Engine Electrical System (G4ED/ G4EE - GSL 1.6/1.4)

GENERAL

GENERAL E12522AB

SPECIFICATION

IGNITION SYSTEM

Items		Specification	
		1.6 DOHC	1.4 DOHC
Ignition coil	Primary resistance	0.87 ± 10 % (Ω)	
	Secondary resistance	13.0 ± 15 % (kΩ)	
Spark plugs (Unleaded)	NGK	BKR5ES-11	
	CHAMPION	RC10YC4	
	Gap	1.0 ~ 1.1 mm (0.0394 ~ 0.0433in.)	
Spark plugs (Leaded)	NGK	BKR5ES	
	CHAMPION	RC10YC	
	Gap	0.9 ~ 1.0 mm (0.0354 ~ 0.0394in.)	

STARTING SYSTEM

Items			Specification	
			1.6 DOHC	1.4 DOHC
Starter	Rated voltage		12 V, 0.9 kW	
	No. of pinion teeth		8	
	No-load characteristics	Voltage	11.5 V	
		Ampere	60A, MAX	
		Speed	5,500 rpm, MIN	
	Commutator diameter	Standard	33 mm (1.2992in.)	
	Under cut depth	Standard	0.5 mm (0.0197in.)	
		Limit	0.2 mm (0.0079in.)	

CHARGING SYSTEM

Items		Specification	
		1.6 DOHC	1.4 DOHC
Alternator	Type	Battery voltage sensing	
	Rate voltage	13.5 V, 90A	
	Speed in use	1,000 ~ 18,000 rpm	
	Voltage regulator	Electronic built-in type	
	Regulator setting voltage	14.55 ± 0.2 V	
	Temperature compensation	-7 ± 3 mV / °C	
Battery	Type	MF 45AH	
	Cold cranking amperage [at -18°C(-0.4°F)]	410 A	
	Reserve capacity	80 min	
	Specific gravity [at 20°C(68°F)]	1.280 ± 0.01	

CAUTION

- ***COLD CRANKING AMPERAGE is the amperage a battery can deliver for 30 seconds and maintain a terminal voltage of 7.2V or greater at a specified temperature.***
- ***RESERVE CAPACITY RATING is amount of time a battery can deliver 25A and maintain a minimum terminal voltage of 10.5V at 26.7°C(80.1°F).***

TROUBLESHOOTING EF5DCBCE

IGNITION SYSTEM

Symptom	Suspect area	Remedy
Engine will not start or is hard to start (Cranks OK)	Ignition lock switch	Inspect ignition lock switch, or replace as required
	Ignition coil	Inspect ignition coil, or replace as required
	Spark plugs	Inspect spark plugs, or replace as required
	Ignition wiring disconnected or broken	Repair wiring, or replace as required
	Spark plugs cable	Inspect cable, or replace as required
Rough idle or stalls	Ignition wiring	Repair wiring, or replace as required
	Ignition coil	Inspect ignition coil, or replace as required
	Spark plugs cable	Inspect cable, or replace as required
Engine hesitates / poor acceleration	Spark plugs and spark plug cables	Inspect spark plugs / cable, or replace as required
	Ignition wiring	Repair wiring, or replace as required
Poor mileage	Spark plugs and spark plug cables	Inspect spark plugs / cable, or replace as required

CHARGING SYSTEM

Symptom	Suspect area	Remedy
Charging warning indicator does not light with ignition switch "ON" and engine off.	Fuse blown	Check fuses
	Light burned out	Replace light
	Wiring connection loose	Tighten loose connection
	Electronic voltage regulator	Replace voltage regulator
Charging warning indicator does not go out with engine running. (Battery requires frequent recharging)	Drive belt loose or worn	Adjust belt tension or replace belt
	Battery cable loose, corroded or worn	Inspect cable connection, repair or replace cable
	Electronic voltage regulator or alternator	Replace voltage regulator or alternator
	Wiring	Repair or replace wiring
Overcharge	Electronic voltage regulator	Replace voltage regulator
	Voltage sensing wire	Repair or replace wiring
Discharge	Drive belt loose or worn	Adjust belt tension or replace belt
	Wiring connection loose or short circuit	Inspect wiring connection, repair or replace wiring
	Electronic voltage regulator or alternator	Replace voltage regulator or alternator
	Poor grounding	Inspect ground or repair
	Worn battery	Replace battery

