loads.</p> <p>Are all of the system electrical loads OFF?</p>	—	Go to Step 35	—
35	<p>The J 42000 automatically retests the battery. A RETESTING message and SYSTEM NOISE message on the display alternates up to 5 minutes while all circuits power down. The test results will then display on the tester.</p> <p>Are the test results displayed on the tester?</p>	—	Go to Step 14	Go to Step 36
36	<p>An undetected load or parasitic drain can cause the alternating RETESTING and SYSTEM NOISE messages to continue for more than 5 minutes.</p> <ol style="list-style-type: none"> <li>1. Disconnect the J 42000 tester.</li> <li>2. Eliminate all electrical drains. Refer to <i>Battery (Parasitic) Load Test</i>.</li> </ol> <p>Are all electrical loads and parasitic drains eliminated?</p>	—	Go to Step 2	—
37	<p>A J 42000 problem is indicated. Inspect the tester for correct operation.</p> <p>Is the tester operating properly?</p>	—	Go to Step 2	Go to Step 38
38	<p>Repair or replace the tester.</p> <p>Is the action complete?</p>	—	Go to Step 1	—
39	<p>A problem exists with the battery's built-in hydrometer. Replace the battery. Refer to <i>Battery Replacement</i>.</p> <p>Is the action complete?</p>	—	System OK	—

## Battery Load Test

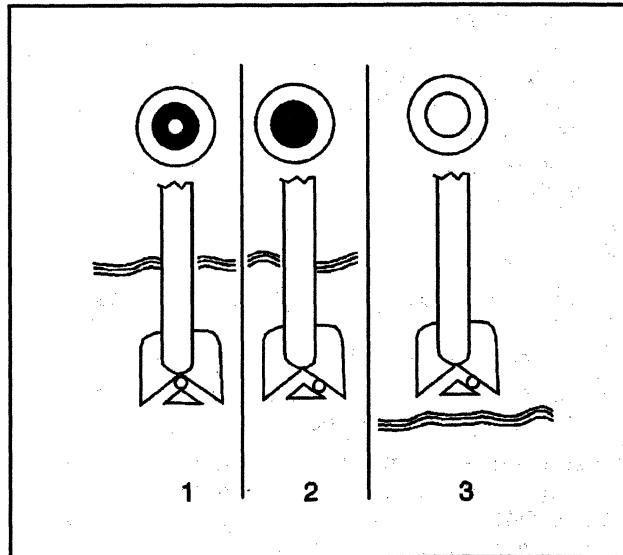
### Tools Required

GM P/N 12303040

### Visual Inspection

1. Before performing the load test, visually inspect the battery for obvious damage, such as a cracked or broken case.
2. Repair the cause of any damage or replace the battery. Refer to *Battery Replacement*.

### Hydrometer Check

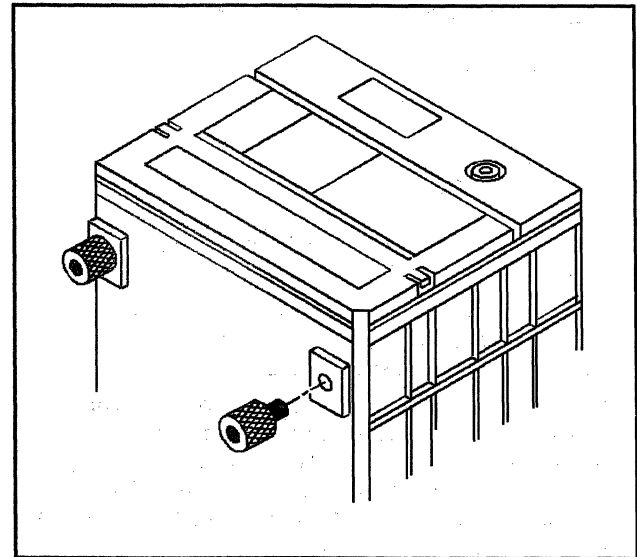


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- If the green dot is visible (1), perform the load test.
- If the green dot is not visible (2), charge the battery. Refer to *Battery Charging*.
- If the dot is clear or yellow (3), replace the battery. Refer to *Battery Replacement*.

**Important:** Do not load test a frozen battery. Replace it instead.

1. Use a voltmeter in order to check the voltage across the battery terminals. If the green dot is visible, the voltage should be 12 volts or above. Unless the battery has just been discharged (such as, by load testing or cranking the engine), replace the battery if the voltage is below 12 volts.



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2. Install battery side terminal adapters.
3. Connect a voltmeter and a battery lead tester across the battery terminals.

**Important:** Do not complete this step if the battery has not been recently charged.

4. If the battery has been charging, apply a 300 ampere load for 15 seconds in order to remove the surface charge from the battery. Remove the load.
5. Wait 15 seconds in order to let the battery recover, then apply the specified load from the specifications. Read the voltage after 15 seconds, then turn off the load.

**Important:** The battery temperature must be estimated by the feel and by the temperature the battery has been exposed to for the preceding few hours.

6. When the voltage does not drop below the minimum voltage, the battery is good and should be returned to service. If the voltage is less than the minimum, replace the battery. Refer to *Battery Temperature vs Minimum Voltage*.

## Battery (Parasitic) Load Test

### Tools Required

- J 36169-A Fused Jumper Wire
- J 38758 Parasitic Draw Test Switch
- J 39200 Digital Multimeter
- Scan Tool or Equivalent

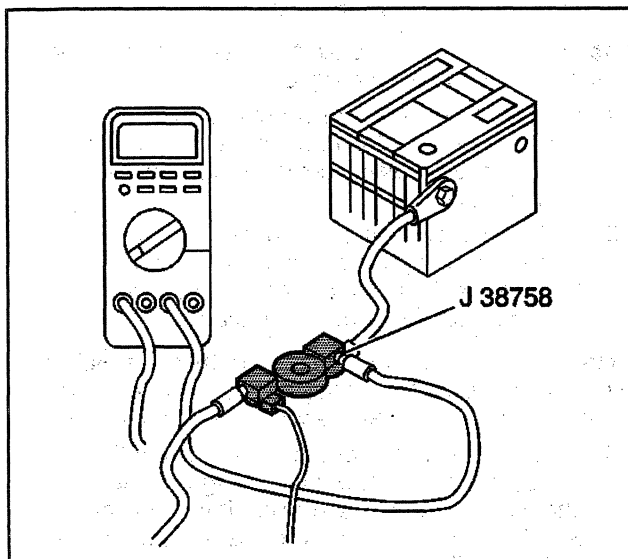
**Caution:** Refer to **Batteries Produce Explosive Gasses Caution in Cautions and Notices.**

**Notice:** Do not turn the parasitic draw test switch to the OFF position with the engine running. Damage will occur to the vehicle's electrical system.

**Notice:** The test switch must be in the ON position when removing the fuses in order to maintain continuity in the electrical system. This avoids damaging the digital multimeter due to accidental overloading, such as a door being opened to change a fuse.

**Caution:** Refer to **Battery Disconnect Caution in Cautions and Notices.**

1. Disconnect the battery negative cable.



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2. Install the male end of the J 38758 to the negative battery terminal.
3. Turn OFF the test switch.
4. Install the negative battery cable to the female end of the test switch.
5. Install the Scan Tool (or equivalent) or wait for 20 minutes.
6. Turn ON the test switch.
7. Road test the vehicle while activating all accessories, including the radio and the air conditioning.
8. Lower the door glass, then exit the vehicle. Do not move the door handle after closing the door.
9. Open the hood.

**Important:** The power down timer will reset to 20 minutes if any wake up inputs are received by a Class 2 device (after the scan tool has put all Class 2 devices to sleep).

10. Put all of the Class 2 devices into the sleep mode.
11. Turn OFF the ignition switch. Remove the key.

**Important:** From this point on, electrical continuity must be maintained in the ground circuit of the battery through the Test Switch J 38758 in the ON position or through the ammeter J 39200.

12. Components such as PCM, VCM, Automatic Air Conditioning, and the Truck Body Control Module have timers that draw several amps of current while they cycle down. This can give a false parasitic drain reading. Wait 20 minutes for these components to power down before continuing this test (or use the scan tool to put all Class 2 devices to sleep).
13. Connect a jumper wire with a 10 A fuse J 36169-A to the terminals of the test switch.
14. Turn the test switch to the OFF position.
15. Wait ten seconds.  
If the fuse does not blow, the current is less than 10 A.  
The ammeter can be used safely.
16. Before the fused jumper wire is removed, turn the test switch to the ON position.

**Important:** If an ammeter other than the J 39200 is used, ensure that the vehicle does not have a high current drain that would damage the ammeter when connected to the circuit.

17. Perform the following procedure in order to detect a high current drain:

1. Set the ammeter J 39200 to the 10 A scale.
2. Connect the ammeter to the test switch terminals.
3. Turn OFF the test switch. This allows the current to flow through the ammeter.
4. Wait one minute, then inspect the current reading.

- When there is a current reading of 2 A or less, turn ON the test switch, this maintains continuity in the electrical system.

- Then, switch the meter down to the 2 A scale, for a more accurate reading, when the test switch is reopened.

5. Open the test switch.
6. Take the reading in milliamps.
7. Note the battery reserve capacity. Refer to **Battery Usage.**

- Divide this number by 4.  
Example:  $90/4 = 22.5$
- Compare this to the ammeter reading.
- The current drain in milliamps should not exceed this number.
- Example: if a battery has a reserve capacity of 90 minutes, the current drain should not exceed 22 milliamps.

8. When the current draw is too high, remove the electrical system fuses one at a time until the draw returns to a value less than or equal to specifications.
    - Start with the fuses that are hot all the time.
    - To remove the fuse, you must first open the door, which causes a high enough current flow to damage the ammeter.
    - Protect the ammeter, without disturbing the electrical continuity, by turning ON the test tool before opening the door.
    - Remove the courtesy lamp fuse.
    - Note the ammeter reading.
    - If the parasitic load is still excessive, start removing the remaining fuses one at a time.
    - Keep the courtesy lamp fuse out during diagnosis, so the door can remain open.
    - Perform Steps 11 through 13 each time a fuse is removed.
  9. Removing the PCM or VCM fuse should cause a drop of less than 10 milliamps.  
A drop greater than 10 milliamps indicates a possible short to ground.
  10. Check the orange wires along with the components connected to the orange wires.  
No drop in the milliampere reading indicates the PCM or VCM is not drawing current.
  11. Repeat the parasitic current drain test procedure after any repair has been completed.
  12. When the cause of the excessive current draw has been located and repaired, remove the ammeter and the parasitic draw test switch.
- Notice:** Refer to *Fastener Notice* in Cautions and Notices.
13. Connect the battery negative cable to the negative battery terminal.
- Tighten**  
Tighten the battery negative cable bolt to 15 N·m (11 lb ft).

### Battery Is Undercharged or Overcharged

Step	Action	Value(s)	Yes	No
1	Perform the <i>Charging System Check</i> . Is the generator OK?	—	Go to Step 2	Go to Step 13
2	1. Turn OFF all accessories. Connect the generator 4-way connector (if disconnected). 2. Start the engine and run at 2500 RPM. 3. Check the voltage across the battery terminals. Is the voltage within the specified range?	13–16 V	Go to Step 3	Go to Step 5
3	Stop the engine. Perform the <i>Battery (Parasitic) Load Test</i> . Is the parasitic load below the specified value?	22 ma	System OK	Go to Step 4
4	Determine the source of the excessive parasitic drain and repair as necessary. Is the repair complete?	—	System OK	—
5	Was the voltage across the battery terminals with the engine running at 2500 RPM too low?	—	Go to Step 6	Go to Step 9
6	1. Disconnect the generator 4-way connector. Turn the ignition switch to RUN. 2. Use a <i>J 39200</i> in order to measure the CKT 225 voltage in cavity B of the generator connector. Is the voltage above the specified value?	12 V	Go to Step 7	Go to Step 10
7	Check CKT 225 between the generator and the PCM for an Intermittent shorted/grounded condition or a poor connection. Is CKT 225 OK?	—	Go to Step 14	Go to Step 8
8	Repair CKT 225 as necessary. Refer to <i>Wiring Repairs</i> in Wiring Systems. Is CKT 225 repair complete?	—	Go to Step 15	—
9	Check the Generator 4-way connector for a mis-wired condition in cavity D. This cavity should not be in this vehicle. Has the mis-wired condition been repaired?	—	Go to Step 15	—

## Battery Is Undercharged or Overcharged (cont'd)

Step	Action	Value(s)	Yes	No
10	1. Disconnect or backprobe the CKT 225 connector at the PCM. 2. Turn the ignition switch to RUN. 3. Use a J 39200 to inspect the voltage output of the PCM to CKT 225. Is the voltage above the specified value?	12 V	Go to Step 11	Go to Step 12
11	Repair CKT 225 for a shorted, grounded, or open condition. Refer to <i>Wiring Repairs</i> in Wiring Systems. Is the CKT 225 repair complete?	—	Go to Step 15	—
12	Repair or replace the PCM. Refer to PCM Replacement/Programming. Is the repair complete?	—	Go to Step 15	—
13	Replace the generator. Refer to <i>Generator Replacement (CS 144)</i> or <i>Generator Replacement (CS 130D)</i> or <i>Generator Replacement - Auxiliary</i> . Is the repair complete?	—	Go to Step 15	—
14	1. Disconnect the battery negative cable. 2. Disconnect and clean all connections between the battery positive terminal and the generator output terminal. Check all cables for an intermittent open condition. Refer to <i>Starting and Charging Schematics</i> . 3. Disconnect and clean all connections in the ground circuit between the battery negative terminal and the generator housing. Check all cables for an intermittent open condition. 4. Connect the battery negative cable. Is the repair complete?	—	Go to Step 15	—
15	1. Turn OFF all accessories. Connect the generator 4-way connector (if disconnected). 2. Start the engine and run at 2500 RPM. 3. Check the voltage across the battery terminals. Is the voltage within the specified range?	13—16 V	System OK	Go to Step 5

## Charge Indicator Always On

Step	Action	Value(s)	Yes	No
1	1. Turn OFF the engine. 2. Disconnect the generator connector. 3. Move the ignition switch to the RUN position. Does the battery indicator light?	—	Go to Step 3	Go to Step 2
2	Repair or replace the generator. Refer to <i>Generator Replacement (CS 144)</i> . Is the repair complete?	—	Go to Charging System Check	—
3	1. Remove CKT 25 (BRN) from connector C100. 2. Turn ignition switch to the RUN position. Does the battery indicator light?	—	Go to Step 4	Go to Step 5
4	Locate and repair the short to ground in CKT 25 (BRN) between C100 and the battery indicator bulb. Refer to <i>Wiring Repairs</i> in Wiring Systems. Is the repair complete?	—	Go to Charging System Check	—
5	Locate and repair the short to ground in CKT 25 (BRN) between C100 and the generator. Refer to <i>Wiring Repairs</i> in Wiring Systems. Is the repair complete?	—	Go to Charging System Check	—

## Charge Indicator Inoperative

Step	Action	Value(s)	Yes	No
1	1. Disconnect the generator connector. 2. Turn the ignition switch to the RUN position. 3. Connect a fused jumper from cavity B, CKT 25 (BRN), of the generator connector, to ground. Does the battery indicator light?	—	Go to Step 4	Go to Step 2
2	1. Disconnect the instrument cluster connector. 2. Turn the ignition switch to the Run position. 3. Measure the voltage between the instrument cluster connector terminal 22 to ground. Is the voltage reading the same as battery voltage?	—	Go to Step 5	Go to Step 3
3	Repair the open in CKT 39 (PNK) between the IP fuse block and the instrument cluster. Refer to <i>Wiring Repairs</i> in <i>Wiring Systems</i> . Is the repair complete?	—	Go to Charging System Check	—
4	Repair or replace the generator. Refer to <i>Generator Replacement (CS 144)</i> . Is the repair or replacement complete?	—	Go to Charging System Check	—
5	1. Connect a jumper wire from cavity 22 of the IP Cluster to B+. 2. Connect a jumper wire from cavity 19 of the IP Cluster to ground. Does the battery indicator light?	—	Go to Step 7	Go to Step 6
6	Replace the instrument cluster. Refer to <i>IP Cluster Replacement</i> in <i>Instrument Panel, Gauges and Console</i> . Is the replacement complete?	—	Go to Charging System Check	—
7	Repair the open in CKT 25 (BRN) between the instrument cluster and the generator. Refer to <i>Wiring Repairs</i> in <i>Wiring Systems</i> . Is the repair complete?	—	Go to Charging System Check	—

## Engine Cranks/Cranks Slowly, but Does Not Start

Step	Action	Value(s)	Yes	No
1	1. Ensure the battery is fully charged. 2. Turn the ignition switch to START. 3. Wait 15 seconds and measure the voltage at the battery while cranking the engine. Is the reading greater than the specified value?	9.5 V	Go to Step 2	Go to Step 3
2	Measure the voltage between the B (neg) terminal and the engine block while cranking the engine. Is the reading greater than the specified value?	0.5 V	Go to Step 4	Go to Step 5
3	Load test the battery. Is the battery OK?	—	Go to Step 6	Go to Step 7
4	Replace the negative battery cable. Refer to <i>Battery Cable</i> . Does the starter solenoid continue to click and the engine to crank slowly or not at all?	—	Go to Step 5	Go to Starting System Check
5	Measure the voltage between the B (pos) terminal and the starter solenoid terminal B, CKT 1 (BLK), while cranking the engine. Is the reading greater than the specified value?	0.5 V	Go to Step 8	Go to Step 6
6	Repair or replace the starter motor. Refer to <i>Starter Motor Replacement (Gas, 7.4L) (7.4L)</i> . Does the starter solenoid continue to click and the engine to crank slowly or not at all?	—	Go to Step 7	Go to Starting System Check
7	Replace the battery. Refer to <i>Battery Replacement</i> . Does the starter solenoid continue to click and the engine to crank slowly or not at all?	—	Go to Step 8	Go to Starting System Check
8	Replace the positive battery cable. Refer to <i>Battery Cable</i> . Is the repair complete?	—	Go to Starting System Check	—



**Generator Noise Test**

Generator noise may be caused by the following conditions:

- A loose drive belt.
- Loose mounting bolts.
- A loose or poor fitting terminal.
- A faulty component inside the generator.

Replace the generator if the drive belt and the mounting bolts are snug and there is still excessive generator noise.

Do not disassemble the generator. Separating the two end frames will damage the slip ring end frame bearing. CS-130 generator is serviceable by complete replacement only.

**Generator Not Operating Properly**

Step	Action	Value(s)	Yes	No
DEFINITION: Generator on-vehicle test which will test the generator independently from the vehicle wiring.				
1	Perform the charging system check. Refer to <i>Charging System Check</i> . Has the charging system check been performed?	—	Go to Step 2	—
2	1. Connect the red alligator clip of a <i>J 41450-B</i> CS Generator Electronic Tester to the generator output terminal. (The output wire is attached to the generator with a ring terminal and nut.) 2. Connect the black alligator clip of the <i>J 41450-B</i> to the metal generator housing. The green POWER lamp of the tester should light and remain lighted while the tester is being used. Does the green POWER lamp on the tester light?	—	Go to Step 9	Go to Step 3
3	1. Recheck the alligator clip connections that were made in Step 2. 2. Correct the connections if they were reversed. Does the green POWER lamp on the tester light after the correct connections are verified?	—	Go to Step 9	Go to Step 4
4	Connect a digital multimeter (DMM) from the generator output terminal to the generator metal housing. Is the voltage above the specified value?	12 V	Go to Step 18	Go to Step 5
5	Use a DMM to check the voltage between the battery terminals. Is the voltage above the specified value?	12 V	Go to Step 6	Go to Step 8
6	1. Inspect the circuit between the generator output terminal and the battery positive terminal for a loose connection or open circuit condition. Be sure to check for an open fusible link and/or any blown in-line fuses that may be used on the vehicle. 2. If a loose connection or open circuit was located, repair it. If an open fusible link or blown fuse was found, be sure to check the system for possible causes of a circuit overload, such as a direct B+ short to ground. Is the circuit okay between the generator output terminal and the battery positive terminal?	—	Go to Step 7	—
7	Repair the loose connection or open circuit between the battery negative terminal and the generator housing. Is the repair complete?	—	Go to Step 2	—
8	1. Inspect the battery. Refer to <i>Battery (Parasitic) Load Test</i> . 2. Charge or replace the battery if necessary. Is the battery OK?	—	Go to Step 2	—
9	1. Leave the <i>J 41450-B</i> alligator clips attached as in Step 2, and disconnect the vehicle 4-way generator connector. 2. Locate the matching 4-way connector of the <i>J 41450-B</i> and connect it to the generator. Does the red DIAGNOSTIC lamp on the tester light?	—	Go to Step 11	Go to Step 10

## Generator Not Operating Properly (cont'd)

Step	Action	Value(s)	Yes	No
10	<p>Perform the following test of the DIAGNOSTIC lamp of the <i>J 41450-B</i> :</p> <ol style="list-style-type: none"> <li>1. Disconnect the <i>J 41450-B</i> 4-way connector from the generator, but leave the <i>J 41450-B</i> alligator clips connected as in Step 2.</li> <li>2. Prepare a jumper wire with an in-line 100 ohm resistor. The watt rating of the resistor is not important. (An inexpensive 100Ω resistor can be purchased at an electronics supply store.)</li> <li>3. At one end of the prepared jumper wire, attach a Metri-Pack 150 male terminal probe adapter from a <i>J 35616-A</i> Connector Test Adapter Kit.</li> <li>4. Connect the prepared jumper wire to the <i>J 41450-B</i> L terminal (which is called the B terminal on CS 130D, LR, and AD generators). The tester connector terminals are the same as the generator connector terminals, so terminal identification on the <i>J 41450-B</i> can be accomplished by referring to <i>Engine Electrical Connector End Views</i>.</li> <li>5. Connect the other end of the jumper to the battery negative terminal.</li> </ol> <p>Does the red DIAGNOSTIC lamp on the tester light when the jumper is connected?</p>	—	Go to Step 19	Go to Step 18
11	<ol style="list-style-type: none"> <li>1. Prior to connecting a carbon pile load tester, make sure that the load dial of the carbon pile tester is turned completely to the OFF position.</li> <li>2. Connect the cable leads of the carbon pile tester to the battery of the vehicle.</li> <li>3. Connect an inductive ammeter to the output lead(s) of the generator. Make sure that all output leads pass through the ammeter inductive clip. The carbon pile tester may have its own inductive ammeter, or use a <i>J 35590</i> Current Clamp.</li> <li>4. Start the engine and allow it to idle briefly.</li> </ol> <p>Does the red DIAGNOSTIC lamp on the <i>J 41450-B</i> light?</p>	—	Go to Step 19	Go to Step 12
12	<p>Increase the engine speed to 2500 RPM.</p> <p>Does the red DIAGNOSTIC lamp on the <i>J 41450-B</i> light?</p>	—	Go to Step 19	Go to Step 13
13	<ol style="list-style-type: none"> <li>1. Maintain the engine speed at 2500 RPM.</li> <li>2. Turn on the load of the carbon pile tester, and increase the load until the generator output is equal to the load test value given in <i>Generator Usage</i>.</li> </ol> <p>As the load is increased, is the generator capable of producing the amount of load test current specified in <i>Generator Usage</i> ?</p>	—	Go to Step 14	Go to Step 19
14	<p>Maintain the engine speed at 2500 RPM and continue to operate the generator at the load test value.</p> <p>Is the red DIAGNOSTIC lamp on the <i>J 41450-B</i> lighted?</p>	—	Go to Step 19	Go to Step 15
15	<ol style="list-style-type: none"> <li>1. Maintain the engine speed at 2500 RPM and continue to operate the generator at the load test value.</li> <li>2. Connect a DMM from the generator output terminal to the battery positive (+) terminal.</li> </ol> <p>Is the voltage above the specified value?</p>	0.5 V	Go to Step 22	Go to Step 16
16	<ol style="list-style-type: none"> <li>1. Maintain the engine speed at 2500 RPM and continue to operate the generator at the load test value.</li> <li>2. Connect a DMM from the generator metal housing to the battery negative (–) terminal.</li> </ol> <p>Is the voltage above the specified value?</p>	0.5 V	Go to Step 23	Go to Step 17

## Generator Not Operating Properly (cont'd)

Step	Action	Value(s)	Yes	No
17	<ol style="list-style-type: none"> <li>1. Disconnect the DMM.</li> <li>2. Turn OFF the load in the carbon pile tester.</li> <li>3. Turn the ignition switch to LOCK to stop the engine.</li> <li>4. Disconnect the carbon pile tester cables from the battery.</li> <li>5. Disconnect the <i>J 41450-B</i> 4-way connector from the generator.</li> <li>6. Inspect the generator 4-way connector on the vehicle.</li> </ol> <p>Does the vehicle have a wire in the L terminal cavity (or B terminal for CS 130D, LR, and AD generators) of the generator 4-way connector?</p>	—	Generator OK	Go to <i>Step 24</i>
18	<p>There is an internal problem in the <i>J 41450-B</i>. Replace the <i>J 41450-B</i>.</p> <p>Has the <i>J 41450-B</i> been replaced?</p>	—	Go to <i>Step 2</i>	—
19	<p><b>Important:</b> Before generator repair or replacement, the L terminal circuit (if applicable) must be tested for resistance in order to avoid a repeat failure.</p> <p>Disconnect and examine the generator 4-way connector. Is there a wire in the L cavity (or B cavity for CS 130D, LR, and AD generators) of the generator connector?</p>	—	Go to <i>Step 20</i>	Go to <i>Step 24</i>
20	<ol style="list-style-type: none"> <li>1. Be sure the 4-way generator connector is disconnected.</li> <li>2. Turn the ignition key to the RUN position.</li> <li>3. Connect a fused jumper wire (with a 5 amp fuse) from ground to the vehicle 4-way generator connector terminal L (or B terminal for CS 130D, LR, and AD generators). To connect the jumper to the generator, use a Metri-Pack 150 connector test adapter from <i>J 35616-A</i>. Refer to <i>Engine Electrical Connector End Views</i>.</li> </ol> <p>Does the fuse blow?</p>	—	Go to <i>Step 21</i>	Go to <i>Step 25</i>
21	<p>There is a short to B+ voltage when the ignition key is in the RUN position. The short may be a result of a miswired condition. The L terminal circuit must be a resistance circuit either through a charge indicator or the PCM. If direct battery voltage is applied to the generator at the L terminal, the regulator will eventually be destroyed, causing a repeat failure. Repair the short to B+ voltage in the L terminal circuit (or B terminal circuit for CS 130D, LR, and AD generators).</p> <p>Is the short circuit repaired?</p>	—	Go to <i>Step 25</i>	—
22	<ol style="list-style-type: none"> <li>1. Turn off the engine.</li> <li>2. Disconnect the battery negative terminal.</li> <li>3. Inspect the circuit between the battery positive terminal and the generator output terminal for a high-resistance connection. Disassemble and clean all connections in this circuit.</li> <li>4. Assemble the connections and tighten to specifications.</li> <li>5. Connect the battery negative terminal. Tighten to specifications. Refer to <i>Fastener Tightening Specifications</i>.</li> </ol> <p>Is the repair complete?</p>	—	Go to <i>Step 2</i>	—
23	<ol style="list-style-type: none"> <li>1. Turn off the engine.</li> <li>2. Inspect the ground circuit for high resistance from the battery negative terminal to the generator housing. Disassemble and clean all connections.</li> <li>3. Assemble the connections and tighten to specifications. Refer to <i>Fastener Tightening Specifications</i>.</li> </ol> <p>Is the repair complete?</p>	—	Go to <i>Step 2</i>	—

## Generator Not Operating Properly (cont'd)

Step	Action	Value(s)	Yes	No
24	<p>The tester turns the generator on in a different way than the vehicle does, so an additional test is necessary. This Step is applicable only for vehicles that do not use an L terminal connection (or B terminal for CS 130D, LR, and AD generators).</p> <ol style="list-style-type: none"> <li>1. Remove the 4-way connector from the generator.</li> <li>2. Measure the generator internal resistance between the L and I/F terminals (B and C terminals for CS 130D, LR, and AD generators). Use Metri-Pack 150 terminal adapters from a J 35616-A Connector Test Adapter Kit. The L and I/F terminals are the two middle terminals on the generator.</li> </ol> <p>Is the resistance between the generator I/F and L terminals equal to or below the specified value?</p>	500 $\Omega$	Generator OK	Go to Step 25
25	<p>Repair or replace the generator. Refer to <i>Generator Replacement (CS 144)</i> or <i>Generator Replacement (CS 130D)</i>.</p> <p>Is the repair complete?</p>	—	Go to Step 2	—

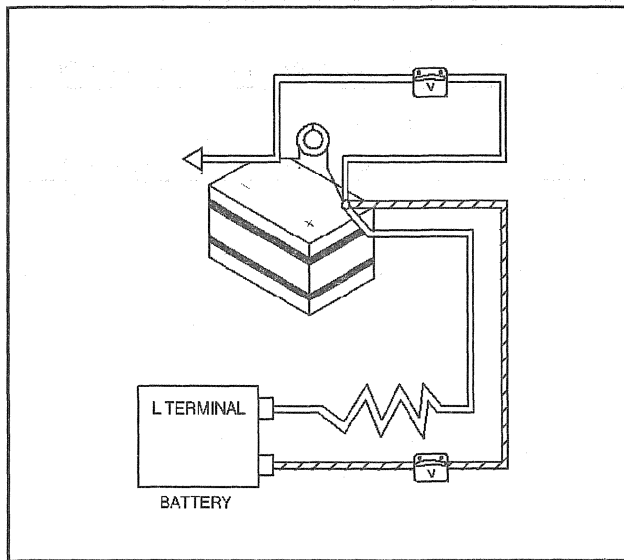
## Generator Assembly Bench Check

## Tools Required

J 39200 Digital Multimeter

**Important:** Perform the following inspection in order to verify operation of a repaired CS-144 generator:

1. Mount the generator in a test stand. Ensure that the test stand is capable of driving a generator at 6500 RPM.



1049

2. Make the connections as shown.

**Important:** Ensure that the battery is fully charged when making this test.

Run the engine at 2500 RPM and at ambient temperature.

3. Slowly increase the generator speed and observe the voltage using J 39200 Digital Multimeter.

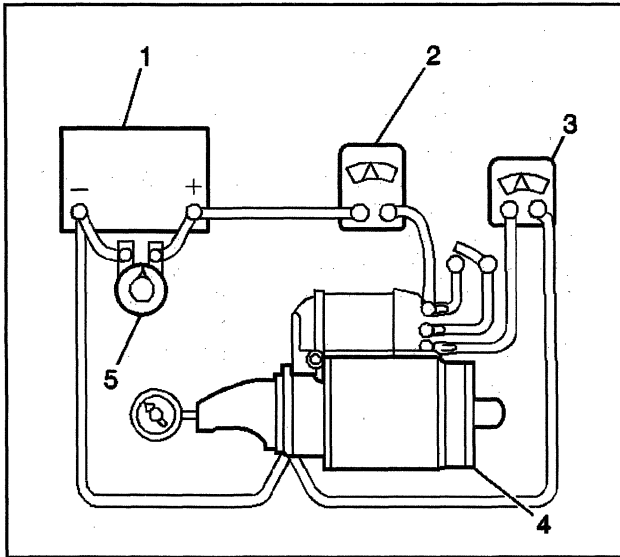
4. If the voltage is uncontrolled and increases above 16 Volts, repair or replace the generator.
5. If the voltage is below 16 Volts, perform the following steps:
  - Increase the generator speed.
  - Connect the carbon pile.
  - Adjust the carbon pile in order to obtain maximum amperage output.
  - Maintain 13 Volts or more.
6. Use an ammeter in order to check the amperage.
  - If the output is within 15 Amps of rated output, the generator is good.
  - If the output is not within 15 Amps of rated output, then repair or replace the generator.

## Starter Motor Noise Diagnosis

Step	Action	Value	Yes	No
1	Do you hear a high pitched whine during cranking (before the engine fires) but the engine cranks and fires normally?	—	Go to Step 2	Go to Step 4
2	The distance is too far between the starter pinion and the flywheel. Has the noise been corrected?	—	System OK	Go to Step 3
3	Adjust, repair, or install new parts as necessary. Is repair complete?	—	System OK	Go to Step 4
4	1. As the key is being turned, do you hear a high-pitched whine after the engine fires? 2. The engine cranks and fires normally. Is there a high pitched whine?	—	Go to Step 5	Go to Step 7
5	This is often misdiagnosed as starter hang-in or a weak solenoid. Is diagnosis correct?	—	Go to Step 6	—
6	1. The distance is too small between the starter pinion and the flywheel. 2. Flywheel runout makes this appear to be intermittent. Has the noise been corrected?	—	System OK	Go to Step 3
7	1. Is there a whine after the engine fires, but while the starter is still held engaged? 2. It may sound like a siren if the engine is revved while the starter is engaged. Do you hear a whine?	—	Go to Step 8	Go to Step 9
8	Usually this is because of a failed starter motor clutch. Refer to <i>Starter Motor Overhaul (28-MT)</i> . Has the noise been corrected?	—	System OK	Go to Step 3
9	Do you hear a rumble, a growl, or, in severe cases, a knock as the starter is coasting down to a stop after starting the engine?	—	Go to Step 10	System OK
10	Check for a bent or unbalanced starter armature. Refer to <i>Starter Motor Overhaul (28-MT)</i> . Is the armature faulty?	—	Go to Step 3	System OK

**Starter No Load Test (28-MT)****Tools Required**

- J 39200 Digital Multimeter
- J 35590 Current Clamp

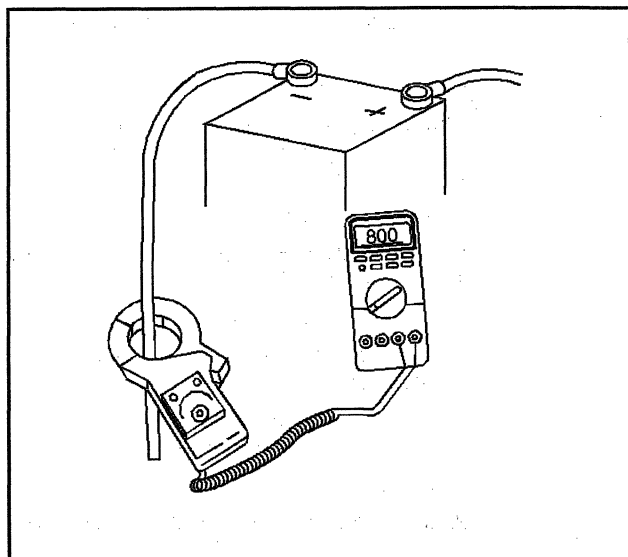


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1. Connect a voltmeter from the motor terminal to the motor frame.  
On starter motors with ground terminals, connect the voltmeter to the ground terminals rather than the frame.
2. Use an RPM indicator in order to measure pinion speed.
3. Connect the motor and an ammeter in series with the following components:
  - A fully charged battery(1) of the specified voltage
  - A switch in the open position from the solenoid battery terminal to the solenoid switch terminal.
4. Close the switch.
5. Compare the following measurements with the no load test specified values for the 28-MT Starter Motors in *Starter Motor Usage (Load Test @ 10 Volts 28-MT)*.
  - RPM
  - Current
  - Voltage
6. Evaluate the measurements by understanding that the measurement is not necessary in order to obtain the exact voltage specified. A good reading can be made by understanding that if the voltage is slightly higher, the RPM will be slightly higher and the current will remain basically unchanged
7. Use the following procedure in order to obtain the exact specified voltage (if desired):
  - 7.1. Connect a carbon pile across the battery.
  - 7.2. Compare the reduced voltage with the no load test specified values for the 28-MT and PG260 Starter Motors in *Starter Motor Usage (Load Test @ 10 Volts 28-MT)*.
8. Disconnect the circuit only with the switch open.
9. Use the following information in order to interpret the test results:
  - 9.1. Rated current draw and no-load speed indicate normal condition of the starter motor.
  - 9.2. Low free speed and high current draw indicate the following conditions:
    - Excessive friction  
Tight, dirty, or worn bearings, a bent armature shaft or loose pole shoes allow the armature to drag.
    - A shorted armature  
Inspect a shorted armature on a growler after disassembly.
    - Grounded armature fields  
Verify the grounded armature after disassembly.
  - 9.3. Failure to operate with no current draw indicates the following conditions:
    - A direct ground  
A direct ground exists in the terminal or fields.
    - Seized bearings  
Seized bearings should have been noted by hand turning the armature by hand.
  - 9.4. Failure to operate with no current draw indicates the following conditions:
    - An open field circuit  
An open field circuit can be tested after disassembly by inspecting the internal connections and tracing the circuit with a J 39200 digital multimeter.
    - Open armature coils  
Inspect the commutator for badly burned bars.
    - Broken brush springs, worn brushes  
High insulation between the commutator bars or other causes which would prevent proper contact between the brushes and the commutator.
  - 9.5. Low no-load speed and low current draw indicate a higher internal resistance due to the following conditions:
    - Poor connections
    - Defective leads
    - A dirty commutator
    - An open field circuit
    - Open armature coils
    - Broken brush springs, worn brushes
  - 9.6. High free speed and high current draw indicate shorted fields. If shorted fields are suspected, replace the field coil assembly and inspect for improved performance.

**Starter No Load Test (PG260)****Tools Required**

- J 39200 Digital Multimeter
- J 35590 Adapters, or equivalent



105184

**Notice:** Never operate the starter motor more than 15 seconds at a time without pausing in order to allow it to cool for at least 2 minutes. Overheating will damage the starter motor.

**Important:** Verify that both batteries are in good condition.

1. Disable the fuel system by removing the fuel solenoid fuse.
2. Calculate the current draw. Select the 200 A or 2000 A scale on the current clamp.
3. Zero the current clamp. Clamp the J 39200 to the negative battery cable.
4. Crank the engine. Observe the meter readings. The reading should be 330 – 360 amps. If the amperage is over 360 amps, an internal starter failure may be the cause. If the amperage is under 330 amps, a battery cable or connection may be the cause.

