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## SECTION 1E

# ENGINE ELECTRICAL

**CAUTION:** Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in B unless otherwise noted.

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## DESCRIPTION AND OPERATION

### BATTERY

The battery has three major functions in the electrical system. First, the battery provides a source of energy for cranking the engine. Second, the battery acts as a voltage stabilizer for the electrical system. Finally, the battery can, for a limited time, provide energy when the electrical demand exceeds the output of the generator.

The sealed battery is standard on all cars. There are no vent plugs in the cover. The battery is completely sealed, except for two small vent holes in the sides. These vent holes allow the small amount of gas produced in the battery to escape.

The sealed battery has the following advantages over conventional batteries:

- No water need be added for the life of the battery.
- It is protected against overcharge. If too much voltage is applied to the battery, it will not accept as much current as a conventional battery. In a conventional battery, the excess voltage will still try to charge the battery, leading to gassing, which causes liquid loss.
- It is not as liable to self-discharge as a conventional battery. This is particularly important when a battery is left standing for long periods of time.
- It has more power available in a lighter and a smaller case.

### RATINGS

A battery has two ratings: (1) A reserve capacity rating designated at 27°C (81°F), which is the time a fully charged battery will provide 25 amperes current flow at or above 10.5 volts; (2) A cold cranking amp rating determined under testing at -18°C (0°F), which indicates the cranking load capacity.

### RESERVE CAPACITY

The reserve capacity is the maximum length of time it is possible to travel at night with the minimum electrical load and no generator output. Expressed in minutes, Reserve Capacity (or RC rating) is the time required for a fully charged battery, at a temperature of 27°C (81°F) and being discharged at a current of 25 amperes, to reach a terminal voltage of 10.5 volts.

### COLD CRANKING AMPERAGE

The cold cranking amperage test is expressed at a battery temperature of -18°C (0°F). The current rating is the minimum amperage, which must be maintained by the battery for 30 seconds at the specified temperature, while meeting a minimum voltage requirement of 7.2 volts. This rating is a measure of cold cranking capacity.

The battery is not designed to last indefinitely. However, with proper care, the battery will provide many years of service.

If the battery tests well, but fails to perform satisfactorily in service for no apparent reason, the following factors may point to the cause of the trouble:

- Vehicle accessories are left on overnight.
- Slow average driving speeds are used for short periods.
- The vehicle's electrical load is more than the generator output, particularly with the addition of aftermarket equipment.
- Defects in the charging system, such as electrical shorts, a slipping generator belt, a faulty generator, or a faulty voltage regulator.
- Battery abuse, including failure to keep the battery cable terminals clean and tight, or a loose battery hold-down.
- Mechanical problems in the electrical system, such as shorted or pinched wires.

### BUILT-IN HYDROMETER

The sealed battery has a built-in, temperature-compensated hydrometer in the top of the battery. This hydrometer is to be used with the following diagnostic procedure:

1. When observing the hydrometer, make sure that the battery has a clean top.
2. Under normal operation, two indications can be observed:
  - GREEN DOT VISIBLE – Any green appearance is interpreted as a “green dot,” meaning the battery is ready for testing.
  - DARK GREEN DOT IS NOT VISIBLE – If there is a cranking complaint, the battery should be tested. The charging and electrical systems should also be checked at this time.
3. Occasionally, a third condition may appear:
  - CLEAR OR BRIGHT YELLOW – This means the fluid level is below the bottom of the hydrometer. This may have been caused by excessive or prolonged charging, a broken case, excessive tipping, or normal battery wear. Finding a battery in this condition may indicate high charging by a faulty charging system. Therefore, the charging and the electrical systems may need to be checked if a cranking complaint exists. If the cranking complaint is caused by the battery, replace the battery.

## CHARGING PROCEDURE

1. Batteries with the green dot showing do not require charging unless they have just been discharged, such as in cranking a vehicle.
2. When charging sealed-terminal batteries out of the vehicle, install the adapter kit. Make sure all the charger connections are clean and tight. For best results, batteries should be charged while the electrolyte and the plates are at room temperature. A battery that is extremely cold may not accept current for several hours after starting the charger.
3. Charge the battery until the green dot appears. The battery should be checked every half-hour while charging. Tipping or shaking the battery may be necessary to make the green dot appear.
4. After charging, the battery should be load tested. Refer to "Starter Motor" in this section.

## CHARGING TIME REQUIRED

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

- **Size of Battery** – A completely discharged large heavy-duty battery requires more than twice the recharging as a completely discharged small passenger car battery.
- **Temperature** – A longer time will be needed to charge any battery at  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) than at  $27^{\circ}\text{C}$  ( $81^{\circ}\text{F}$ ). When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first. The battery will accept a higher current rate as the battery warms.
- **Charger Capacity** – A charger which can supply only 5 amperes will require a much longer charging period than a charger that can supply 30 amperes or more.
- **State-of-Charge** – A completely discharged battery requires more than twice as much charge as a one-half charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted by the battery is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.

## CHARGING A COMPLETELY DISCHARGED BATTERY (OFF THE VEHICLE)

Unless this procedure is properly followed, a perfectly good battery may be needlessly replaced.

The following procedure should be used to recharge a completely discharged battery:

1. Measure the voltage at the battery terminals with an accurate voltmeter. If the reading is below 10 volts, the charge current will be very low, and it could take some time before the battery accepts the current in

excess of a few milliamperes. Refer to "Charging Time Required" in this section, which focuses on the factors affecting both the charging time required and the rough estimates in the table below. Such low current may not be detectable on ammeters available in the field.

2. Set the battery charger on the high setting.

**Important:** Some chargers feature polarity protection circuitry, which prevents charging unless the charger leads are correctly connected to the battery terminals. A completely discharged battery may not have enough voltage to activate this circuitry, even though the leads are connected properly, making it appear that the battery will not accept charging current. Therefore, follow the specific charger manufacturer's instruction for bypassing or overriding the circuitry so that the charger will turn on and charge a low-voltage battery.

3. Battery chargers vary in the amount of voltage and current provided. The time required for the battery to accept a measurable charger current at various voltages may be as follows:

Voltage	Hours
16.0 or more	Up to 4 hours
14.0–15.9	Up to 8 hours
13.9 or less	Up to 16 hours

- If the charge current is not measurable at the end of the above charging times, the battery should be replaced.
- If the charge current is measurable during the charging time, the battery is good, and charging should be completed in the normal manner.

**Important:** It is important to remember that a completely discharged battery must be recharged for a sufficient number of ampere hours (AH) to restore the battery to a usable state. As a general rule, using the reserve capacity rating (RC) as the number of ampere hours of charge usually brings the green dot into view.

- If the charge current is still not measurable after using the charging time calculated by the above method, the battery should be replaced.
- If the charge current is measurable during the charging time, the battery is good, and charging should be completed in the normal manner.

## JUMP STARTING PROCEDURE

1. Position the vehicle with the good (charged) battery so that the jumper cables will reach from one battery to the other.
2. Turn off the ignition, all the lights, and all the electrical loads in both vehicles. Leave the hazard flasher on if there may be other traffic and any other lights needed for the work area.

3. In both vehicles, apply the parking brake firmly.

**Notice:** Make sure the cables are not on or near pulleys, fans, or other parts that will move when the engine starts, damaging the parts.

4. Shift a manual transaxle to NEUTRAL.

**Caution:** *Do not use cables that have loose or missing insulation, or injury could result.*

5. Clamp one end of the first jumper cable to the positive terminal on the battery. Make sure it does not touch any other metal parts. Clamp the other end of the same cable to the positive terminal on the other battery. Never connect the other end to the negative terminal of the discharged battery.

**Caution:** *Do not attach the cable directly to the negative terminal of the discharged battery. Doing so could cause sparks and possible battery explosion.*

6. Clamp one end of the second cable to the negative terminal of the booster battery. Make the final connection to a solid engine ground, such as the engine lift bracket, at least 450 millimeters (18 inches) from the discharged battery.