STARTING SYSTEM

Symptom	Suspect area	Remedy
Engine will not crank	Battery charge low Battery cables loose, corroded or worn out Transaxle range switch (Vehicle with automatic transaxle only) Fuse blown Starter motor faulty Ignition switch faulty	Charge or replace battery Repair or replace cables Refer to TR group-automatic transaxle Replace fuse Replace Replace
Engine cranks slowly	Battery charge low Battery cables loose, corroded or worn out Starter motor faulty	Charge or replace battery Repair or replace cables Replace
Starter keeps running	Starter motor Ignition switch	Replace Replace
Starter spins but engine will not crank	Short in wiring Pinion gear teeth broken or starter motor Ring gear teeth broken	Repair wiring Replace Replace fly wheel or torque converter

IGNITION SYSTEM

DESCRITION E9724F12

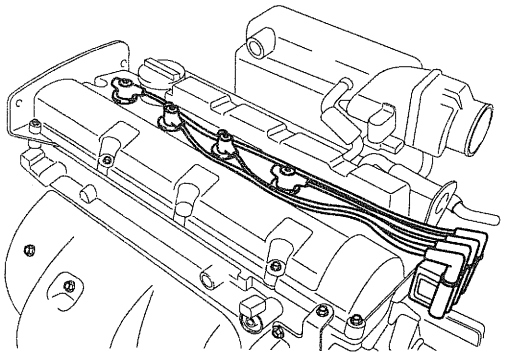
Ignition timing is controlled by the electronic control ignition timing system. The standard reference ignition timing data for the engine operating conditions are pre-programmed in the memory of the ECM (Engine Control Module).

The engine operating conditions (speed, load, warm-up condition, etc.) are detected by the various sensors. Based on these sensor signals and the ignition timing data, signals to interrupt the primary current are sent to the ECM. The ignition coil is activated, and timing is controlled.

ON-VEHICLE INSPECTION E4F36345

SPARK TEST

1. Remove the spark plug cable.



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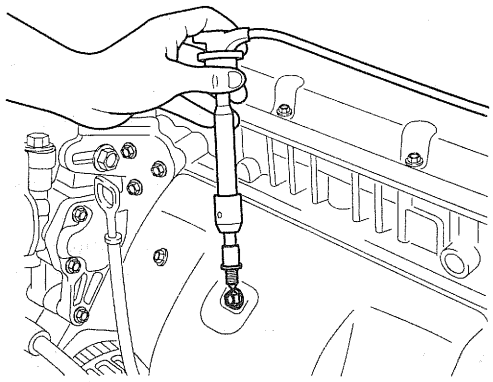
2. Using a spark plug socket, remove the spark plug.
3. Install the spark plug to the spark plug cable.
4. Ground the spark plug to the engine.



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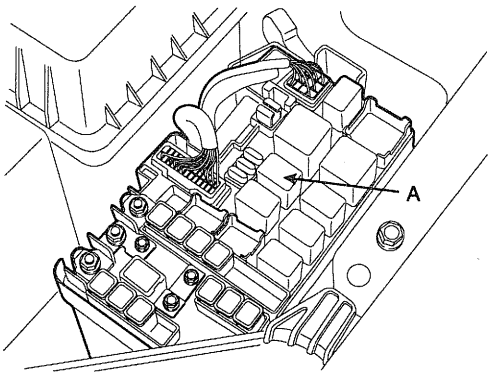
5. Check is spark occurs while engine is being cranked.

NOTE

To prevent fuel being injected from injectors while the engine is being cranked, remove the fuel pump(A) relay from the fuse box.
Crank the engine for no more than 5 ~ 10 seconds.