**Starter Solenoid Does Not Click**

Step	Action	Value(s)	Yes	No
1	1. Place the transmission in park (A/T) or actuate the clutch pedal (M/T). 2. Move the ignition switch to the START position. 3. Measure the voltage between the starter solenoid terminal S, CKT 6 (PPL) and an engine ground. Is the voltage reading the same as the battery voltage?	—	Go to Step 13	Go to Step 2
2	1. Remove the starter relay from the underhood fuse block. 2. Connect a J 34142-B test lamp from the starter relay socket cavity 30 to ground. Does the test lamp light?	—	Go to Step 3	Go to Step 14
3	Connect a jumper wire between cavity 30 and 87 of the starter relay socket. Does the starter solenoid click?	—	Go to Step 4	Go to Step 15
4	1. Connect CKT 6 (PPL) at the starter solenoid. 2. Connect a J 34142-B test lamp between starter relay socket cavity 85 to B+. Does the test lamp light?	—	Go to Step 5	Go to Step 16
5	1. Place the transmission in park (A/T) or actuate the clutch pedal (M/T). 2. Move the ignition switch to the START position. 3. Measure the voltage between the starter relay socket cavity 86 and 85. Is the voltage reading the same as the battery voltage?	—	Go to Step 17	Go to Step 6
6	Is the vehicle equipped with a manual transmission?	—	Go to Step 7	Go to Step 9

## Starter Solenoid Does Not Click (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Disconnect the clutch pedal position switch connector. 2. Move the ignition switch to the START position. 3. Measure the voltage between the clutch pedal position switch connector cavity A, CKT 806 (PPL), to ground. Is the voltage reading the same as the battery voltage?	—	Go to Step 8	Go to Step 11
8	1. Engage the parking brake. 2. Actuate the clutch pedal and place the transmission in neutral. 3. Connect a fused jumper between the clutch pedal position switch connector cavity A, CKT 806 (PPL), to cavity C, CKT 1035 (PPL/WHT). 4. Move the ignition switch to the START position. Does the engine crank?	—	Go to Step 18	Go to Step 19
9	1. Disconnect the transmission range switch connector. 2. Move the ignition switch to the START position. 3. Measure the voltage between the transmission range switch connector C1 cavity E, CKT 806 (PPL), to ground. Is the voltage reading the same as the battery voltage?	—	Go to Step 10	Go to Step 11
10	1. Connect a fused jumper between transmission range switch connector C1 cavity E, CKT 806 (PPL), to cavity G, CKT 1035 (PPL/WHT). 2. Move the ignition switch to the START position. Does the engine crank?	—	Go to Step 20	Go to Step 21
11	1. Move the ignition switch to the START position. 2. Measure the voltage between the ignition switch connector C266 cavity D1, CKT 5 (YEL), to ground. Is the voltage reading the same as the battery voltage?	—	Go to Step 22	Go to Step 12
12	Measure the voltage between the connector C266 cavity D5 and ground. Is the voltage reading the same as the battery voltage?	—	Go to Step 23	Go to Step 24
13	1. Clean the starter motor, the starter motor mounting surfaces, and the mounting bolts. Refer to <i>Starter Motor Inspection (28-MT)</i> . 2. Repeat the test. If the starter motor does not pass the test, replace the starter motor. Is the repair or replacement complete?	—	Go to Starting System Check	—
14	Install the starter relay and repair the open in CKT 244 (RED) between fuse 6 and the starter relay. Refer to <i>Wiring Repairs</i> in Wiring Systems. Is the repair complete?	—	Go to Starting System Check	—
15	Install the starter relay and repair the open in CKT 6 (PPL) between the starter relay and the starter solenoid. Refer to <i>Wiring Repairs</i> in Wiring Systems. Is the repair complete?	—	Go to Starting System Check	—
16	Install the starter relay and repair the open in CKT 150 (BLK) between the starter relay and ground G105. Refer to <i>Wiring Repairs</i> in Wiring Systems. Is the repair complete?	—	Go to Starting System Check	—
17	Replace the starter relay. Is the replacement complete?	—	Go to Starting System Check	—



## Starter Solenoid Does Not Click (cont'd)

Step	Action	Value(s)	Yes	No
18	1. Adjust the clutch pedal position switch. 2. Retest the system. 3. If the starter motor does not operate, replace the clutch pedal position switch. Refer to <i>Clutch Start Switch Replacement</i> in Transmission/Transaxle. Is the repair or replacement complete?	—	Go to <i>Starting System Check</i>	—
19	Repair the open in CKT 1035 (PPL) between the clutch pedal position switch and the starter relay. Refer to <i>Wiring Repairs</i> in Wiring Systems. Is the repair complete?	—	Go to <i>Starting System Check</i>	—
20	Replace the transmission range switch. Refer to <i>Park/Neutral Position Switch Replacement</i> (4L60-E) or <i>Park/Neutral Position Switch Replacement</i> (4L80-E) in Transmission/Transaxle. Is the replacement complete?	—	Go to <i>Starting System Check</i>	—
21	Repair the open in CKT 5 (YEL) between the transmission range switch and the starter relay. Refer to <i>Wiring Repairs</i> in Wiring Systems. Is the repair complete?	—	Go to <i>Starting System Check</i>	—
22	1. Check for an open in CKT 5 (YEL) between the ignition switch and the IP fuse block. 2. If OK, repair the open in CKT 806 (PPL) between the IP fuse block and the clutch pedal position switch (M/T) or the transmission range switch (A/T). Refer to <i>Wiring Repairs</i> in Wiring Systems. Is the repair or replacement complete?	—	Go to <i>Starting System Check</i>	—
23	Replace the ignition switch. Refer to <i>Ignition Lock Cylinder Replacement - On Vehicle</i> (Standard Column) or <i>Ignition Lock Cylinder Replacement - On Vehicle</i> (Tilt Column) in Steering Systems. Is the replacement complete?	—	Go to <i>Starting System Check</i>	—
24	Repair the open in CKT 242 (RED) between the ignition switch and the underhood fuse block. Refer to <i>Wiring Repairs</i> in Wiring Systems. Is the replacement complete?	—	Go to <i>Starting System Check</i>	—

**Starter Solenoid Clicks, Engine Does Not Crank**

Step	Action	Value(s)	Yes	No
1	Are there any other engine problems that could affect starting?	—	Go to <i>Starting System Check</i>	Go to <i>Step 2</i>
2	1. Ensure the battery is fully charged. 2. Move Ignition Switch to the Start Position. 3. Measure Voltage across the RH Battery. Is the voltage reading greater than the value after 15 seconds?	—	Go to <i>Step 3</i>	Go to <i>Step 6</i>
3	Measure battery voltage at terminal B of the starter solenoid. Is the voltage reading the same as battery voltage?	—	Go to <i>Step 4</i>	Go to <i>Step 8</i>
4	Measure voltage between the negative RH Battery terminal and the Engine Block. Is the voltage reading less than the value?	—	Go to <i>Step 5</i>	Go to <i>Step 9</i>
5	Replace the Negative Battery cable. Refer to <i>Battery Cable</i> . Is the repair complete?	—	Go to <i>Starting System Check</i>	—
6	Perform a Battery Load test. Is the battery good?	—	Go to <i>Step 7</i>	Go to <i>Step 11</i>
7	Replace the Stator Motor. Refer to <i>Starter Motor Replacement (Gas, 7.4L) (7.4L)</i> . Is the repair complete?	—	Go to <i>Starting System Check</i>	—
8	Replace the Positive Battery cable between the RH Battery and the Starter Solenoid. Refer to <i>Battery Cable</i> . Is the repair complete?	—	Go to <i>Starting System Check</i>	—
9	1. Connect an auxiliary ground wire between the starter casing and Battery Negative terminal. 2. Turn the Ignition Switch to the start position. Does the engine crank?	—	Go to <i>Step 10</i>	Go to <i>Step 7</i>
10	1. Remove the starter motor. 2. Clean the starter motor mounting surfaces. Refer to <i>Starter Motor Inspection (28-MT)</i> . 3. Re-install the starter motor. 4. Turn the ignition switch to the start position. Does the engine crank?	—	Go to <i>Starting System Check</i>	Go to <i>Step 7</i>
11	Replace the Battery. Refer to <i>Battery Replacement</i> . Is the repair complete?	—	Go to <i>Starting System Check</i>	—

**Voltmeter Displaying High or Low**

Step	Action	Value(s)	Yes	No
1	1. Start the vehicle. 2. Connect a J 39200 DMM across the battery terminals. Is the voltage reading within specifications?	12.0 – 16.0 V	Go to <i>Step 2</i>	Go to <i>Step 3</i>
2	Replace the instrument cluster. Refer to <i>IP Cluster Replacement</i> in Instrument Panel, Gauges and Console. Is the replacement complete?	—	Go to <i>Charging System Check</i>	--
3	Inspect the generator. Refer to <i>Generator Assembly Bench Check</i> . Is the repair complete?	—	Go to <i>Charging System Check</i>	—

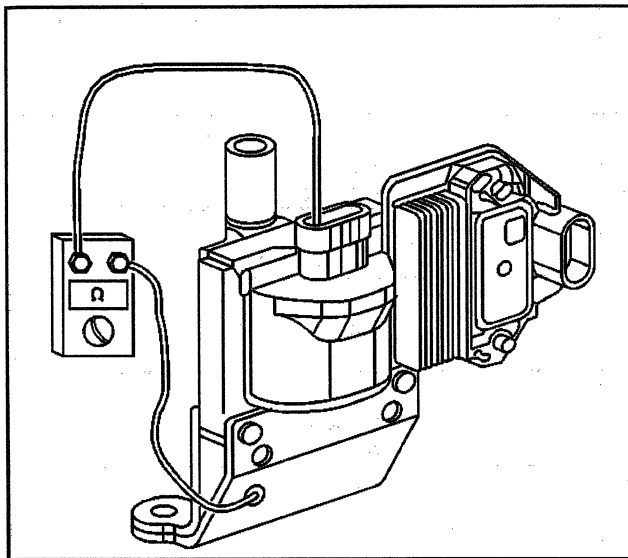
## Ignition Coil(s) Not Operating Properly

### Tools Required

J 39200 Digital Multimeter

1. Remove the ignition Coil. Refer to *Ignition Coil and ICM Replacement (5.0L, 5.7L)* *Ignition Coil and ICM Replacement (HVS 7.4L)*.

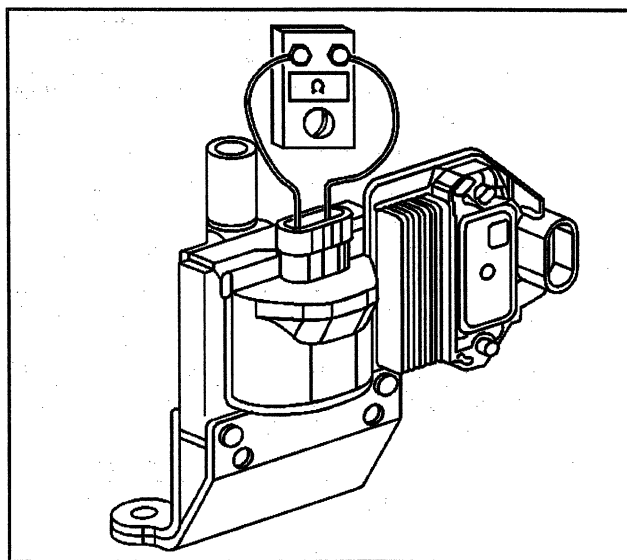
**Notice:** Do not insert the J 39200 digital multimeter probe into the ignition coil connectors. The female terminals could be deformed, resulting in intermittent operation. Only make contact with the front edge of the terminals.



43746

2. Connect an ohmmeter as shown.

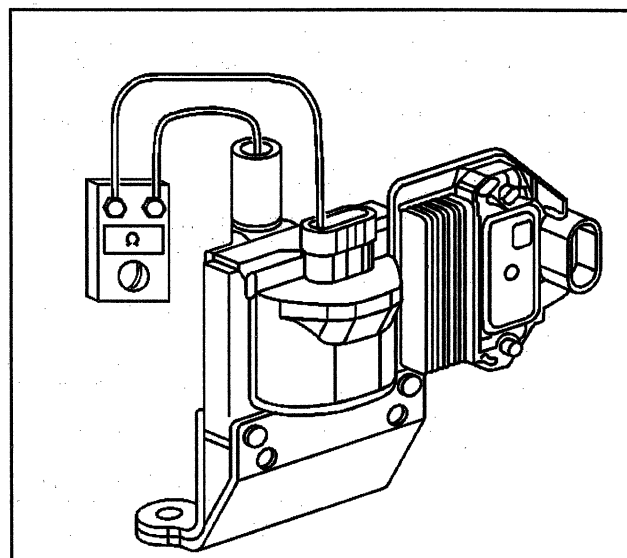
- Use the high scale.
- If the reading is not infinite, replace the coil. Refer to *Ignition Coil and ICM Replacement (5.0L, 5.7L)* *Ignition Coil and ICM Replacement (HVS 7.4L)*.



43747

3. Connect an ohmmeter as shown.

- Use the low scale.
- The reading should be 0.1 ohms. If not, replace the coil. Refer to *Ignition Coil and ICM Replacement (5.0L, 5.7L)* *Ignition Coil and ICM Replacement (HVS 7.4L)*.



43749

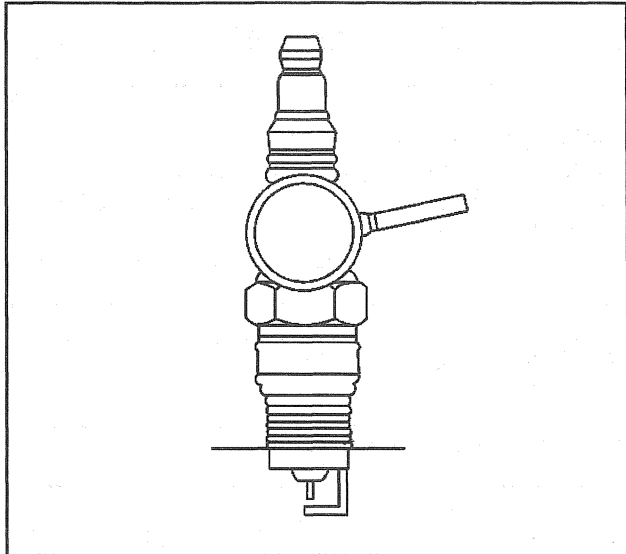
4. Connect an ohmmeter as shown.

- Use the high scale.
- If the reading is not 5-25k ohms, replace the coil. Refer to *Ignition Coil and ICM Replacement (5.0L, 5.7L)* *Ignition Coil and ICM Replacement (HVS 7.4L)*.

## Spark Plug Visual Diagnosis

**Notice:** These spark plugs have a ceramic insulator that is 3.175 mm (1/16 in) longer than earlier model spark plugs. Use a spark plug socket that is deep enough for these longer plugs (J 39358). Failure to do so could cause cracking of the insulator and arcing inside the plug resulting in an engine misfire.

Resistor type spark plugs with tapered seats are used. No gasket is needed on these plugs. These spark plugs are a High Efficiency (HE) spark plug that has a fine wire electrode, nickel plated shell and a platinum pad across from the electrode.



34390

- Normal service is a mixture of idling, low speed, and high speed operation.

- Occasional high speed driving is essential to good spark plug performance.
- Increased combustion heat burns away excess carbon deposits, which accumulate from frequent idling or stop-and-go driving.
- The heat resistant, insulating boot covers the spark plug terminal.
  - The boot extends over a portion of the spark plug insulator.
  - These boots prevent engine misfiring.
- Corona discharge is a steady blue light appearing (in darkness) around the insulator, just above the shell crimp.
  - Do not mistake this for a shorted insulator. This is visible evidence of a high-tension field.
  - This has no effect on ignition system performance.
  - This discharge repels dust particles.
  - This leaves a clear ring on the insulator just above the shell.
  - This is not evidence that combustion gases are escaping.

## Spark Plug Visual Diagnosis

Problem	Action
Brown to Grayish-Tan Deposits and Slight Electrode Wear	
The spark plug has normal wear.	Clean, regap, and reinstall the spark plug. Refer to <i>Spark Plug Replacement</i> .
Dry, Fluffy Black Carbon Deposits	
The spark plug has poor ignition output.	Inspect the spark plug wires and coil connections.
Wet, Oily Deposits with Very Little Electrode Wear	
Break-in of a new or recently overhauled engine.	Degrease, clean, and reinstall the spark plugs. Refer to <i>Spark Plug Replacement</i> .
The clearances of the valve stem guides are excessive.	Refer to <i>Cylinder Head Clean and Inspect</i> in Engine Mechanical — 5.0L, 5.7L or <i>Cylinder Head Clean and Inspect</i> in Engine Mechanical — 7.4L.
The intake valve seals are worn.	Replace the valve seals. Refer to <i>Valve Stem Oil Seal and Valve Spring Replacement</i> in Engine Mechanical — 5.0L, 5.7L or <i>Valve Stem Oil Seal and Valve Spring Replacement</i> in Engine Mechanical — 7.4L.
Colored Coatings on Insulator/Engine Misfires	
DEFINITION: The spark plug has red, brown, yellow, and white colored coatings on the insulator. The engine misfires intermittently under severe operating conditions.	
The coatings are the by-products of combustion.	<ol style="list-style-type: none"> <li>1. Clean, regap, and reinstall the spark plug. Refer to <i>Spark Plug Replacement</i>.</li> <li>2. If the plug is heavily coated, replace the spark plug. Refer to <i>Spark Plug Replacement</i>.</li> </ol>

## Spark Plug Visual Diagnosis (cont'd)

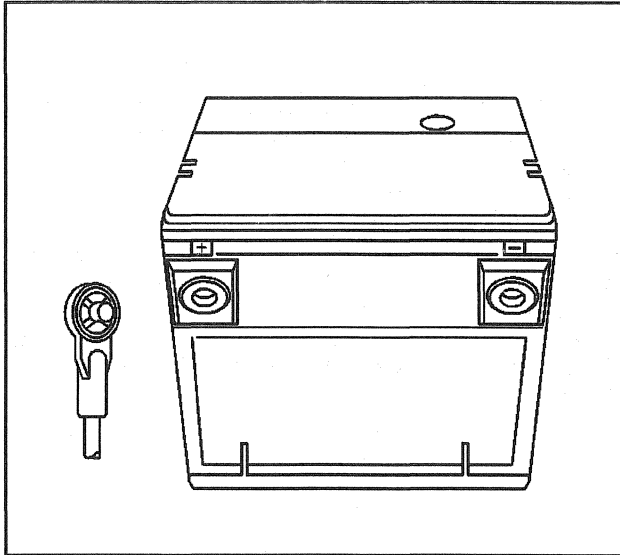
Problem	Action
<b>Heavy Colored Coating Deposits</b>	
DEFINITION: Heavy colored coating deposits on the portion of the spark plug that projects into the chamber, and on the side facing the intake valve.	
The valve seals are leaking (if this condition is found in only one or two cylinders).	<ol style="list-style-type: none"> <li>1. Inspect the valve seals. Replace the seals as necessary. Refer to <i>Valve Stem Oil Seal and Valve Spring Replacement</i> in Engine Mechanical — 5.0L, 5.7L or <i>Valve Stem Oil Seal and Valve Spring Replacement</i> in Engine Mechanical — 7.4L.</li> <li>2. Clean, regap, and reinstall the spark plugs. Refer to <i>Spark Plug Replacement</i>.</li> </ol>
<b>Shiny Yellow Glaze Coating on Insulator</b>	
The coating is caused from the melted by-products of combustion.	<ol style="list-style-type: none"> <li>1. Avoid sudden acceleration or wide open throttle after long periods of low speed driving.</li> <li>2. Replace the spark plugs. Refer to <i>Spark Plug Replacement</i>.</li> </ol>
<b>Burned or Blistered Insulator Tips and Badly Eroded Electrodes</b>	
The spark plugs are overheating.	<ul style="list-style-type: none"> <li>• Inspect the cooling system.</li> <li>• Test for a lean air/fuel mixture. Refer to Engine Controls.</li> <li>• Inspect the heat range of the spark plugs. The plugs may be too hot.</li> <li>• Inspect the ignition timing. The timing may be over-advanced. Refer to <i>Ignition System Description (Distributor Ignition HVS)</i>.</li> <li>• Verify the torque value of the spark plugs in order to ensure good plug to engine seat contact. Refer to.</li> </ul>
<b>Broken or Cracked Insulator Tips</b>	
The plugs show heat shock from a sudden rise in tip temperature under severe operating conditions.	Replace the spark plugs. Refer to <i>Spark Plug Replacement</i> .
The spark plugs are improperly gapped.	Gap the plug to specification. Refer to <i>Spark Plug Replacement</i> .

## Spark Plug Wires Not Operating Properly

## Tools Required

J 39200 Digital Multimeter

1. Check the routing of the wires. Improper routing can cause crossfiring.
2. Check each wire for any signs of cracks, burns, damage, or splits in the wire.
3. Inspect each boot for signs of tears, piercing, arc through, or carbon tracking. If the boot needs to be replaced, twist it a half turn in either direction to break the seal before pulling on the boot in order to remove the wire.
4. With the engine ON, inspect for any arcing to ground or other components.
5. Connect an ohmmeter to the end of each suspect wire. If the meter reads over 30,000 ohms, replace the wire.

**Battery Terminal Check**

319032

**Caution:** Refer to *Battery Disconnect Caution in Cautions and Notices*.

1. Attempt to rotate the battery cables clockwise with light finger pressure. If either cable will turn with light finger pressure, use a torque wrench to inspect the bolt torque as the cables are removed as follows:
  - 1.1. Disconnect the battery negative cable. The torque to loosen should be 10-20 N·m (7-15 lb ft).
  - 1.2. Disconnect the battery positive cable. The torque to loosen should be 10-20 N·m (7-15 lb ft).

2. If either cable turned clockwise with light finger pressure, but the bolt torque inspection was within specifications, inspect for:
  - 2.1. The cable bolt being too long.
  - 2.2. Foreign material inside the nut in the battery terminal.
  - 2.3. Damage to the battery terminal face or the cable connector ring.
  - 2.4. On stacked cable installations, inspect the lead spacer for damage.
3. Clean and wire brush both the terminals and the connectors to remove any surface oxidation that may be present on either the battery terminals or the cable connectors.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

4. Connect the battery cables to the battery as follows:
  - 4.1. Connect the battery positive cable first.

**Tighten**

Tighten the battery positive cable terminal bolt to 15 N·m (11 lb ft).

- 4.2. Connect the battery negative cable last. Refer to *Battery Disconnect Caution* in Cautions and Notices.

**Tighten**

Tighten the battery negative cable terminal bolt to 15 N·m (11 lb ft).

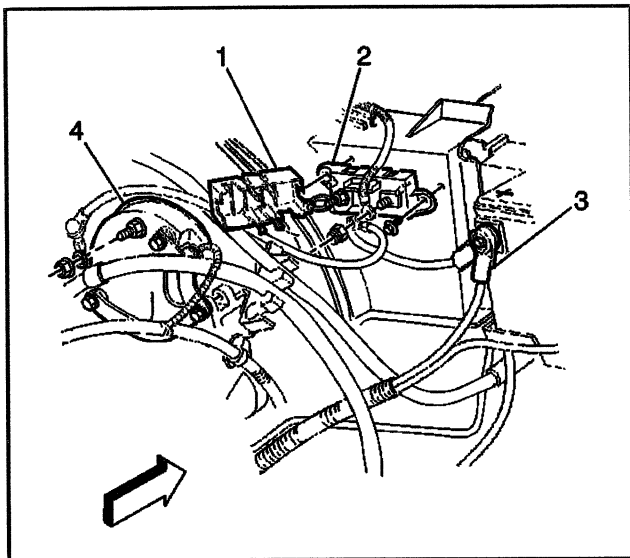
- 4.3. Reset the clock, the push - button radio tuning, and other accessories before the vehicle is put back into service.

## Repair Instructions

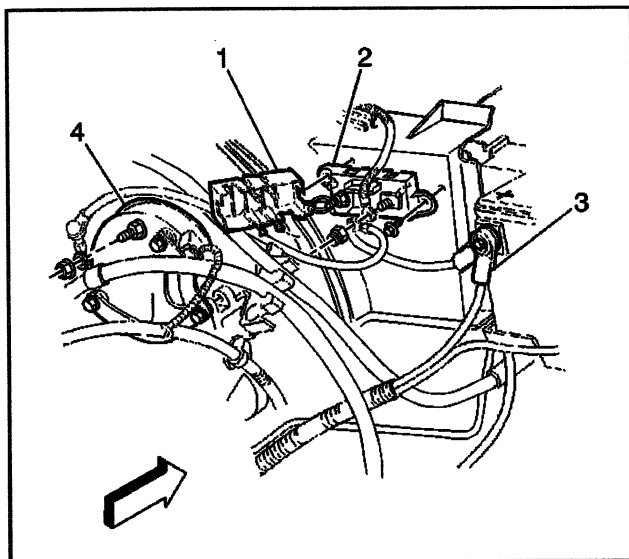
### Battery Cable

Excessive resistance caused by poor terminal connections and partial short circuits through worn cable insulation will result in an abnormal voltage drop in the starter cable. Low voltage at the starter will prevent the normal starter operation and cause hard starting.

Whenever the battery cables (3) are replaced, use a replacement cable that is the same in the type, the diameter, and the length. Some positive cables have additional feed wires attached to them and some of the negative cables have additional ground leads attached.



105120



105120

Ensure that replacement battery cables are routed to the battery (2) in the same manner as the original.

**Caution:** In order to prevent possible personal injury from a moving vehicle or from an operating engine, perform the following steps before performing the checks:

1. Place the transmission in park.
2. Engage the parking brakes and block the wheels.
3. Disconnect the battery feed at the distributor.

**Notice:** When installing the positive battery cable to the starter solenoid, the inner nut on the solenoid battery terminal must be tightened before the battery cable and the other leads are installed. Failure to do so will result in the solenoid or the solenoid terminal damage.

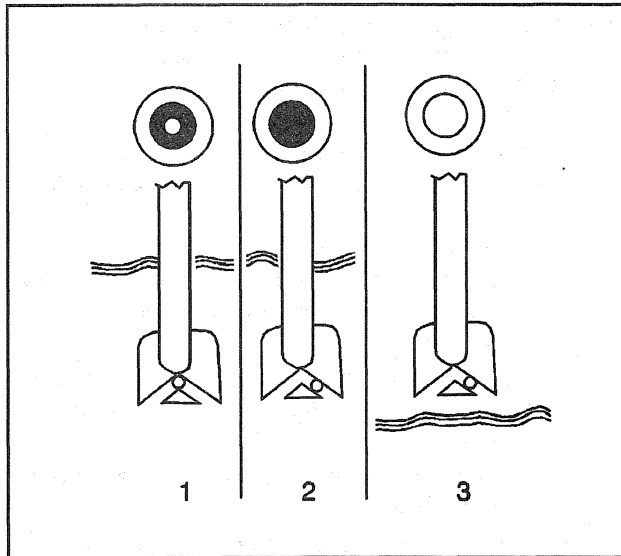
1. Inspect the voltage drop between the ground (the negative battery terminal) and the vehicle frame. Place one probe of the J 39200 on the grounded battery post (not on the cable clamp) and the other on the frame. Operate the starter and note the voltage reading.
2. Inspect the voltage drop between the positive battery terminal (3) and the starter terminal stud with the starter operating.
3. Inspect the voltage drop between the starter housing and the frame with the starter operating.
4. If the voltage drop in any of the above is more than 0.5 volts, there is excessive resistance in the circuit.

In order to eliminate resistance, the cables should be disconnected and the connections should be cleaned.

If the cables are frayed or the clamps are corroded, the cables should be replaced.

When selecting the new cables, ensure that the new cables are the same length and the same diameter as the original cables being replaced.

## Battery Charging



181056

1. Use a charger, with an end voltage of 16 V, equipped with a voltmeter that is accurate to within 1 percent.

The ambient temperature should be 15–38°C (60–100°F). A battery that is extremely cold will not accept immeasurable current for several hours after starting the charger.

2. The charging area should be well ventilated.
3. Do not charge the battery when the built in hydrometer is clear or yellow (3). Replace the battery if there is a cranking problem.
4. Do not charge a battery that appears to be frozen.
5. Batteries showing a green dot in the hydrometer (1) do not need to be charged unless they have just been discharged (such as cranking the engine).

### Charging Time Required

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

- The size of the battery – A completely discharged, large, heavy-duty battery requires more than twice the recharging time as a completely discharged, smaller battery.
- The temperature – A longer time is 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 is very low at first. Then, as the battery warms, the battery accepts a higher rate of current.
- The charging capacity – A charger which can supply only five amperes requires a much longer charging period than a charger that can supply 30 amperes or more.

- The state-of-charge – A completely discharged battery requires more than twice as much charge time as a half charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the battery accepts very low current at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current also increases.

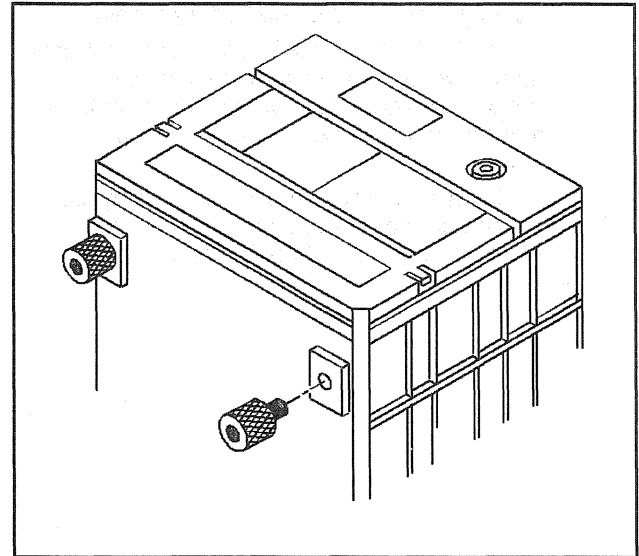
### Charging Procedure

#### Tools Required

GM P/N 12303040 Battery Terminal Adapters

**Notice:** Turn OFF the ignition when connecting or disconnecting the battery cables, the battery charger or the jumper cables. Failure to do so may damage the PCM or other electronic components.

1. Do not charge a battery with a green hydrometer dot unless it has just been discharged, such as in cranking.
2. When charging side-terminal batteries while on-vehicle, use the following procedure:
  - 2.1. Turn OFF the charger.
  - 2.2. Connect the charger positive lead to the positive cable terminal located in the engine compartment on the right side.
  - 2.3. Connect the negative charger lead to a solid engine ground, such as the generator mounting bracket.



42433

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

3. When charging side-terminal batteries out of vehicle, install battery side terminal adapters.

#### Tighten

Tighten the battery side terminal adapters to 15 N·m (11 lb ft).



4. Make sure all battery terminals are clean and tight.  
Best results occur when charging a battery that is at room temperature. A battery that is extremely cold may not accept current for several hours.
5. Charge the battery until the hydrometer has a green dot.
6. Inspect the battery every half hour after starting the battery charger.
7. Tap the hydrometer lightly to dislodge any air bubbles. The bubbles may cause a false indication.
8. After charging, load test the battery. Refer to *Battery Load Test*.

### Battery Charge Low or Completely Discharged

1. Measure the battery voltage at the battery terminals using a digital multimeter.
  - A reading of less than 11 V indicates that the initial charging will be very low.
  - It could take some time before the battery accepts current in excess of a few milliamperes.
2. Set the battery charger on the highest setting.
3. If necessary, disable the polarity protection circuitry:
  - This circuitry, available on most chargers, prevents charging unless the charger leads are properly connected to the battery terminals.
  - A completely discharged battery may not have enough voltage to activate this circuitry, even though the leads are properly connected, implying that the battery will not accept a charge.
  - Most chargers have an override or a bypass function so that the charger will turn ON and charge a low voltage battery.

**Important:** The required battery charge time varies according to the voltage capabilities of the battery charger. A charger of less than 14 volts could take up to 16 hours before it appears to be accepting current, followed up by several hours of the appearance of charging.

4. To determine the amount of hours the battery may need to be charged, the following calculation can be made:
  - The reserve capacity rating on the battery label is the number of ampere-hours of charge required in order to produce the green hydrometer dot.
  - After the meter on the charger starts to show current flow, note the number of amps being accepted.
  - Determine the reserve capacity of the battery. Refer to *Battery Usage*.
  - Divide the reserve capacity by the number of amps shown on the meter to determine how many hours of charging is needed.
5. When the green dot appears in the hydrometer, discontinue charging.
6. If the green hydrometer dot is not visible after an ampere-hour charge equal to twice the reserve capacity rating, replace the battery. Refer to *Battery Replacement*.
7. After charging, load test the battery. Refer to *Battery Load Test*.

## Battery Replacement

### Removal Procedure

**Caution:** Refer to *Battery Disconnect Caution in Cautions and Notices*.

1. Disconnect the negative battery cable from the negative battery terminal.
2. Disconnect the positive battery cable from the positive battery terminal.
3. Remove the battery hold-down retainer bolt and retainer.
4. Remove the battery from the battery tray.
5. Inspect the battery for:
  - Damage
  - Worn or corroded cables and connectors
  - Damage or foreign objects in the battery carrier
6. If damage is noted, find and correct the fault.
7. Clean any corrosion from the battery cables and connectors.
8. Clean the battery tray and remove any foreign objects from it.

### Installation Procedure

**Notice:** Refer to *Fastener Notice* in *Cautions and Notices*.

1. Install the battery into the battery tray.
2. Connect the hold-down retainer and bolt.

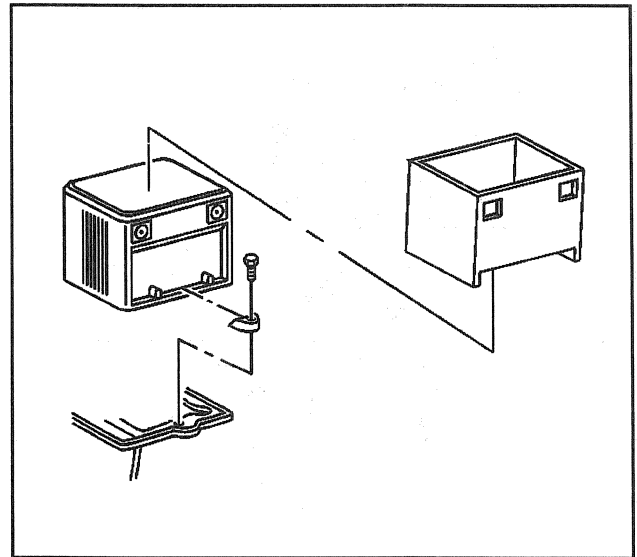
#### **Tighten**

Tighten the hold-down retainer bolt to 23 N·m (17 lb ft).

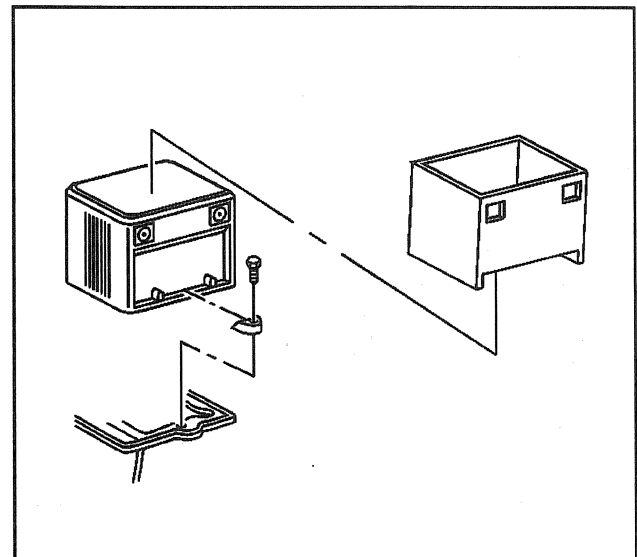
3. Connect the positive battery cable and the positive battery cable terminal to the battery.
4. Connect the negative battery cable and the negative battery cable terminal to the battery.

#### **Tighten**

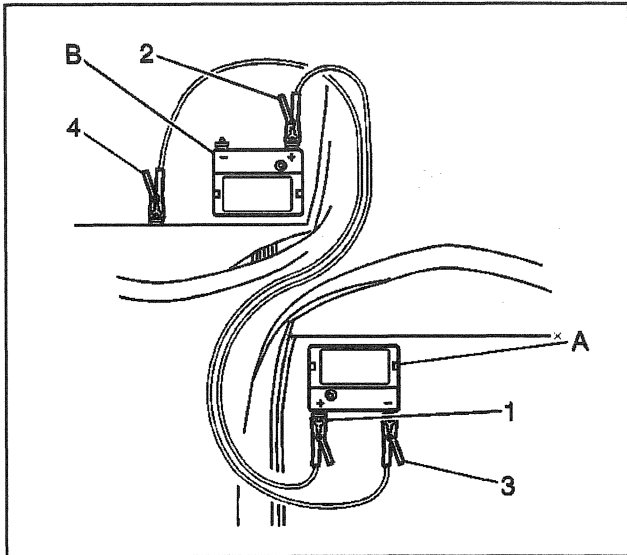
Tighten the battery terminals to 15 N·m (11 lb ft).



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### Jump Starting in Case of Emergency

**Caution:** Batteries produce explosive gasses. Batteries contain corrosive acid. Batteries supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury while working near a battery:

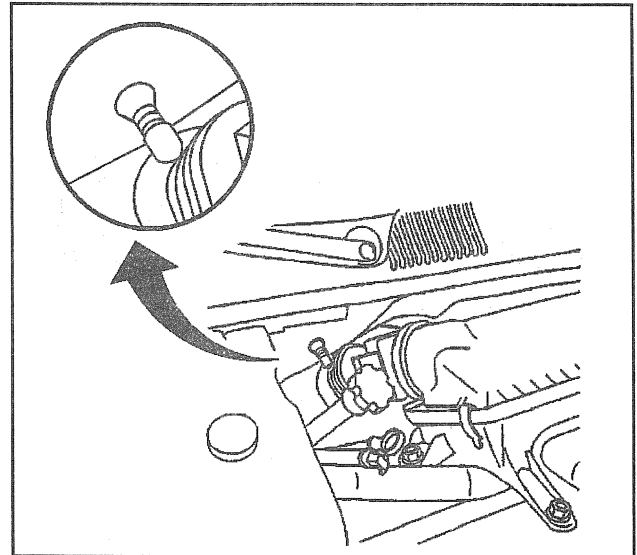
- Always shield your eyes.
- Avoid leaning over the battery whenever possible.
- Do not expose the battery to open flames or sparks.
- Do not allow battery acid to contact the eyes or the skin.
  - Flush any contacted areas with water immediately and thoroughly.
  - Get medical help.

**Notice:** This vehicle has a 12 Volt, negative ground electrical system. Make sure the vehicle or equipment being used to jump start the engine is also 12 Volt, negative ground. Use of any other type of system will damage the vehicle's electrical components.

Do not try to jump start a vehicle if you are unsure of the other vehicle's voltage or ground, or if the other vehicle's voltage and ground are different. Diesel engine vehicles have more than one battery. Should the vehicle have an optional diesel engine, use only the battery on the driver's side on the engine compartment when jump starting. This procedure can be used to start a single-battery vehicle from any of the diesel engine vehicle's batteries. However, at low temperatures, it may not be possible to start a diesel engine vehicle from a single battery in another vehicle. The booster and discharged batteries should be treated carefully when using jumper cables.

1. Position the vehicle with the booster (charged) battery so that the jumper cables will reach.
  - Do not let the two vehicles touch.
  - Make sure that the jumper cables do not have loose ends, or missing insulation.
2. Place an automatic transmission in PARK.
3. Set the parking brake.
4. Block the wheels.
5. Turn off all electrical loads that are not needed (leave the hazard flashers ON).
6. Turn OFF the ignition switch.
7. Check the built-in battery hydrometer of the discharged battery. If the hydrometer is clear or light yellow, do not jump (charge) the battery. Refer to *Battery Hydrometer Displays Yellow Dot* in Engine Electrical.
8. Attach the end of one jumper cable to the positive terminal (1) of the booster battery (A).
9. Attach the other end of the same cable to the positive terminal (2) of the discharged battery (B).
10. Attach one end of the remaining jumper cable to the negative terminal (3) of the booster battery (A).

11. Remove the plastic cap from the grounding stud attached to the engine compartment body surface. Make the final connection of the negative cable (4) to the grounding stud on the body of the vehicle being started.
12. Start the engine of the vehicle that is providing the jump start and turn off all electrical accessories.
13. Crank the engine of the vehicle with the discharged battery.
14. Reverse steps 8, 9, 10, and 11 exactly when removing the jumper cables. The negative battery cable (4) must be disconnected from the engine that was jump started first.



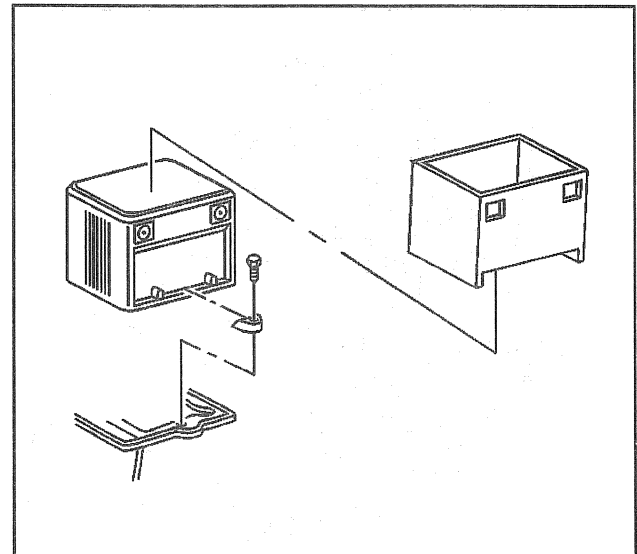
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## Battery Insulator Replacement

### Removal Procedure

**Caution:** Refer to *Battery Disconnect Caution in Cautions and Notices*.

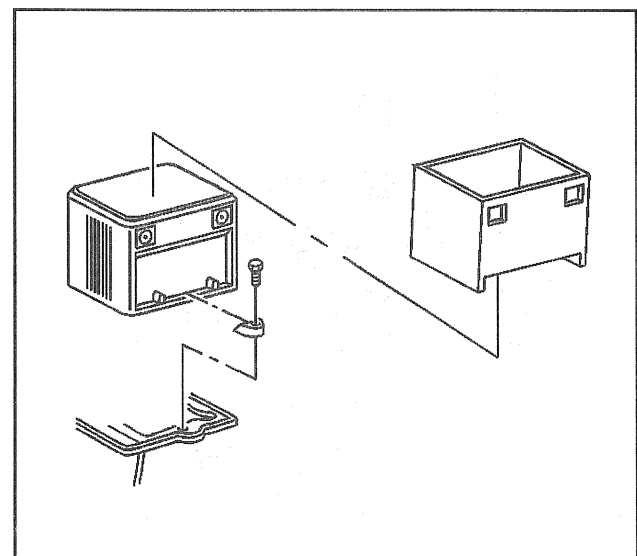
1. Disconnect the battery negative cable from the battery negative terminal. Refer to *Battery Negative Cable Disconnect/Connect Procedure*.
2. Disconnect the battery positive cable from the battery positive terminal.
3. Slide the insulator from the battery.