7. Start the engine of the vehicle with the good battery. Run the engine at a moderate speed for several minutes. Then start the engine of the vehicle which has the discharged battery.

8. Remove the jumper cables by reversing the above sequence exactly. Remove the negative cable from the vehicle with the discharged battery first. While removing each clamp, take care that it does not touch any other metal while the other end remains attached.

### GENERATOR

The Delco-Remy CS charging system has several models available, including the Ø114D (A-type) or CS114D (B-type). The number denotes the outer diameter in millimeters of the stator lamination.

CS generators are equipped with internal regulators. The Y connection (A-type) or Delta (B-type) stator, a rectifier bridge, and a rotor with slip rings and brushes are electrically similar to earlier generators. A conventional pulley and fan are used. There is no test hole.

Unlike three-wire generators, the Ø114D (A-type) or CS114D (B-type) may be used with only two connections: battery positive and an "L" terminal to the charge indicator lamp.

As with other charging systems, the charge indicator lamp lights when the ignition switch is turned to ON, and goes out when the engine is running. If the charge indicator is on with the engine running, a charging system defect is indicated.

The regulator voltage setting varies with temperature and limits the system voltage by controlling the rotor

field current. The regulator switches rotor field current on and off. By varying the on-off time, correct average field current for proper system voltage control is obtained. At high speeds, the on-time may be 10 percent and the off-time 90 percent. At low speeds, with high electrical loads, on-time may be 90 percent and the off-time 10 percent.

### CHARGING SYSTEM

The Delco-Remy CS charging system has several models available, including the Ø114D (A-type) or CS114D (B-type). The number denotes the outer diameter in millimeters of the stator laminations.

CS generators use a new type of regulator that incorporates a diode trio. The Y connection (A-type) or Delta (B-type) stator, a rectifier bridge, and a rotor with slip rings and brushes are electrically similar to earlier generators. A conventional pulley and fan are used. There is no test hole.

### STARTER

Wound field starter motors have pole pieces, arranged around the armature, which are energized by wound field coils.

Enclosed shift lever cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing, protecting them from exposure to dirt, icy conditions, and splashes.

In the basic circuit, solenoid windings are energized when the switch is closed. The resulting plunger and shift lever movement causes the pinion to engage the engine flywheel ring gear. The solenoid main contacts close. Cranking then takes place.

When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage. To prevent excessive overrun, the switch should be released immediately after the engine starts.

### STARTING SYSTEM

The engine electrical system includes the battery, the ignition, the starter, the generator, and all the related wiring. Diagnostic tables will aid in troubleshooting system faults. When a fault is traced to a particular component, refer to that component section of the service manual.

The starting system circuit consists of the battery, the starter motor, the ignition switch, and all the related electrical wiring. All of these components are connected electrically.

### DISTRIBUTOR

Distributor distributes the high tension voltage induced from ignition coil, to each spark plug of each cylinder in

the sequence of ignition order. It also adjusts the ignition timing according to the engine condition.

This vehicle uses the distributor (optical sensor type) which controls the preliminary current of the ignition coil by the ECM.

The ignition timing change is controlled electronically by the ECM.

When diagnosing the ignition system, refer to *Section 1F, Engine Controls*.

## **IGNITION COIL**

Ignition coil is a sort of transformer to generate high voltage (15,000–25,000V) which can bring spark at the spark plugs and has an iron cored closed magnetic type.

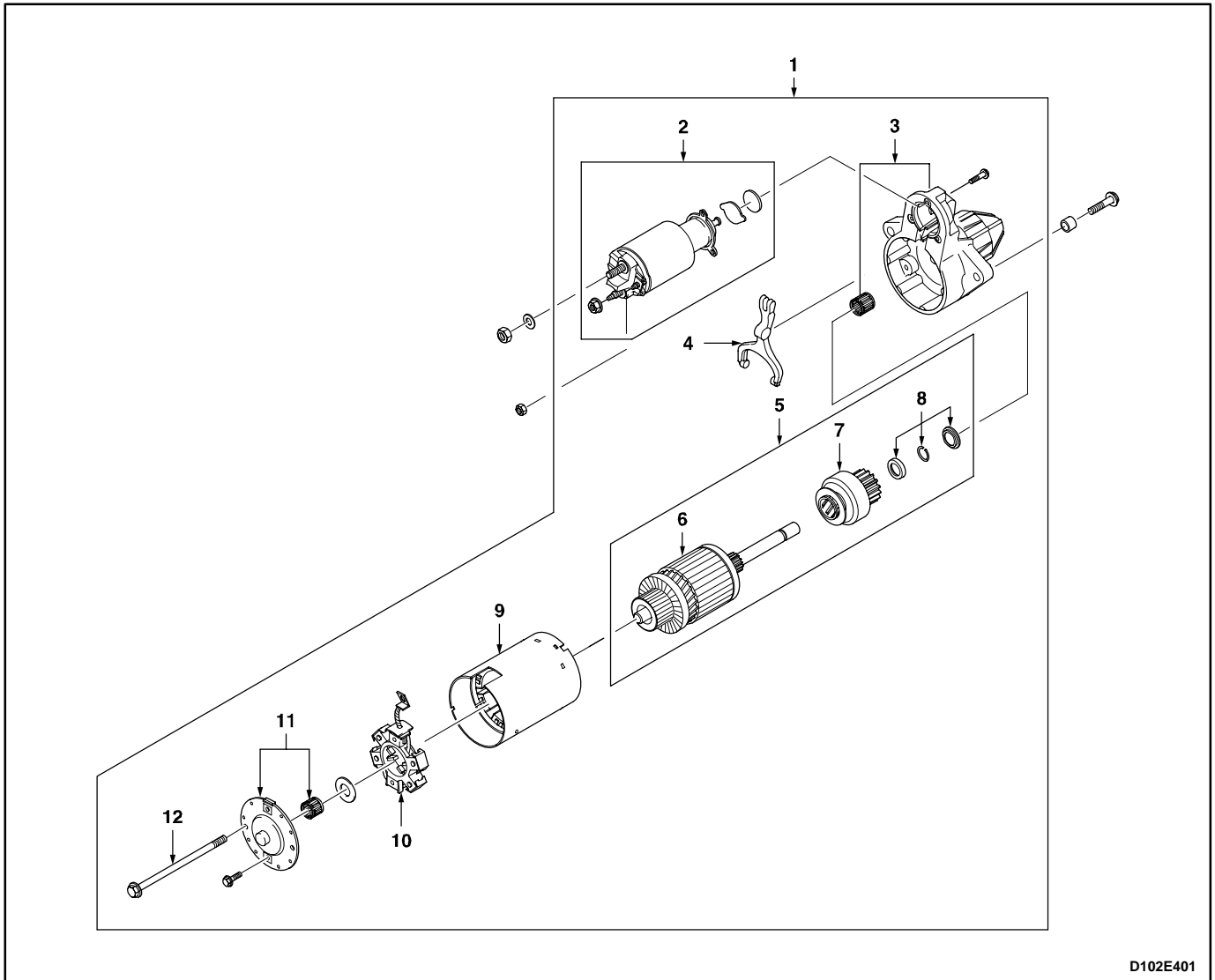
The closed magnetic typed ignition coil is used for the High Energy Ignition (H.E.I) system. Comparing with the iron cored open magnetic type, the closed type almost has no loss of magnetic flux, and smaller in size, so it produces the high voltage of secondary voltage.

## **SPARK PLUG**

It is a part of ignition secondary current, and it burns the compressed mixture by sparking the high voltage induced from the ignition coil.