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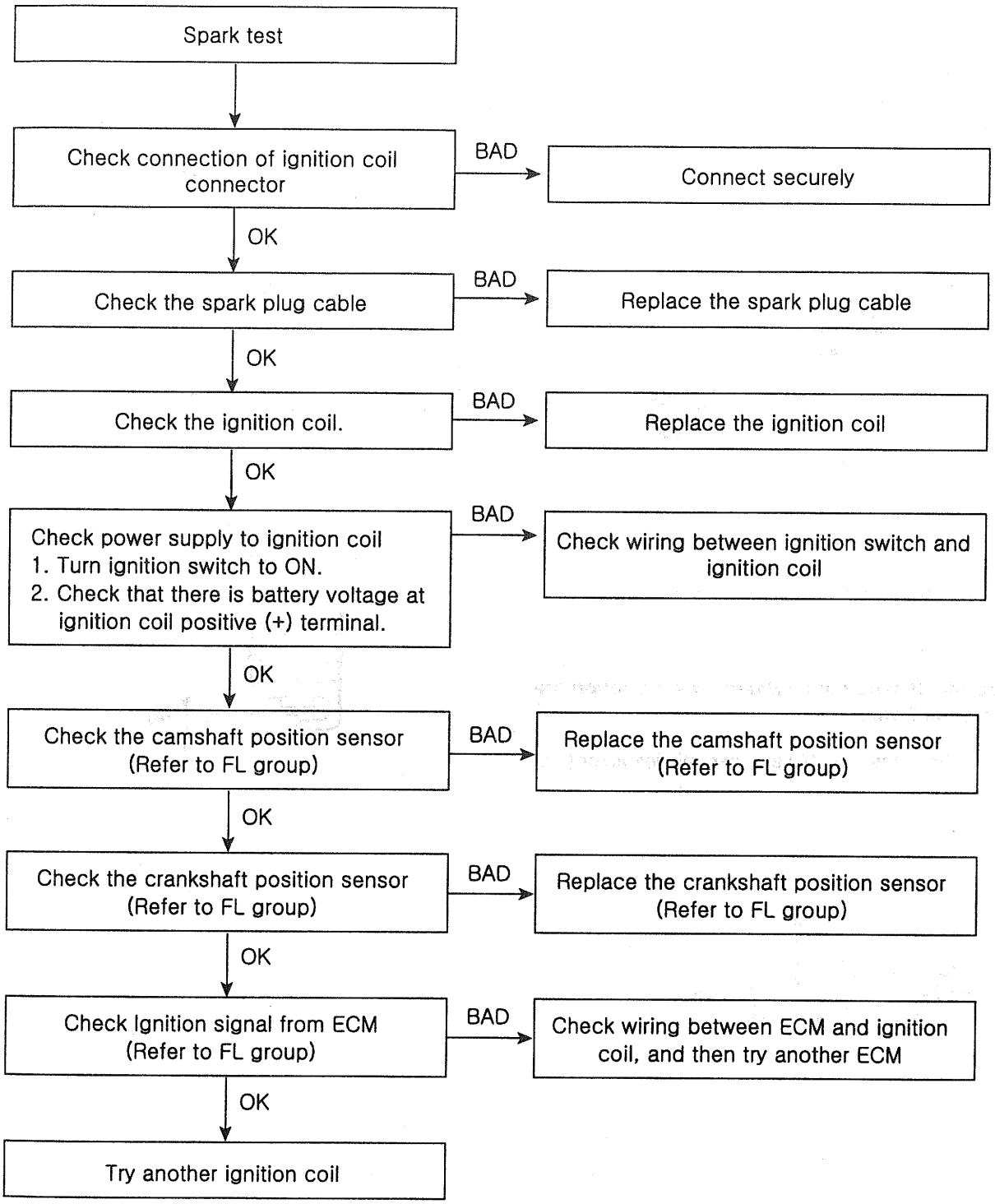
6. Inspect all the spark plugs.
7. Using a spark plug socket, install the spark plug.
8. Install the spark plug cable.


Spark test
Check connection of ignition coil connector
BAD
Connect securely
OK
Check the spark plug cable
BAD
Replace the spark plug cable
OK
Check the ignition coil.
BAD
Replace the ignition coil
OK
Check power supply to ignition coil
1. Turn ignition switch to ON.
2. Check that there is battery voltage at ignition coil positive (+) terminal.
BAD
Check wiring between ignition switch and ignition coil
OK
Check the camshaft position sensor (Refer to FL group)
BAD
Replace the camshaft position sensor (Refer to FL group)
OK
Check the crankshaft position sensor (Refer to FL group)
BAD
Replace the crankshaft position sensor (Refer to FL group)
OK
Check Ignition signal from ECM (Refer to FL group)
BAD
Check wiring between ECM and ignition coil, and then try another ECM
OK
Try another ignition coil