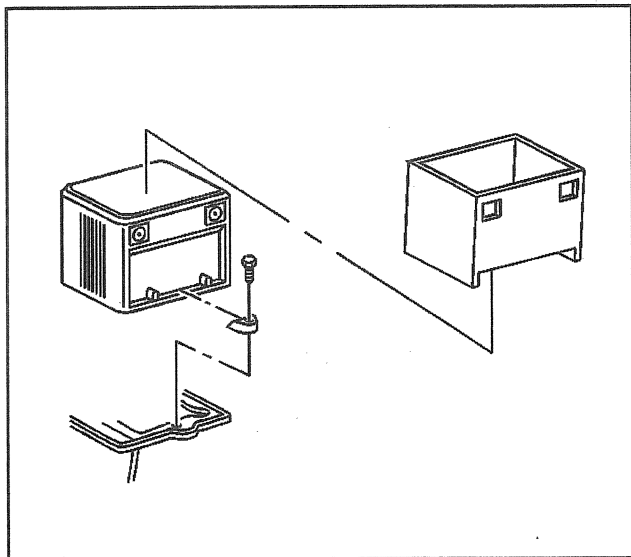
362327

### Installation Procedure

1. Install the insulator to the battery by sliding it on.
2. Connect the battery positive cable to the battery positive terminal.
3. Connect the battery negative cable to the battery negative terminal.



362327



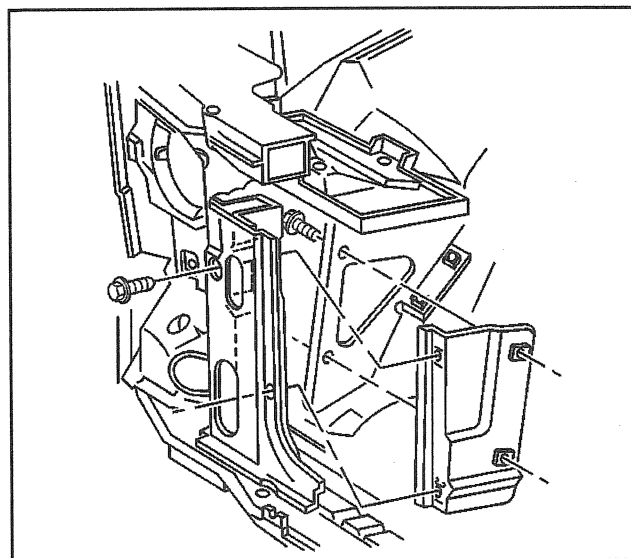
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## Battery Tray Replacement (Single or Auxiliary)

### Removal Procedure

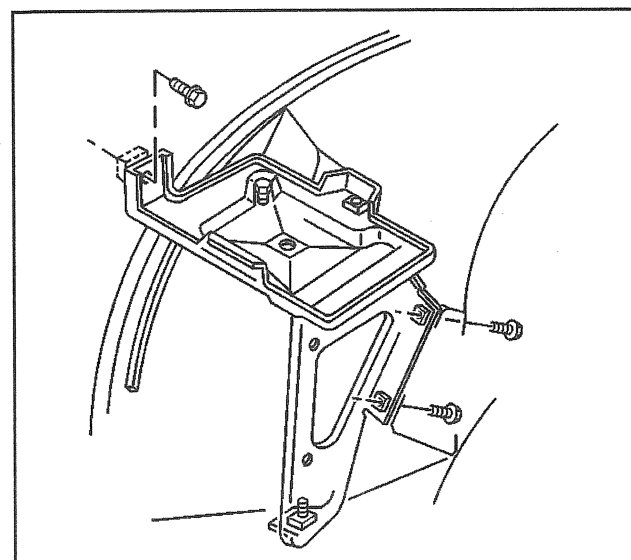
**Caution:** Refer to *Battery Disconnect Caution in Cautions and Notices*.

1. Disconnect the battery negative cable from the battery negative terminal. Refer to *Battery Negative Cable Disconnect/Connect Procedure*.
2. Disconnect the battery positive cable from the battery positive terminal.
3. Remove the battery hold-down bolt and retainer.
4. Remove the battery.



186825

5. Remove the battery tray reinforcement bolts.
6. Remove the battery tray reinforcement from the vehicle.



186812

7. Remove the battery tray bolts.
8. Remove the battery tray from the vehicle.

**Installation Procedure**

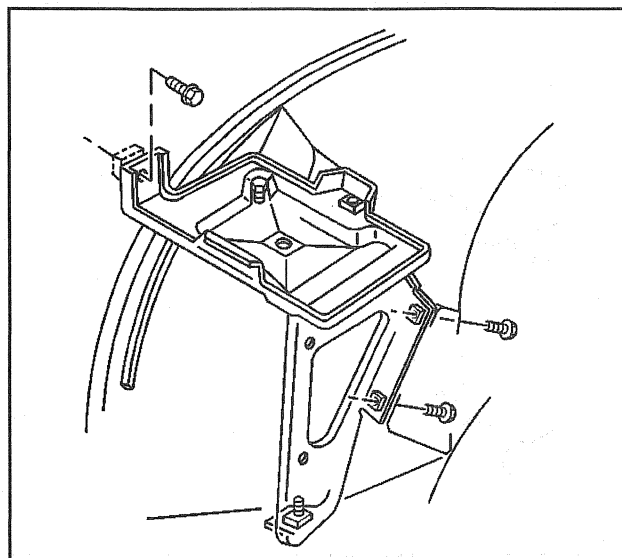
1. Install the battery tray to the vehicle.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

2. Install the battery tray bolts.

**Tighten**

Tighten the bolts to 25 N·m (18 lb ft).



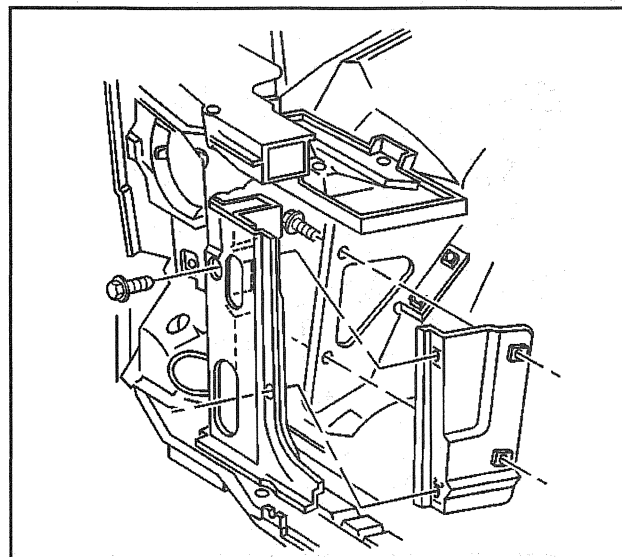
186812

3. Install the battery tray reinforcement to the vehicle

4. Install the battery tray reinforcement bolts.

**Tighten**

Tighten the retainer bolt to 25 N·m (18 lb ft).



186825

5. Install the battery.

6. Install the hold-down retainer and bolt.

**Tighten**

Tighten the retainer bolt to 25 N·m (18 lb ft).

7. Install the battery positive cable to the battery.

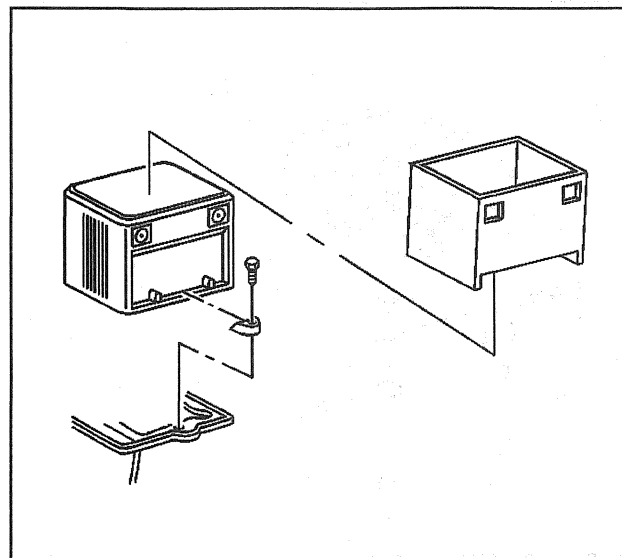
**Tighten**

Tighten the cable to 17 N·m (13 lb in).

8. Install the battery negative cable to the battery.

**Tighten**

Tighten the cable to 17 N·m (13 lb in).

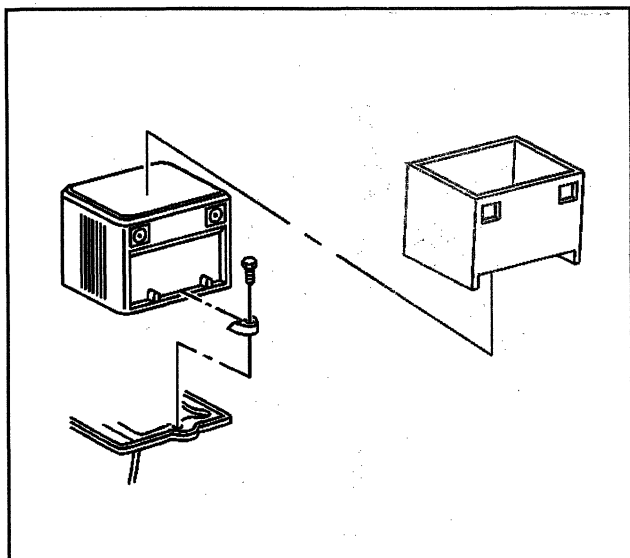


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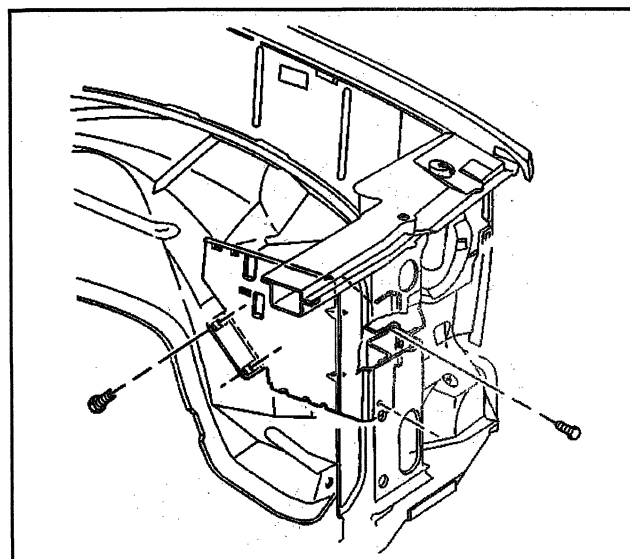
**Battery Tray Replacement (With Auxiliary)****Removal Procedure**

**Caution:** Refer to *Battery Disconnect Caution in Cautions and Notices*.

1. Disconnect the battery negative cable from the battery negative terminal. Refer to *Battery Negative Cable Disconnect/Connect Procedure*.
2. Disconnect the battery positive cable from the battery positive terminal.
3. Remove the battery hold-down bolt and retainer.
4. Remove the battery.

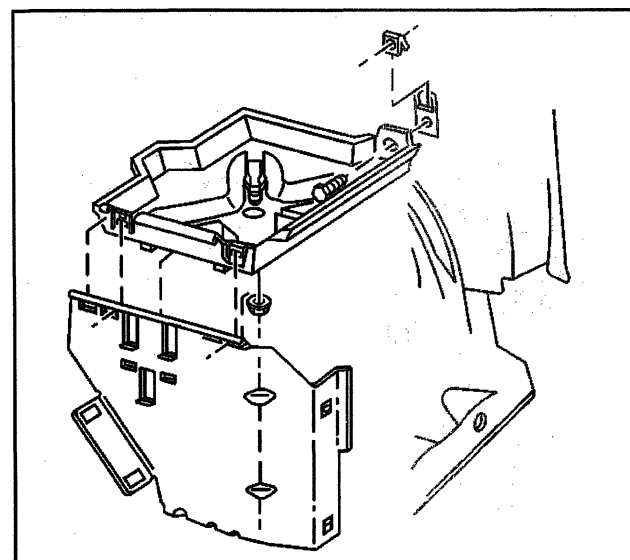


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186823

5. Remove the battery tray reinforcement bolts.
6. Remove the battery tray reinforcement from the vehicle.



186821

7. Remove the battery tray bolts.
8. Remove the battery tray from the vehicle.

**Installation Procedure**

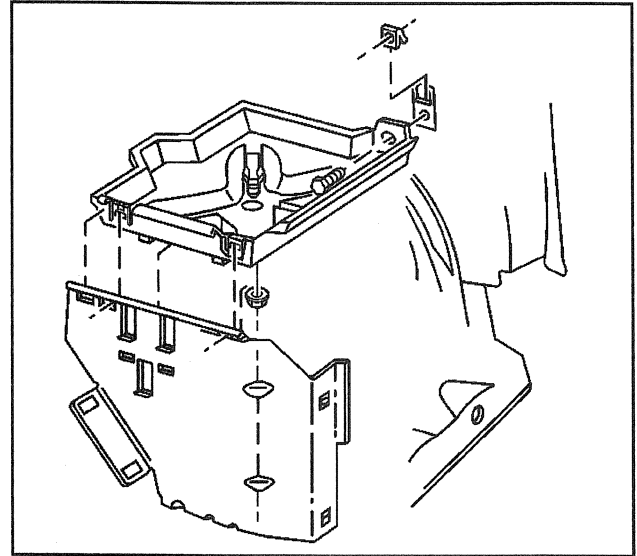
1. Install the battery tray to the vehicle.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

2. Install the battery tray bolts.

**Tighten**

Tighten the bolts to 25 N·m (18 lb ft).

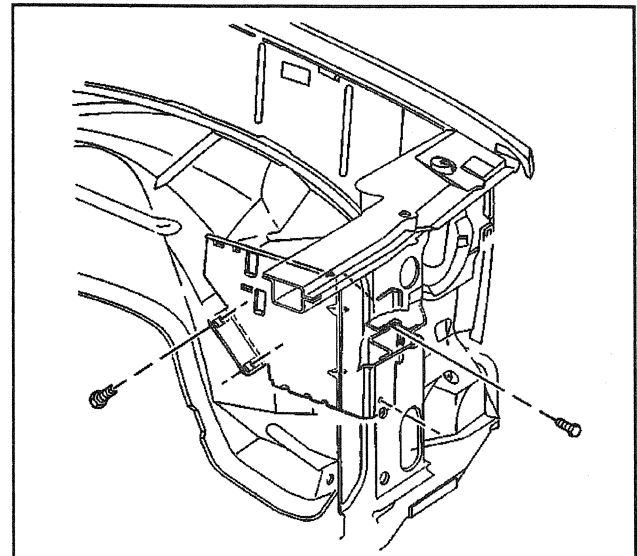


186821

3. Install the battery tray reinforcement to the vehicle
4. Install the battery tray reinforcement bolts.

**Tighten**

Tighten the retainer bolt to 25 N·m (18 lb ft).



186823

5. Install the battery.
6. Install the hold-down retainer and bolt.

**Tighten**

Tighten the retainer bolt to 15 N·m (11 lb ft).

7. Install the battery positive cable to the battery.

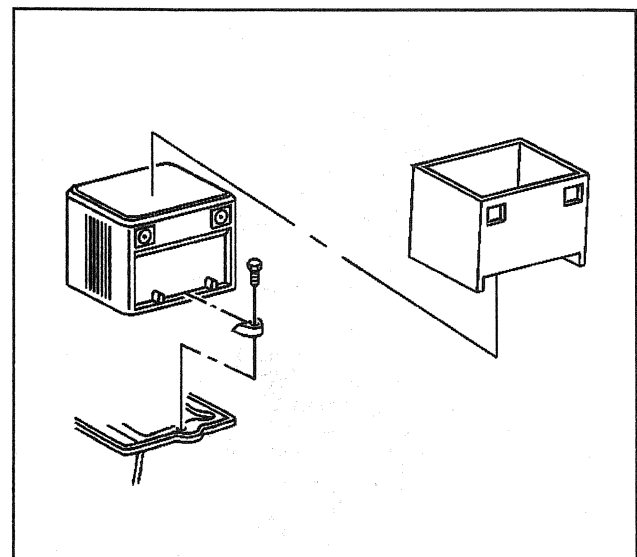
**Tighten**

Tighten the cable to 10 N·m (89 lb in).

8. Install the battery negative cable to the battery.

**Tighten**

Tighten the cable to 10 N·m (89 lb in).



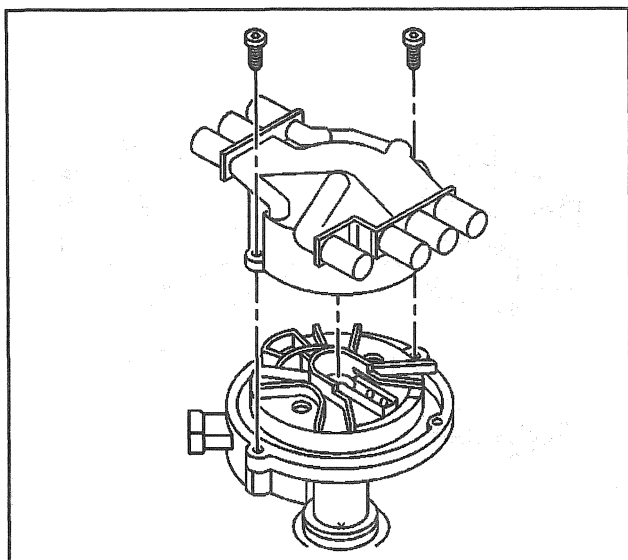
362327



## Distributor Inspection

**Important:** Discoloration of the cap and some whitish build up around the cap terminals is normal. Yellowing of the rotor cap, darkening and some carbon build up under the rotor segment is normal. Replacement of the cap and the rotor is not necessary unless there is a driveability concern.

1. Inspect the cap for cracks, tiny holes or carbon tracks between the cap terminal traces. Diagnose the carbon tracks using the following procedure:
  - 1.1. Remove the cap. Place 1 base ohmmeter lead on a cap terminal.
  - 1.2. Use the other lead in order to probe all other terminals and the center carbon ball.
  - 1.3. Move the base lead to the next terminal. Probe all other leads.
  - 1.4. Continue this procedure until you test all the secondary terminals.
  - 1.5. If there are any non-infinite readings, replace the cap.
2. Inspect the cap for over excessive build-up of corrosion on the terminals. Scrape clean the terminals. Replace the cap if the corrosion is excessive. Some buildup is normal
3. Inspect the rotor segment for excessive wear. Replace the rotor if excessive looseness in the rotor segment is present.
4. Inspect the shaft for shaft-to-bushing looseness.
  - 4.1. Insert the shaft in the housing.
  - 4.2. If the shaft wobbles, replace the housing assembly.
5. Inspect the housing for cracks or damage.
  - For vehicles equipped with the 5.0/5.7L engines, refer to *Enhanced Ignition System Diagnosis* in Engine Controls— 5.0, 5.7L.
  - For vehicles equipped with the 7.4L engines, refer to *Enhanced Ignition System Diagnosis* in Engine Controls —7.4L.



301393

## Distributor Overhaul

### Disassembly Procedure

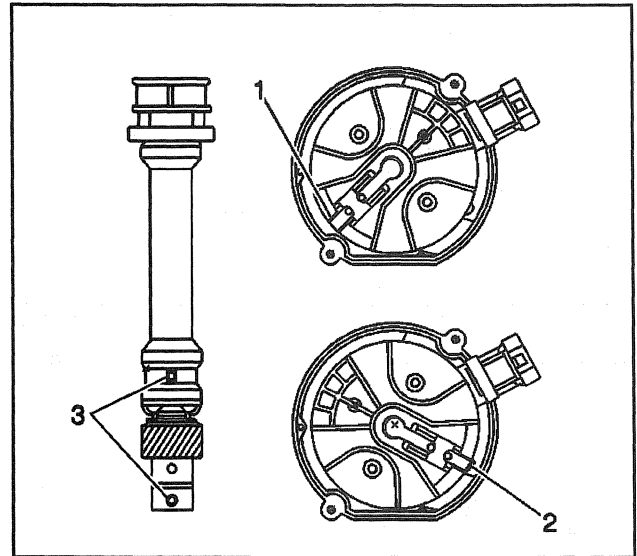
**Notice:** The OBD II ignition system distributor driven gear and rotor can be installed in multiple positions. In order to avoid mistakes, make sure to mark the distributor in the following positions:

1. The distributor driven gear.
2. The distributor shaft.
3. The rotor holes for the same mounting position upon reassembly.

Installing the driven gear 180 degrees out of alignment, or locating the rotor in the wrong holes, will cause a no-start condition. Premature engine wear or damage may result.

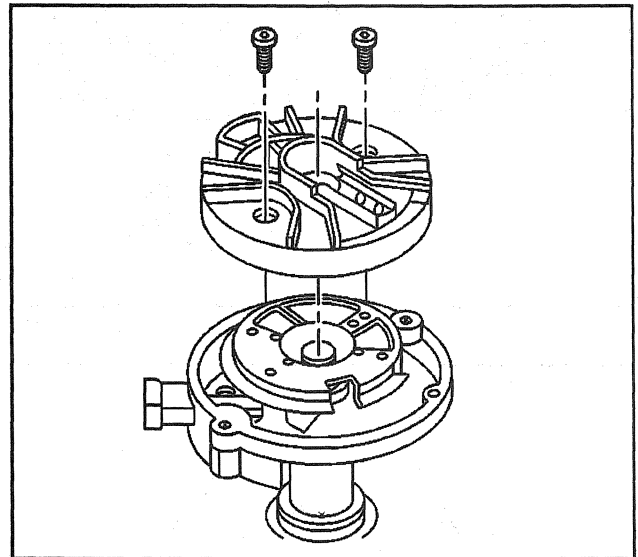
Installing the driven gear 180 degrees out of alignment, or locating the rotor in the wrong holes, will cause a no-start condition. Premature engine wear or damage may result.

1. Remove the two screws that hold the distributor cap to the housing.
2. Discard the screws.
3. Remove the distributor cap from the housing.
4. Align white paint mark on the bottom stem of the distributor, and the pre-drilled indent hole in the bottom of the gear (3).
5. With the gear in this position, the rotor segment should be positioned as shown for a V6 engine (1) or V8 engine (2). If not, replace the distributor.

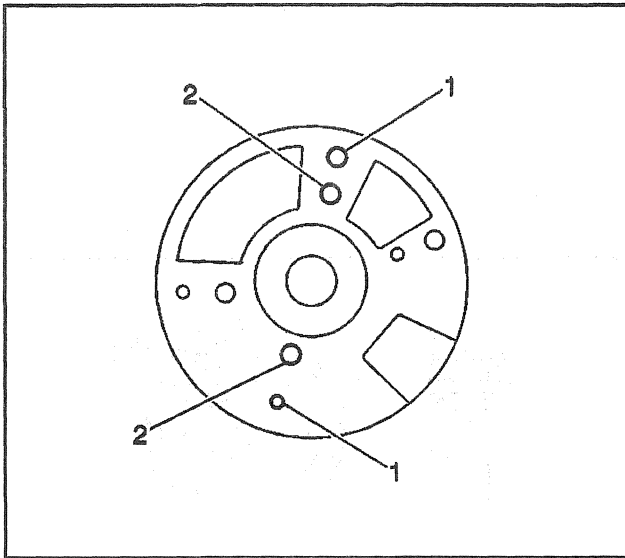


301395

6. Remove the two screws from the rotor.
7. Remove the rotor.



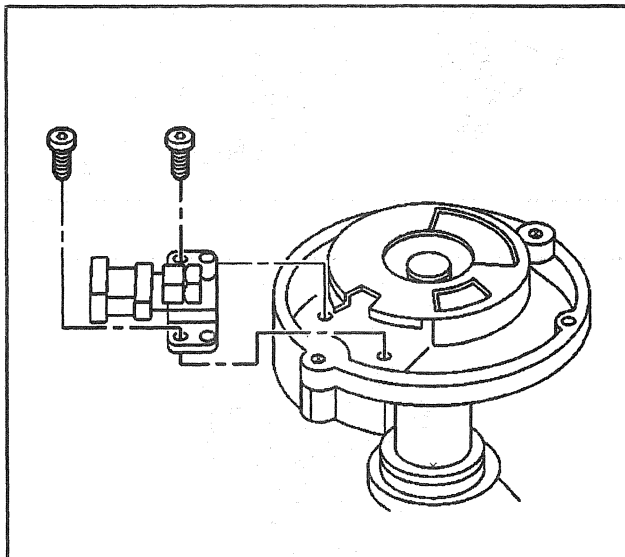
301396



156752

8. Note the locating holes that the rotor was removed from

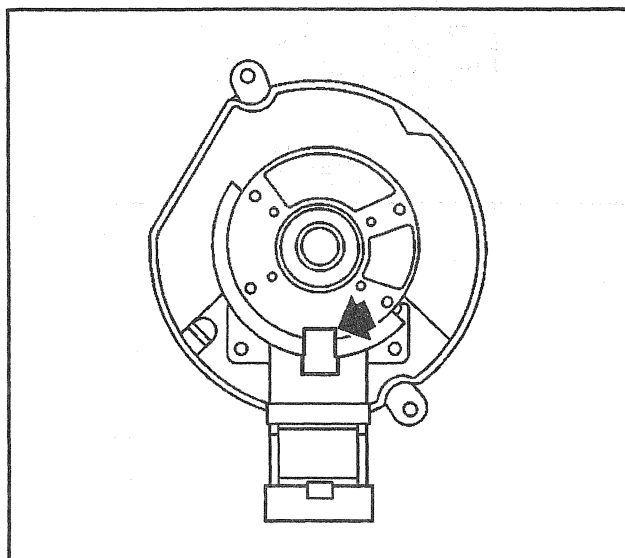
- The rotor screw holes(1).
- The rotor locator pin holes(2).



301398

9. Remove the two screws that hold the camshaft position (CMP) sensor.

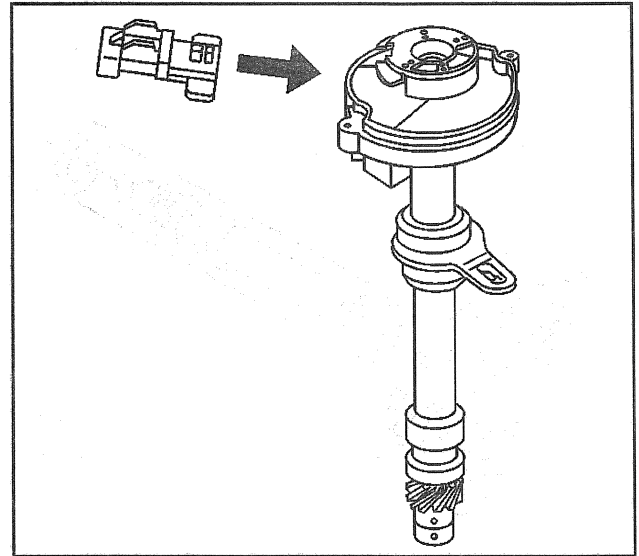
10. Discard the screws.



156754

11. Line up the square-cut hole in the vane wheel with the CMP sensor.

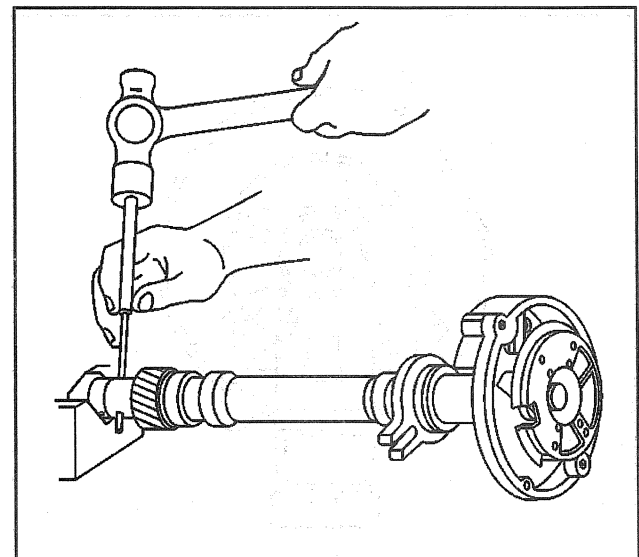
12. Remove the CMP sensor.
13. Note the dimple located below the roll pin hole on one side of the gear. The dimple will be used to properly orient the gear onto the shaft during reassembly.



156755

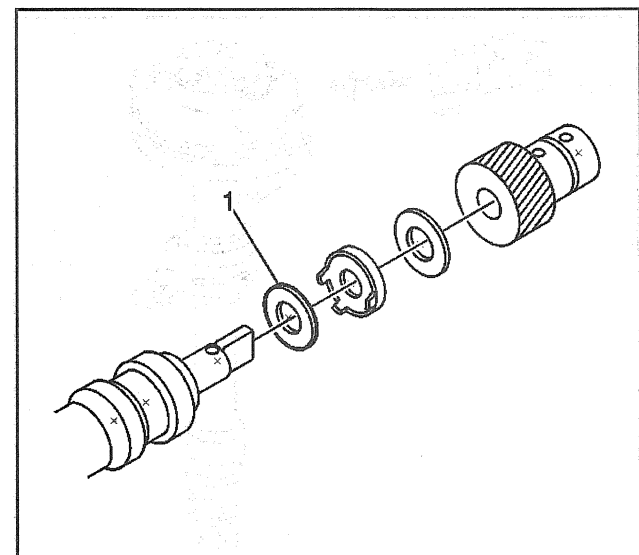
**Caution: Refer to Safety Glasses Caution in Cautions and Notices.**

14. Support the distributor drive gear in a V-block or similar fixture.
15. Drive out the roll pin with a suitable punch.

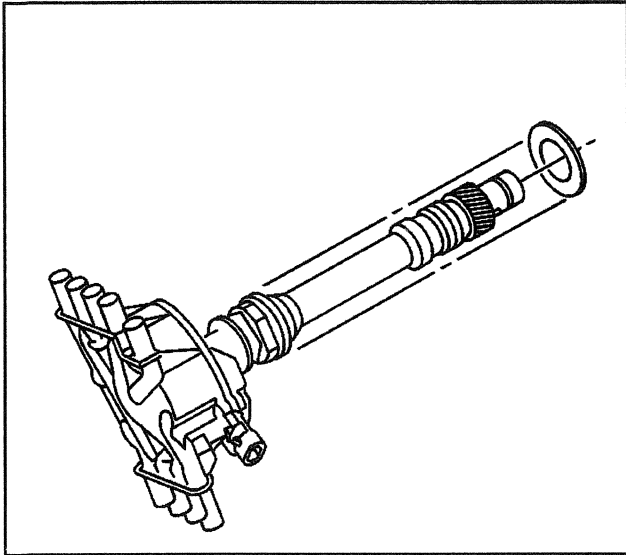


301198

16. Remove the driven gear from the distributor shaft.
17. Remove the round washer.
18. Remove the tang washer.
19. Remove the round washer (1), if equipped, 7.4L engine only.

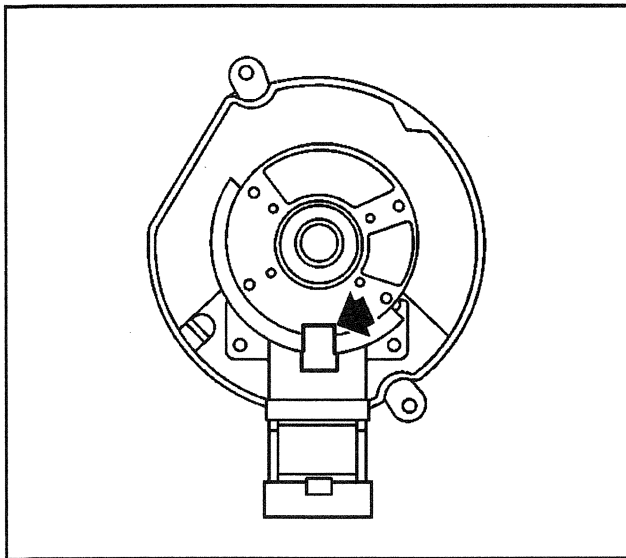


301405



301419

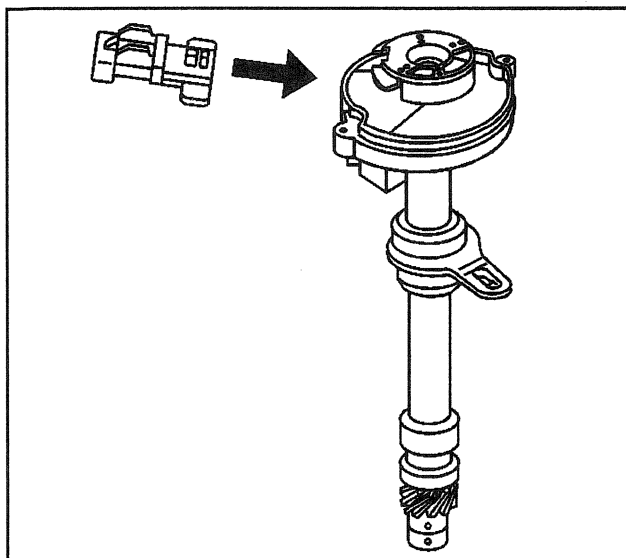
20. Remove the old oil seal.



156754

### Assembly Procedure

1. Line up the square-cut hole in the vane wheel for the camshaft position (CMP) sensor.



156755

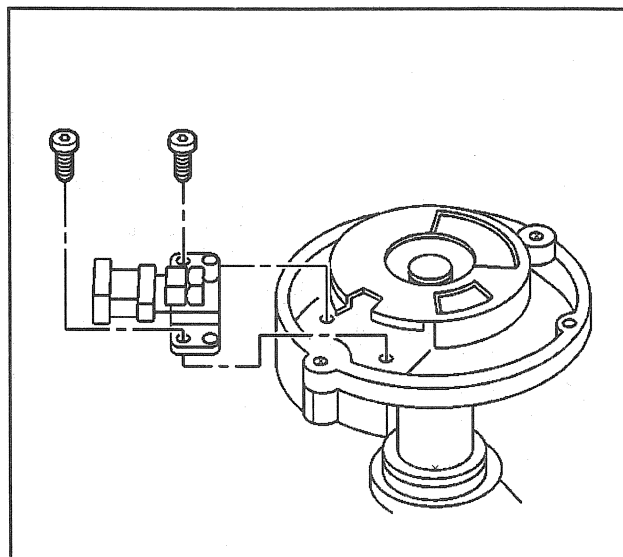
2. Insert the sensor into the housing.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

3. Install two NEW screws for the camshaft position (CMP) sensor.

**Tighten**

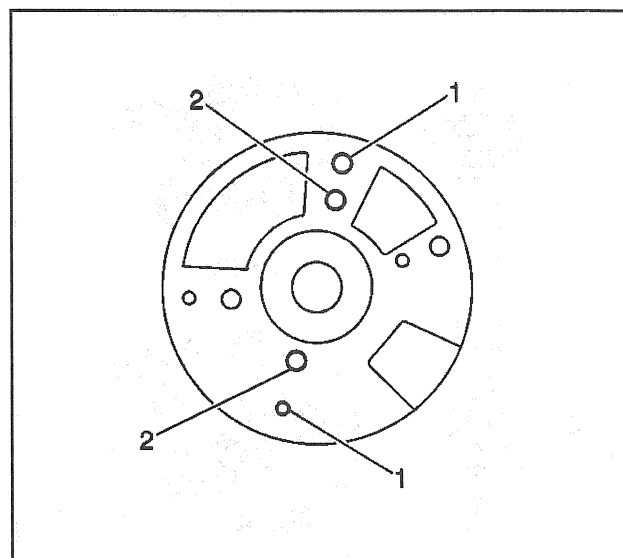
Tighten the screws to 2.2 N·m (20 lb in).



301398

4. Identify the correct rotor mounting position.

- At the rotor screw holes (1).
- At the rotor locator pin holes (2).

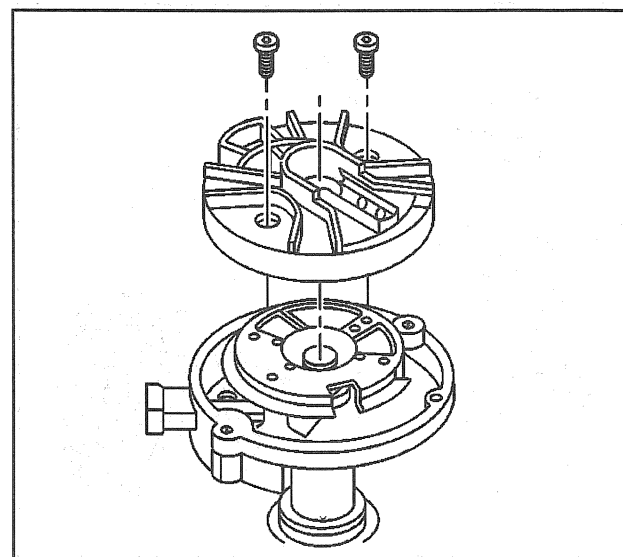


156752

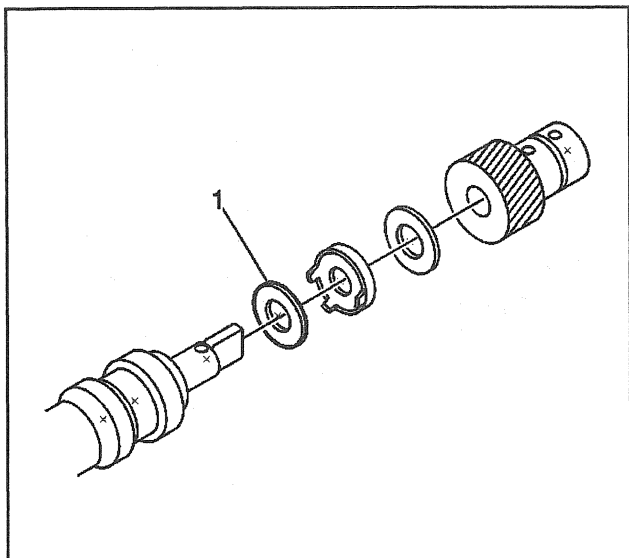
5. Install the distributor rotor according to the index marks.
6. Install two rotor hold down screws.

**Tighten**

Tighten the screws to 1.9 N·m (17 lb in).



301396



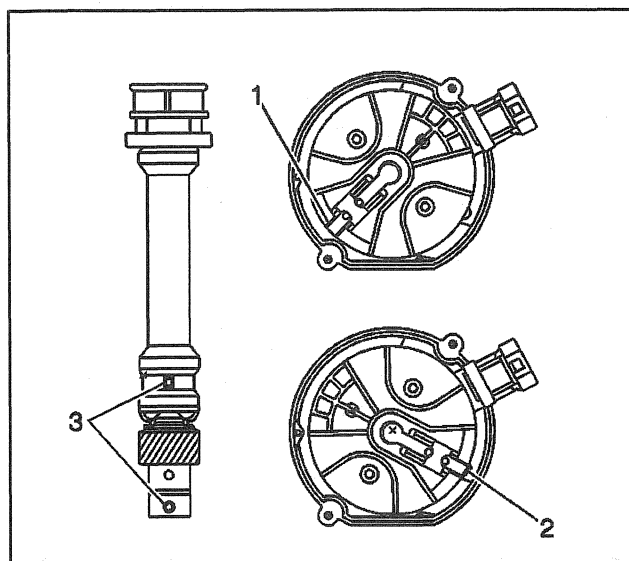
301405

**Notice:** The OBD II ignition system distributor driven gear and rotor can be installed in multiple positions. In order to avoid mistakes, make sure to mark the distributor in the following positions:

- 6.1. The distributor driven gear.
- 6.2. The distributor shaft.
- 6.3. The rotor holes for the same mounting position upon reassembly.

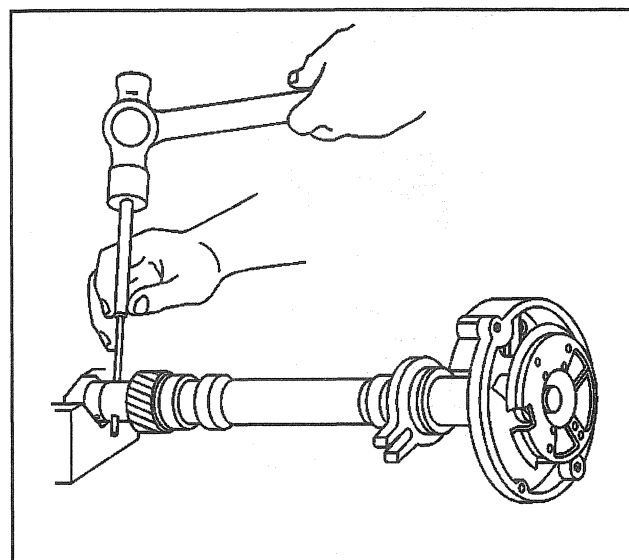
Installing the driven gear 180 degrees out of alignment, or locating the rotor in the wrong holes, will cause a no-start condition. Premature engine wear or damage may result.