# COMPONENT LOCATOR

## STARTING SYSTEM

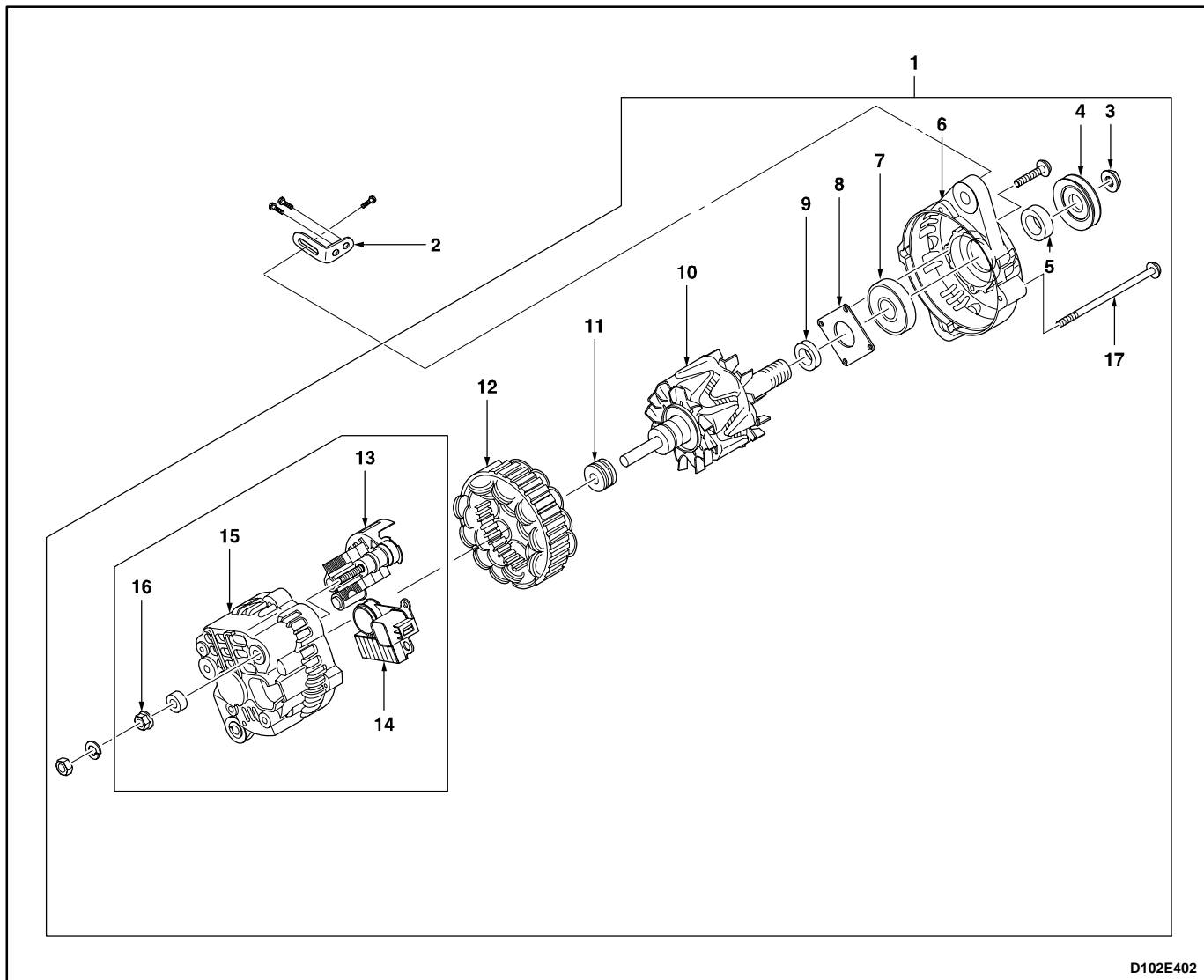


D102E401

- 1 Starter Motor Assembly
- 2 Starter Solenoid Assembly
- 3 Starter Housing
- 4 Shift Lever
- 5 Armature Set
- 6 Armature

- 7 Pinion Gear Assembly
- 8 Ring Set
- 9 Field Frame Assembly
- 10 Brush Holder Assembly
- 11 Contact End Frame Assembly
- 12 Starter Through - Bolts

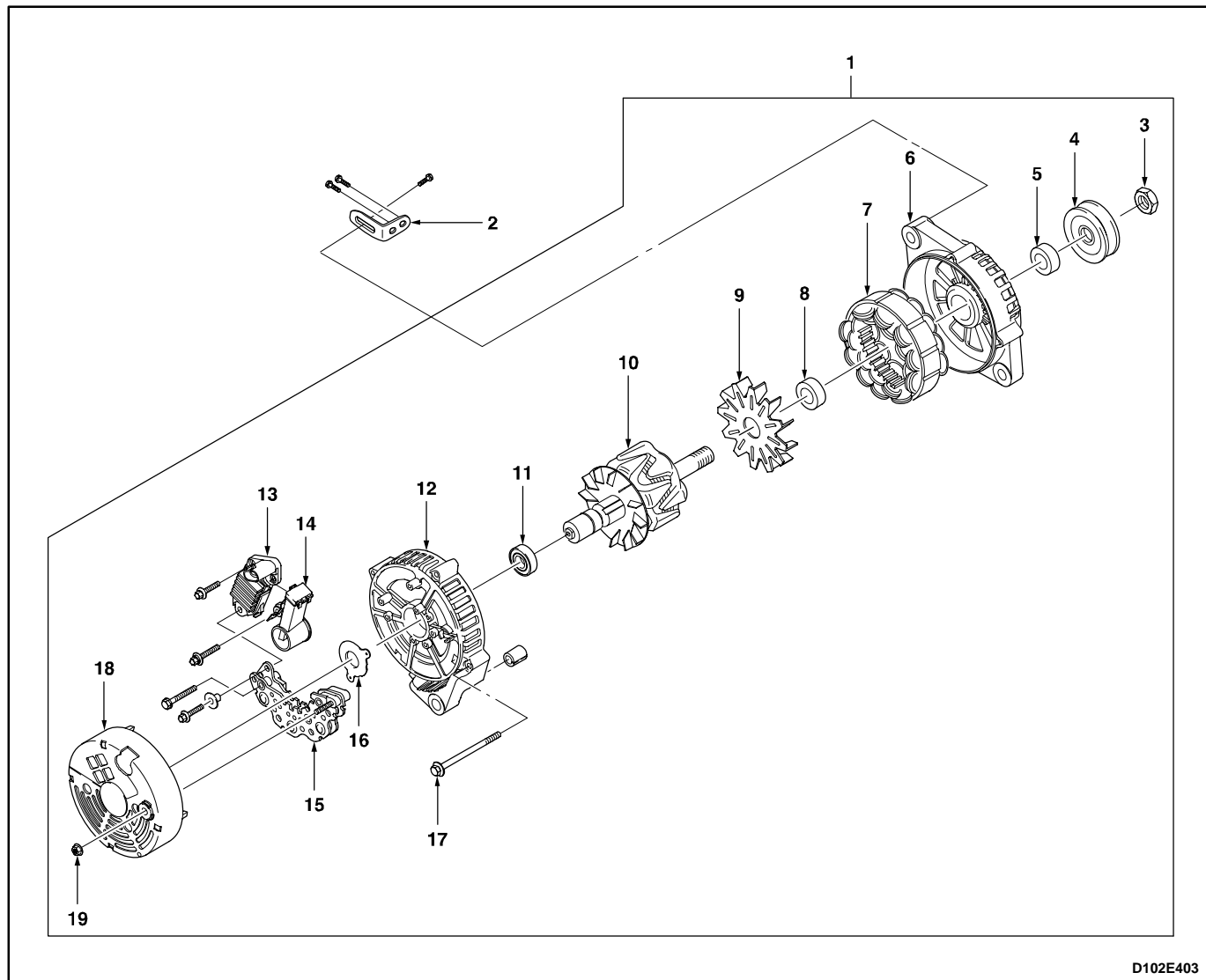
## CHARGING SYSTEM (A-TYPE : MANDO)