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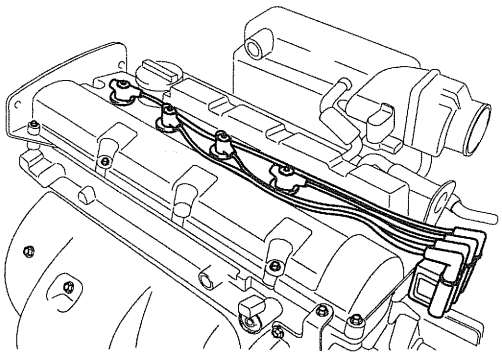
INSPECT SPARK PLUG

1. Remove the spark plug cable.

> **NOTE**
> *When removing the spark plug cable, pull on the spark plug cable boot (not the cable), as it may be damaged.*



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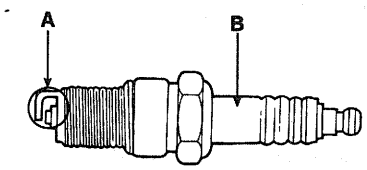
2. Using a spark plug socket, remove the spark plug.

> **CAUTION**
> ***Be careful that no contaminates enter through the spark plug holes.***

3. Inspect the electrodes (A) and ceramic insulator (B).



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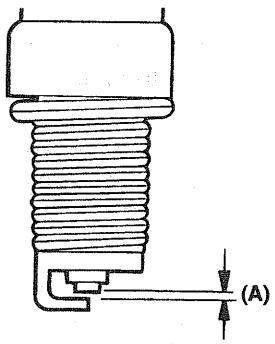
INSPECTION OF ELECTRODES

Condition	Dark deposits	White deposits
Description	- Fuel mixture too rich - Low air intake	- Fuel mixture too lean - Advanced ignition timing - Insufficient plug tightening torque

4. Check the electrode gap (A).

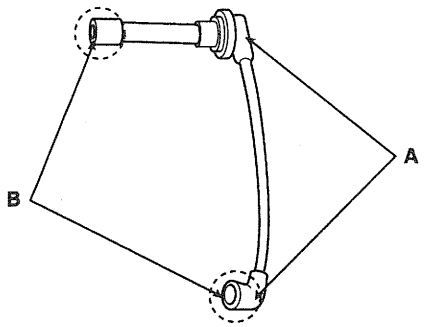
Standard
Unleaded : 1.0 ~ 1.1 mm (0.0394 ~ 0.0433 in.)
Leaded: 0.9 ~ 1.0 mm (0.0354 ~ 0.0394in.)



EBKD002L

INSPECT SPARK PLUG CABLE

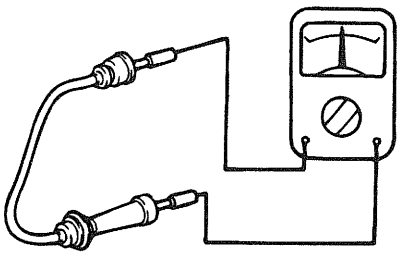
1. Carefully remove the spark plug cable by pulling on the rubber boots (A).
   Check the condition of the spark plug cable terminals (B), if any terminal is corroded, cleans it, and if it broken or distorted, replace the spark plug cable.



ABGE009A

2. Connect the ohmmeter probes and measure resistance.

RESISTANCE : 5.6kΩ /m ± 20%

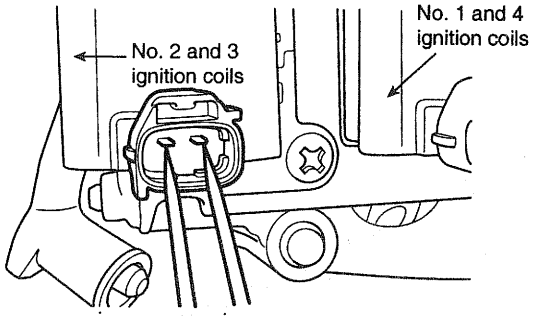


EBKD002P

3. Resistance should not be higher than 10kΩ /m.
   If resistance is higher, replace the cable.

INSPECT IGNITION COIL

1. Measure the primary coil resistance between terminals (+) and (-).



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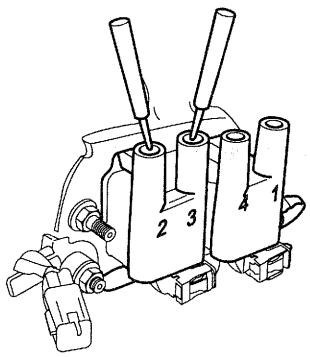
Standard value: 0.87Ω ± 10%