7. Install the round washer (1), 7.4L engine only.
8. Install the tang washer over the bottom of the distributor shaft.
9. Install the round washer.
10. Install the driven gear according to the index marks.



301395

11. Align the rotor segment as shown for a V6 engine (1) or V8 engine (2).
12. Install the gear and align white paint mark on the bottom stem of the distributor, and the pre-drilled indent hole in the bottom of the gear (3).
13. Check to see if the driven gear is installed incorrectly, the dimple will be approximately 180 degrees opposite the rotor segment when it is installed in the distributor.



301198

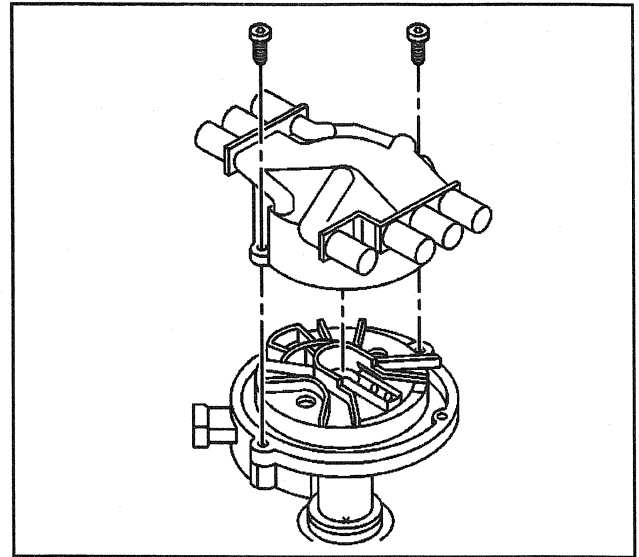
**Caution:** Refer to Safety Glasses Caution in Cautions and Notices.

14. Support the distributor drive gear in a V-block or similar fixture.
15. Install the roll pin with a suitable punch and hammer in order to hold the driven gear in the correct position.

16. Install the distributor cap.
17. Install two NEW distributor cap screws.

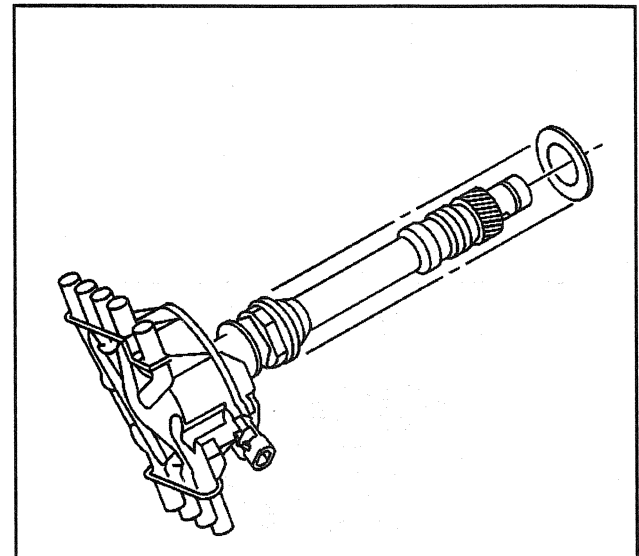
**Tighten**

Tighten the screws to 2.4 N·m (21 lb in).



301393

18. Install the new oil seal under the mounting flange of the distributor base.



301419



## Distributor Replacement (5.0L, 5.7L)

### Removal Procedure

**Notice:** There are two procedures available to install the distributor.

Use Installation Procedure 1 when the crankshaft has NOT been rotated from the original position.

Use Installation Procedure 2 when any of the following components are removed:

- The intake manifold.
- The cylinder head.
- The camshaft.
- The timing chain or sprockets.
- The complete engine.

If the Malfunction Indicator Lamp turns on, and a DTC code P1345 sets after installing the distributor, this indicates an incorrectly installed distributor.

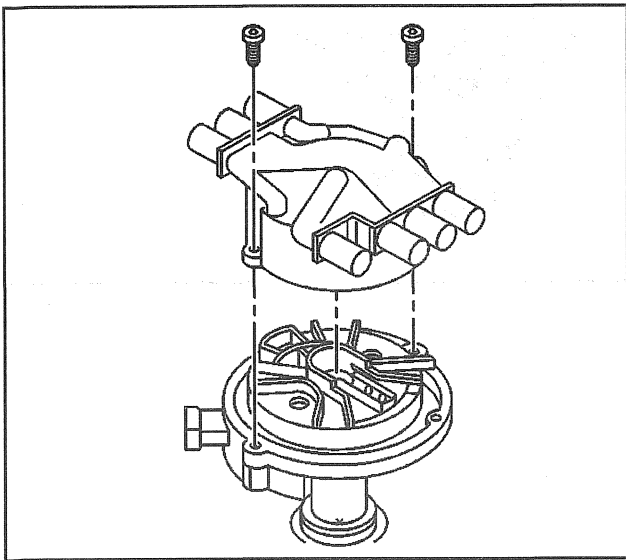
Engine damage or distributor damage may occur. Use Procedure 2 in order to install the distributor.

1. Turn OFF the ignition switch.

Remove the spark plug wires from the distributor cap

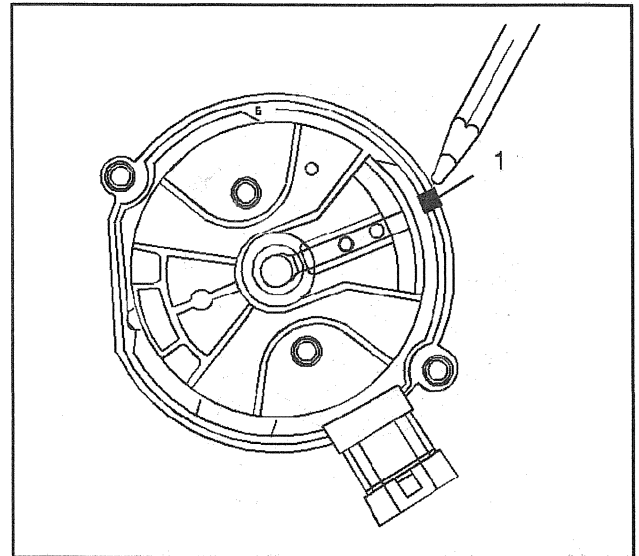
- Twist each spark plug 1/2 turn.
- Pull only on the boot in order to remove the wire from the distributor cap.

2. Remove the electrical connector from the base of the distributor.
3. Remove the two screws that hold the distributor cap to the housing.
4. Discard the screws.
5. Remove the distributor cap from the housing.



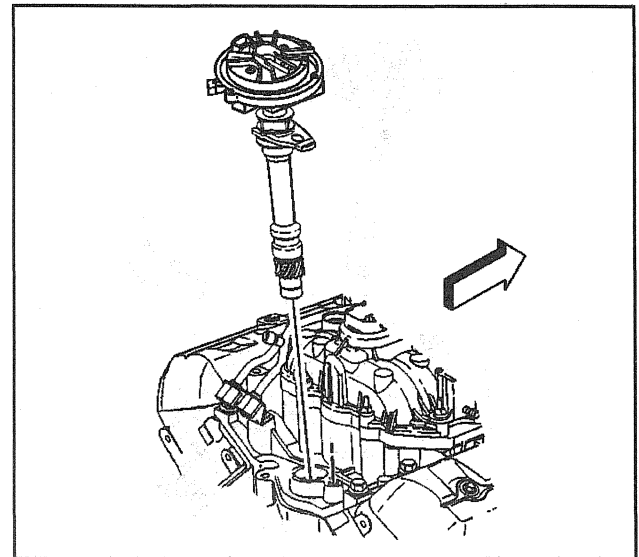
301393

6. Use a grease pencil in order to note the position of the rotor in relation to the distributor housing (1).
7. Mark the distributor housing and the intake manifold with a grease pencil.



4373

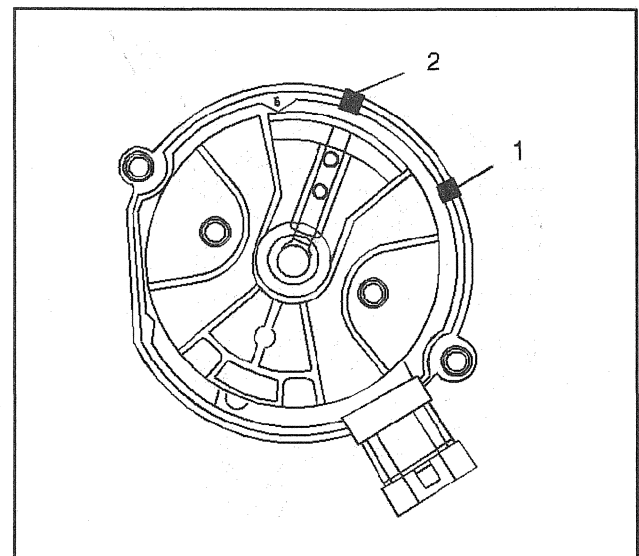
8. Remove the mounting clamp hold down bolt.
9. Remove the distributor.



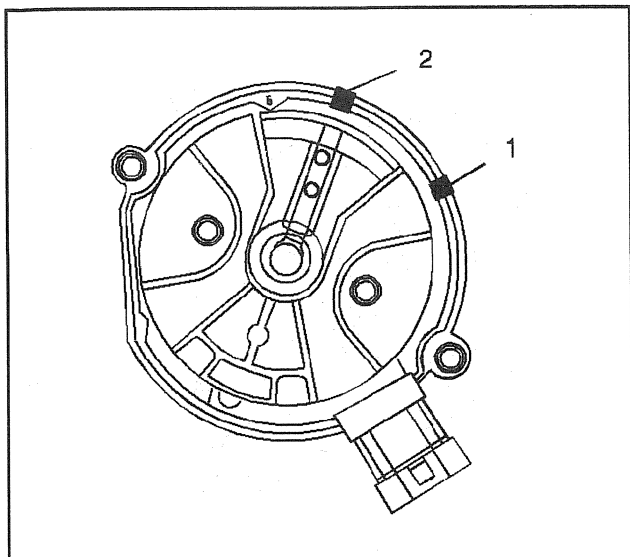
34397

10. As the distributor is being removed from the engine, watch the rotor move in a counter-clockwise direction about 42 degrees. This will appear as slightly more than one clock position.
11. Note the position of the rotor segment.
  - 11.1. Place a second mark on the base of the distributor.

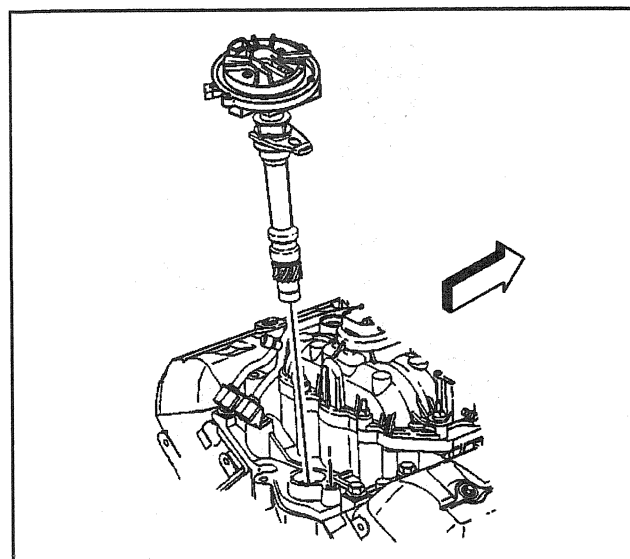
This will aid in achieving proper rotor alignment during the distributor installation.
  - 11.2. The second mark on the distributor housing is identified in the graphic as number 2.



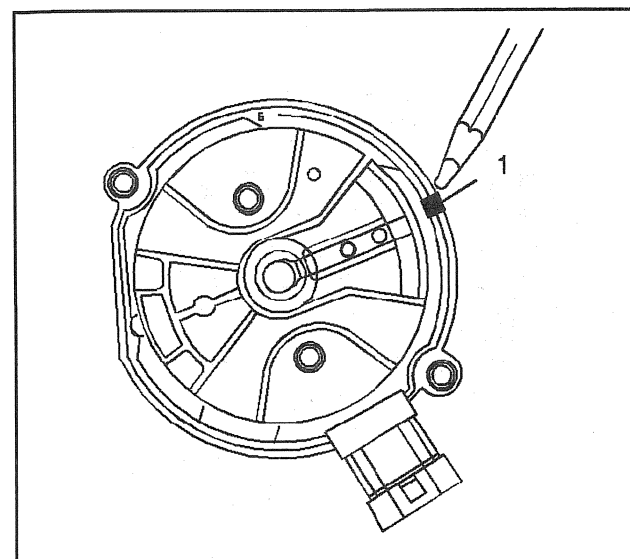
4376



4376



34397



4373

### Installation Procedure 1

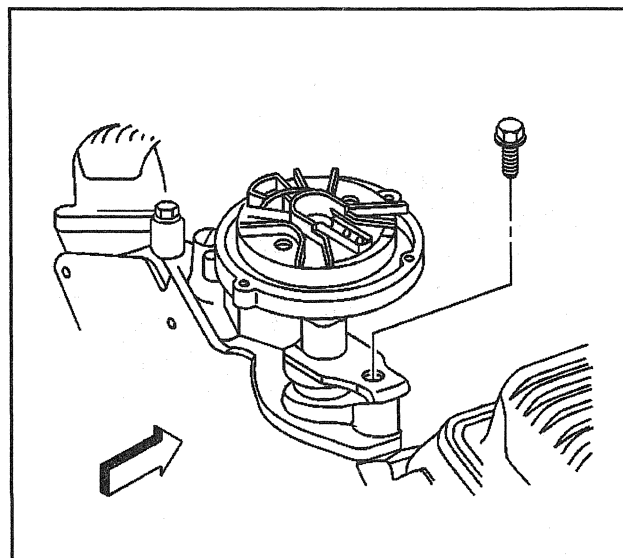
1. If installing a new distributor assembly, place two marks on the new distributor housing in the same location as the two marks on the original housing.
2. Remove the new distributor cap, if necessary.
3. Align the rotor with mark made at location 2.
4. Guide the distributor into the engine.
5. Align the hole in the distributor hold-down base over the mounting hole in the intake manifold.
6. As the distributor is being installed, observe the rotor moving in a clockwise direction about 42 degrees.
7. Once the distributor is completely seated, the rotor segment should be aligned with the mark on the distributor base in location number 1.
  - If the rotor segment is not aligned with the number 1 mark, the driven gear teeth and the camshaft have meshed one or more teeth out of alignment.
  - In order to correct this condition, remove the distributor and reinstall it.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

8. Install the distributor mounting clamp bolt.

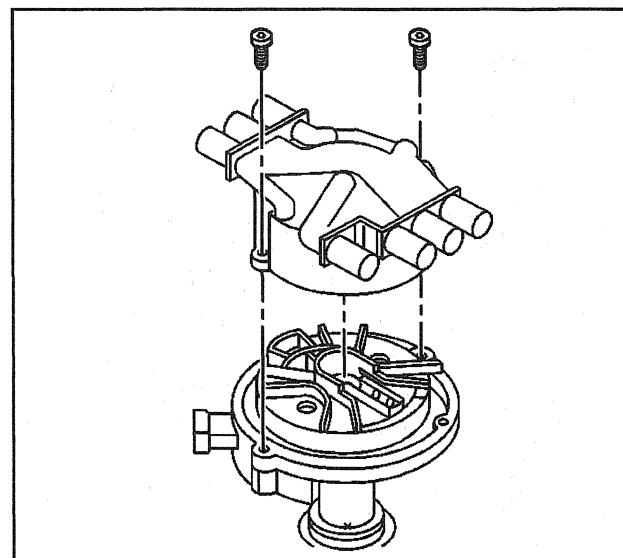
**Tighten**

Tighten the distributor clamp bolt to 25 N·m (18 lb ft).



366609

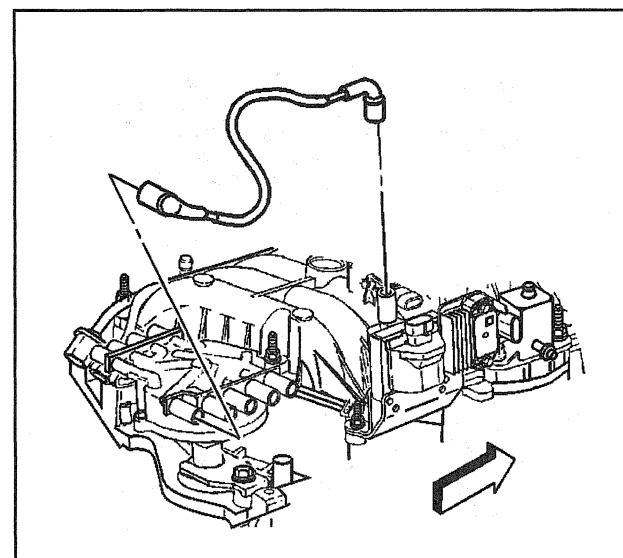
9. Install the distributor cap.
  10. Install two NEW distributor cap screws.
- Tighten**
- Tighten the screws to 2.4 N·m (21 lb in).
11. Install the electrical connector to the distributor.
  12. Install the spark plug wires to the distributor cap.



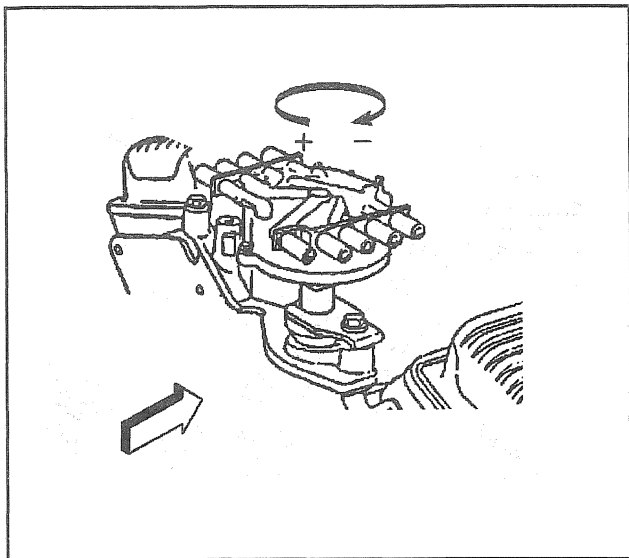
301393

13. Install the ignition coil wire.

The wire must not touch anything like the dip stick, rubbing will make a ground/short after time of use.



341359

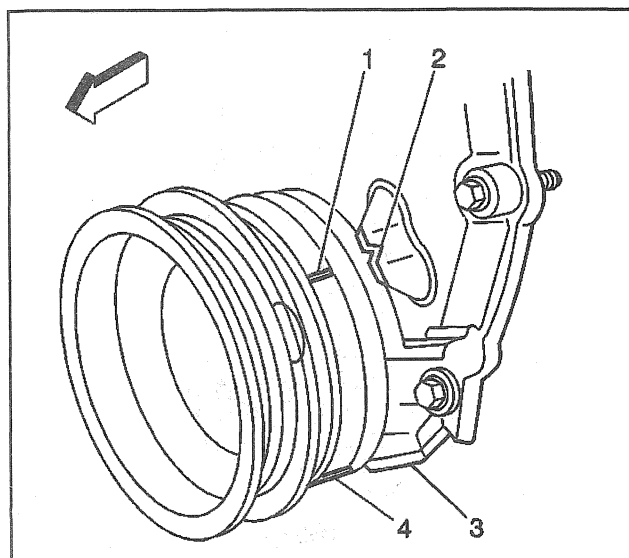


18446

14. For V8 engines, connect a scan tool.
15. Monitor the Camshaft Retard Offset value. Refer to Engine Controls Camshaft Retard Offset Adjustment.

**Important:** If the Malfunction Indicator lamp is turned on after installing the distributor, and a DTC P1345 is found, the distributor has been installed incorrectly.

16. Refer to Installation Procedure 2 for proper distributor installation.



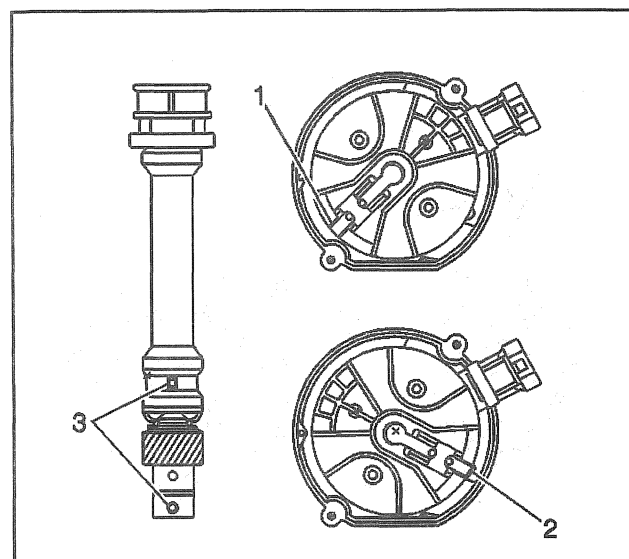
334551

### Installation Procedure 2

**Important:** Rotate the number 1 cylinder to Top Dead Center (TDC) of the compression stroke. The engine front cover has 2 alignment tabs and the crankshaft balancer has 2 alignment marks (spaced 90 degrees apart) which are used for positioning number 1 piston at top dead center (TDC). With the piston on the compression stroke and at top dead center, the crankshaft balancer alignment mark (1) must align with the engine front cover tab (2) and the crankshaft balancer alignment mark (4) must align with the engine front cover tab (3).

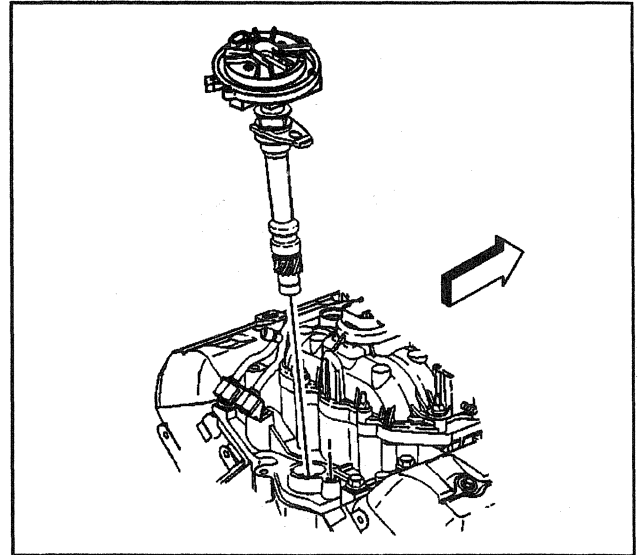
1. Rotate the crankshaft balancer clockwise until the alignment marks on the crankshaft balancer are aligned with the tabs on the engine front cover and the number 1 piston is at top dead center of the compression stroke.
2. Align white paint mark on the bottom stem of the distributor, and the pre-drilled indent hole in the bottom of the gear (3).
3. With the gear in this position, the rotor segment should be positioned as shown for a V6 engine (1) or V8 engine (2).
  - The alignment will not be exact.
  - If the driven gear is installed incorrectly, the dimple will be approximately 180 degrees opposite of the rotor segment when it is installed in the distributor.

**Notice:** Refer to *Distributor Driven Gear Can Be Installed in Multiple Positions* in Cautions and Notices.



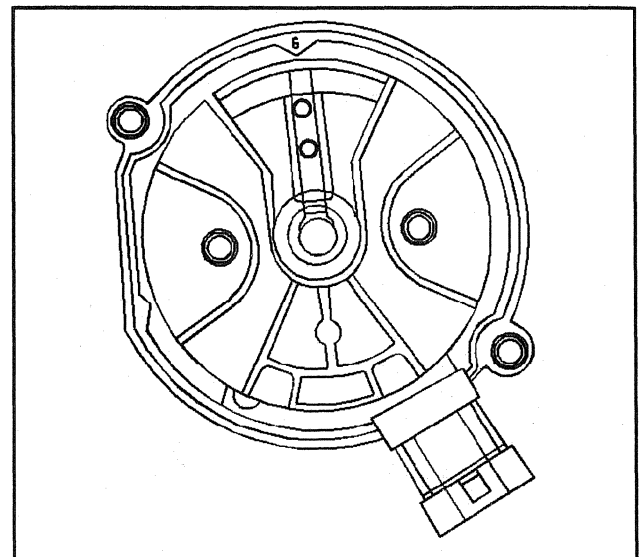
301395

4. Using a long screw driver, align the oil pump drive shaft to the drive tab of the distributor.
5. Guide the distributor into the engine.  
Ensure that the spark plug towers are perpendicular to the centerline of the engine.



34397

6. Once the distributor is fully seated, the rotor segment should be aligned with the pointer cast into the distributor base.
  - This pointer may have a 6 cast into it, indicating that the distributor is to be used on a 6 cylinder engine or an 8 cast into it, indicating that the distributor is to be used on an 8 cylinder engine.
  - If the rotor segment does not come within a few degrees of the pointer, the gear mesh between the distributor and the camshaft may be off a tooth or more.
  - If this is the case, repeat the procedure again in order to achieve proper alignment.



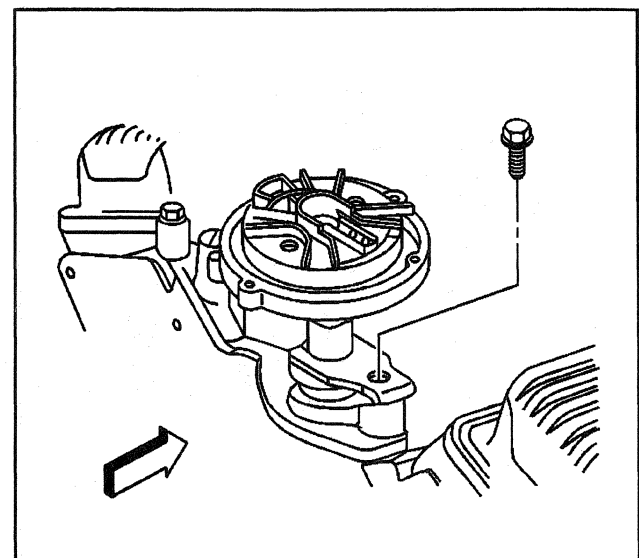
4350

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

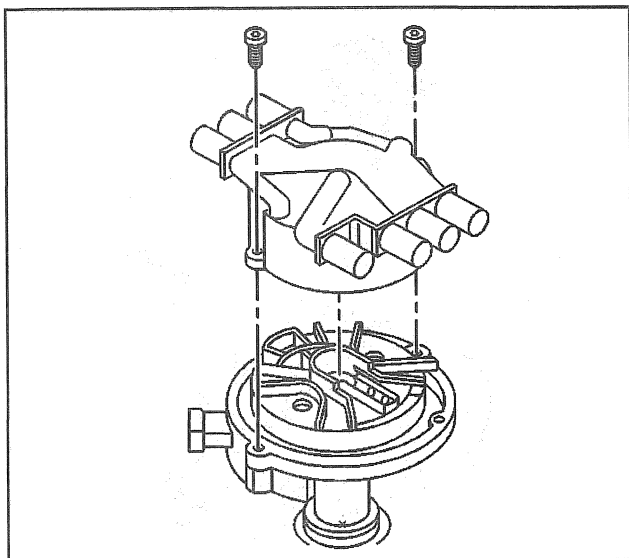
7. Install the distributor mounting clamp bolt.

**Tighten**

Tighten the distributor clamp bolt to 25 N·m (18 lb ft).



366609



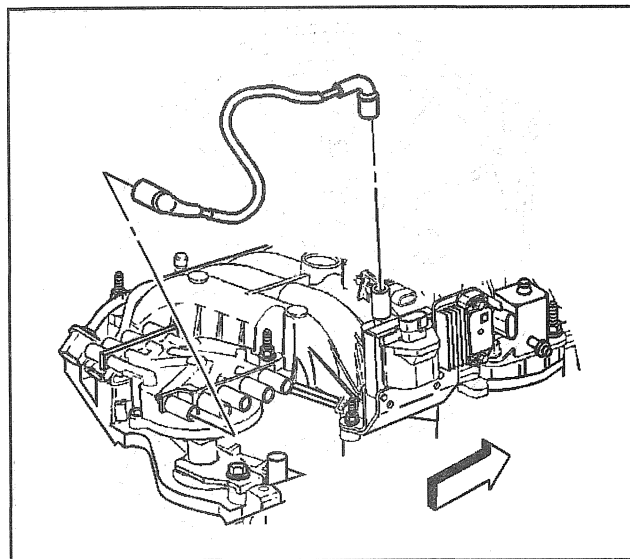
301393

8. Install the distributor cap.
9. Install two NEW distributor cap screws.

**Tighten**

Tighten the screws to 2.4 N·m (21 lb in).

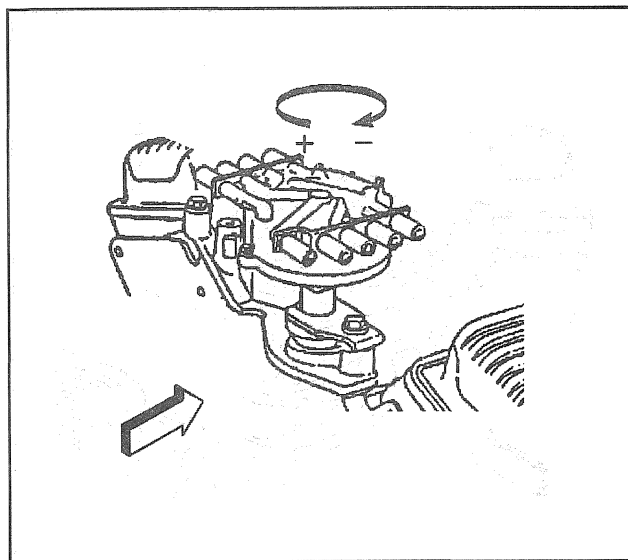
10. Install the electrical connector to the distributor.
11. Install the spark plug wires to the distributor cap.



341359

12. Install the ignition coil wire.

The wire must not touch anything like the dip stick, rubbing will make a ground/short after time of use.



18446

13. For V8 engines, connect a scan tool.
14. Monitor the Camshaft Retard Offset value. Refer to Engine Controls Camshaft Retard Offset Adjustment.

**Important:** If the Malfunction Indicator lamp is turned on after installing the distributor, and a DTC P1345 is found, the distributor has been installed incorrectly.

15. Refer to Installation Procedure 2 for proper distributor installation.

## Distributor Replacement (7.4L)

### Removal Procedure

**Notice:** There are two procedures available to install the distributor.

Use Installation Procedure 1 when the crankshaft has NOT been rotated from the original position.

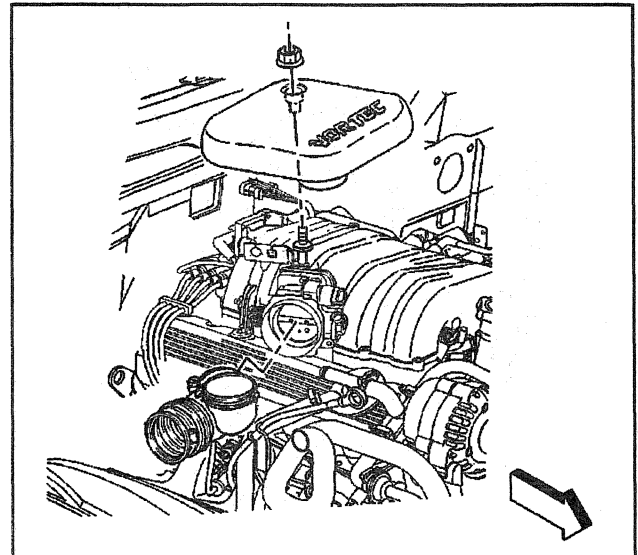
Use Installation Procedure 2 when any of the following components are removed:

- The intake manifold.
- The cylinder head.
- The camshaft.
- The timing chain or sprockets.
- The complete engine.

If the Malfunction Indicator Lamp turns on, and a DTC code P1345 sets after installing the distributor, this indicates an incorrectly installed distributor.

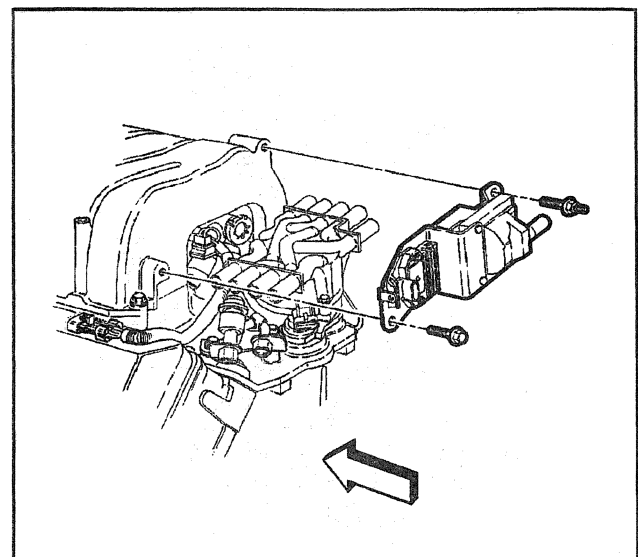
Engine damage or distributor damage may occur. Use Procedure 2 in order to install the distributor.

1. Turn OFF the ignition switch.
2. Remove the air cleaner assembly 7.4L.



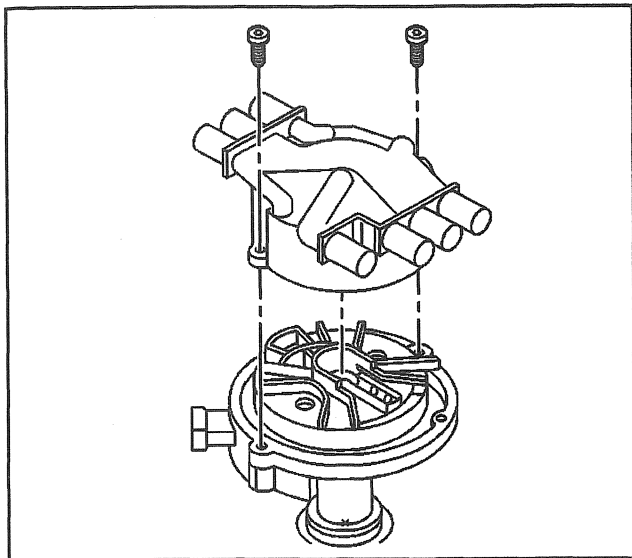
175670

3. Remove the ignition coil.  
Refer to Ignition Coil and ICM Replacement.
4. Remove the spark plug wires from the distributor cap.
  - Twist each spark plug 1/2 turn.
  - Pull only on the boot in order to remove the wire from the distributor cap.
5. Remove the electrical connector from the base of the distributor.



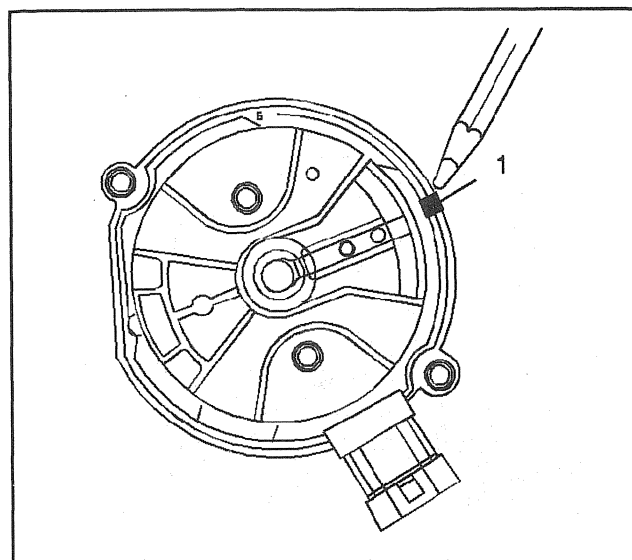
68506





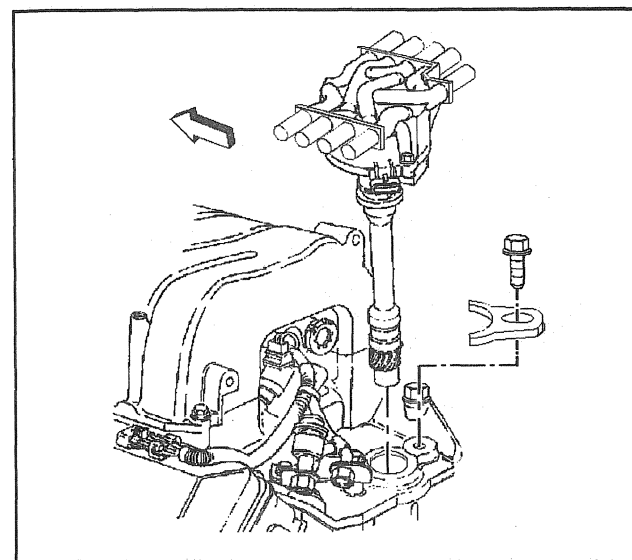
301393

6. Remove the two screws that hold the distributor cap to the housing.
7. Discard the screws.
8. Remove the distributor cap from the housing.



4373

9. Use a grease pencil in order to note the position of the rotor in relation to the distributor housing (1).
10. Mark the distributor housing and the intake manifold with a grease pencil.



68504

11. Remove the mounting clamp hold down bolt.
12. Remove the distributor.

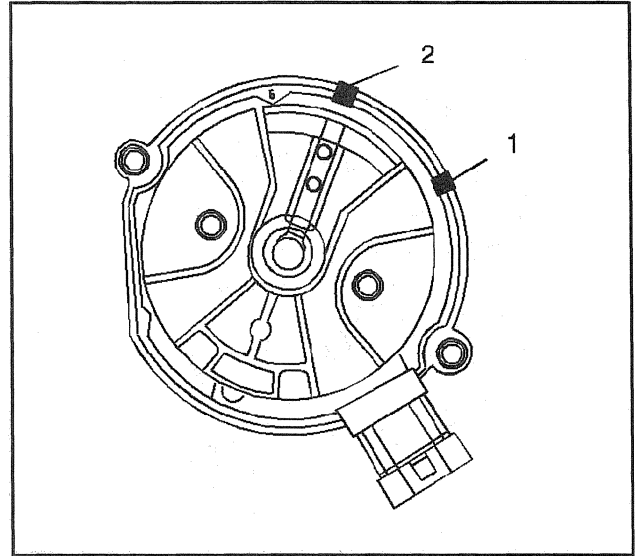
13. As the distributor is being removed from the engine, watch the rotor move in a counter-clockwise direction about 42 degrees. This will appear as slightly more than one clock position.

14. Note the position of the rotor segment.

- 14.1. Place a second mark on the base of the distributor.

This will aid in achieving proper rotor alignment during the distributor installation.

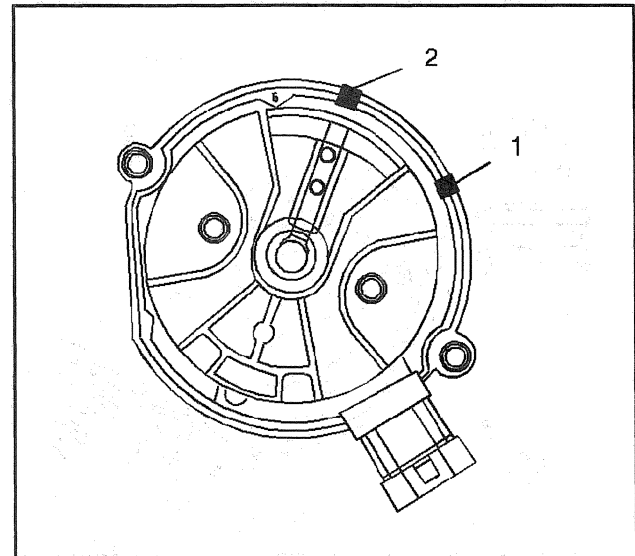
- 14.2. The second mark on the distributor housing is identified in the graphic as number 2.