D102E402

- |                            |  |
|----------------------------|--|
| 1 Generator Assembly       | 10 Generator Rotor Assembly                  |
| 2 Generator Shackle        | 11 Rear Bearing                              |
| 3 Generator Drive End Nut  | 12 Generator Stator Assembly                 |
| 4 Generator Pulley         | 13 Rectifier Assembly                        |
| 5 Generator Collar (Large) | 14 Voltage Regulator / Brush Holder Assembly |
| 6 Generator Front Bracket  | 15 Generator Rear Bracket                    |
| 7 Front Bearing            | 16 Battery Positive Terminal Nut             |
| 8 Bearing Spot Plate       | 17 Through Bolt                              |
| 9 Generator Collar (Small) |  |

## CHARGING SYSTEM (B-TYPE : DAC)

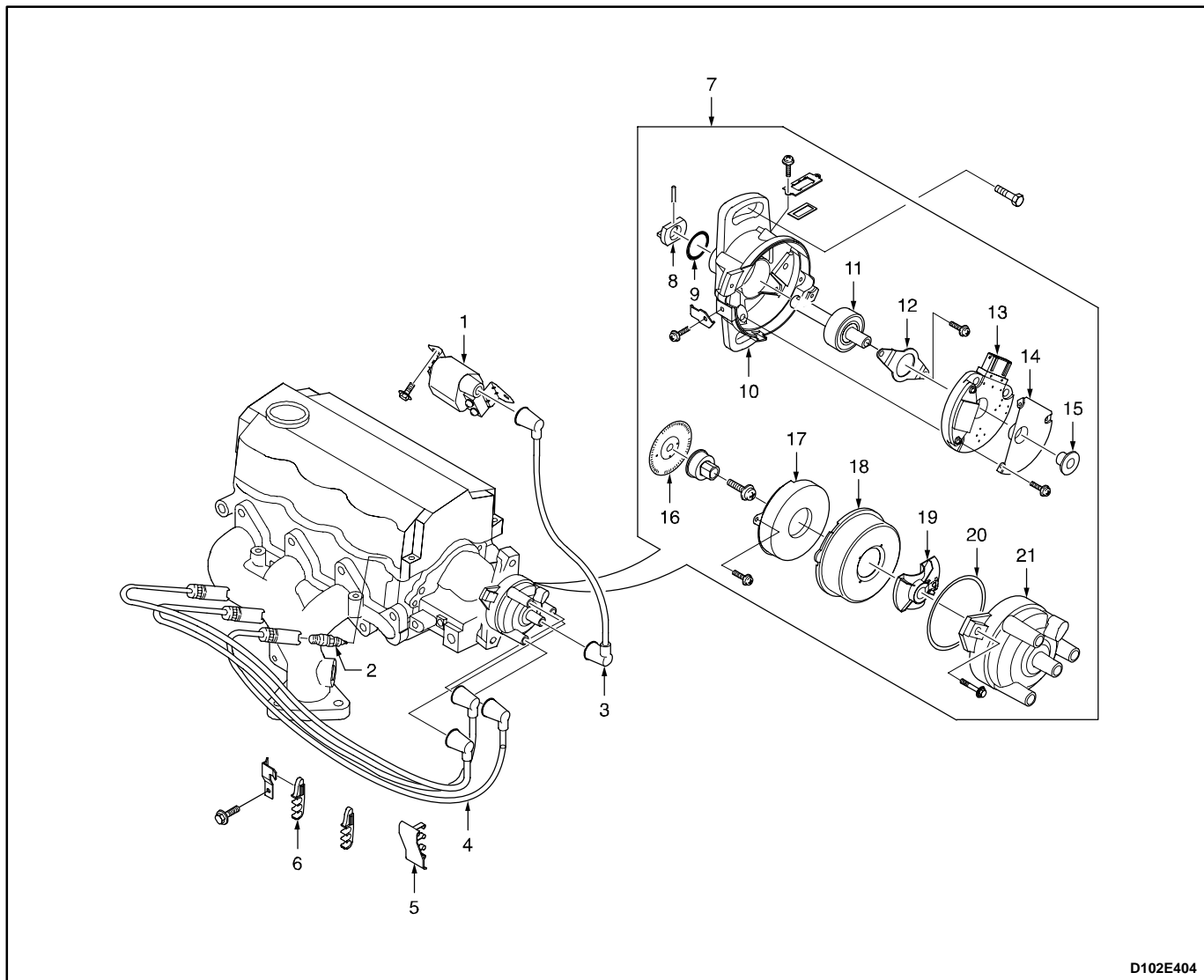


D102E403

- |                               |                                  |
|-------------------------------|----------------------------------|
| 1 Generator Assembly          | 11 Frame Bearing                 |
| 2 Generator Shackle           | 12 Generator Frame               |
| 3 Generator Drive End Nut     | 13 Regulator Assembly            |
| 4 Generator Pully             | 14 Brush Holder Assembly         |
| 5 Generator Collar            | 15 Rectifier Assembly            |
| 6 Generator Drive End Bracket | 16 Shield                        |
| 7 Generator Stator Assembly   | 17 Through - Bolt                |
| 8 Frame Bearing               | 18 Generator Cover               |
| 9 Generator Fan               | 19 Battery Positive Terminal Nut |
| 10 Generator Rotor Assembly   |                                  |



## IGNITION SYSTEM



D102E404

- |                               |                         |
|-------------------------------|-------------------------|
| 1 Ignition Coil               | 12 Plate                |
| 2 Spark Plug                  | 13 Optical Sensor Unit  |
| 3 Ignition Wire (#0)          | 14 Plate                |
| 4 Ignition Wires (#1, #2, #3) | 15 Bushing              |
| 5 Support Clamp               | 16 Disc Wheel           |
| 6 Mounting Clamp              | 17 Inner Cover          |
| 7 Distributor Assembly        | 18 Outer Cover          |
| 8 Coupling                    | 19 Distributor Rotor    |
| 9 Distributor Oil Seal        | 20 Distributor Cap Seal |
| 10 Distributor Housing        | 21 Distributor Cap      |
| 11 Distributor Shaft          |                         |