2. Measure the secondary coil resistance between the high-voltage terminals for the No.1 and No. 4 cylinders, and between the high voltage terminals for the No. 2 and No. 3 cylinders.

Standard value: 13.0kΩ ± 15%

CAUTION

Be sure, when measuring the resistance of the secondary coil, to disconnect the connector of the ignition coil.

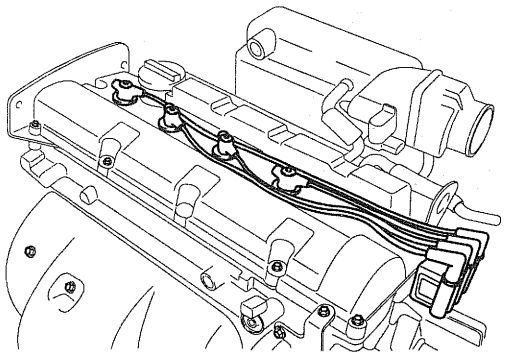


EBKD002C

REPLACEMENT E0AFE6B4

IGNITION COIL

1. Remove the engine cover.
2. Disconnect the spark plug cables and the ignition coil connector.



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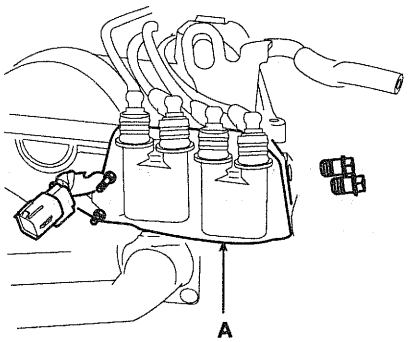
3. Remove the ignition coil (A).



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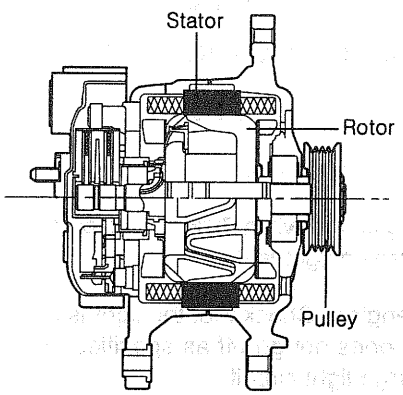
4. Installation is the reverse of removal.

CHARGING SYSTEM

DESCRIPTION E024309A

The charging system included a battery, an alternator with a built-in regulator, and the charging indicator light and wire.
The Alternator has eight built-in diodes, each rectifying AC current to DC current.
Therefore, DC current appears at alternator "B" terminal.
In addition, the charging voltage of this alternator is regulated by the battery voltage detection system.
The alternator is regulated by the battery voltage detection system. The main components of the alternator are the rotor, stator, rectifier, capacitor brushes, bearings and V-ribbed belt pulley. The brush holder contains a built-in electronic voltage regulator.



LBJF003A

ON-VEHICLE INPECTION E0EDEC50

⚠ *CAUTION*

- ***Check that the battery cables are connected to the correct terminals.***
- ***Disconnect the battery cables when the battery is given a quick charge.***
- ***Never disconnect the battery while the engine is running.***

CHECK BATTERY VOLTAGE

1. If 20 minutes have not passed since the engine was stopped, turn the ignition switch ON and turn on the electrical system (headlamp, blower motor, rear defogger etc.) for 60 seconds to remove the surface charge.
2. Turn the ignition switch OFF and turn off the electrical systems.
3. Measure the battery voltage between the negative (-) and positive (+) terminals of the battery.

Standard voltage : 12.5 ~ 12.9V at 20°C(68°F)

If the voltage is less than specification, charge the battery.