4376

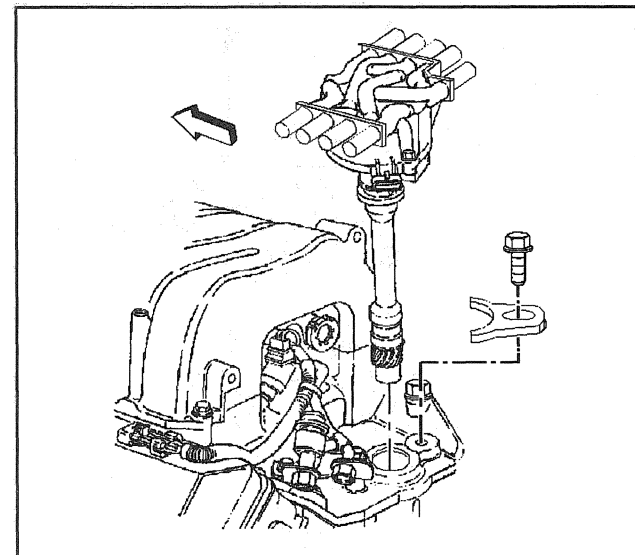
### Installation Procedure 1

1. If installing a new distributor assembly, place two marks on the new distributor housing in the same location as the two marks on the original housing.
2. Remove the new distributor cap, if necessary.
3. Align the rotor with mark made at location 2.

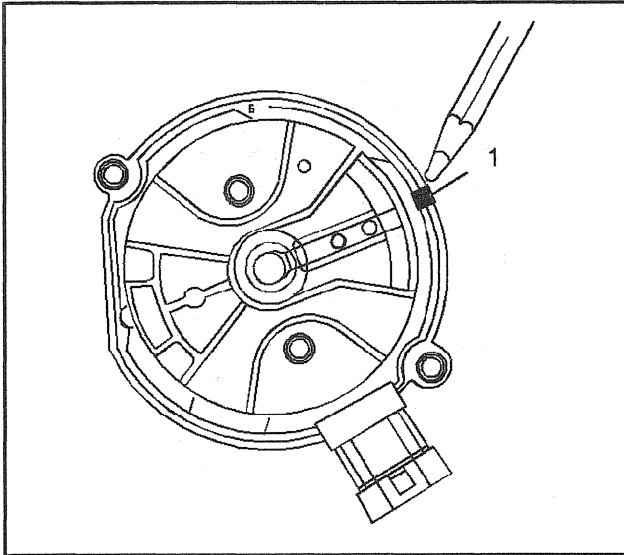


4376

4. Guide the distributor into the engine.
5. Align the hole in the distributor hold-down base over the mounting hole in the intake manifold.



68504



4373

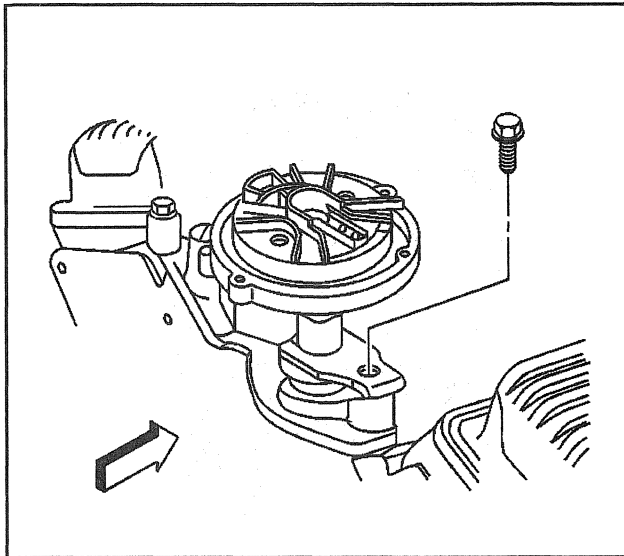
6. As the distributor is being installed, observe the rotor moving in a clockwise direction about 42 degrees.
7. Once the distributor is completely seated, the rotor segment should be aligned with the mark on the distributor base in location number 1.
  - If the rotor segment is not aligned with the number 1 mark, the driven gear teeth and the camshaft have meshed one or more teeth out of alignment.
  - In order to correct this condition, remove the distributor and reinstall it.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

8. Install the distributor mounting clamp bolt.

**Tighten**

Tighten the distributor clamp bolt to 25 N·m (18 lb ft).



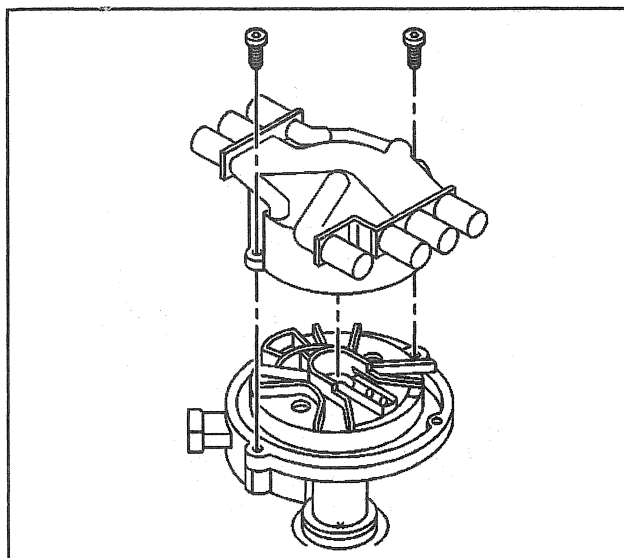
366609

9. Install the distributor cap.
10. Install two NEW distributor cap screws.

**Tighten**

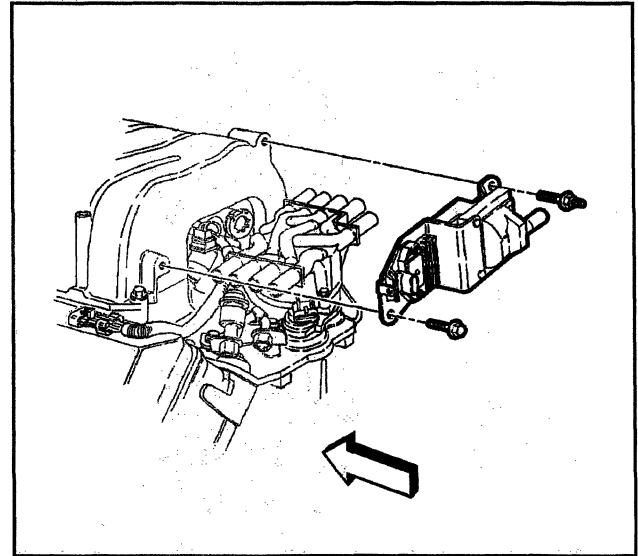
Tighten the screws to 2.4 N·m (21 lb in).

11. Install the electrical connector to the distributor.
12. Install the spark plug wires to the distributor cap.



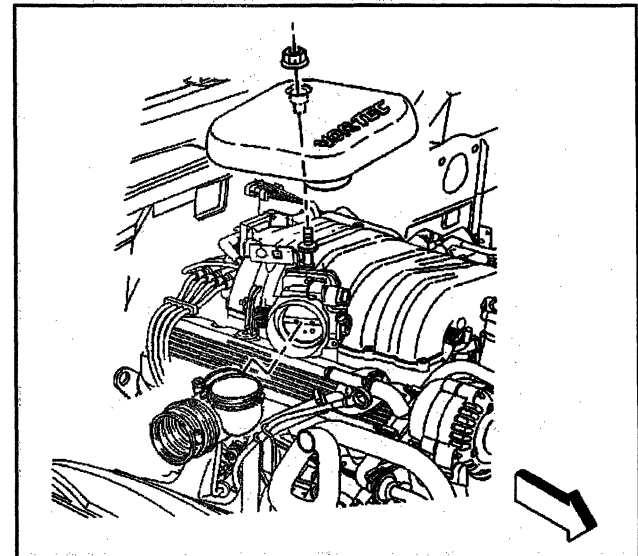
301393

13. Install the ignition coil.  
Refer to Ignition Coil and ICM Replacement.



68506

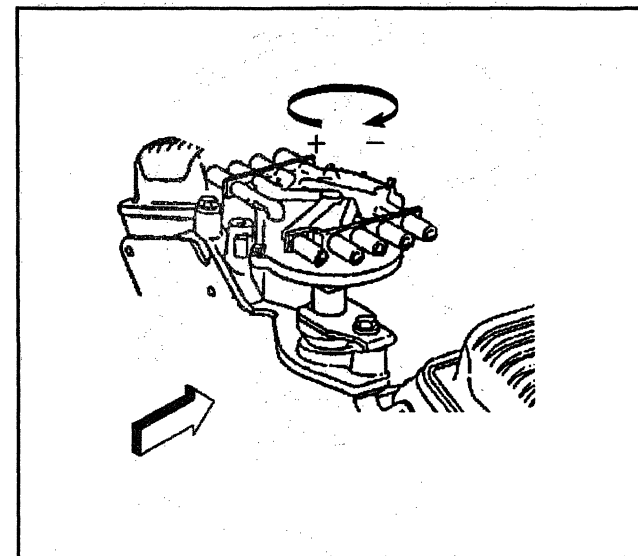
14. Install the air cleaner assembly.



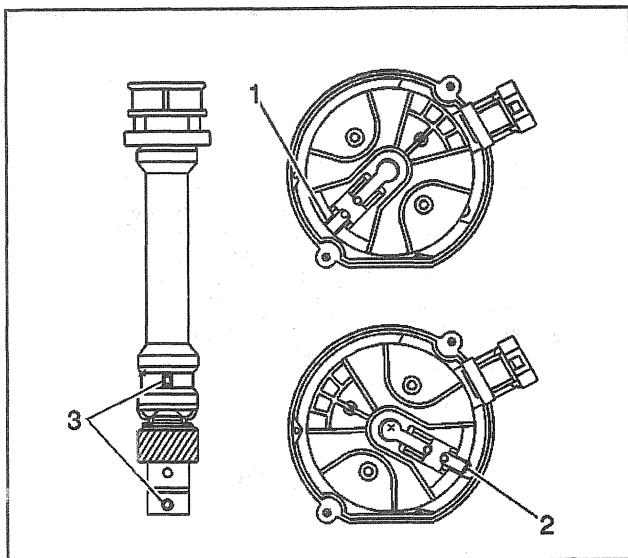
175670

15. For 7.4L engines, connect a scan tool.
16. Monitor the Camshaft Retard Offset value. Refer to Engine Controls Camshaft Retard Offset Adjustment.

**Important:** If the Malfunction Indicator lamp is turned on after installing the distributor, and a DTC P1345 is found, the distributor has been installed incorrectly. Refer to Installation Procedure 2 for proper distributor installation.



18446

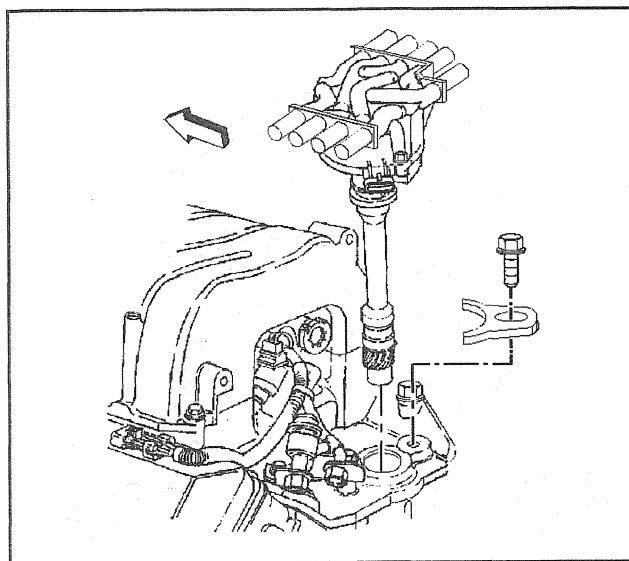


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**Installation Procedure 2**

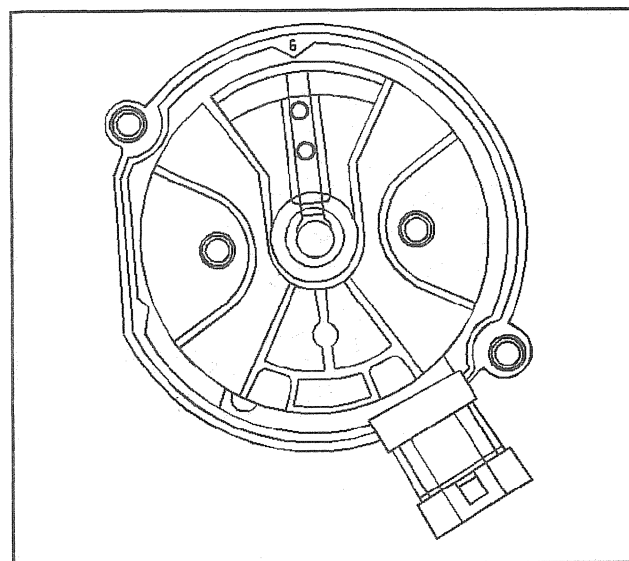
1. Rotate the number 1 cylinder to Top Dead Center (TDC) of the compression stroke.
2. Align white paint mark on the bottom stem of the distributor, and the pre-drilled indent hole in the bottom of the gear (3).
3. With the gear in this position, the rotor segment should be positioned as shown for a V6 engine (1) or V8 engine (2).
  - The alignment will not be exact.
  - If the driven gear is installed incorrectly, the dimple will be approximately 180 degrees opposite of the rotor segment when it is installed in the distributor.

**Notice:** Refer to *Distributor Driven Gear Can Be Installed in Multiple Positions* in Cautions and Notices.



68504

4. Using a long screw driver, align the oil pump drive shaft to the drive tab of the distributor.
5. Guide the distributor into the engine. Ensure that the spark plug towers are perpendicular to the centerline of the engine.



4350

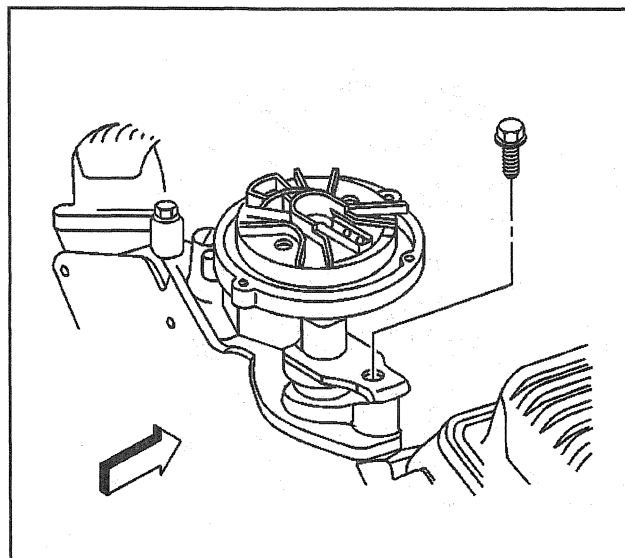
6. Once the distributor is fully seated, the rotor segment should be aligned with the pointer cast into the distributor base.
  - This pointer may have a 6 cast into it, indicating that the distributor is to be used on a 6 cylinder engine or a 8 cast into it, indicating that the distributor is to be used on a 8 cylinder engine.
  - If the rotor segment does not come within a few degrees of the pointer, the gear mesh between the distributor and the camshaft may be off a tooth or more.
  - If this is the case, repeat the procedure again in order to achieve proper alignment.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

7. Install the distributor mounting clamp and bolt.

**Tighten**

Tighten the distributor clamp bolt to 25 N·m (18 lb ft).



366609

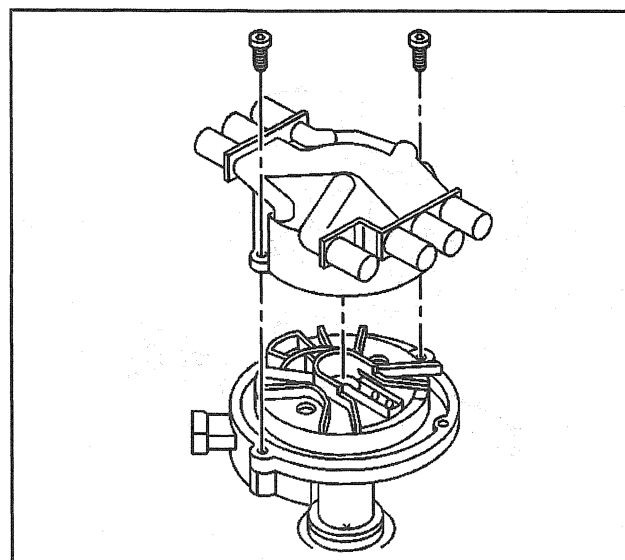
8. Install the distributor cap.

9. Install two NEW distributor cap screws.

**Tighten**

Tighten the screws to 2.4 N·m (21 lb in).

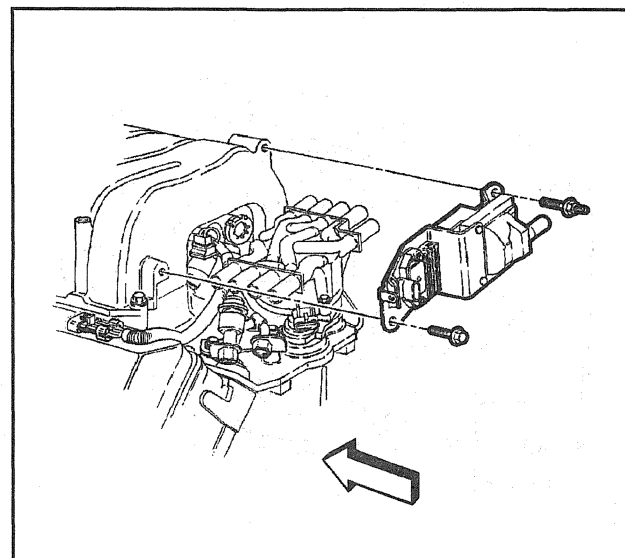
10. Install the electrical connector to the distributor.  
11. Install the spark plug wires to the distributor cap.



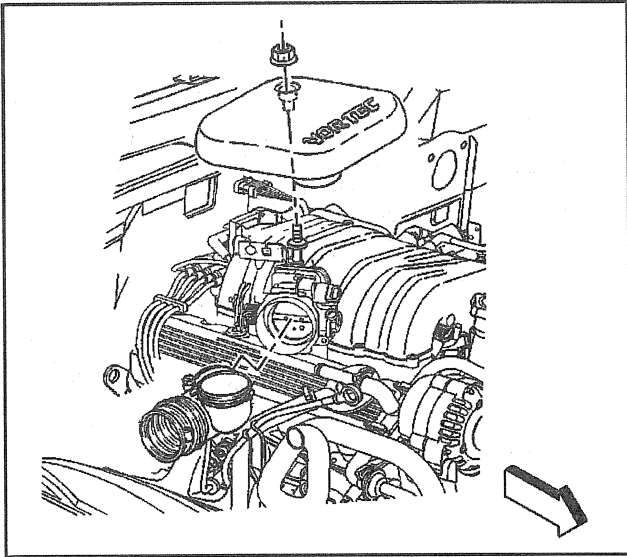
301393

12. Install the ignition coil.

Refer to Ignition Coil and ICM Replacement.

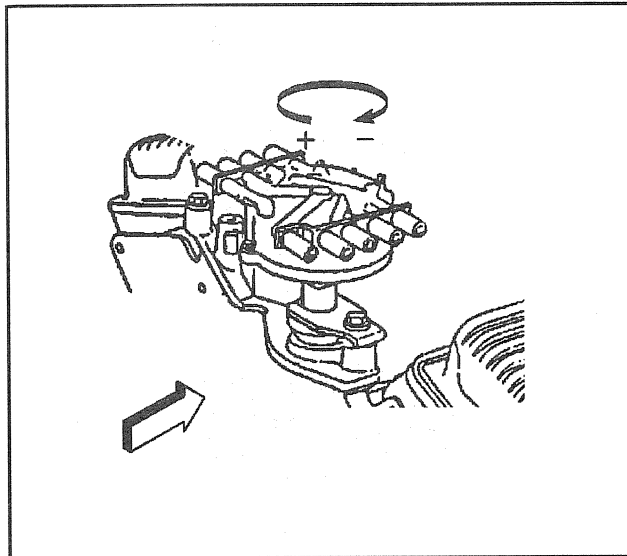


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175670

13. Install the air cleaner assembly.



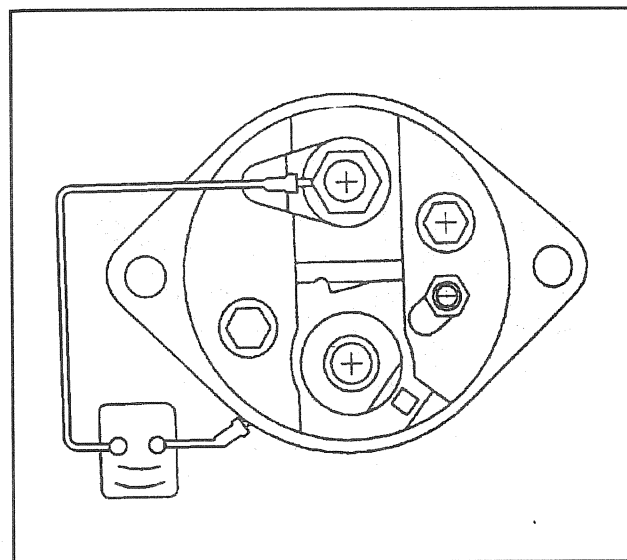
18446

14. For 7.4L engines, connect a scan tool.

15. Monitor the Camshaft Retard Offset value. Refer to Engine Controls Camshaft Retard Offset Adjustment.

**Important:** If the Malfunction Indicator lamp is turned on after installing the distributor, and a DTC P1345 is found, the distributor has been installed incorrectly.

Repeat Installation Procedure 2 for proper distributor installation.



182259

## Starter Motor Inspection (28-MT)

### Cleaning and Inspection Procedure

**Notice:** Do not clean or immerse the starter motor parts in grease dissolving solvents. The solvents will dissolve the grease packed in the drive or the bearings, and may damage the armature or the field coil insulation.

Perform the following cleaning and inspection procedure in order to determine the serviceability of the starter motor components and assemblies.

1. Clean all starter motor components with a clean soft cloth prior to testing.
2. Inspect all of the components for the following conditions:
  - Cracks
  - Distortion
  - Structural damage
 Replace any components or assemblies that exhibit any of the above conditions.

3. Inspect the threaded components for the following conditions:
  - Stripped threads
  - Crossed threads
  - Otherwise damaged threads

Replace the components exhibiting the above conditions if the above condition cannot be cleaned up using a suitable tap or die.

4. Inspect the solenoid assembly for a cut or a torn boot. If the boot is damaged, replace the solenoid assembly.
5. Inspect the clutch drive assembly. Replace the assembly if the following conditions exist:
  - The pinion gear turns roughly or turns in both directions
  - The pinion gear has teeth that are broken or show evidence of step wear
  - The shift lever collar shows deep scoring or other damage
6. Inspect the brush holder assembly for loose riveted joints and cracked or broken insulation. Replace the brush holder assembly if damaged.
7. Inspect the brushes for excessive wear. The minimum allowable brush length is 12 mm (0.472 in). Replace excessively worn brushes in sets.
8. Inspect the drive end housing bushing for scoring or other damage. Replace the damaged bushing.
9. Perform the following ball bearing inspection procedure:
  - 9.1. Hold the armature or driveshaft. Slowly rotate the outer bearing race by hand
  - 9.2. Verify that the bearing turns freely without binding or the feel of flat spots
  - 9.3. Replace any damaged bearings
10. Inspect the armature assembly for the following conditions:
  - Gear teeth that are broken, or that show evidence of step wear or root interference.
  - A rough commutator surface. Polish the surface with 400 grit polishing cloth if necessary. Thoroughly clean metal dusts from between the commutator bars. If the commutator surface cannot be repaired in this manner, replace the armature assembly. Do not turn the commutator in a lathe.
  - A worn commutator. Replace the armature assembly if the commutator outer diameter is less than 36 mm (1.378 in) or if the undercut depth at any point is less than 0.2 mm (0.008 in). Do not undercut the insulation.

11. Inspect the driveshaft for the following conditions. Replace the driveshaft if necessary.

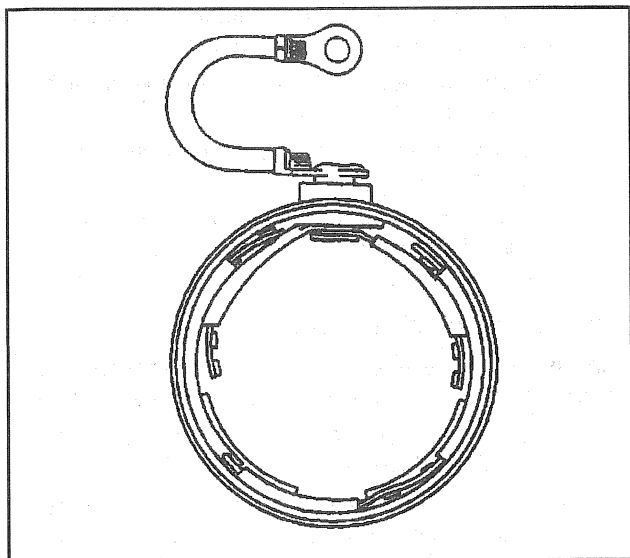
- Scored or damaged shaft where the driveshaft turns inside the bushing
- Internal gear with teeth broken or showing evidence of step wear
- A damaged spline. The clutch drive assembly must slide smoothly and easily over the full length the spline.

### Component Electrical Testing

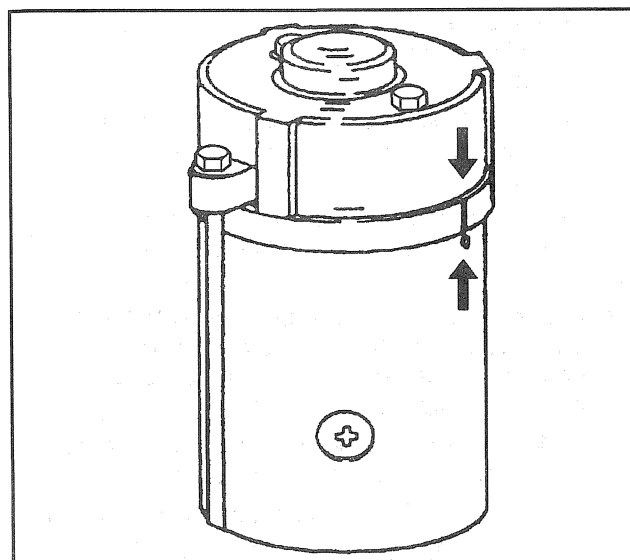
Perform the following electrical tests in order to determine the serviceability of the starter assemblies:

1. Use an ohmmeter in order to test the windings of the solenoid assembly for continuity:
  - Test the resistance of the solenoid pull-in and hold-in windings in a series by measuring the resistance between the motor terminal and the solenoid case.
  - A resistance reading well above 1.3 ohms indicates a break or fault in the winding continuity.
  - A resistance reading well below .8 ohms indicates a short or ground in the winding circuit.
  - Replace the solenoid assembly if the resistance reading is extremely high or very low.
2. Use the following procedure in order to test the armature assembly. Replace a shorted or grounded armature, or an armature that shows evidence of opens.
  - 2.1. Perform the following procedure in order to test the armature for short circuits.
    - 2.1.1. Rotate the armature in a growler.
    - 2.1.2. Hold a steel strip such as a hacksaw against the armature.
    - 2.1.3. If the steel strip vibrates in an area, a short is present.
  - 2.2. Use a ohmmeter in order to test for continuity between the armature shaft and any point on the commutator. Continuity indicates a ground.
  - 2.3. Inspect the points where the armature conductors join the commutator and or individual commutator segments for signs of arcing or burning. These signs indicate opens.

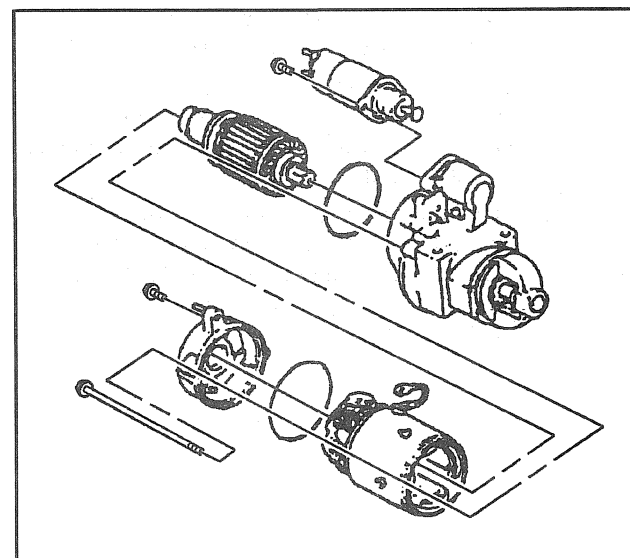




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3. Perform the following procedure in order to inspect the frame and field assembly for grounds or opens:

- 3.1. Inspect the field coil connections for opens between the field terminal and the connection points for insulated brushes on the filed coil straps.
- 3.2. Use a self-powered test lamp or ohmmeter in order to test for continuity or grounds between the frame and the field terminal.
- 3.3. Replace the frame and field assembly that has grounds or opens.

### Starter Motor Overhaul (28-MT)

If the 28-MT motor does not perform to specifications, disassembly may be necessary in order to perform further testing of the components. Disassemble the starter motor only as necessary in order to perform repair or replacement of the components.

Do not attempt to disassemble the following components that are serviced as assemblies:

- The solenoid assembly
- The clutch drive assembly
- The brush holder assembly
- The armature assembly
- The frame and field assembly

### Preliminary Starter Motor Disassembly

1. Scribe marks completely down 1 side of the starter motor in order to ensure proper alignment of all of the components during assembly. Use a colored pencil or a marker that will show on all of the components.
2. Use the following procedure in order to remove the motor lead on the frame assembly from the solenoid assembly:
  - 2.1. Remove the nut from the motor terminal.
  - 2.2. Slip off the motor lead.
  - 2.3. Reinstall the nut.
3. Remove 2 through-bolts.
4. Remove 2 brush plate screws.
5. Remove the commutator end frame and the O-ring seal

**Important:** Do not lose the small dowel pin that is installed between the frame assembly and the gear reduction and drive group. The dowel pin is necessary for assembly. If the dowel pin is lost, replace the dowel pin with a 2 mm X 10 mm (0.79 in X 0.394 in) long pin. Obtain the new pin or manufacture the pin locally.

6. Remove the following components:

- The frame
- The field
- The brush holder group
- The dowel pin
- The O-ring seal

The armature may come off with the frame, the field and the brush holder group or the gear reduction and drive group.

7. Remove the armature assembly that has the bearings.

Do not remove the bearings from the armature assembly unless replacement of the bearings is necessary. Refer to Armature Bearing Replacement.

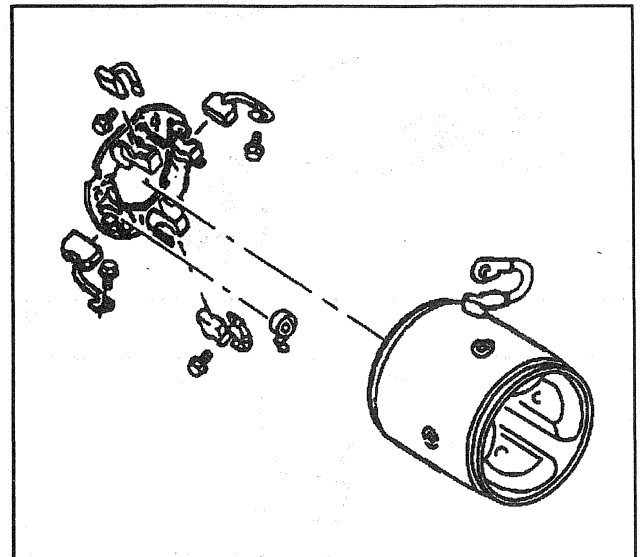
8. Remove the solenoid screws.

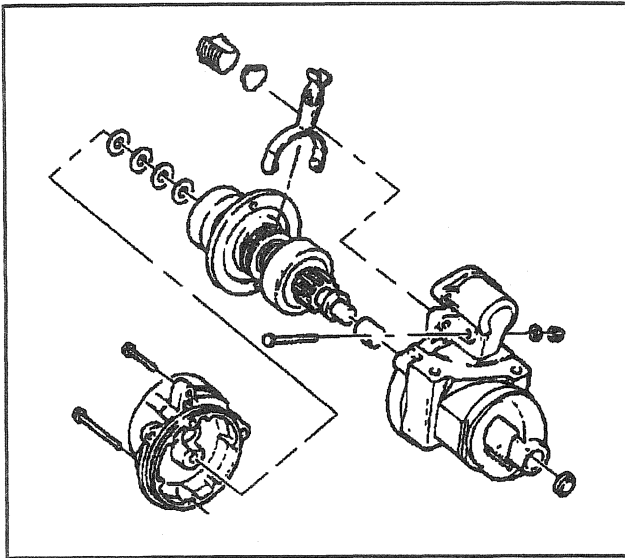
9. Remove the solenoid assembly.

Pivot the inside end of the solenoid assembly out of the engagement shift lever drive group in order to withdraw the solenoid assembly.

### Frame and Field Disassembly

1. Disassemble the insulated brush screws. Move the brush holder assembly with the brushes slightly away from the frame and the field assembly in order to reach across with a screwdriver and remove the screws.
2. Disassemble the frame and the field assembly.
3. Disassemble the grounded brush screws.
4. Disassemble the brushes if the brushes need replacement.
5. Use the following procedure in order to disassemble the brush springs if the brush springs need replacement:
  - 5.1. Grasp the brush end of each brush spring with needle nose pliers.
  - 5.2. Twist the spring end away from the brush. Remove the brush.

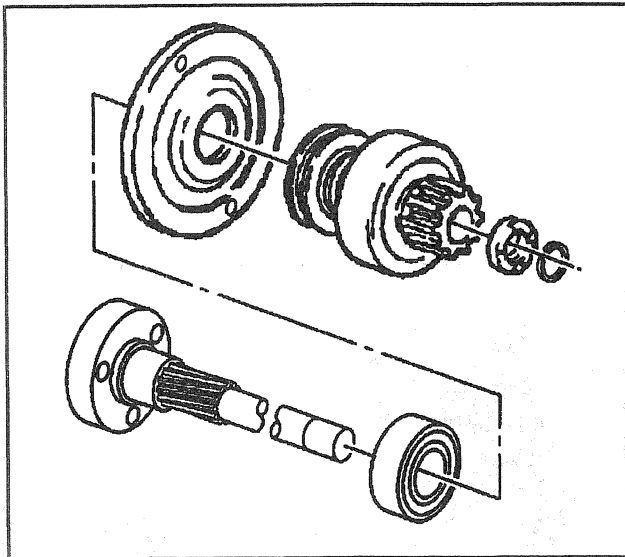




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### Reduction and Drive Group Disassembly

1. Disassemble the housing bolts.
  2. Disassemble the armature support bracket.
- Important:** Washers may stick to the bracket or to the driveshaft and the clutch group as the bracket is removed. In either case, note the position and the number of each of these washers.
3. Disassemble the washers.
  4. Disassemble the drive housing plug and plate. Pry out the housing plug with a large flat-bladed tool.
  5. Disassemble the following components:
    - The shift lever nut
    - The washer
    - The screw
  6. Disassemble the shift lever and the driveshaft and clutch group from the drive housing together. Then separate these components. Do not remove the bushing plug or the bushing from the drive housing unless replacement is necessary.

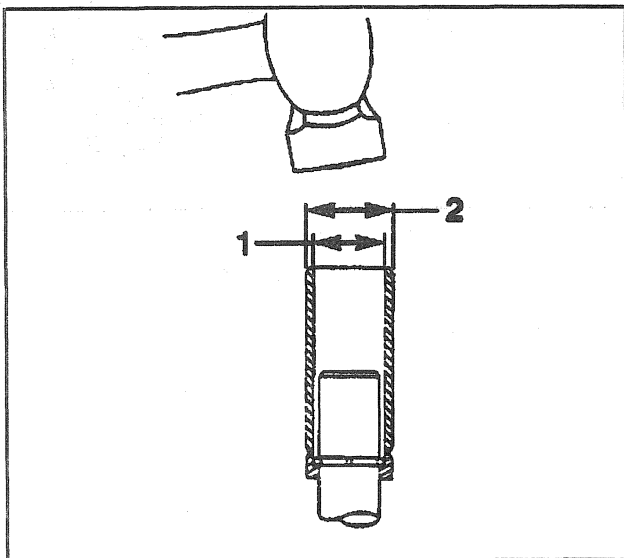


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### Driveshaft and Clutch Disassembly

Disassembly of the driveshaft and clutch group is not required unless it is necessary to clean, inspect, or replace one or more parts of the group separately.

1. Disassemble the stop rings and the pinion stop.



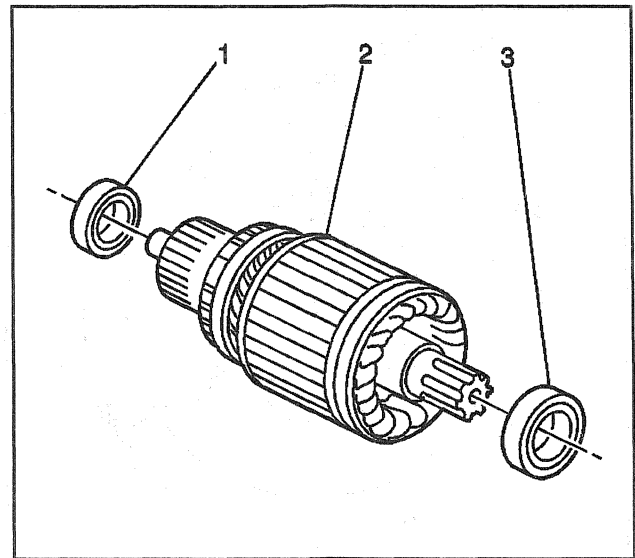
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2. Position the driveshaft and clutch group on a work bench with the internal gear end down.
3. Fabricate a tube approximately 22 mm wide (2). Drive the pinion stop toward the clutch drive assembly until the pinion stop clears the stop rings.
4. Pry the stop rings out of the driveshaft groove. Slide the stop rings off the end of the shaft. Do not scratch the driveshaft.
5. Inspect the edges of the shaft groove for burrs that may form through repeated cranking cycles. These burrs may make removal of the pinion stop and the clutch drive assembly difficult.
6. Slide the pinion stop off the driveshaft. Discard the old pinion stop and the stop rings. Use new components for assembly.
7. Disassemble the driveshaft support from the driveshaft. Do not remove the bearing from the driveshaft unless replacement is required.

### Armature Bearing Removal

**Notice:** Ball bearings that are removed from the armature must be replaced with new bearings. The removal procedure causes internal damage to the bearings.

1. Remove the armature bearings (1,3) and the armature (2) if replacing the armature and the bearings is necessary.
2. Use a suitable bearing puller in order to remove the commutator end or the drive end bearings from the armature assembly.



213071

### Armature Bearing Installation

1. Use a tube that bears only on the bearing inner race in order to install the new commutator end and/or the drive end bearings to the armature assembly.
2. Press on the bearing until the inner race bottoms out against the shoulder of the armature shaft.
3. Install the armature and armature bearings.

### Center Support Bearing Removal

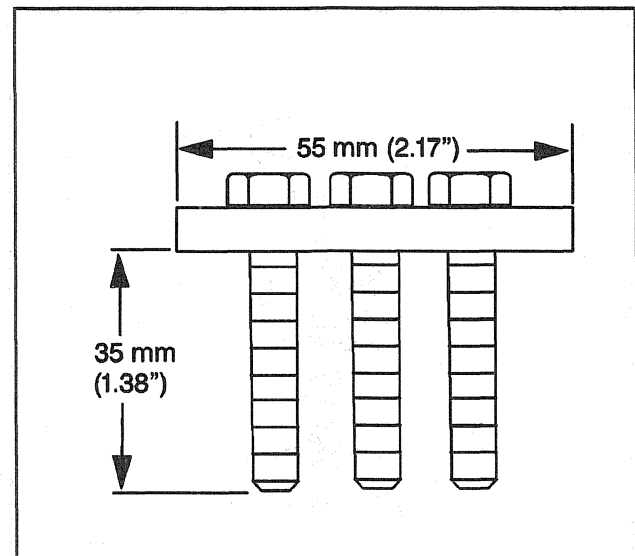
#### Tools Required

##### Locally Fabricated Tool

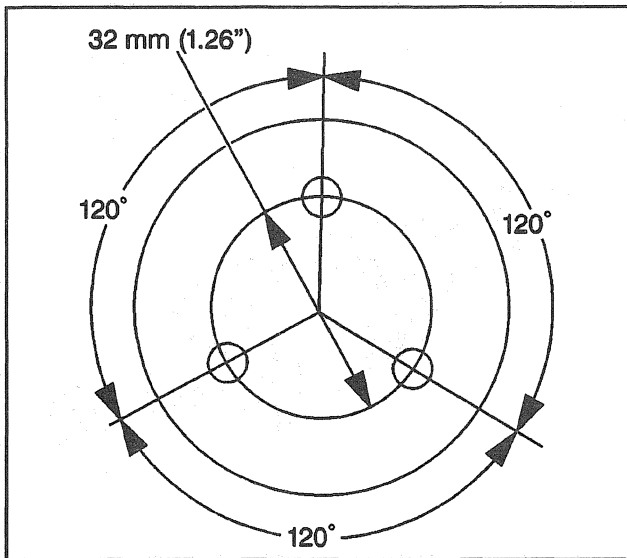
Use the following procedure in order to remove the center support bearing from the driveshaft if the center support bearing needs replacement:

**Notice:** Ball bearings that are removed from the armature must be replaced with new bearings. The removal procedure causes internal damage to the bearings.