# DIAGNOSTIC INFORMATION AND PROCEDURE

## IGNITION SYSTEM

Condition	Probable Cause	Correction
No Crank	<ul style="list-style-type: none"> <li>● Low battery voltage.</li> </ul>	<ul style="list-style-type: none"> <li>● Charging the battery or Replace the battery.</li> </ul>
	<ul style="list-style-type: none"> <li>● Battery cable is loose, corroded, or damaged.</li> </ul>	<ul style="list-style-type: none"> <li>● Repair or Replace the battery cable.</li> </ul>
	<ul style="list-style-type: none"> <li>● Faulty starter motor or starter motor circuit is open.</li> </ul>	<ul style="list-style-type: none"> <li>● Repair or Replace the starter motor/starter motor circuit.</li> </ul>
	<ul style="list-style-type: none"> <li>● Faulty ignition switch or fuse Ef2 is blown.</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the ignition switch or fuse Ef2.</li> </ul>
	<ul style="list-style-type: none"> <li>● Ground short.</li> </ul>	<ul style="list-style-type: none"> <li>● Repair the ground short.</li> </ul>
Crank OK, But Too Slow	<ul style="list-style-type: none"> <li>● Low battery voltage.</li> </ul>	<ul style="list-style-type: none"> <li>● Charging the battery or Replace the battery.</li> </ul>
	<ul style="list-style-type: none"> <li>● Batter.</li> <li>● Battery cables is loose, corroded, or damaged.</li> </ul>	<ul style="list-style-type: none"> <li>● Repair or Replace the battery cable.</li> </ul>
	<ul style="list-style-type: none"> <li>● Faulty starter motor.</li> </ul>	<ul style="list-style-type: none"> <li>● Repair or Replace the starter motor.</li> </ul>
Starter Motor Does Not Stop	<ul style="list-style-type: none"> <li>● Faulty starter motor.</li> </ul>	<ul style="list-style-type: none"> <li>● Repair or Replace the starter motor.</li> </ul>
	<ul style="list-style-type: none"> <li>● Faulty ignition switch.</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the ignition switch.</li> </ul>
Starter Motor Running, But Not Cranking	<ul style="list-style-type: none"> <li>● Broken the clutch pinion gear or faulty starter motor.</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the starter motor.</li> </ul>
	<ul style="list-style-type: none"> <li>● Broken the flywheel ring gear.</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the flywheel.</li> </ul>
	<ul style="list-style-type: none"> <li>● Connected circuit is open.</li> </ul>	<ul style="list-style-type: none"> <li>● Repair the open circuit.</li> </ul>
Overcharging Battery	<ul style="list-style-type: none"> <li>● Faulty the IC regulator.</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the IC regulator.</li> </ul>
Battery Discharge	<ul style="list-style-type: none"> <li>● Loosen the generator drive belt.</li> </ul>	<ul style="list-style-type: none"> <li>● Adjust the belt tension or Replace the belt.</li> </ul>
	<ul style="list-style-type: none"> <li>● The circuit is open or a short.</li> </ul>	<ul style="list-style-type: none"> <li>● Repair the open or a short circuit.</li> </ul>
	<ul style="list-style-type: none"> <li>● Faulty IC regulator.</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the IC regulator.</li> </ul>
	<ul style="list-style-type: none"> <li>● Battery run down.</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the battery.</li> </ul>
	<ul style="list-style-type: none"> <li>● Open ground circuit.</li> </ul>	<ul style="list-style-type: none"> <li>● Repair the open ground circuit.</li> </ul>
Charging Indicator Lamp Does Not Work When the Ignition Switch ON (Engine Does Not Work)	<ul style="list-style-type: none"> <li>● Fault IC regulator.</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the IC regulator.</li> </ul>
	<ul style="list-style-type: none"> <li>● Charging indicator lamp is blown or fuse F8 is blown.</li> </ul>	<ul style="list-style-type: none"> <li>● Repair or Replace the charging indicator lamp/fuse F8.</li> </ul>
	<ul style="list-style-type: none"> <li>● Faulty ignition switch.</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the ignition switch.</li> </ul>
	<ul style="list-style-type: none"> <li>● Generator ground circuit is open or a short.</li> </ul>	<ul style="list-style-type: none"> <li>● Repair the circuit.</li> </ul>
Charging Indicator Lamp Does Not Put Out Lights After Starting the Engine	<ul style="list-style-type: none"> <li>● Faulty IC regulator.</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the IC regulator.</li> </ul>
	<ul style="list-style-type: none"> <li>● Battery cable is corroded or damaged.</li> </ul>	<ul style="list-style-type: none"> <li>● Repair or Replace the battery cable.</li> </ul>
	<ul style="list-style-type: none"> <li>● Loosen the generator drive belt.</li> </ul>	<ul style="list-style-type: none"> <li>● Adjust the belt tension or Replace the belt.</li> </ul>
	<ul style="list-style-type: none"> <li>● Faulty wiring harness.</li> </ul>	<ul style="list-style-type: none"> <li>● Repair the wiring harness.</li> </ul>

## IGNITION SYSTEM (Cont'd)

Condition	Probable Cause	Correction
Hard to Starting the Engine	<ul style="list-style-type: none"> <li>● Faulty ignition coil.</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the ignition coil.</li> </ul>
	<ul style="list-style-type: none"> <li>● Faulty distributor (include the optical sensor).</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the distributor or the optical sensor.</li> </ul>
	<ul style="list-style-type: none"> <li>● Faulty spark plug.</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the spark plug or Adjust the gap.</li> </ul>
	<ul style="list-style-type: none"> <li>● Poor ignition timing.</li> </ul>	<ul style="list-style-type: none"> <li>● Reset the valve timing.</li> </ul>
Engine Idling State is Unstable	<ul style="list-style-type: none"> <li>● Faulty spark plug.</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the spark plug or Adjust the gap.</li> </ul>
	<ul style="list-style-type: none"> <li>● Faulty ignition coil.</li> </ul>	<ul style="list-style-type: none"> <li>● Replace the ignition coil.</li> </ul>
	<ul style="list-style-type: none"> <li>● Poor ignition timing.</li> </ul>	<ul style="list-style-type: none"> <li>● Reset the valve timing.</li> </ul>
Poor Engine Accelerating	<ul style="list-style-type: none"> <li>● Poor ignition timing.</li> </ul>	<ul style="list-style-type: none"> <li>● Reset the valve timing.</li> </ul>

## BATTERY LOAD TEST

1. Check the battery for obvious damage, such as a cracked or broken case or cover, which could permit the loss of electrolyte. If obvious damage is noted, replace the battery.

**Caution:** Do not charge the battery if the hydrometer is clear or light yellow. Instead, replace the battery. If the battery feels hot or if violent gassing or spewing of electrolyte through the vent hole occurs, discontinue charging or reduce the charging rate to avoid injury.

2. Check the hydrometer. If the green dot is visible, go to the load test procedure. If the indicator is dark but green is not visible, charge the battery. For charging a battery removed from the vehicle, refer to "Charging a Completely Discharged Battery" in this section.
3. Connect a voltmeter and a battery load tester across the battery terminals.
4. Apply a 300-ampere load for 15 seconds to remove any surface charge from the battery.
5. Remove the load.
6. Wait 15 seconds to let the battery recover, and apply a 270-ampere load.

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

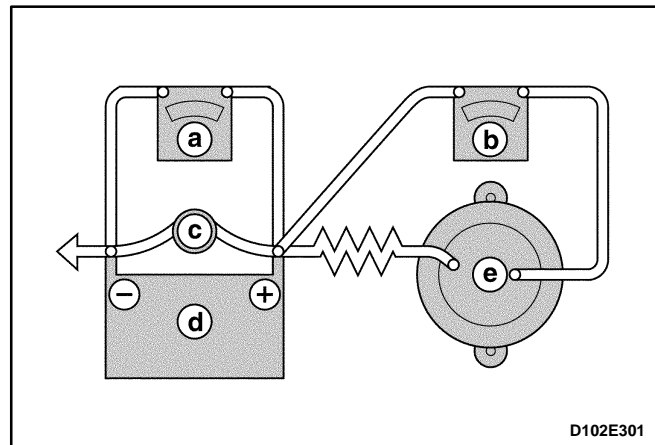
7. If the voltage does not drop below the minimum listed, the battery is good and should be reinstalled. If the voltage is less than the minimum listed, replace the battery. Refer to "Battery Specifications" in this section.

## GENERATOR OUTPUT TEST

1. Perform the generator system test. Refer to "Generator System Check" in this section.
2. Replace the generator if it fails that test. Refer to "Generator" in the On-Vehicle Service section. If it passes the test, perform the on-vehicle output check which follows.

**Important:** Always check the generator for output before assuming that a grounded "L" terminal circuit has damaged the regulator.

3. Attach a digital multimeter (a), an ammeter (b), and a carbon pile load (c) to the battery (d) and the generator (e) of the vehicle.



**Important:** Be sure the vehicle battery is fully charged, and the carbon pile load is turned off.

4. With the ignition switch in the OFF position, check and record the battery voltage.
5. Remove the harness connector from the generator.
6. Turn the ignition switch to the ON position with the engine not running. Use a digital multimeter to check for voltage in the harness connector "L" terminal.
7. The reading should be near the specified battery voltage of 12 volts. If the voltage is too low, check the indicator "L" terminal circuits for open and grounded circuits causing voltage loss. Correct any open wires, terminal connections, etc., as necessary. Refer to "Charging System" in this section.
8. Attach the generator harness connector.
9. Run the engine at a moderate idle, and measure the voltage across the battery terminals. The reading should be above that recorded in Step 4 but less than 15 volts. If the reading is over 15 volts or below the previous reading, replace the generator. Refer to "Generator" in the On-Vehicle Service section.
10. Run the engine at a moderate idle, and measure the generator amperage output.
11. Turn on the carbon pile, and adjust it to obtain the maximum amps while maintaining the battery voltage above 13 volts.
12. If the reading is within 15 amps of the generator's rating noted on the generator, the generator is good. If not, replace the generator. Refer to "Generator" in the On-Vehicle Service section.
13. With the generator operating at the maximum output, measure the voltage between the generator housing and the battery negative terminal. The voltage drop should be 0.5 volt or less. If the voltage drop is more than 0.5 volt, check the ground path from the generator housing to the negative battery cable.
14. Check, clean, tighten, and recheck all of the ground connections.