CHECK THE BATTERY TERMINALS AND FUSES

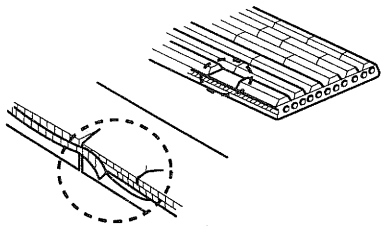
1. Check that the battery terminals are not loose or corroded.
2. Check the fuses for continuity.

INSPECT DRIVE BELT

1. Visually check the belt for excessive wear, frayed cords etc.
   If any defect has been found, replace the drive belt.

   NOTE

   Cracks on the rib side of a belt are considered acceptable. If the belt has chunks missing from the ribs, it should be replaced.



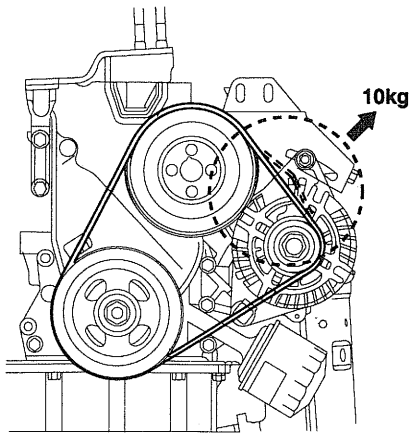
EBKD004B

2. Measure the drive belt tension and adjust it.
   Apply a force of 98N (10kg, 22lb), and measure the deflection between the alternator and the water pump pulley.

DEFLECTION

New belt	3.3 ~ 3.7mm (0.1299 ~ 0.1457in.)
Used belt	4.2 ~ 4.7mm (0.1654 ~ 0.1850in.)

If the belt tension is not as specified, adjust it.



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NOTE

- *"New belt" refers to a belt which has been used less than 5 minutes on a running engine.*
- *"Used belt" refers to a belt which has been used on a running engine for 5 minutes or more.*
- *After installing a belt, check that it fits properly in the ribbed grooves.*
- *Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.*
- *After installing a new belt, run the engine for about 5 minutes and recheck the belt tension.*

VISUALLY CHECK ALTERNATOR WIRING AND LISTEN FOR ABNORMAL NOISES

1. Check that the wiring is in good condition.
2. Check that there is no abnormal noise from the alternator while the engine is running.

CHECK DISCHARGE WARNING LIGHT CIRCUIT

1. Warm up the engine and then turn it off.
2. Turn off all accessories.
3. Turn the ignition switch "ON". Check that the discharge warning light is lit.
4. Start the engine. Check that the light is lit.
   If the light does not go off as specified, troubleshoot the discharge light circuit.

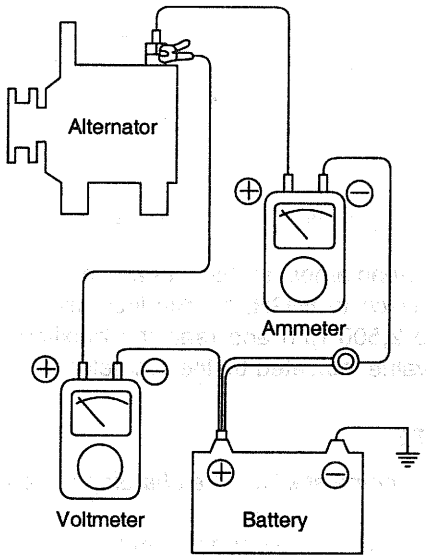
INSPECT CHARGING SYSTEM

VOLTAGE DROP TEST OF ALTERNATOR OUTPUT WIRE

This test determines whether or not the wiring between the alternator "B" terminal and the battery (+) terminal is good by the voltage drop method.

PREPARATION

1. Turn the ignition switch to "OFF".
2. Disconnect the output wire from the alternator "B" terminal. Connect the (+) lead wire of ammeter to the "B" terminal of alternator and the (-) lead wire of ammeter to the output wire. Connect the (+) lead wire of voltmeter to the "B" terminal of alternator and the (-) lead wire of voltmeter to the (+) terminal of battery.



BBGE002A

TEST

1. Start the engine.
2. Turn on the headlamps and blower motor, and set the engine speed until the ammeter indicates 20A.
   And then, read the voltmeter at this time.