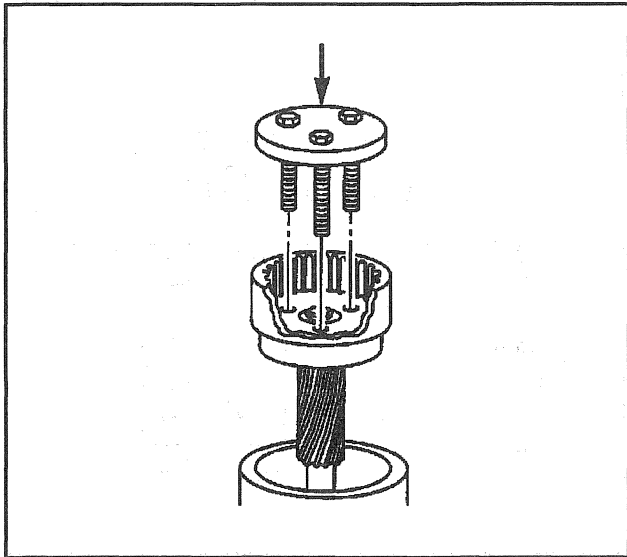
1. Inspect the center support bearing in order to determine if the center support bearing needs replacement.
2. Proceed with the following steps if the center support bearing needs replacement.
3. Fabricate a tool for removing the center support bearing using the dimensions shown.



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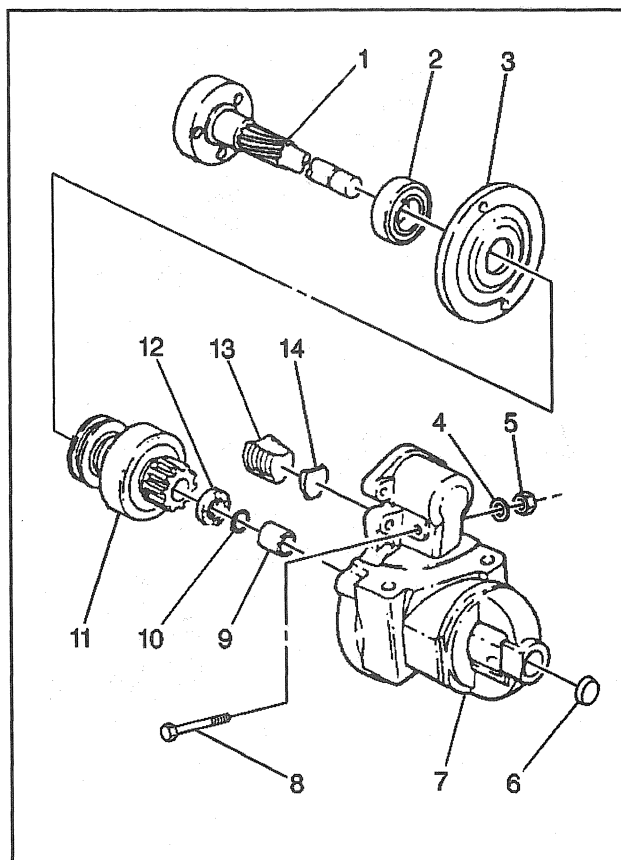


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4. Place the bolts in the fabricated tool.

5. Place the driveshaft in a suitable support fixture.

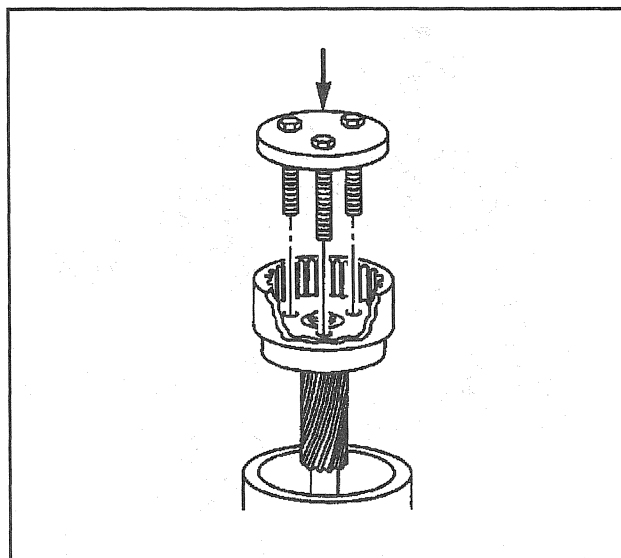
6. Place the bolt ends of the locally fabricated tool through the access holes in the wide end of the driveshaft.
7. Squarely press the bearing (1) off the surface on the center shaft.



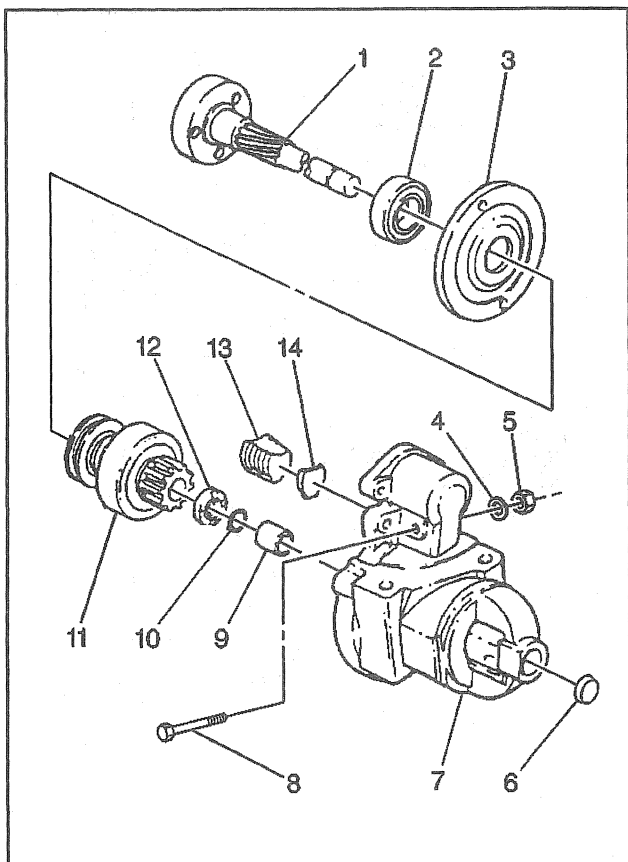
213078

### Center Support Bearing Installation

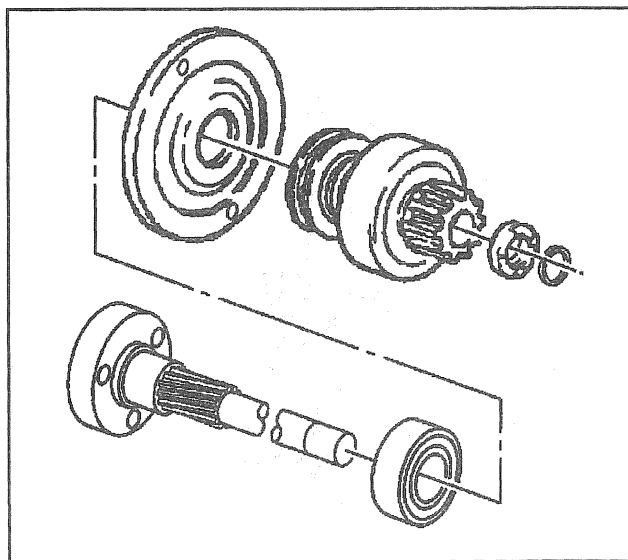
1. Install the new bearing into the driveshaft using the locally fabricated tool that bears only on the bearing inner race.
2. Press on the bearing (1) until the inner race bottoms out against the shoulder on the driveshaft.



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### Drive End Housing Bushing Removal

1. Inspect the drive end housing bushing (9) in order to verify if the drive end housing bushing needs replacement.
2. Use the following procedure in order to remove the drive end housing bushing (9) from the drive end housing (7) if the drive end housing bushing needs replacement.
  - 2.1. Drive out the plug, if present, from inside the drive housing.
  - 2.2. Use a file in order to clean away any remnants of the old stake and any metal shavings in order to prepare for installation of a new plug.
  - 2.3. Use a suitable tool in order to press out the bushing.

### Drive End Housing Bushing Installation

1. Use a suitable tool in order to press the new bushing into the drive housing until the bushing is flush with the inside of the housing.
2. Install a new plug, if used, in the drive housing.
3. Stake the housing material over the plug at 3 places, equally spaced.

### Lubrication Procedure

Armature bearings and the driveshaft support bearing are permanently lubricated. Do not add lubricant to these bearings. Use GM P/N 1960954 grease lubricant or the equivalent in order to lubricate the following areas during assembly. Avoid using excessive lubrication.

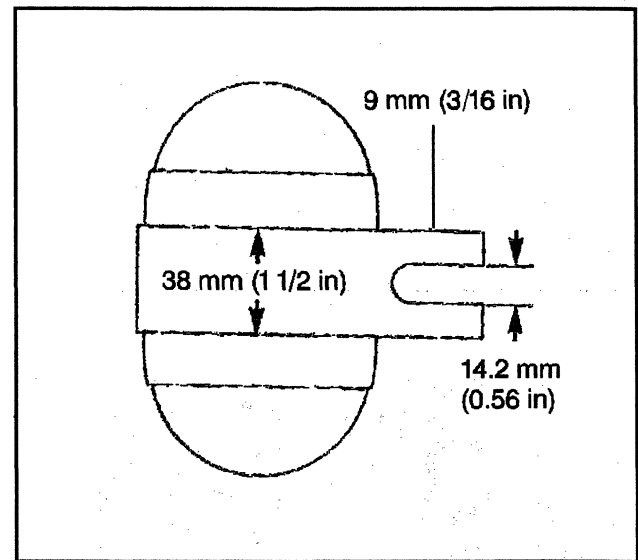
- The drive end housing bushing in the drive housing
- The pivot hole and the working surface on the ends of the shift lever
- The following components on the driveshaft:
  - The internal gear
  - The shaft
  - The spline

### Driveshaft and Clutch Assembly

If disassembled, position the driveshaft on a work surface with the internal gear end down. Assemble the driveshaft and clutch group in the following way:

**Important:** If the center support bearing is being replaced, install the center support bearing on the driveshaft.

1. Install the driveshaft support to the driveshaft, seating the bearing in the support.
2. Install the clutch drive assembly to the driveshaft.
3. Install the new pinion stop onto the driveshaft.
  - Slide the pinion stop onto the driveshaft until the recess for the stop rings faces up.
  - Install the stop rings into the groove in the driveshaft.
  - Pick the assembly up. Support the assembly under the pinion stop. A metal block, with a U-shaped cutout that will slide over the shaft between the pinion gear and stop, can be clamped in a vise order to provide support.
  - Ensure that the stop rings are seat fully in the pinion stop recess.
  - Stake the upper edge of the pinion stop over the stop ring at 4 equally spaced places.  
Do not allow the staked metal to contact the driveshaft.

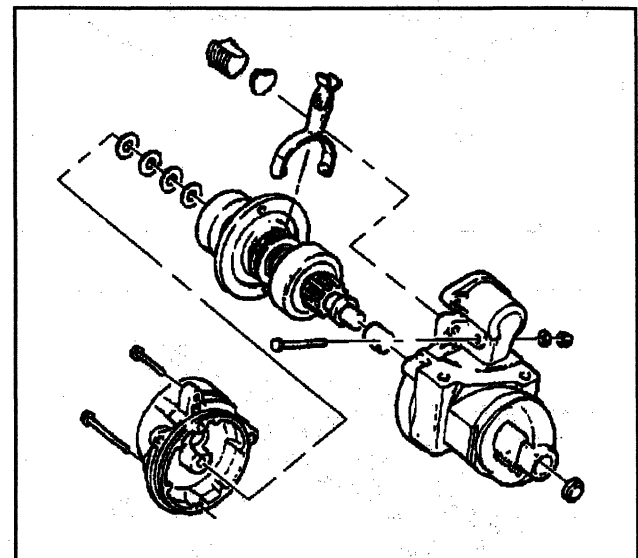


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### Reduction and Drive Group Assembly

**Important:**

- If the drive end bushing and the plug are being replaced, install these components into the drive housing.
  - Lubricate the following components:
    - The drive end housing bushing
    - The shift lever
    - The driveshaft
1. Install the arms on the shift lever with the shift collar onto the driveshaft and clutch group.
  2. Install the assembled shift lever and the driveshaft and clutch group into the drive housing.
    - Align the holes in the driveshaft support with the holes in the drive housing.
    - Ensure that the driveshaft support fully seats in the drive housing and that the driveshaft bearing remains fully seated in the driveshaft support.



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**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

3. Install the following components:

- The shift lever screw
- The washer
- The nut

**Tighten**

Tighten the nut to 4.5 N·m (40 lb in).

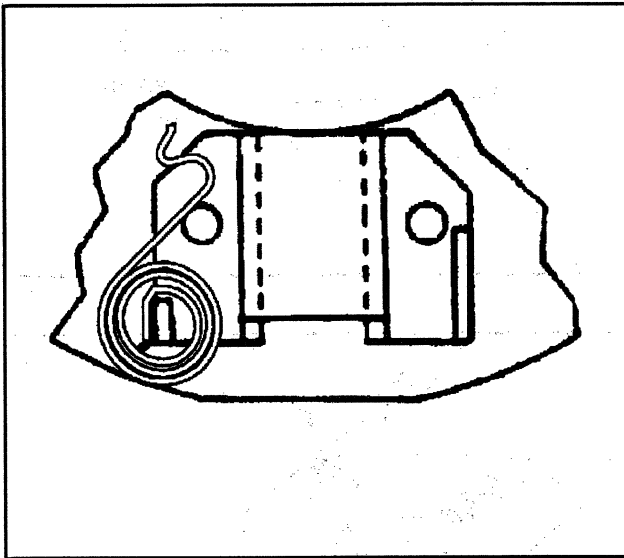
4. Install the plate, if used, and the drive housing.
5. Install the washers in the same number and position as noted at disassembly.
6. Install the armature support bracket to the drive housing. Align the mark made prior to the disassembly with the mark on the drive housing.
7. Install the drive housing.

**Tighten**

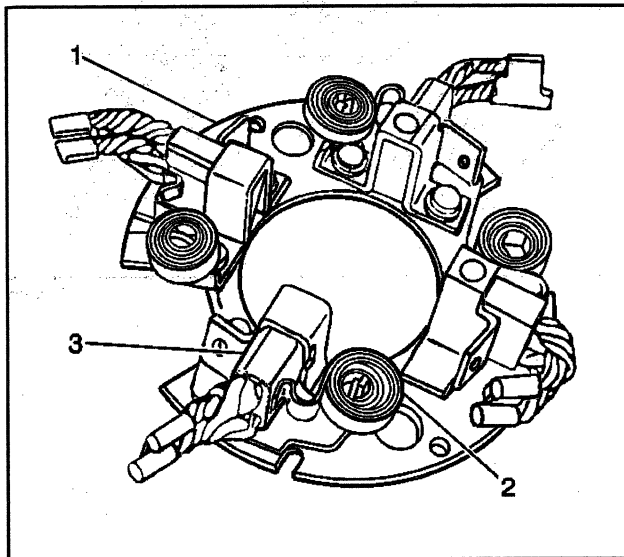
Tighten the drive housing bolts to 8.5 N·m (75 lb in).

**Frame and Field Assembly**

1. Install the brush springs if removed.
  - 1.1. Start each brush spring onto the post on the brush holder assembly just enough in order to hold the inside end of spring from turning.
  - 1.2. Grasp the free end of the spring with needle nose pliers. Twist the spring to the right over the top of the brush socket.
  - 1.3. Push the spring fully onto the post. Then Release the free end in order to engage the notch in the brush socket.



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**Notice:** Brush leads may be damaged by excessive handling. Do not overflex the leads near the clip welds or the clips may break

2. Install the brushes (3), to the brush holder assembly (1) with the springs (2).
  - 2.1. Ensure that the insulated brushes go into the brush sockets of the brush holder assembly that mounts on the insulation.
  - 2.2. To install each brush, grasp the free end of the brush spring with needle nose pliers. Twist the spring to the right in order to clear the brush socket. Insert the brush partly into the brush socket.
  - 2.3. Gradually release the springs so that the spring end contacts the side, not end, of the brush. This will hold the brushes retracted until the brush holder is installed over the armature commutator.

3. Position the terminals of the grounded brush leads behind the terminal tabs on the brush holder.
4. Install the grounded brush screws.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

5. Insert the brush screws through the terminal tabs on the brush holder. Thread the brush screws into the brush lead terminals.

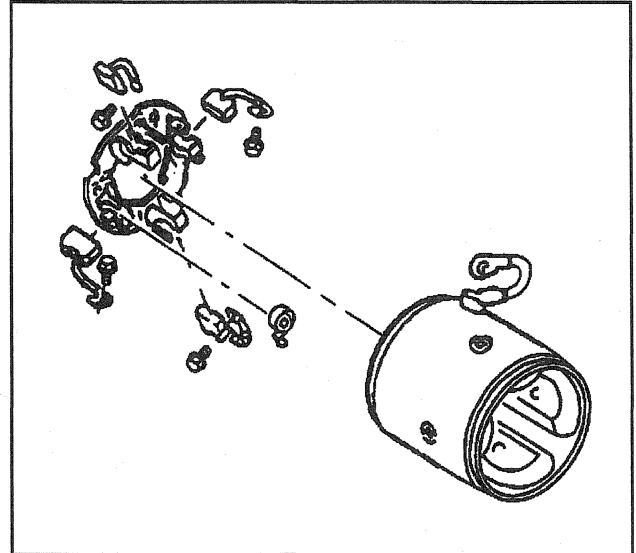
**Tighten**

Tighten the grounded brush screws to 1.5 N·m (13 lb in).

6. Install the frame and field assembly to the brush holder assembly.
  - 6.1. Position the brush holder assembly (with installed brushes) over the terminal end of the frame and field assembly.
  - 6.2. Attach the terminals of the insulated brush leads to the conductors in the frame and field assembly with the insulated brush screws.

**Tighten**

Tighten the insulated brush screws to 1.5 N·m (13 lb in).



84554

### Starter Motor Unit Assembly

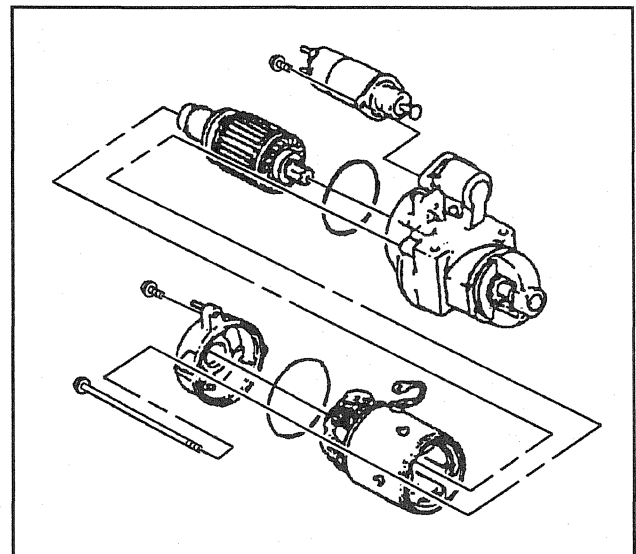
1. Support the gear reduction and drive group.
2. Place the pinion gear end down.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

3. Use the following procedure in order to install the solenoid assembly:
  - 3.1. Pivot the plunger of the solenoid assembly in order to engage the plunger to the shift lever in the gear reduction and drive group.
  - 3.2. Position the solenoid mounting flange.
  - 3.3. Install the solenoid mounting screws.

**Tighten**

Tighten the solenoid screws to 2.8 N·m (25 lb in)



182249

4. Install the frame seal.

**Important:** If you are replacing the armature bearings, install the bearings onto the armature. Refer to Armature Bearing Replacement.

5. Use the following procedure in order to install the armature assembly and the bearings into the gear reduction and drive group.

5.1. Ensure that the teeth align.

5.2. Seat the bearing on the armature shaft fully into the housing recess.

6. Use the following procedure in order to install the frame the field and the brush holder group.

6.1. Place the dowel pin into the hole in the armature support bracket of the gear reduction and drive group.

6.2. Position the frame the field and the brush holder group over the armature assembly.

6.3. Align the hole for the dowel pin.

6.4. Align the marks made during disassembly.

6.5. Seat the frame the field and the brush holder group into the gear reduction and drive group.

6.6. Twist the brush springs away from the brushes.

6.7. Slide the brushes in order to contact the commutator on the armature.

6.8. Release the brush springs in order to contact the ends of the brushes.

6.9. Verify that the brush spring tension is 44.5–49 N·m (10–11 lb).

6.10. If the brush spring tension is not correct, replace the brush springs.

**Important:** The O-ring seal will damage easily during installation of the commutator end frame. In order to prevent damage to the O-ring seal, use the following procedure.

7. Use the following procedure in order to install the O-ring seal.

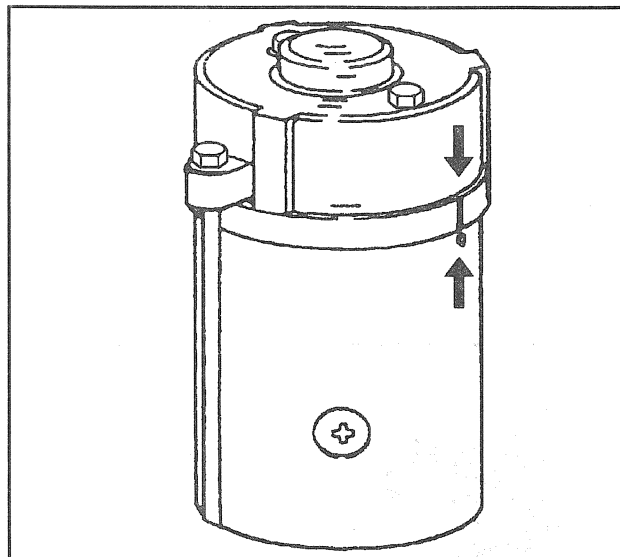
7.1. Install the O-ring seal onto the frame, field and brush holder group in the normal position. The O-ring seal is in the normal position when the seal is against the shoulder on the field frame that will abut the installed commutator end frame.

7.2. Carefully roll the O-ring seal out of the normal position and up onto the major outer diameter of the field frame.

7.3. Allow the seal to remain on the outer diameter of the field frame until the commutator end frame is partially installed.

8. Use the following procedure in order to install the commutator end frame.

- 8.1. Align the marks on the commutator end frame and the frame and field assembly made at disassembly.
- 8.2. Position the commutator end frame onto the frame and field assembly.
- 8.3. Leave a gap slightly larger than the thickness of the O-ring seal.



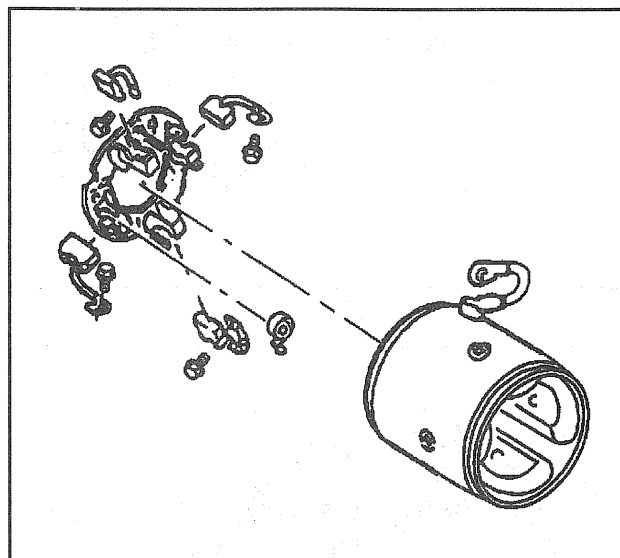
182272

9. Use the following procedure in order to install the brush plate screws.

- 9.1. Use a scribe or a similar tool in order to align the tapped holes in the brush holder assembly to the screw holes in the commutator end frame.
- 9.2. Install the brush plate screws.

**Tighten**

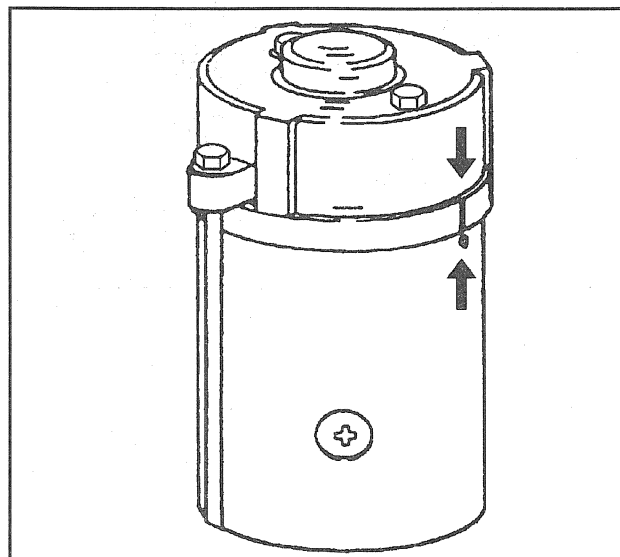
Tighten the brush plate screws to 2.8 N·m (25 lb in).



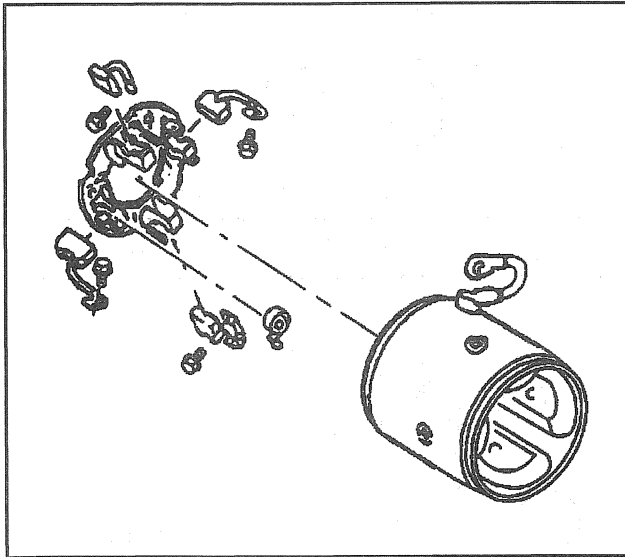
84554

10. Use the following procedure in order to install the through-bolts.

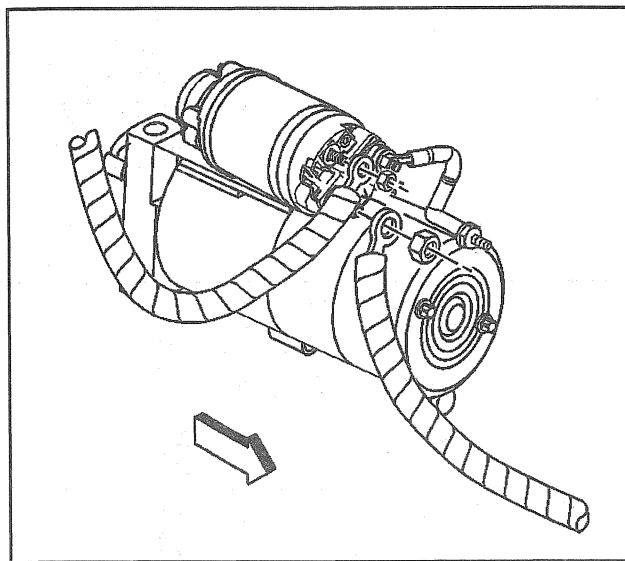
- 10.1. Position the through-bolts.
- 10.2. Tighten the through-bolts by hand, but do not close the gap between the commutator end frame and the frame and field assembly where the O-ring seal will be located.
- 10.3. Roll the O-ring seal down into the normal position. The normal position is between the commutator end frame and the frame and field assembly.



182272



84554



413049

10.4. Align the timing ribs on the edge of the commutator end frame to the timing spots on the frame and field assembly in order to ensure proper alignment of the brushes.

10.5. Although the marks are located in 2 places on the motor, the marks will only match in 1 way.

#### **Tighten**

Tighten the through-bolts to 8.5 N-m (75 lb in).

11. Use the following procedure in order to install the motor lead onto the frame and field assembly.

11.1. Remove the nut from the terminal on the solenoid.

11.2. Install the motor lead terminal.

11.3. Reinstall the solenoid motor terminal nut.

#### **Tighten**

Tighten the solenoid motor terminal nut to 11 N-m (100 lb in).

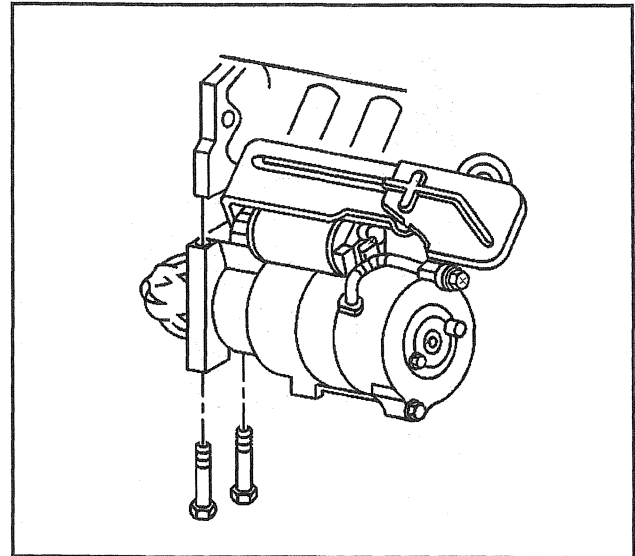
## **Starter Motor Replacement (Gas, 7.4L)**

### **Removal Procedure**

**Caution:** Refer to *Battery Disconnect Caution in Cautions and Notices*.

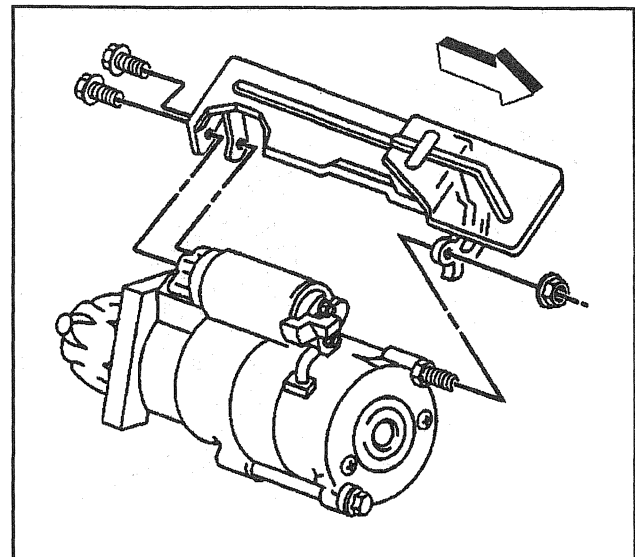
1. Disconnect the battery negative cable.
2. Raise the vehicle and support with suitable safety stands.
3. Disconnect the battery positive cable and wiring harness from the starter.

4. Remove the starter mounting bolts and washers (with the shims, if equipped).
5. Remove the starter.



84599

6. Remove the starter heat shield as necessary.



105380

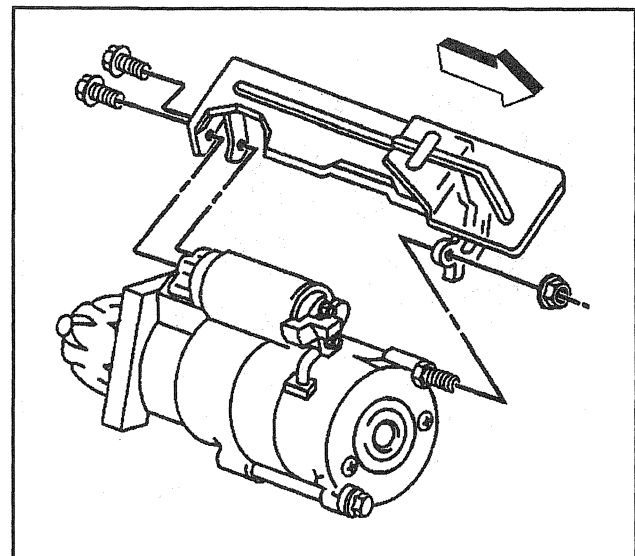
### Installation Procedure

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

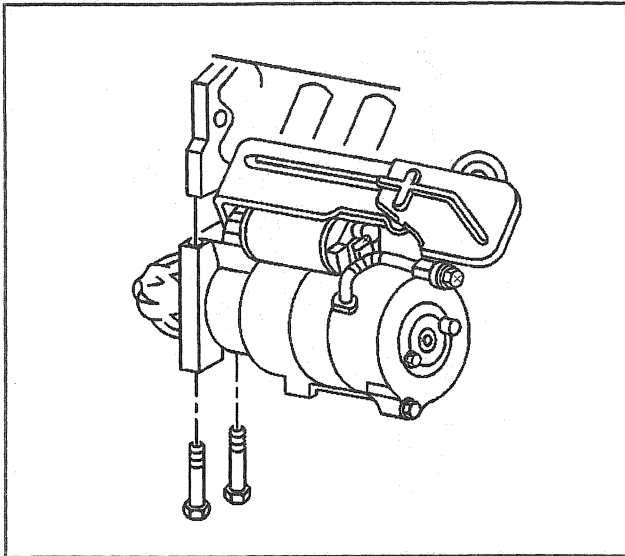
1. Install the starter heat shield as necessary to the starter.

#### Tighten

- Tighten the starter shield bolts to 3 N·m (35 lb in).
- Tighten the starter shield nut to 5 N·m (44 lb in).



105380

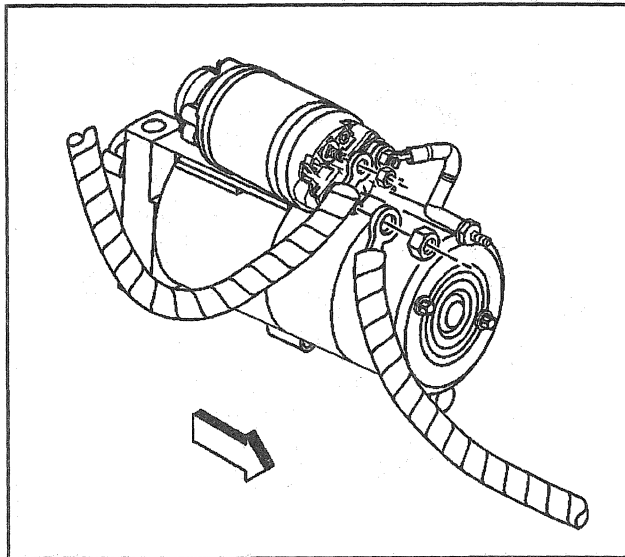


84599

2. Install the starter to the engine with shims as necessary.
3. Install the starter mounting bolts and washers through the starter to the engine.

**Tighten**

Tighten the starter mounting bolts to 50 N·m (37 lb ft).



413049

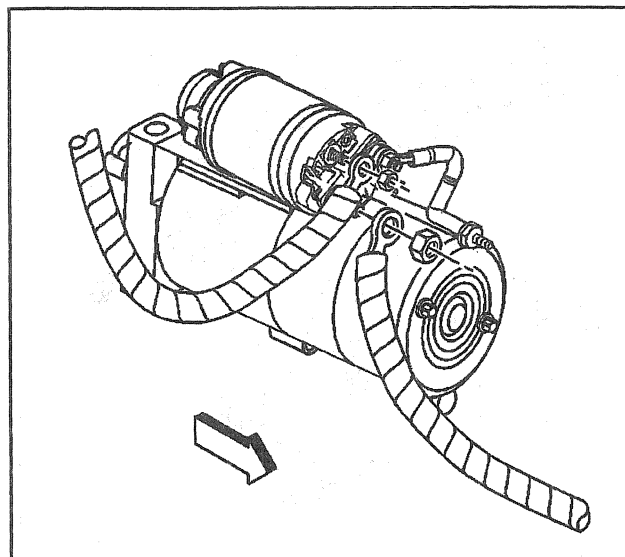
4. Install the wiring harness and the battery positive cable to the starter.

**Tighten**

4.1. Tighten the battery positive cable to 10 N·m (89 lb in).

4.2. Tighten the ignition switch wires to the solenoid to 2 N·m (18 lb in).

5. Remove the stands and lower the vehicle.
6. Connect the battery negative cable.



413049

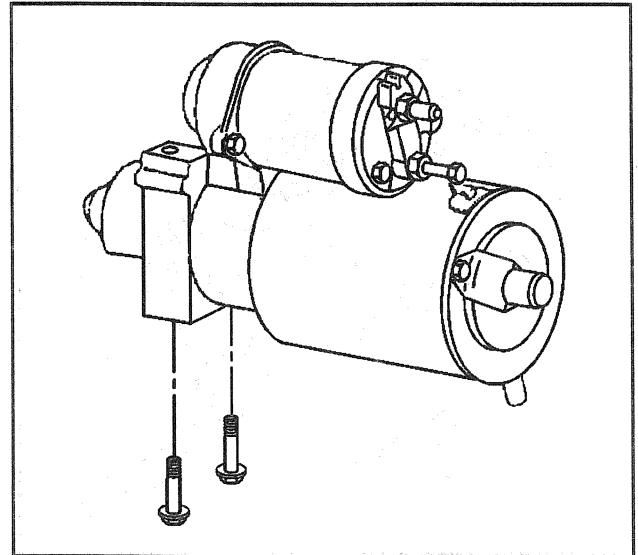
## Starter Motor Replacement (Gas, 5.0L or 5.7L)

**Removal Procedure**

**Caution:** Refer to *Battery Disconnect Caution in Cautions and Notices*.

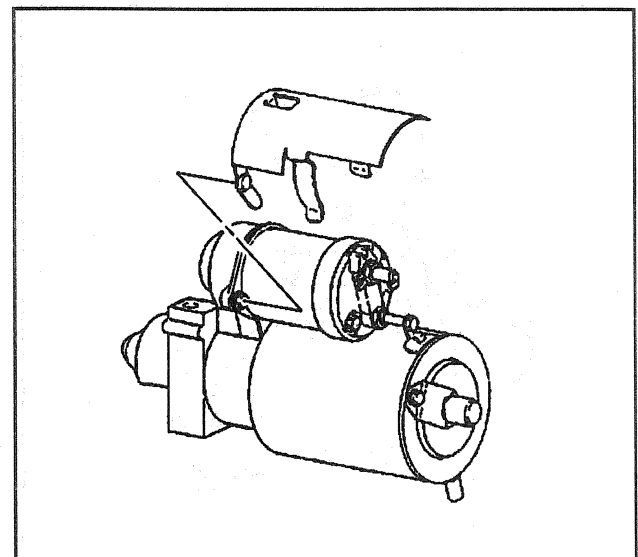
1. Disconnect the battery negative cable.
2. Raise the vehicle and support with suitable safety stands.
3. Disconnect the battery positive cable and the wiring harness from the starter.