## GENERATOR SYSTEM CHECK

When operating normally, the generator indicator lamp will come on when the ignition switch is in the ON position and go out when the engine starts. If the lamp operates abnormally or if an undercharged or overcharged battery condition occurs, the following procedure may be used to diagnose the charging system. Remember that an undercharged battery is often caused by accessories being left on overnight or by a defective switch that allows a lamp, such as a trunk or glove box lamp, to stay on.

Diagnose the generator with the following procedure:

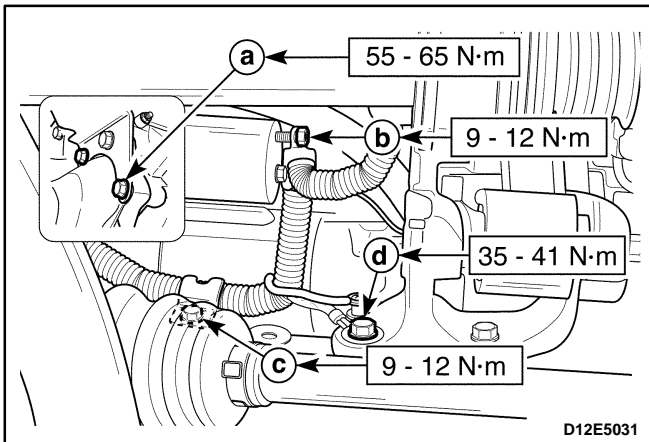
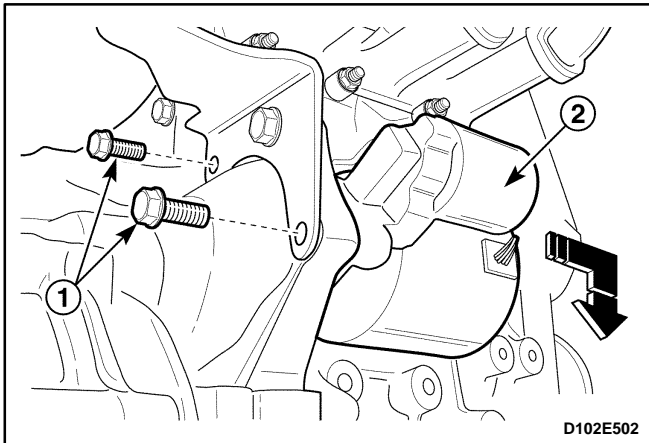
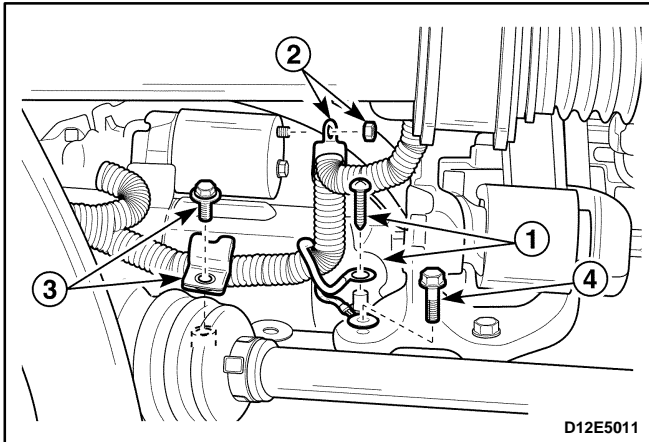
1. Visually check the belt and wiring.
2. With the ignition switch in the ON position and the engine stopped, the charge indicator lamp should be on. If not, detach the harness at the generator and ground the "L" terminal in the harness with a fused, 5-ampere jumper lead.

- If the lamp lights, replace the generator. Refer to "Generator" in the On-Vehicle Service section.
  - If the lamp does not light, locate the open circuit between the ignition switch and the harness connector. The indicator lamp bulb may be burned out.
3. With the ignition switch in the ON position and the engine running at moderate speed, the charge indicator lamp should be off. If not, detach the wiring harness at the generator.
    - If the lamp goes off, replace the generator. Refer to "Generator" in the On-Vehicle Service section.
    - If the lamp stays on, check for a short to ground in the harness between the connector and the indicator lamp.

**Important:** Always check the generator for output before assuming that a grounded "L" terminal circuit has damaged the regulator. Refer to "Generator" in the Unit Repair section.

# REPAIR INSTRUCTIONS

## ON-VEHICLE SERVICE



### STARTER

#### Removal Procedure

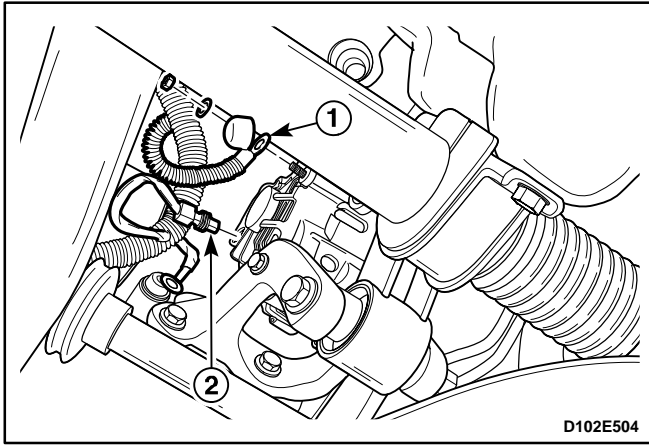
1. Disconnect the negative battery cable.
2. Disconnect the electrical connector and clip around the starter.
  - Remove the engine oil temperature sensor to disconnect the harness connector (1).
  - Remove the starter solenoid nut to disconnect the electrical cable (2).
  - Remove the harness clip bolt to disconnect the harness clip (3).
  - Remove the ground bolt (4).
3. Remove the starter assembly.
  - Remove the starter mounting bolts (1).
  - Remove the starter assembly (2).

#### Installation procedure

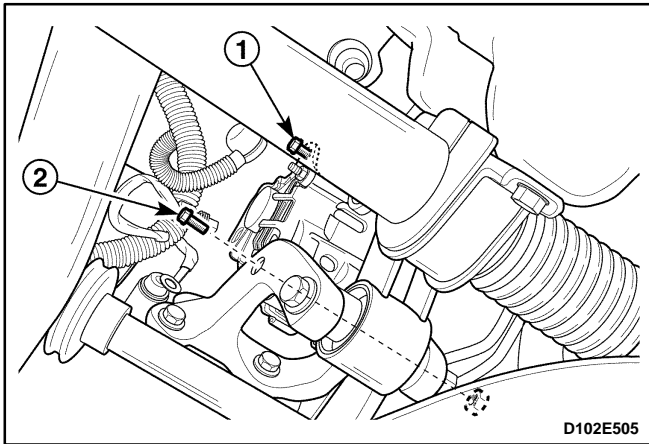
1. Install in the reverse order of removal.
2. Install the starter mounting bolts and starter solenoid nut.