RESULT

1. The voltmeter may indicate the standard value.

Standard value: 0.2V max

2. If the value of the voltmeter is higher than expected (above 0.2V max.), poor wiring is suspected. In this case check the wiring from the alternator "B" terminal to the battery (+) terminal. Check for loose connections, color change due to an over-heated harness, etc. Correct them before testing again.
3. Upon completion of the test, set the engine speed at idle.
   Turn off the headlamps, blower motor and the ignition switch.

OUTPUT CURRENT TEST

This test determines whether or not the alternator gives an output current that is equivalent to the normal output.

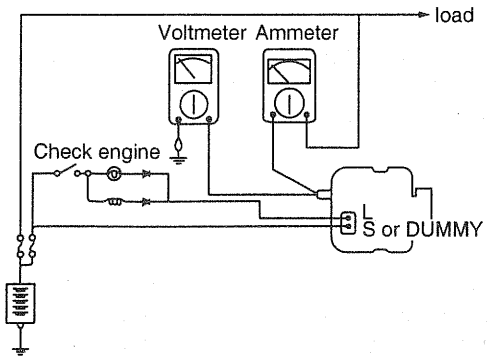
PREPARATION

1. Prior to the test, check the following items and correct as necessary.
   Check the battery installed in the vehicle to ensure that it is good condition. The battery checking method is described in the section "Battery".
   The battery that is used to test the output current should be one that has been partially discharged. With a fully charged battery, the test may not be conducted correctly due to an insufficient load.
   Check the tension of the alternator drive belt. The belt tension check method is described in the section "Inspect drive belt".
2. Turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Disconnect the alternator output wire from the alternator "B" terminal.
5. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire. Be sure to connect the (-) lead wire of the ammeter to the disconnected output wire.

   NOTE

   Tighten each connection securely, as a heavy current will flow. Do not rely on clips.

6. Connect a voltmeter (0 to 20V) between the "B" terminal and ground. Connect the (+) lead wire to the alternator "B" terminal and (-) lead wire to a good ground.
7. Attach an engine tachometer and connect the battery ground cable.
8. Leave the engine hood open.



EBKD013H

TEST

1. Check to see that the voltmeter reads as the same value as the battery voltage. If the voltmeter reads 0V, and the open circuit in the wire between alternator "B" terminal and battery (-) terminal or poor grounding is suspected.
2. Start the engine and turn on the headlamps.
3. Set the headlamps to high beam and the heater blower switch to HIGH, quickly increase the engine speed to 2,500 rpm and read the maximum output current value indicated by the ammeter.

   NOTE

   After the engine start up, the charging current quickly drops.
   Therefore, the above operation must be done quickly to read the maximum current value correctly.

RESULT

1. The ammeter reading must be higher than the limit value. If it is lower but the alternator output wire is in good condition, remove the alternator from the vehicle and test it.

Limit value (90A alternator): 63A min.

NOTE

- *The nominal output current value is shown on the nameplate affixed to the alternator body.*
- *The output current value changes with the electrical load and the temperature of the alternator itself.*
  Therefore, the nominal output current may not be obtained. If such is the case, keep the headlamps on the cause discharge of the battery, or use the lights of another vehicle to increase the electrical load.
  The nominal output current may not be obtained if the temperature of the alternator itself or ambient temperature is too high.
  In such a case, reduce the temperature before testing again.

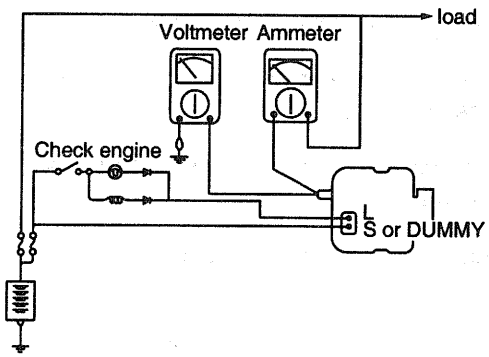
2. Upon completion of the output current test, lower the engine speed to idle and turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Remove the ammeter and voltmeter and the engine tachometer.
5. Connect the alternator output wire to the alternator "B" terminal.
6. Connect the battery ground cable.