4. Remove the starter mounting bolts and washers (with the shims, if equipped).
5. Remove the starter.



360232

6. Note the position of the snap-on shield and then remove the shield as necessary.



184056

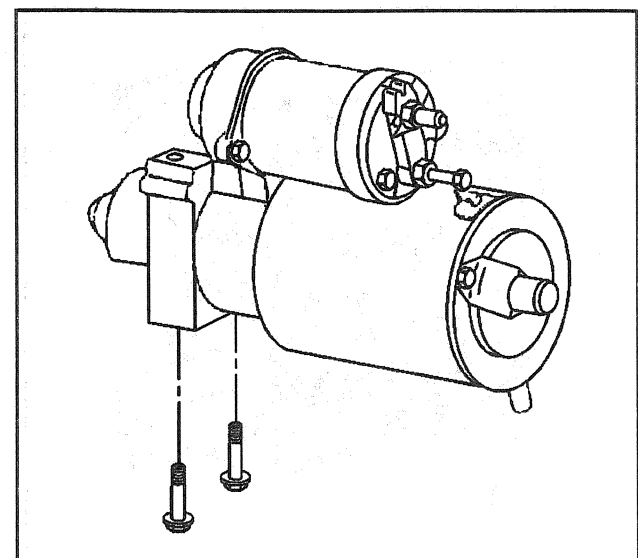
## Installation Procedure

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

1. Install the starter mounting bolts and washers, through the starter to the engine.

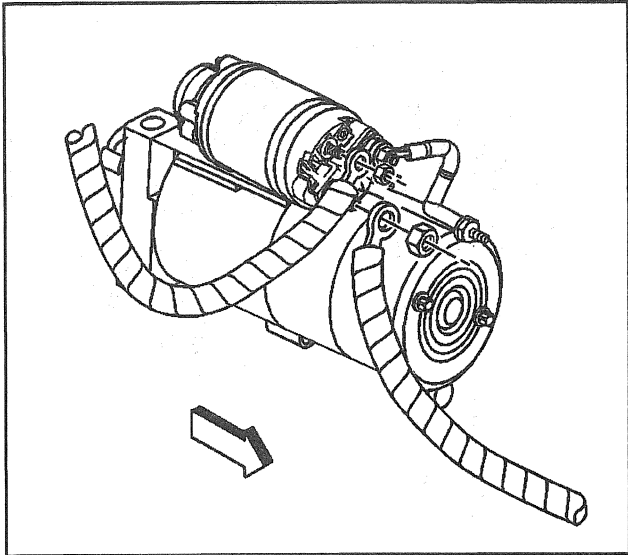
### Tighten

Tighten the starter mounting bolts to 45 N·m (33 lb ft).



360232



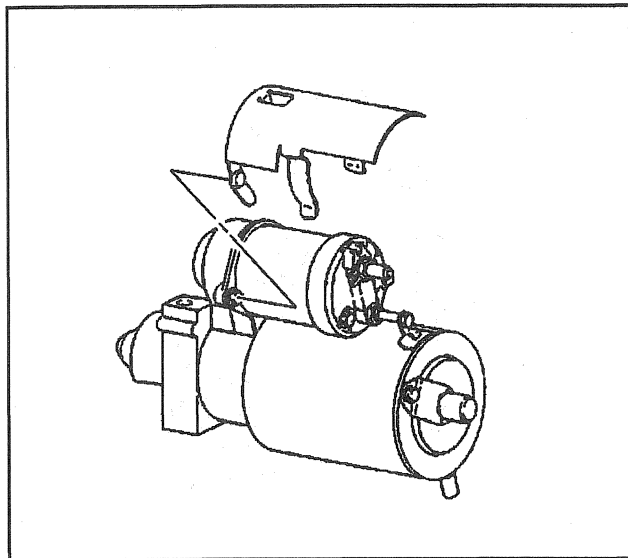


413049

2. Install the wiring harness and the battery positive cable to the starter.

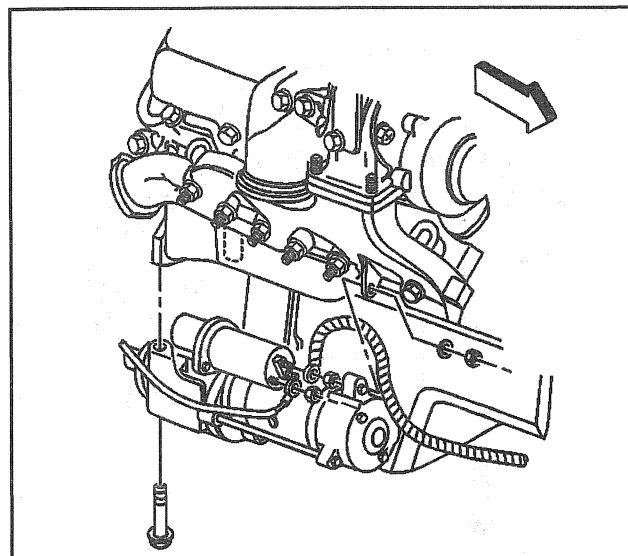
**Tighten**

- Tighten the battery cable to the solenoid to 10 N·m (89 lb in).
- Tighten the ignition switch wires to the solenoid to 2 N·m (18 lb in).



184056

3. Install the snap-on starter shield as necessary. Ensure that the shield is aligned properly.
4. Remove the stands and lower the vehicle.
5. Connect the battery negative cable.



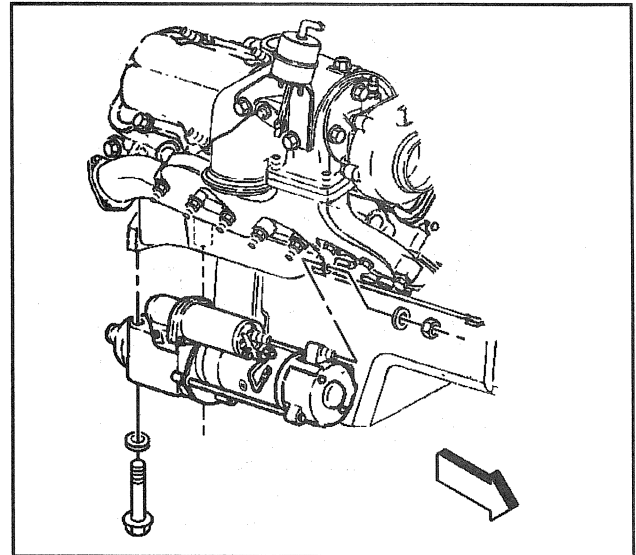
413052

**Starter Motor Replacement (Diesel, 6.5L)****Removal Procedure**

**Caution:** Refer to *Battery Disconnect Caution in Cautions and Notices*.

1. Disconnect the battery negative cable.
2. Raise the vehicle and support with suitable safety stands.
3. Disconnect the battery positive cable and the wiring harness from the starter.

4. Remove the starter mounting bolts and washers.
5. Remove the bracket nut and washer.
6. Remove the starter. A starter shield bolts to the engine.



84601

### Installation Procedure

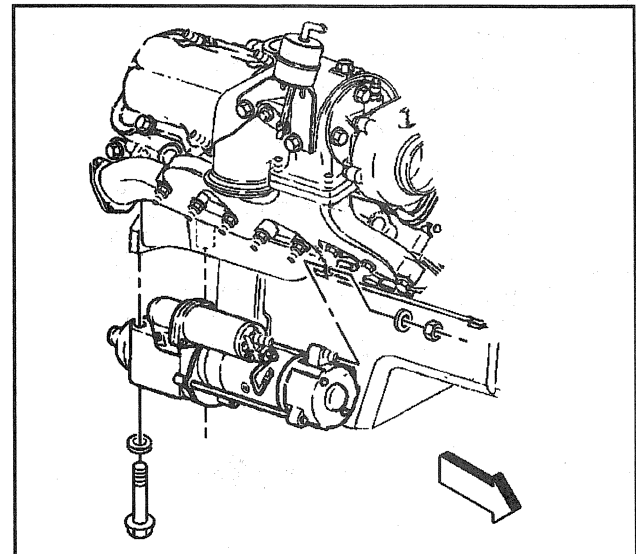
1. Install the starter to the engine.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

2. Install the bracket nut and washer to the bracket over the end of the starter.

#### Tighten

Tighten the bracket nut to 8 N·m (6 lb ft).



84601

3. Install the starter mounting bolts and washers, if equipped, through the starter to the engine.

#### Tighten

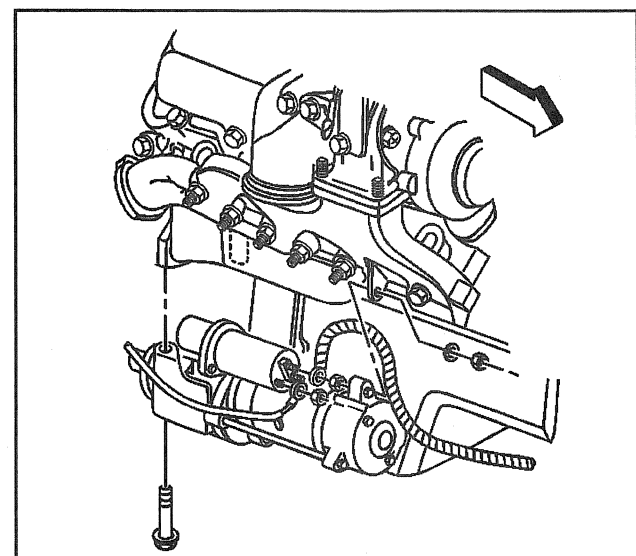
Tighten the starter mounting through bolts to 45 N·m (35 lb ft).

4. Connect the battery positive cable and the wiring harness to the starter.

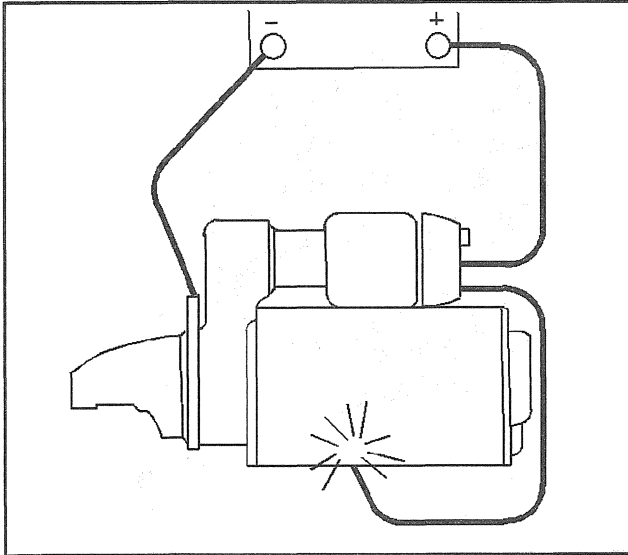
#### Tighten

Tighten the nut to 11 N·m (100 lb in).

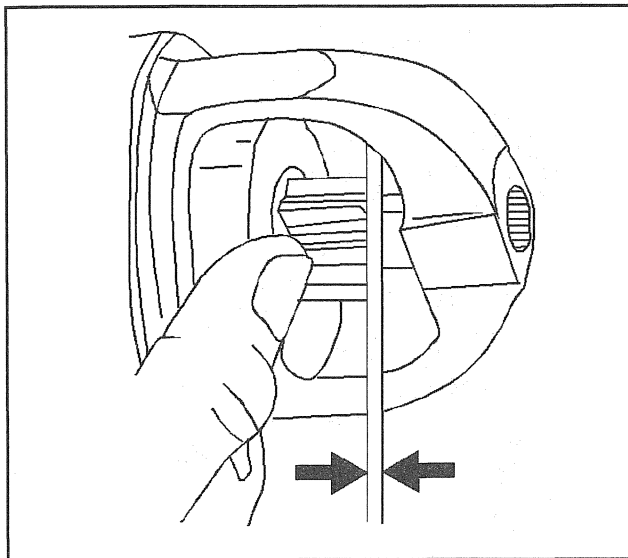
5. Remove the stands and lower the vehicle.
6. Connect the battery negative cable.



413052



1038



1039

### Starter Pinion Clearance Check

The pinion clearance should be checked after reassembly of the starter motor. The pinion clearance cannot be adjusted. Improper clearance is an indication of worn parts. In order to check the pinion clearance, perform the following procedure:

1. Disconnect the starter motor field connector from the solenoid "M" terminal.
2. Insulate the starter motor field connector carefully.
3. Connect a 12 V battery from the solenoid switch terminal to the solenoid frame.
4. Momentarily flash a jumper lead from the solenoid motor terminal to the solenoid frame. This will shift the pinion into the cranking position. The pinion will remain in the cranking position until the battery is disconnected.
5. Push the pinion back toward the commutator end to eliminate thrust movement.
6. Measure the distance between the pinion and the pinion stop collar.  
The clearance should be from 0.25–4.06 mm (0.010–0.160 in.).

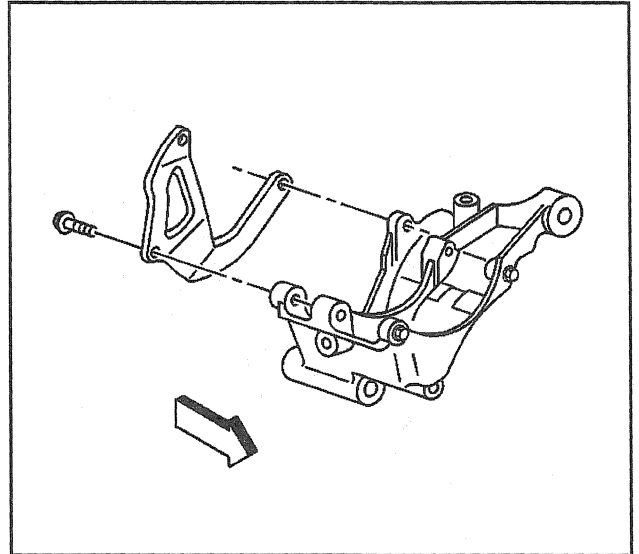
### Ground Strap Replacement

Additional ground straps are used to connect the body frame to the engine and the transmission. Always connect all ground straps to ensure a good ground path to the battery for all electrical components.

Refer to *Ground Distribution Schematics* in Wiring Systems.

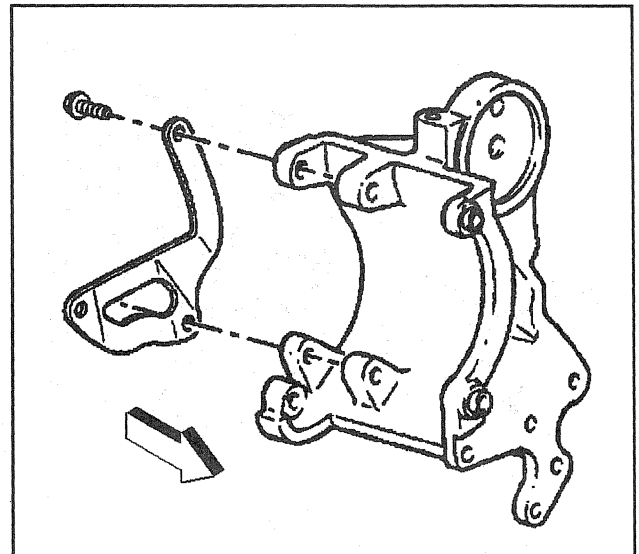
**Generator Brace Replacement (CS- 144)****Removal Procedure**

1. Remove the generator brace retainer bolts from the generator bracket.



105624

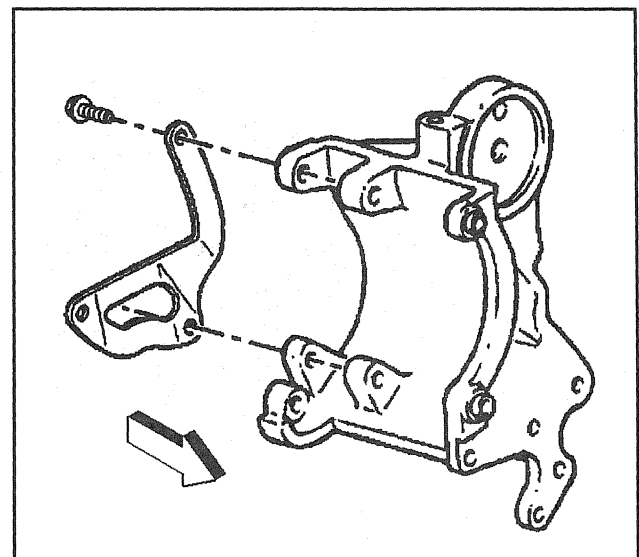
2. Remove the generator brace retainer from the generator bracket.
3. Remove the generator brace.



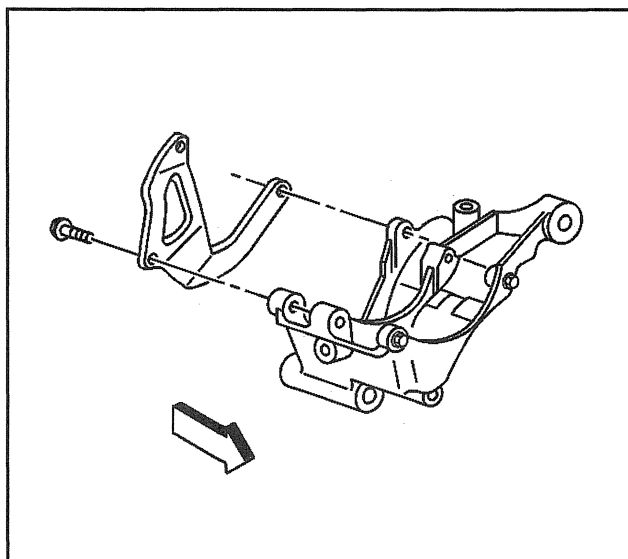
105626

**Installation Procedure**

1. Install the generator brace.
2. Install the generator brace to the generator bracket.



105626



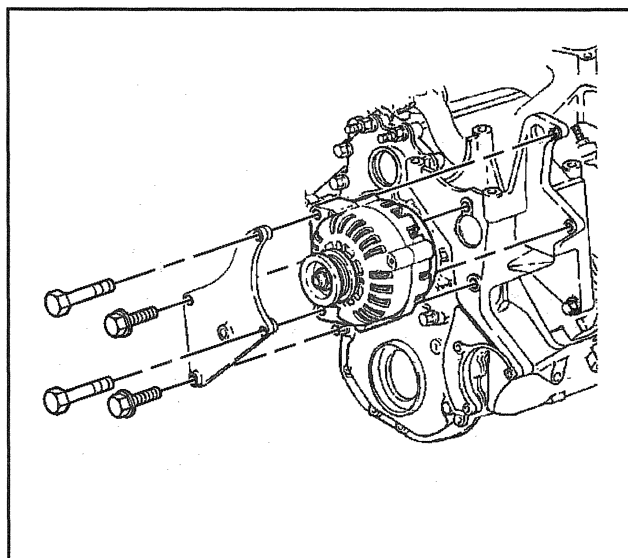
105624

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

3. Install the generator brace retaining bolts to the generator brace and bracket.

#### Tighten

Tighten the generator brace retaining bolts to 50 N·m (37 lb ft).



163784

### Generator Brace Replacement - Auxiliary (Diesel, CS 130D)

#### Removal Procedure

1. Remove the drive belt. Refer to *Drive Belt Replacement (6.5L Drive Belt)* in Engine Mechanical.
2. Remove the mounting bolts from the brace.  
The right-mounted version of the same generator is supported by a different brace at the rear of the generator.
3. Remove the brace.

#### Installation Procedure

1. Install the brace.

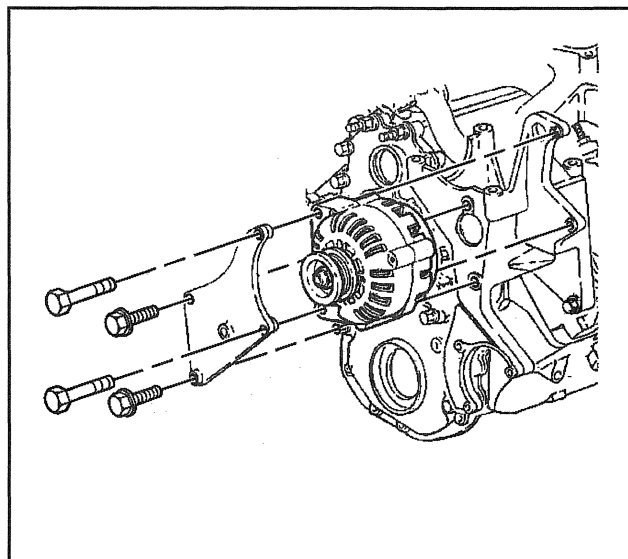
**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

2. Install the mounting bolts to the brace.

#### Tighten

- Tighten the auxiliary generator mounting long bolts to 50 N·m (37 lb ft)  
Tightening specifications include bolts for right mounted brace.
- Tighten the auxiliary generator mounting short bolts to 25 N·m (18 lb ft)

3. Install the drive belt. Refer to *Drive Belt Replacement (6.5L Drive Belt)* in Engine Mechanical.



163784

## Generator Replacement (CS 144)

### Removal Procedure

**Caution:** Refer to *Battery Disconnect Caution in Cautions and Notices*.

1. Disconnect the battery negative cable.
2. Disconnect the terminal plug from the back of the generator.
3. Disconnect the battery lead from the back of the generator.
4. Remove the upper fan shroud as needed. Refer to *Fan Shroud Replacement (Upper)* in Engine Cooling.
5. Remove the drive belt. Refer to *Drive Belt Replacement (6.5L Drive Belt)* in Engine Mechanical (6.5L) or *Drive Belt Replacement* in Engine Mechanical (7.4L).
6. Remove the generator mounting bolts holding the generator to the brace and the bracket.
7. Remove the generator.

### Installation Procedure

1. Install the generator.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

2. Perform the following procedure in order to install the generator mounting bolts holding the generator to the bracket and the brace
  - 2.1. Loosely install the generator mounting bolts holding the generator to the bracket and the brace.
  - 2.2. Install the brace attachment.
  - 2.3. Tighten the generator mounting bolts holding the generator to the bracket and the brace.

#### Tighten

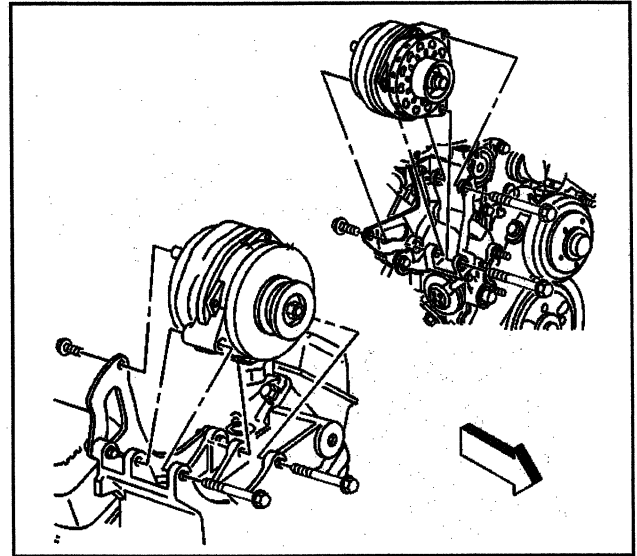
Tighten the generator mounting bolts holding the generator to the bracket and the brace to 50 N·m (37 lb ft).

3. Install the drive belt to the generator. Refer to *Drive Belt Replacement (6.5L Drive Belt)* in Engine Mechanical (6.5L) or *Drive Belt Replacement* in Engine Mechanical (7.4L).
4. Install the upper fan shroud as needed. Refer to *Fan Shroud Replacement (Upper)* in Engine Cooling.
5. Connect the battery lead to the back of the generator.

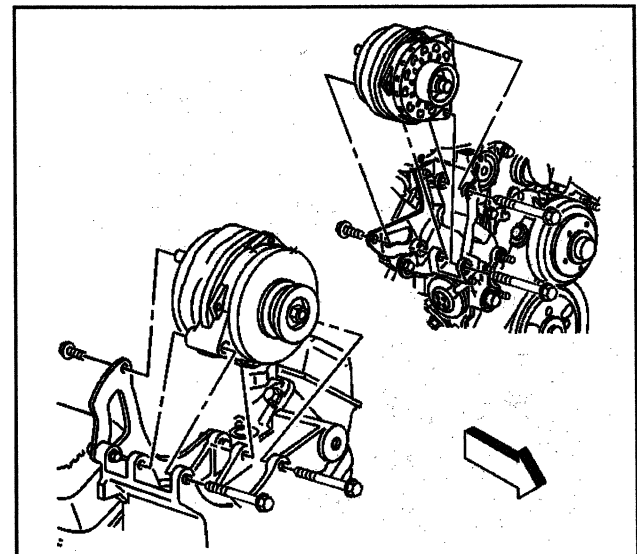
#### Tighten

Tighten the battery terminal nut to 8 N·m (71 lb in).

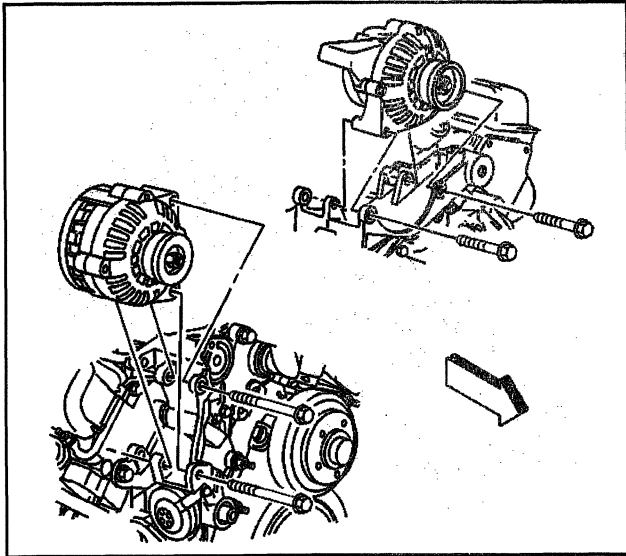
6. Connect the terminal plug to the back of the generator.
7. Connect the battery negative cable.



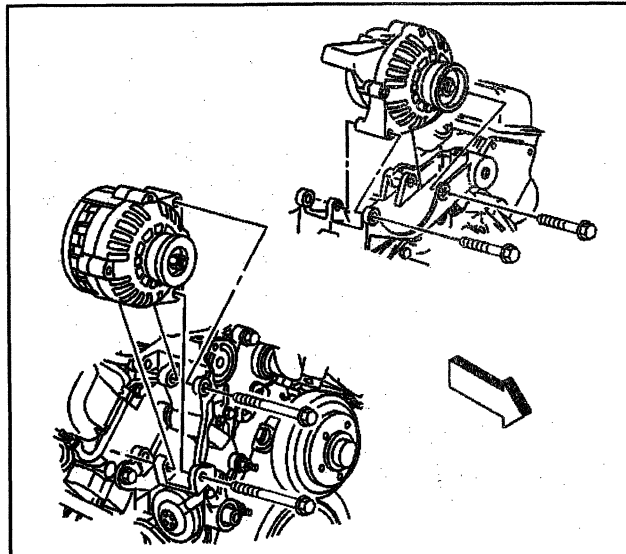
388423



388423



388424



388424

## Generator Replacement (CS 130D)

### Removal Procedure

**Caution:** Refer to *Battery Disconnect Caution in Cautions and Notices*.

1. Disconnect the battery negative cable.
2. Disconnect the terminal plug from the back of the generator.
3. Disconnect the battery lead from the back of the generator.
4. Remove the upper fan shroud as needed. Refer to *Fan Shroud Replacement (Upper)* in Engine Cooling.
5. Remove the drive belt from the generator. Refer to *Drive Belt Replacement* or *Drive Belt Replacement (6.5L Drive Belt)* or *Drive Belt Replacement* in Engine Mechanical.
6. Remove the generator mounting bolts holding the generator to the bracket.
7. Remove the generator.

### Installation Procedure

1. Install the generator.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

2. Install the generator mounting bolts.

#### Tighten

Tighten the generator mounting bolts to 50 N·m (37 lb ft).

3. Install the drive belt to the generator. Refer to *Drive Belt Replacement* or *Drive Belt Replacement (6.5L Drive Belt)* or *Drive Belt Replacement* in Engine Mechanical.
4. Install the upper fan shroud as needed. Refer to *Fan Shroud Replacement (Upper)*.
5. Connect the battery lead to the back of the generator.

#### Tighten

Tighten the battery terminal nut to 8 N·m (71 lb in).

6. Connect the terminal plug to the back of the generator.
7. Connect the battery negative cable.

## Generator Replacement - Auxiliary

### Removal Procedure

**Caution:** Refer to *Battery Disconnect Caution in Cautions and Notices*.

1. Disconnect the battery negative cable.
2. Disconnect the terminal plug from the back of the generator.
3. Disconnect the battery lead from the back of the generator.
4. Remove the upper fan shroud if necessary. Refer to *Fan Shroud Replacement (Upper)* in Engine Cooling.
5. Remove the drive belt from the generator. Refer to *Drive Belt Replacement*, in Engine Mechanical (5.0L and 5.7L), *Drive Belt Replacement (6.5L Drive Belt)*, in Engine Mechanical (6.5L), or *Drive Belt Replacement*, in Engine Mechanical (7.0L and 7.4L).
6. Remove the auxiliary brace bolts. Refer to *Generator Brace Replacement - Auxiliary (Diesel, CS 130D)*.
7. Remove the remaining generator bracket bolts.
8. Lift the hose from the generator support.
9. Remove the generator.

### Installation Procedure

1. Install the generator.

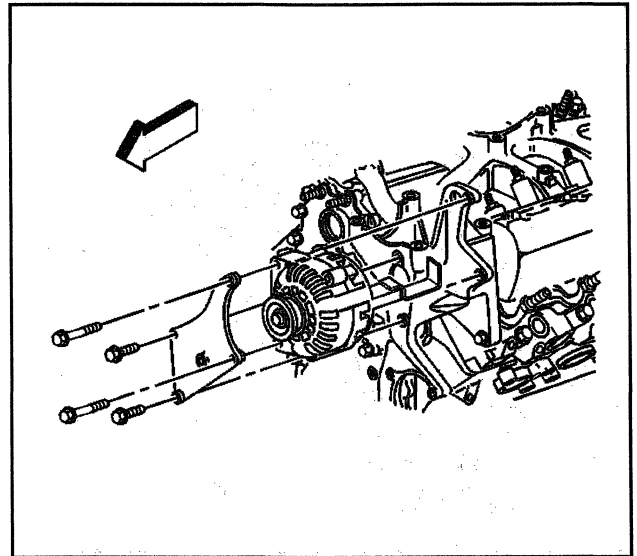
**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

2. Install the generator bracket bolts.

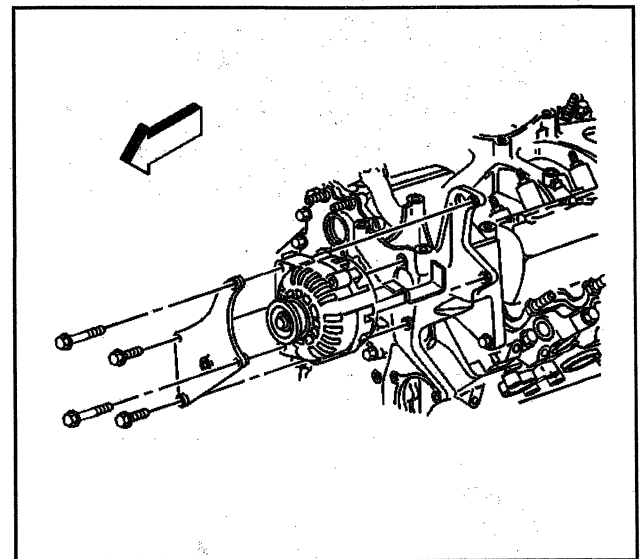
#### Tighten

Tighten the generator mounting bolts to 50 N·m (37 lb ft).

3. Install the auxiliary brace bolts. Refer to *Generator Brace Replacement - Auxiliary (Diesel, CS 130D)*.
  4. Place the hose on the generator support.
  5. Install the drive belt to the generator. Refer to *Drive Belt Replacement*, in Engine Mechanical (5.0L and 5.7L), *Drive Belt Replacement (6.5L Drive Belt)*, in Engine Mechanical (6.5L), or *Drive Belt Replacement*, in Engine Mechanical (7.0L and 7.4L).
  6. Install the upper fan shroud if necessary. Refer to *Fan Shroud Replacement (Upper)* in Engine Cooling.
  7. Connect the battery lead to the back of the generator.
- #### Tighten
- Tighten the battery terminal nut to 8 N·m (71 lb in).
8. Connect the terminal plug from the back of the generator.
  9. Connect the battery negative cable.

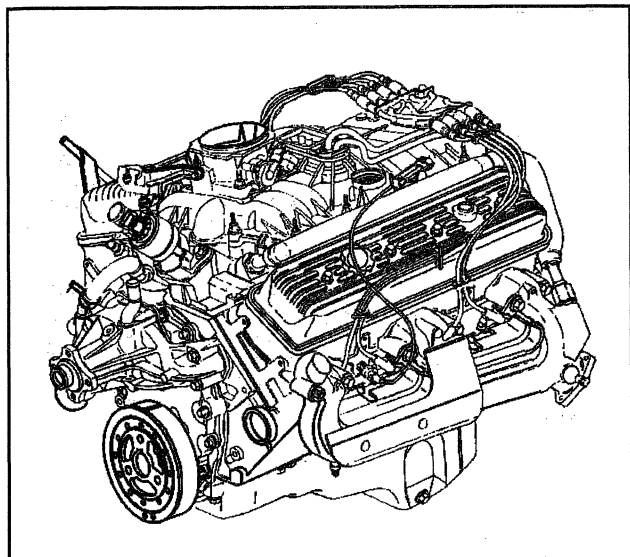


388602

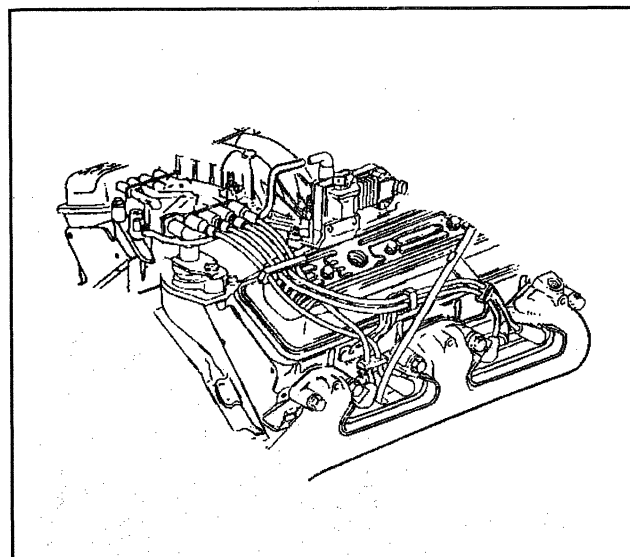


388602

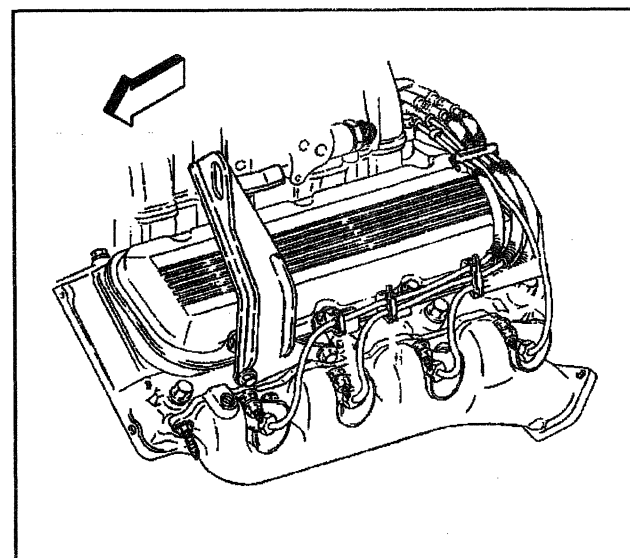




367058



176070



367056

## Spark Plug Wire Harness Replacement (5.0L, 5.7L)

### Removal Procedure

1. Disconnect the spark plug wire at each spark plug for 5.0L, 5.7L.
  - Twist the boots one-half turn before removing.
  - Pull only on the boot or use a tool designed for this purpose in order to remove the wire from each spark plug.
2. Disconnect the spark plug wire from the Distributor.
  - Twist each spark plug boot 1/2 turn.
  - Pull only on the boot or use a tool designed for this purpose in order to remove the wires from the Distributor.

### Installation Procedure

1. Install the spark plug wires at the Distributor for 5.0L, 5.7L.
2. Install the spark plug wire to each spark plug.

**Notice:** Refer to *Spark Plug Boot Notice* in Cautions and Notices.

3. Inspect the wires for proper installation:
  - Push sideways on each boot in order to inspect the seating.
  - Reinstall any loose boot.
  - Wire routings must be kept intact during service and followed exactly when wires have been disconnected or when replacement of the wires is necessary. Failure to route the wires properly can lead to radio ignition noise and crossfiring of the plugs, or shorting of the leads to the ground.
  - Any time the spark plug wires or boots are installed on the spark plugs, new dielectric grease needs to be applied inside the boot.

## Spark Plug Wire Harness Replacement (7.4 L)

### Removal Procedure

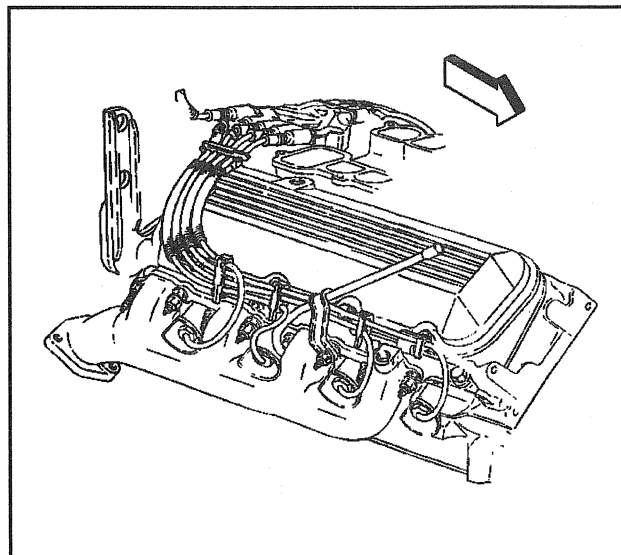
1. Disconnect the spark plug wire at each spark plug for 7.4L.
  - Twist the boots one-half turn before removing.
  - Pull only on the boot or use a tool designed for this purpose in order to remove the wire from each spark plug.
2. Disconnect the spark plug wire from the Distributor.
  - Twist each spark plug boot 1/2 turn.
  - Pull only on the boot or use a tool designed for this purpose in order to remove the wires from the Distributor.

**Installation Procedure**

1. Install the spark plug wires at the Distributor for 7.4L.
2. Install the spark plug wire to each spark plug.

**Notice:** Refer to *Spark Plug Boot Notice* in Cautions and Notices.

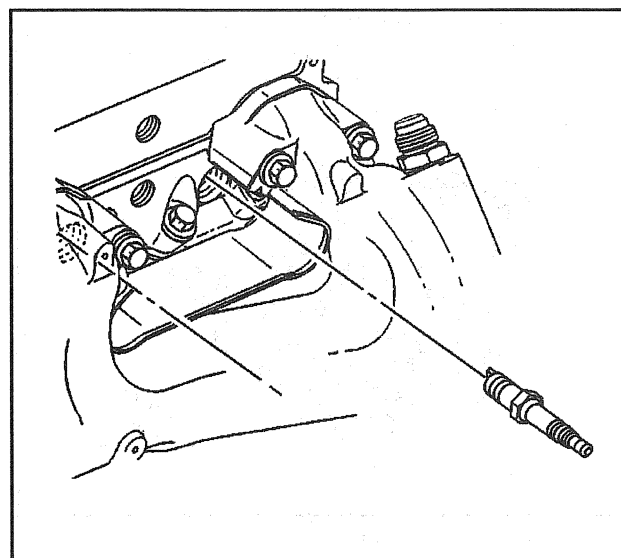
3. Inspect the wires for proper installation:
  - Push sideways on each boot in order to inspect the seating.
  - Reinstall any loose boot.
  - Wire routings must be kept intact during service and followed exactly when wires have been disconnected or when replacement of the wires is necessary. Failure to route the wires properly can lead to radio ignition noise and crossfiring of the plugs, or shorting of the leads to the ground.
  - Any time the spark plug wires or boots are installed on the spark plugs, new dielectric grease needs to be applied inside the boot.



367065

**Spark Plug Replacement****Removal Procedure**

1. Remove the spark plug wires. Refer to *Spark Plug Wire Harness Replacement (5.0L, 5.7L)* *Spark Plug Wire Harness Replacement (7.4 L)*
2. Loosen each spark plug one or two turns.  
Most spark plug are best removed from wheel wells.
3. Brush or air blast away any dirt from around the spark plugs.
4. Remove the spark plugs one at a time and place each plug in a tray marked with the corresponding cylinder numbers.