#### Tighten

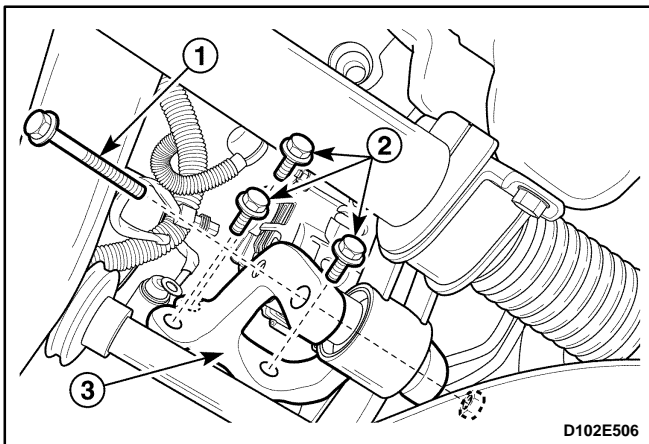
- Tighten the starter mounting bolts to 55–65 N•m (41–48 lb-ft) (a).
- Tighten the starter solenoid nut to 9–12 N•m (80–106 lb-in) (b).
- Tighten the harness clip bolt to 9–12 N•m (80–106 lb-in) (c).
- Tighten the ground bolt to 35–41 N•m (26–30 lb-ft) (d).



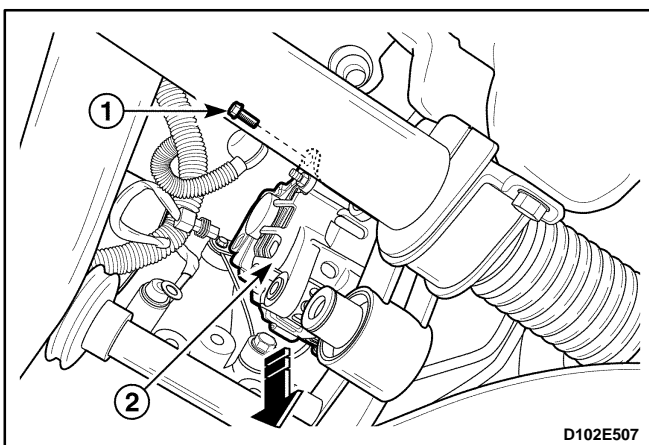
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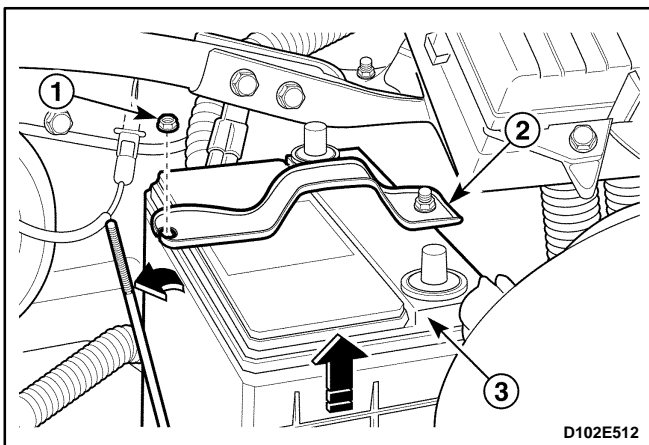
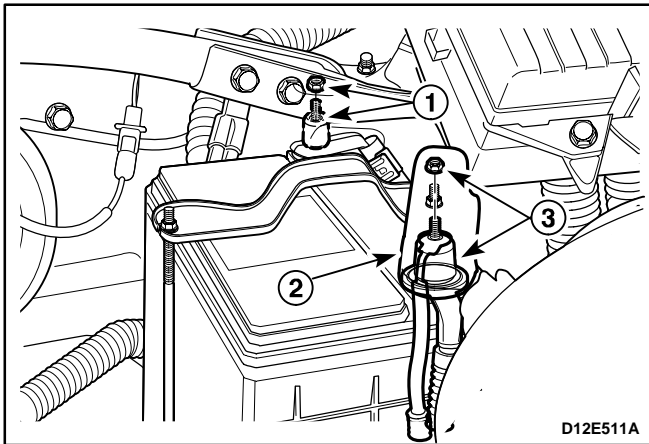
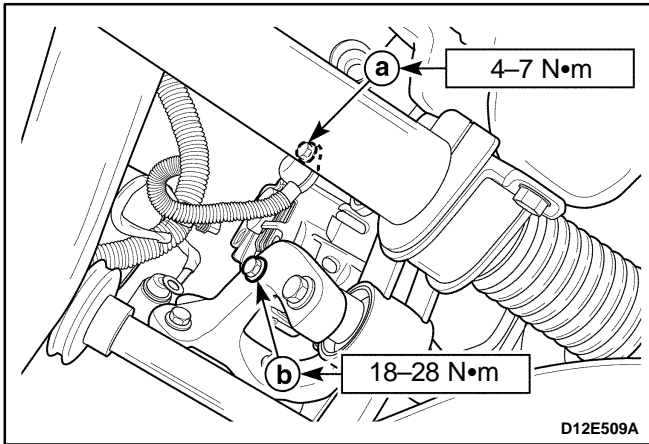
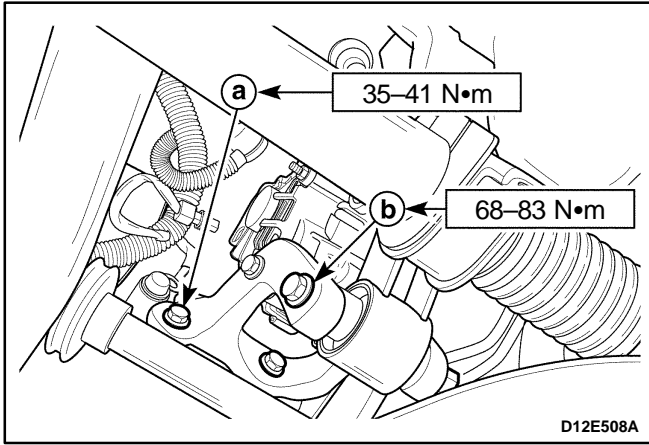


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## GENERATOR

### Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the harness connector.
  - Remove the battery harness connector nut to disconnect the battery positive connector (1).
  - Disconnect the generator harness connector (2).
3. Remove the generator drive belt.
  - Loosen the generator adjusting bolt (1).
  - Remove the lower bracket-to-generator bolt and nut (2).
  - Separate the generator drive belt from the generator.
4. Remove the engine mounting lower bracket.
  - Remove the engine mounting lower bracket, attaching reaction rod bolt and nut (1).
  - Remove the engine mounting lower bracket bolts (2).
  - Remove the engine mounting lower bracket (3).
5. Remove the generator.
  - Remove the generator adjusting bolt (1).
  - Carefully remove the generator (2).



### Installation Procedure

1. Install in the reverse order of removal except generator driver belt.
2. Install the engine mounting lower bracket bolts and nut.

### Tighten

- Tighten the engine mounting lower bracket bolts to 35-41 N•m (25-30 lb-ft) (a).
- Tighten the engine mounting lower bracket, attaching reaction rod bolt and nut to 68-83 N•m (50-61 lb-ft) (b).