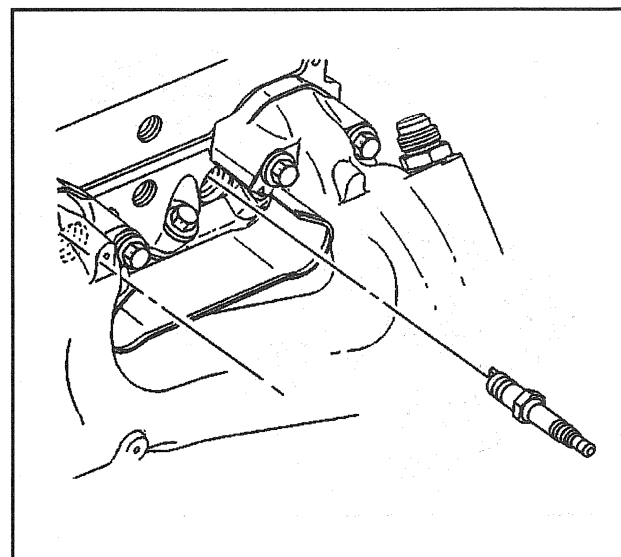
172979

**Installation Procedure**

1. Properly position each spark plug washer.
2. Inspect each spark plug gap. Adjust each plug as needed.

**Specification**

Spark plug gap: 1.524 mm (0.060 in).



172979

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

3. Install the spark plugs.

**Tighten 5.0L, 5.7L**

For (IRON Head—all Subsequent Installations) tighten the spark plugs to 15 N·m (11 lb ft) for 5.0L, 5.7L.

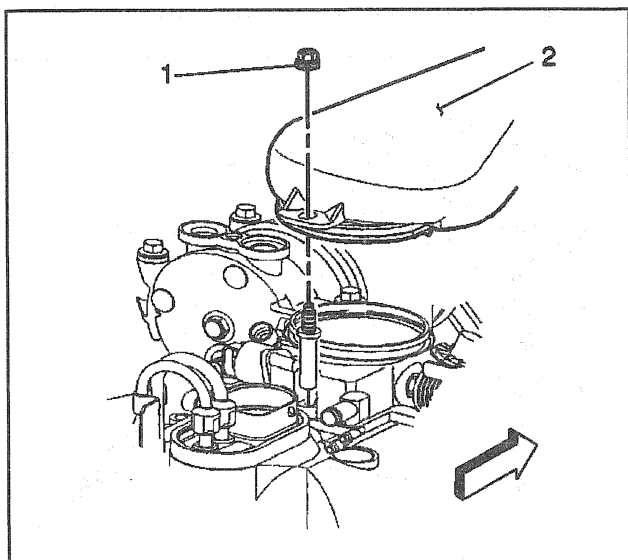
**Tighten 7.4L**

For (IRON Head—all Subsequent Installations) tighten the spark plugs to 20 N·m (15 lb ft) for 7.4L.

**Tighten 5.0L, 5.7L, 7.4L**

For new iron heads tighten the spark plugs to 30 N·m (22 lb ft) for 5.0L, 5.7L, 7.4L.

4. Install the spark plug wires. Refer to *Spark Plug Wire Harness Replacement (5.0L, 5.7L)* *Spark Plug Wire Harness Replacement (7.4 L)*

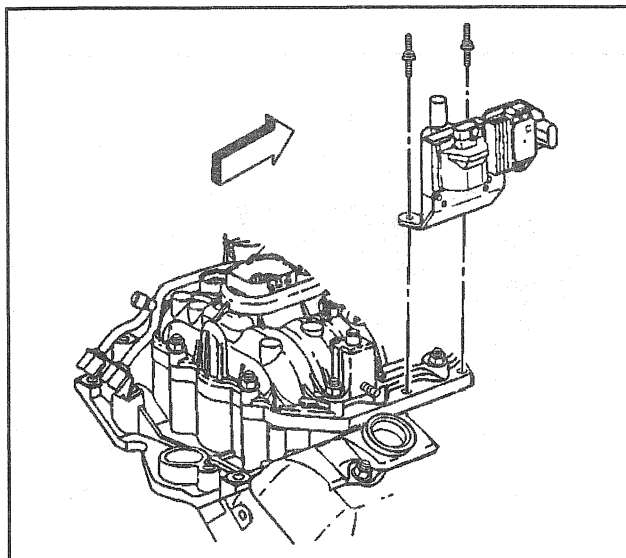


35885

### Ignition Coil and ICM Replacement (5.0L, 5.7L)

#### Removal Procedure

1. Remove the air cleaner assembly (2) and nut (1). Refer to Air Cleaner Duct Replacement in engine controls.
2. Disconnect the electrical connectors.
3. Remove the ignition coil wire to the distributor.



31466

4. Remove the studs holding the bracket and the ignition coil to the intake manifold.
5. Remove the bracket and the ignition coil.
6. Drill and punch out the two rivets holding the ignition coil to the bracket.
7. Remove the ignition coil from the bracket.

**Installation Procedure**

A replacement ignition coil kit comes with two screws in order to attach the ignition coil to the bracket.

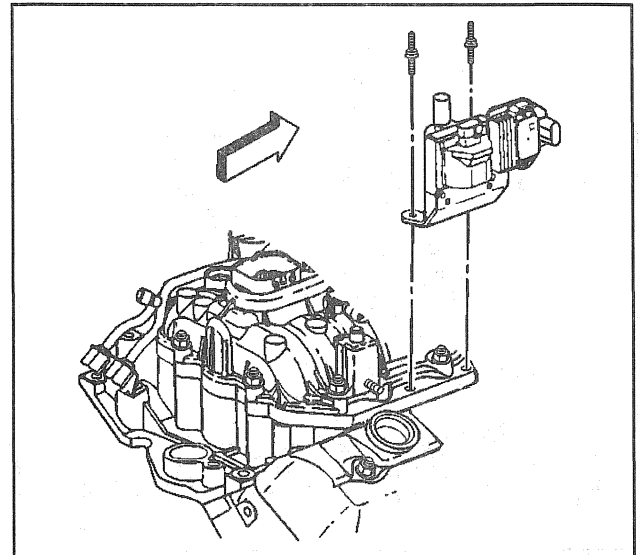
1. Install the ignition coil to the bracket with the two screws.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

2. Install the ignition coil and the bracket to the intake manifold with studs.

**Tighten**

Tighten the studs to 11 N·m (8 lb ft).

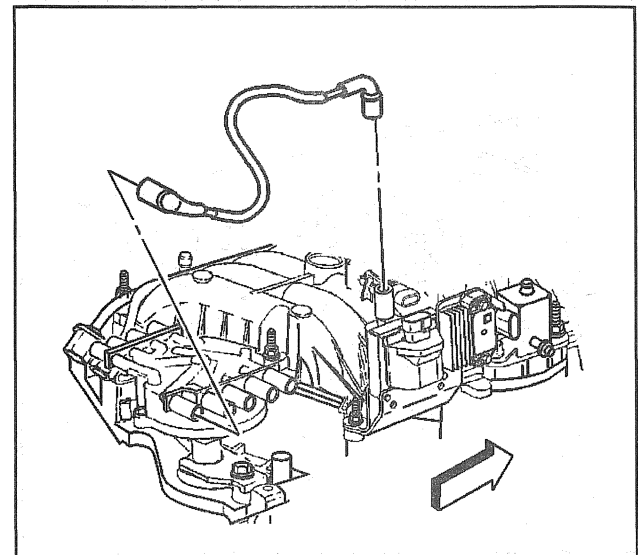


31466

3. Install the ignition coil wire.

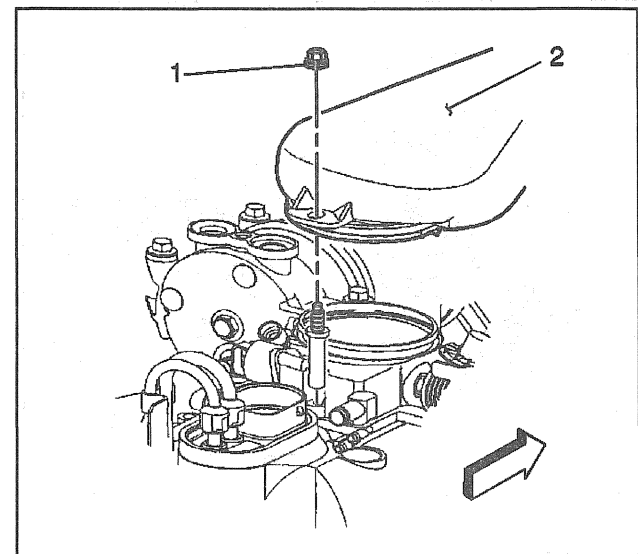
The wire must not touch anything like the dip stick, rubbing will make a ground/short after time of use.

4. Install the electrical connectors.

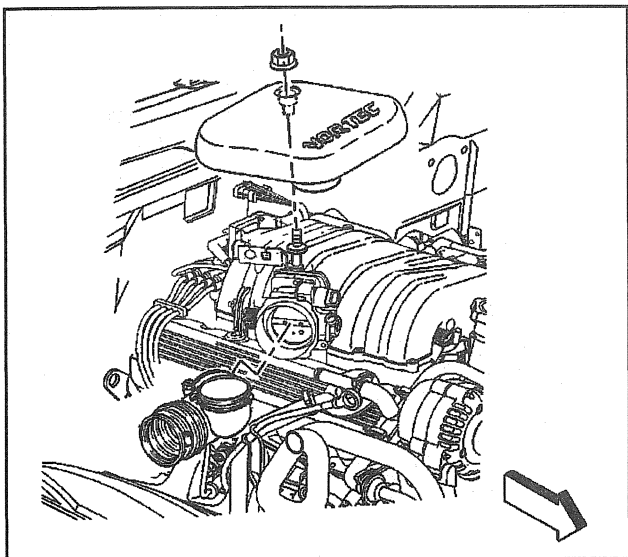


341359

5. Install the air cleaner assembly (2) and nut (1).



35885

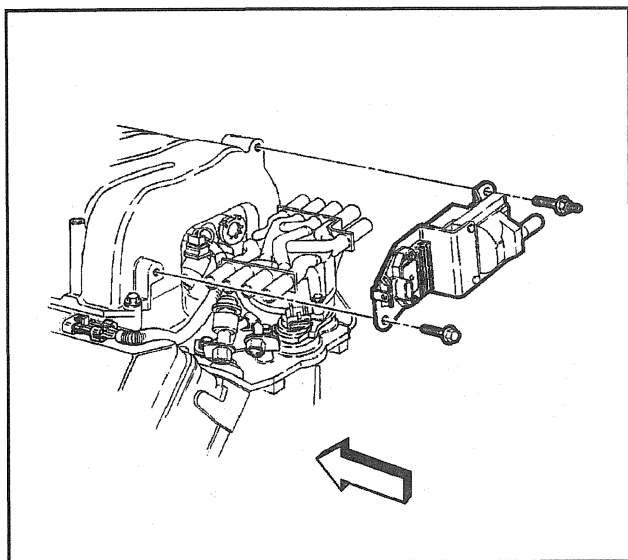


175670

## Ignition Coil and ICM Replacement (HVS 7.4L)

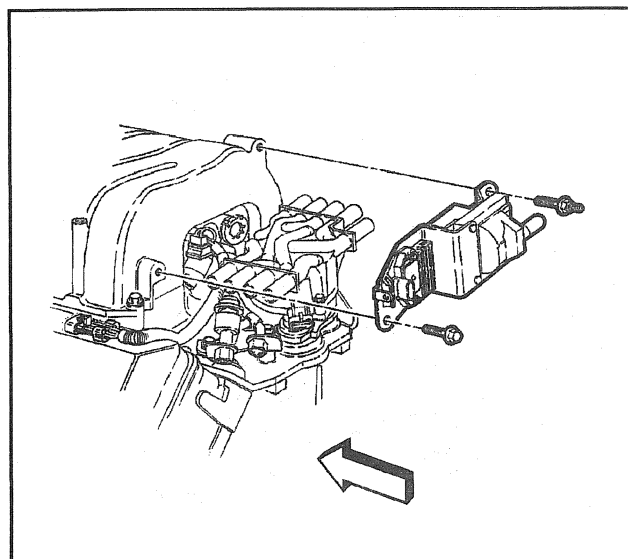
### Removal Procedure

1. Remove the air cleaner assembly. Refer to Air Cleaner Duct Replacement in engine controls.
2. In order to gain access to the ignition coil, relocate the engine wiring harness at the left rear side of the engine.
3. Disconnect the electrical connectors for the ignition coil and the ICM.



68506

4. Remove the bolts retaining the coil to the intake manifold.
5. Remove the ignition coil.



68506

### Installation Procedure

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

1. Install the ignition coil and the bolts to the intake manifold.

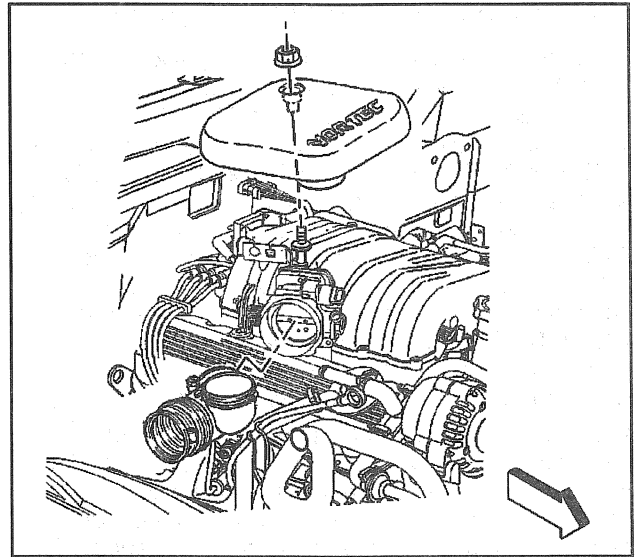
#### Tighten

Tighten the bolts to 27 N·m (22 lb in).

2. Install the electrical connectors.
3. Install the ignition coil wire to coil.

The wire must not touch anything like the dip stick, rubbing will make a ground/short after time of use.

4. Relocate the engine wiring harness at the left rear side of the engine.
5. Install the air cleaner assembly. Refer to Air Cleaner Duct Replacement in engine controls.



175670

## Description and Operation

### Starting System Operation

#### Starter Circuit Operation

Voltage is applied at all times to the ignition switch from the IGN A fuse 6 through the RED (242) wire. When the ignition switch is turned to the START position, voltage is applied to the CRANK fuse 8 through the YEL (5) wire. From the CRANK fuse 8, voltage is either applied to the clutch pedal position switch (M/T) or the transmission range switch (A/T) through the PPL (806) wire. When either the clutch is disengaged (M/T) or the transmission is in park or neutral (A/T), voltage is applied to the coil of the starter relay through the PPL (1035) wire. Since the starter relay is permanently grounded at ground G105 through the BLK (150) wire, the starter relay energizes.

Voltage is applied at all times to the starter relay contacts from IGN A fuse 6 through the RED (242) wire. When the starter relay energizes, the starter relay contacts close, and voltage is applied to the starter motor solenoid. Since the starter motor solenoid is permanently case grounded, the starter motor solenoid will energize two coils. The pull-in winding coil energizes in order to pull the starter motor solenoid contacts closed. When the contacts close, a plunger on the contacts causes the pull-in winding coil circuit to open. The hold-in winding coil then holds the starter motor solenoid contacts closed. Voltage is then applied to the starter motor from the battery through the BLK (1) wire and the closed contacts of the starter motor solenoid. Since the starter motor is also permanently case grounded, the starter motor will run until the ignition switch is moved out of the START position. When this happens, a spring in the starter motor solenoid moves the starter motor solenoid contacts and the plunger back to the rest position.

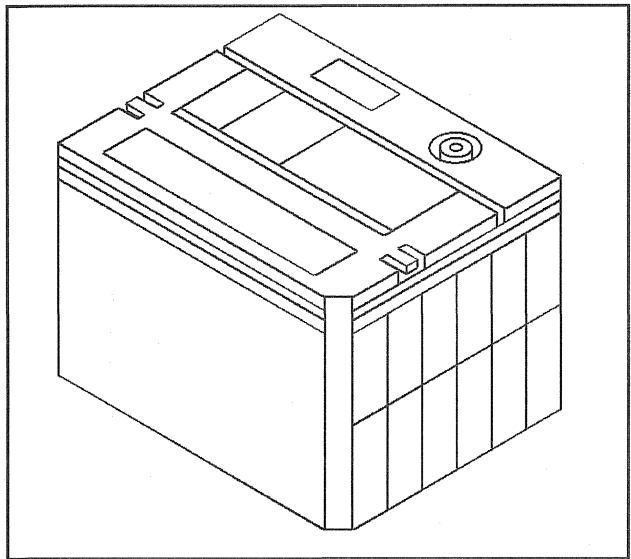
Starting System Circuit Description

Voltage is applied at all times to the ignition switch from the IGN A fuse 6 through CKT 242 (RED). When the ignition switch is turned to the START position, voltage is applied to the CRANK fuse 8 through CKT 5 (YEL). From the CRANK fuse 8, voltage is either applied to the clutch pedal position switch (M/T) or the transmission range switch (A/T) through CKT 806 (PPL). When either the clutch is disengaged (M/T) or the transmission is in park or neutral (A/T), voltage is applied to the coil of the starter relay through CKT 1035 (PPL/WHT). Since the starter relay is permanently grounded at ground G105 through CKT 150 (BLK), the starter relay energizes.

Voltage is applied at all times to the starter relay contacts from IGN A fuse 6 through CKT 242 (RED). When the starter relay energizes, the starter relay contacts close, and voltage is applied to the starter motor solenoid. Since the starter motor solenoid is permanently case grounded, the starter motor solenoid will energize two coils. The pull-in winding coil energizes in order to pull the starter motor solenoid contacts closed. When the contacts close, a plunger on the contacts causes the pull-in winding coil circuit to open. The hold-in winding coil then holds the starter motor solenoid contacts closed. Voltage is then applied to the starter motor from the battery through CKT 1 (BLK) and the closed contacts of the starter motor solenoid. Since the starter motor is also permanently case grounded, the starter motor will run until the ignition switch is moved out of the START position. When this happens, a spring in the starter motor solenoid moves the starter motor solenoid contacts and the plunger back to the rest position.

Battery Description

General Description



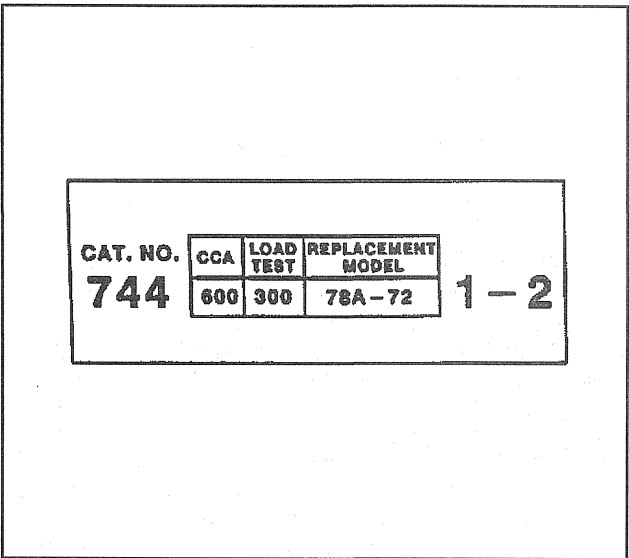
42429

The maintenance-free battery is standard equipment in all vehicles. Batteries with side or top terminals are available.

These vehicles may be equipped with more than one battery, depending on the powertrain used and optional equipment. The battery is completely sealed except for two small vent holes in the sides. These vent holes allow a small amount of gas produced in the battery to escape.

The battery has three functions in the electrical system:

- The battery provides a source of energy for cranking the engine.
- The battery acts as a voltage stabilizer for the electrical system.
- The battery can, for a limited time, provide energy when the electrical load used exceeds the output of the generator.



106519

The battery specification label contains information pertinent to servicing the battery. This information includes test ratings and original equipment. The label also includes numbers for recommended replacement parts.

Battery Ratings

A battery has two ratings:

- Reserve capacity
- Cold cranking amperage

Reserve Capacity

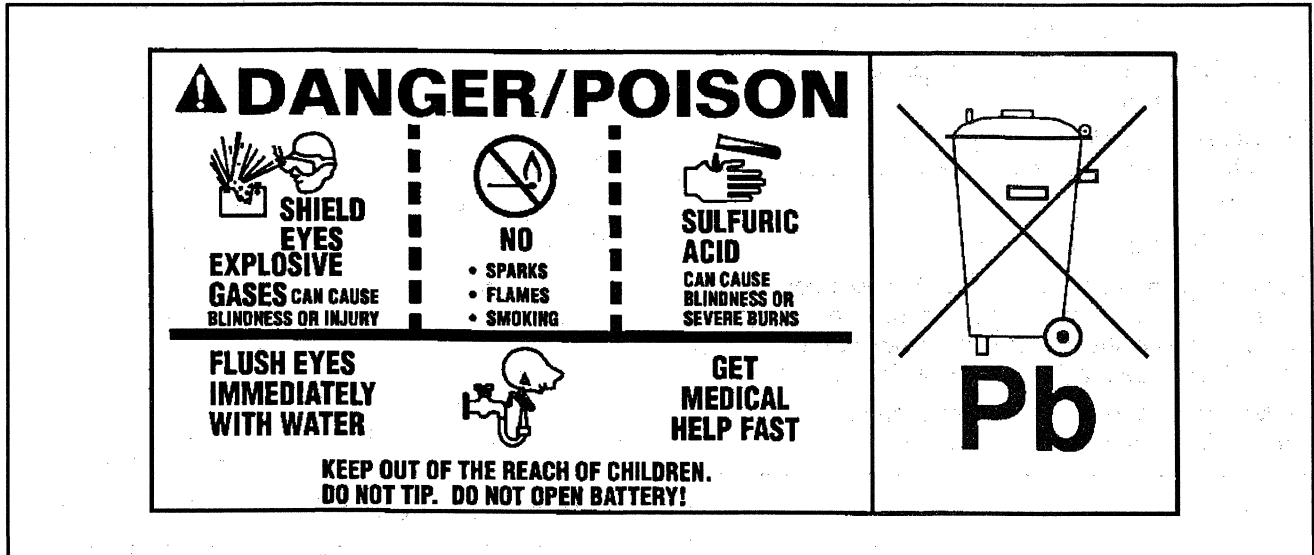
The reserve capacity is an estimate of how long the vehicle can be driven with no generator output, the headlamps turned on, and a minimum electrical load (most of the accessories turned off). It is the maximum amount of time (in minutes) it will take for a fully charged battery, being discharged at a constant rate of 25 amperes and a constant temperature of 27°C (80°F), to reach a terminal voltage of 10.5 volts. Other temperature or current draws, the state of charge, or the condition of the battery will affect how long the battery will actually last when the vehicle is being driven without generator output.

**Cold Cranking Amperage**

Cold cranking amperage is an indication of the ability of the battery to crank the engine at cold temperatures. This rating is the minimum amperage that the battery must maintain for 30 seconds at  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ), while maintaining at least 7.2 volts. The actual performance of a battery will vary with actual temperature.

**Electrolyte Freezing**

The freezing point of electrolyte depends on the specific gravity of the electrolyte, or state of charge. Since freezing may ruin a battery, protect the battery against freezing by keeping the battery charged. As long as the green dot shows in the built-in hydrometer, the battery will not freeze unless the temperature drops below  $-32^{\circ}\text{C}$  ( $-25^{\circ}\text{F}$ ). A fully charged battery will not freeze unless the temperature drops below  $-54^{\circ}\text{C}$  ( $-65^{\circ}\text{F}$ ).

**Protection During Vehicle Storage**

190959

Some electronic devices on the vehicle impose small continuous current drains on the battery. This is commonly called parasitic load. If the vehicle is not used for an extended time, these parasitic loads can discharge and eventually cause permanent damage to the battery. Discharged batteries can also freeze in cold weather. Refer to Electrolyte Freezing.

Do the following steps in order to help keep the battery in a charged state while storing the vehicle:

- If the vehicle is likely to be stored over 30 days, check the built-in hydrometer and make sure the green dot is visible.

**Notice:** Always turn the ignition OFF when connecting or disconnecting battery cables, battery chargers, or jumper cables. Failing to do so may damage the Powertrain Control Module (PCM) or other electronic components.

- Disconnect the negative battery cable. This protects the battery from being discharged by parasitic current drains from the electrical system of the vehicle.

**Important:** Any time the green dot in the built-in hydrometer of the battery is not visible, promptly recharge the battery.

- If the battery cannot be disconnected, establish a regular schedule of recharging the battery every 20–45 days in order to maintain a high state of charge.

**Important:** Original equipment maintenance-free batteries will not be damaged by charge rates of 50 amps or more, as long as the battery does not spew electrolyte from the vents or heat to over  $52^{\circ}\text{C}$  ( $125^{\circ}\text{F}$ ).

- In order to keep the charging time low, use a battery charger that is capable of providing a charging voltage of at least 16 volts.
  1. Inspect the battery being charged every 45-60 minutes. Stop charging or reduce the charging rate as necessary.
  2. Stop charging within one hour after the green dot appears in the hydrometer in order to avoid overcharging.

**Important:** A battery that remains in a discharged state for a long time may be difficult to recharge. The battery may also be permanently damaged.

- Allow ample time for charging. Refer to *Battery Charging*.



When it is time to reconnect the battery, do the following steps:

1. Using a wire brush, lightly clean any oxidation from the contact face of the battery terminal before reconnecting the cable.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

2. Tighten the cable bolt.

#### Tighten

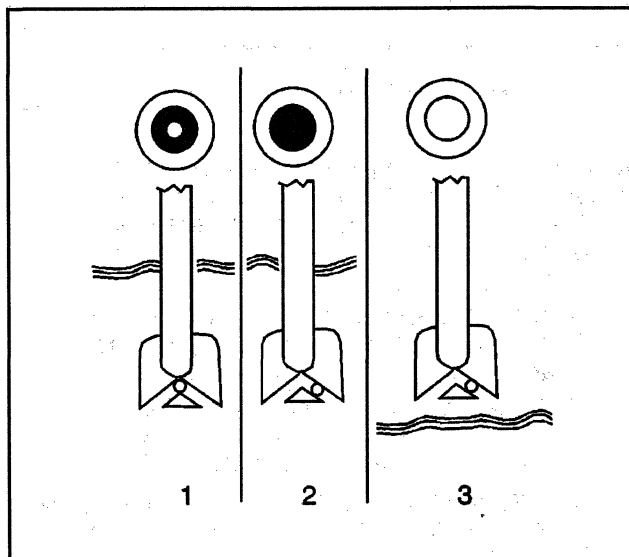
- Tighten the cable bolt on a side terminal battery to 12 N·m (106 lb ft).
- Tighten the cable bolt on top terminal battery to 18 N·m (13 lb ft).

3. Reset the clock, the push-button radio tuning, and other accessories before the vehicle is put back in service.

#### Built-in Hydrometer

A built-in temperature compensation hydrometer is molded into the top of the maintenance free battery. When observing the hydrometer, make sure the battery top is clean. Use a light in poorly-lit areas.

Under normal operating conditions, one of three indications can be observed:



181056

- Any green appearance in the hydrometer is interpreted as a green dot (1). This means the battery is ready for testing.
- A dark dot is visible (2). The green dot is not visible.
  1. If the green dot is not visible and there is a complaint about cranking, refer to *Battery (Parasitic) Load Test*.
  2. Check the output of the charging system.
  3. Check the electrical system for excessive draws.

- A clear or light yellow dot (1) means the electrolyte level is below the bottom of the hydrometer and is too low for diagnosis. The yellow dot may have been caused by the following conditions:

- Excessive or prolonged charging
- A broken case
- Excessive tipping

- When you find a battery in this condition, this may indicate high charging voltages caused by a faulty charging system. Because of this, the charging and electrical systems must be checked.

- Replace the battery if a cranking complaint exists, and the battery has a yellow or clear hydrometer.

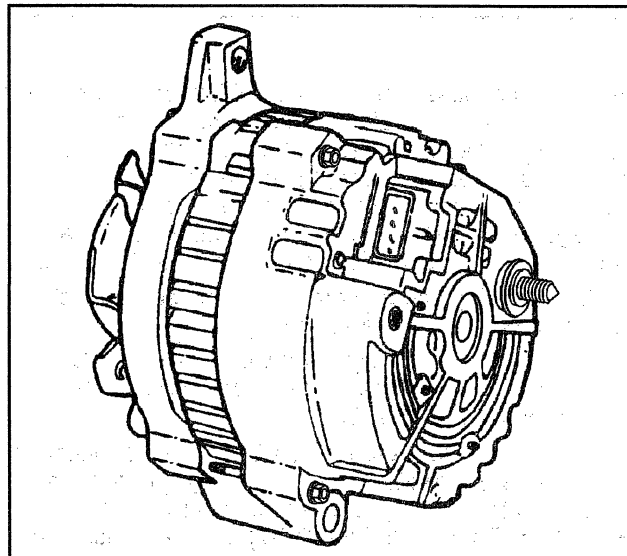
#### Charging System Description

The charging system consists of the following components:

- The battery
- The generator
- A voltage regulator
- Indicator lamp or voltmeter circuitry

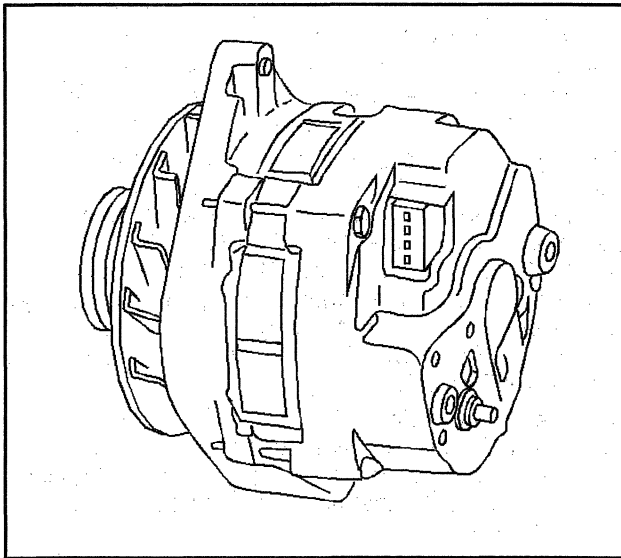
The generator supplies the electrical power for charging the battery and for operating the accessories.

#### CS-Series Generators



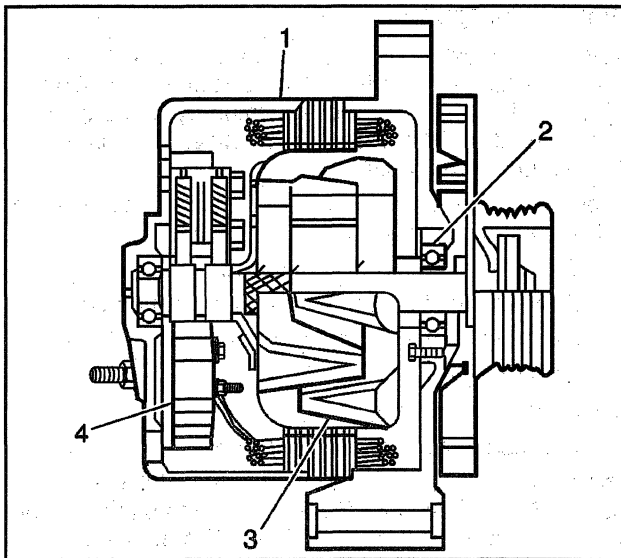
181767

CS-Series generators feature a high ampere output per pound of weight. The CS stands for charging systems. The 130 or 144 is the measurement, in millimeters, of the outside diameter of the stator laminations.



17202

The CS-144 generator is a larger version of the CS-130. Unlike the CS-130, the CS-144 is serviceable.



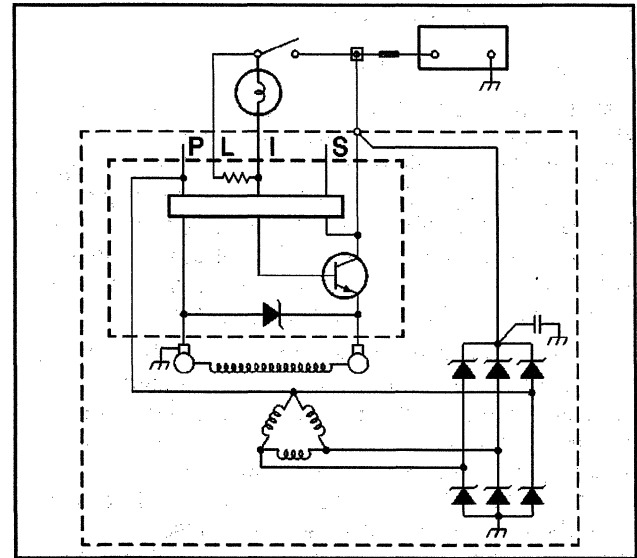
181768

The CS-144 generator, with an internal regulator, does not have a diode trio. The delta stator (1), the rectifier bridge (4), and the rotor with slip rings and brushes (3), are electrically similar to other CS Series generators.

The generator uses a conventional fan and pulley. An internal fan cools the slip rings, the end frame, the rectifier bridge, and the regulator.

The charge indicator turns on when the ignition switch (gasoline engines) or the engine control switch (diesel engines) is closed and the engine is not running, and turns off when the engine is running. If the charge indicator is on with the engine running, this indicates a charging system condition. The indicator will glow at full brilliance, not half lit, if any of the following conditions occur:

- Any charging condition
- System voltage is too high or too low



74064

The regulator limits system voltage by controlling the rotor field current. When the field current is on, the regulator switches the rotor field on and off at a fixed rate of about 400 cycles per second. By varying the overall on/off time, correct average field current for proper system voltage control is maintained. At high speeds, the on time may be 10 percent and the off time may be 90 percent. At low speeds, and with high electrical loads, the on/off time may be 90 percent and 10 percent respectively.

The regulator has four terminals—P, L, I, and S. On all P applications, P, L, I/F, and S is stamped on the regulator.

The L or the I terminal, or both, turns on the regulator and allows field current flow when the switch is closed. The L terminal must connect through an indicator lamp or a suitable resistor. The I terminal connects to B+ or through a resistor. These two terminals are often used in parallel and connected to two different vehicle circuits.

The P terminal connects internally to the stator and may be wired to a tachometer or other device. The S terminal may be used to “sense” voltage at another location on the vehicle for voltage control. If the S terminal is not used, the generator will use an integrated circuit in the regulator to “sense” voltage.

P model vehicles use a voltmeter in place of an indicator lamp. For schematics of the specific generator circuits, refer to

The CS-144 generator requires no periodic maintenance or adjustment. The CS-130 generator must be replaced. Do not disassemble the CS-130 generator.

## Charging System Operation

### Charging Circuit Operation

The generator provides the voltage that operates the electrical system and charges the battery. A magnetic field is created when current flows through the rotor windings. This field rotates as the engine rotates the rotor, creating an AC voltage in the stator windings. A rectifier bridge converts the AC voltage to a DC voltage. This DC voltage is then supplied to the electrical system at the battery terminal.

The current supplied to the rotor controls the amount of output voltage. The regulator in the generator uses digital techniques in order to control the current supplied to the rotor. The rotor current is a regulator-supplied series of electrical pulses. When the ignition switch is first placed in the RUN position, the pulse width is very narrow. This causes the rotor to produce a weak magnetic field. This produces a lower output voltage to the electrical system. Once the engine is running, the regulator monitors the output voltage through an internal wire and changes the pulse width accordingly.

The regulator in the generator also controls the BAT indicator located in the instrument cluster. Voltage is applied to the instrument cluster when the ignition switch is either in the RUN or START position from the GAUGES fuse 4 through the PNK (39) wire. When the regulator monitors that either a voltage high or voltage low condition exists with the engine running, a ground path to the BAT indicator will be provided through the BRN (25) wire.

With the diesel engines, the tachometer input to the instrument cluster is provided by the generator. The generator produces voltage pulses proportional to engine speed to the instrument cluster through the WHT (121) wire.

### Charging System Circuit Description

The generator provides the voltage that operates the electrical system and charges the battery. A magnetic field is created when current flows through the rotor windings. This field rotates as the engine rotates the rotor, creating an AC voltage in the stator windings. A rectifier bridge converts the AC voltage to a DC voltage. This DC voltage is then supplied to the electrical system at the battery terminal.

The current supplied to the rotor controls the amount of output voltage. The regulator in the generator uses digital techniques in order to control the current supplied to the rotor. The rotor current is a regulator-supplied series of electrical pulses. When the ignition switch is first placed in the RUN position, the pulse width is very narrow. This causes the rotor to produce a weak magnetic field. This produces a lower output voltage to the electrical system. Once the engine is running, the regulator monitors the output voltage through an internal wire and changes the pulse width accordingly.

Current flowing between the generator(s) and the RH Battery runs through CKT 2 (RED). A 175A Mega Fuse is also placed inline between the generator(s) and battery on Uplevel/Enhanced Features/Single Battery for generator protection during jump starts.

The regulator in the generator also controls the BAT indicator located in the instrument cluster. Voltage is applied to the instrument cluster when the ignition switch is either in the RUN or START position from the GAUGES fuse 4 through CKT 39 (PNK). When the regulator monitors that either a voltage high or voltage low condition exists with the engine running, a ground path to the BAT indicator will be provided through CKT 25 (BRN).

With the diesel engines, the tachometer input to the instrument cluster is provided by the generator. The generator produces voltage pulses proportional to engine speed to the instrument cluster through CKT 121 (WHT).

## Ignition System Description (Distributor Ignition HVS)

### Distributor Ignition (DI)

**Notice:** The distributor used with the OBD II ignition system is located in a fixed, non-adjustable position. Do not adjust the engine base timing by rotating this distributor. Otherwise, crossfiring and damage to the distributor will result.

These ignition systems consist of a distributor with the following components:

- Camshaft position (CMP) sensor
- Separate ignition coil with sealed connectors
- Secondary ignition wires
- Spark plugs
- Knock sensor (KS)
- Crankshaft position (CKP) sensor

The ignition system is controlled by the Vehicle Control Module (VCM). The VCM monitors information from various engine sensors. The VCM computes the desired spark advance timing, and controls the dwell. The VCM also controls the firing of the ignition coil via an ignition control line to the coil driver. For more detailed information, refer to Engine Controls.

## Special Tools and Equipment

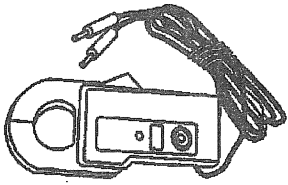
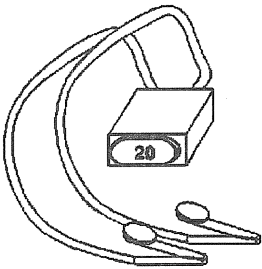
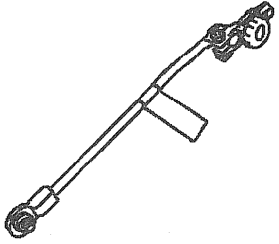
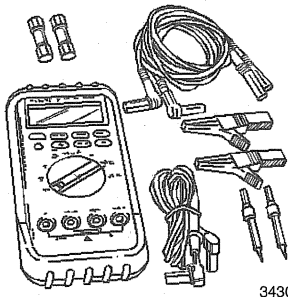

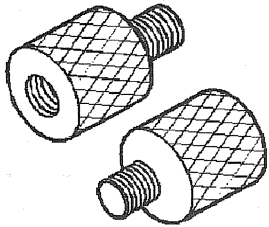
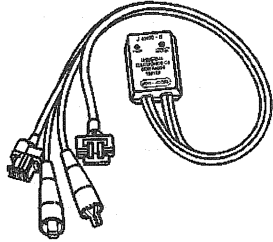
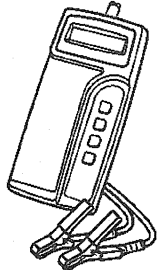
Illustration	Tool Number/ Description
 95591	J 35590 Current Clamp
 1025	J 36169-A Fused Jumper Wire
 3432	J 38758 Parasitic Draw Test Switch Tool
 3430	J 39200 Digital Multimeter
 8443	J 39358 Long Reach Spark Plug Socket

Illustration	Tool Number/ Description
 3431	ST-1201 Battery Side Terminal Adapters (Pair)
 317080	J 41450-B Universal Electronic CS Generator Tester
 404758	J 42000 Digital Battery Tester