3. Install the bolts and nut.

### Tighten

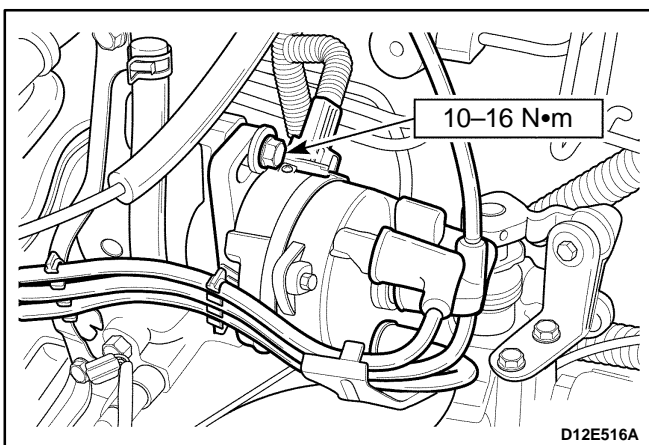
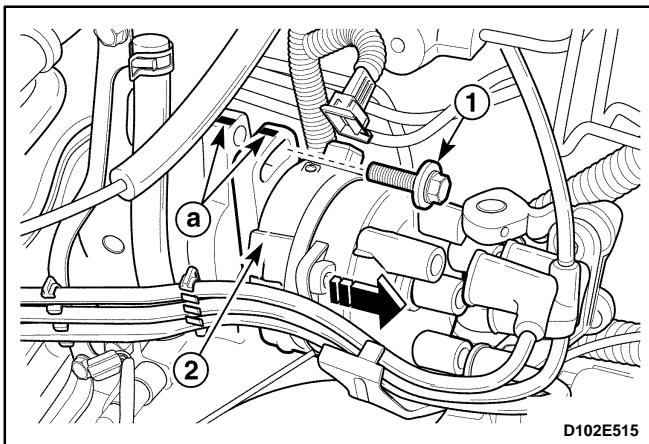
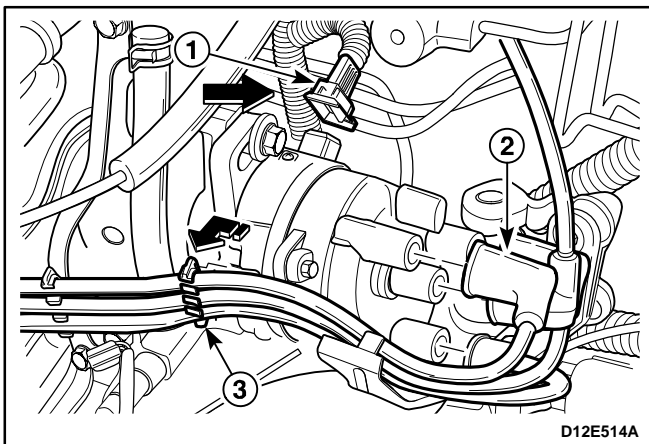
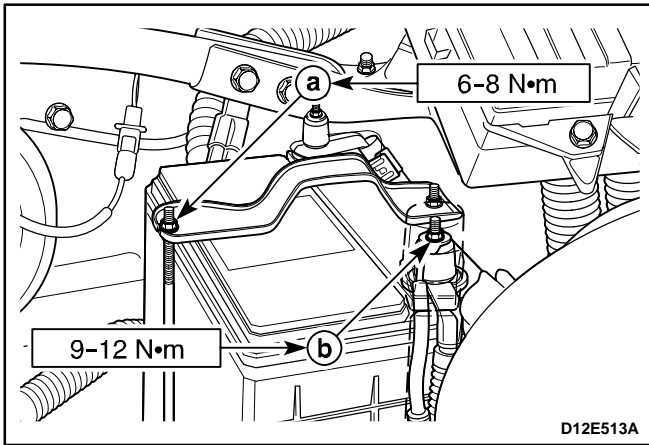
- Tighten the generator adjusting bolt to 4-7 N•m (35-62 lb-in) (a).
- Tighten the generator lower bracket bolt and nut to 18-28 N•m (13-21 lb-ft) (b).
- Inspect the generator drive belt tension.

## BATTERY

### Removal Procedure

1. Disconnect the negative battery cable and then disconnect the positive battery cable.
  - Remove the battery cable nut to disconnect the negative battery cable (1).
  - Remove the battery terminal cap (2).
  - Remove the battery cable nut to disconnect the positive battery cable (3).
2. Remove the battery.
  - Remove the battery rod nut (1).
  - Remove the battery rod (2).
  - Remove the battery (3).





## Installation Procedure

1. Install in the reverse order of removal.
2. Install the battery rod and cable nuts.

## Tighten

- Tighten the battery rod nut to 6–8 N•m (53–71 lb-in) (a).
- Tighten the battery cable nut to 9–12 N•m (80–106 lb-in) (b).

## DISTRIBUTOR

### Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the air filter, resonator with snorkel assembly. Refer to *Section 1B, SOHC Engine Mechanical*.
3. Disconnect the ignition wires and electrical connector.
  - Disconnect the optical sensor connector (1).
  - Disconnect the ignition wires (2).
  - Remove the ignition wire clip (3).

4. Remove the distributor.

**Important:** Mark on the distributor housing and case before remove distributor (a).

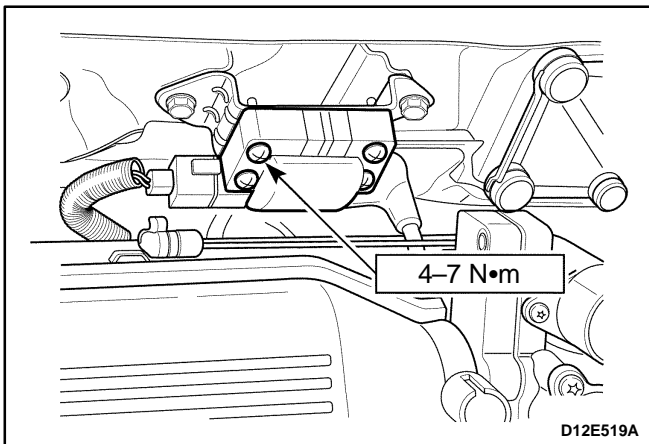
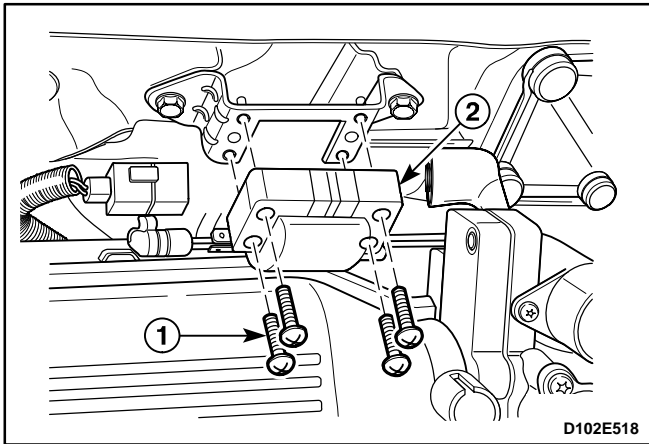
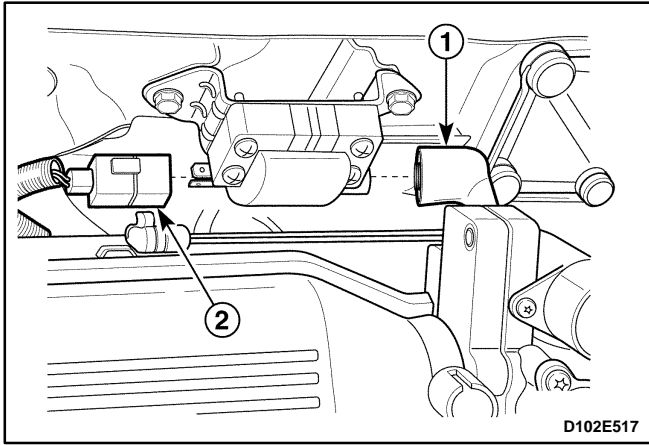
- Remove the distributor bolts (1).
- Carefully remove the distributor assembly (2).

### Installation Procedure

1. Install in the reverse order of removal.
2. Install the distributor bolts.

## Tighten

Tighten the distributor bolts to 10–16 N•m (89–142 lb-in).



## IGNITION COIL

### Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the ignition wires and ignition coil connector.
  - Disconnect the ignition wire (1).
  - Disconnect the ignition coil connector by pushing the connector's lock(2).
3. Remove the ignition coil.
  - Remove the screws (1).
  - Remove the ignition coil (2).

### Installation Procedure

1. Install in the reverse order of removal.
2. Install the ignition coil screws.

#### Tighten

Tighten the ignition coil screws to 4-7 N•m (35-62 lb-in).