REGULATED VOLTAGE TEST

The purpose of this test is to check that the electronic voltage regulator controls voltage correctly.

PREPARATION

1. Prior to the test, check the following items and correct if necessary.
   Check that the battery installed on the vehicle is fully charged. The battery checking method is described in the section "Battery".
   Check the alternator drive belt tension. The belt tension check method is described in the section "Inspect drive belt".
2. Turn ignition switch to "OFF".
3. Disconnect the battery ground cable.
4. Connect a digital voltmeter between the "B" terminal of the alternator and ground. Connect the (+) lead of the voltmeter to the "B" terminal of the alternator. Connect the (-) lead to good ground or the battery (-) terminal.
5. Disconnect the alternator output wire from the alternator "B" terminal.
6. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire. Connect the (-) lead wire of the ammeter to the disconnected output wire.
7. Attach the engine tachometer and connect the battery ground cable.



EBKD013H

TEST

1. Turn on the ignition switch and check to see that the voltmeter indicates the following value.

Voltage: Battery voltage

If it reads 0V, there is an open circuit in the wire between the alternator "B" terminal and the battery and the battery (-) terminal.

2. Start the engine. Keep all lights and accessories off.
3. Run the engine at a speed of about 2,500 rpm and read the voltmeter when the alternator output current drops to 10A or less

RESULT

1. If the voltmeter reading agrees with the value listed in the regulating voltage table below, the voltage regulator is functioning correctly. If the reading is other than the standard value, the voltage regulator or the alternator is faulty.

REGULATING VOLTAGE TABLE

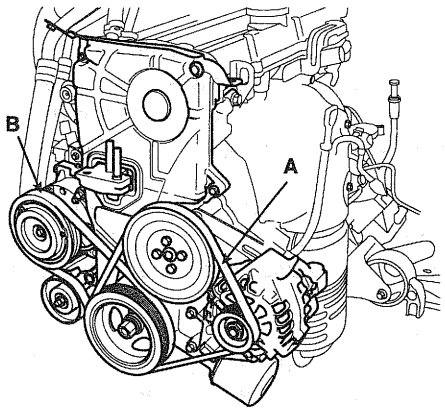
Voltage regulator ambient temperature °C (°F)	Regulating voltage (V)
-20 (-4) 20 (68) 60 (140) 80 (176)	14.2 ~ 15.4 14.0 ~ 15.0 13.7 ~ 14.9 13.5 ~ 14.7

2. Upon completion of the test, reduce the engine speed to idle, and turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Remove the voltmeter and ammeter and the engine tachometer.
5. Connect the alternator output wire to the alternator "B" terminal.
6. Connect the battery ground cable.

ALTERNATOR

REPLACEMENT EAFC6680

1. Disconnect the battery negative terminal first, then the positive terminal.
2. Remove the drive belts.



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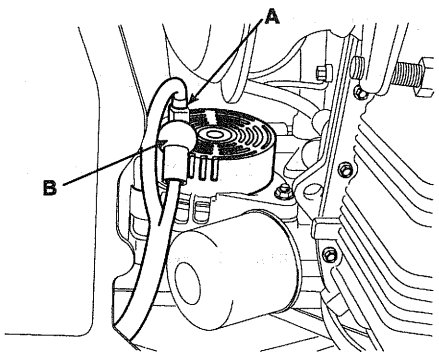
3. Disconnect the alternator connector (A), and remove the cable (B) from alternator "B" terminal.



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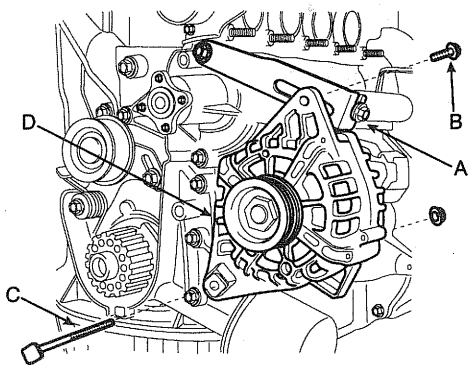
4. Remove the adjusting bolt (A) and mounting bolt (B), then remove the alternator drive belt.

5. Pull out the through bolt (C) and then remove the alternator (D).

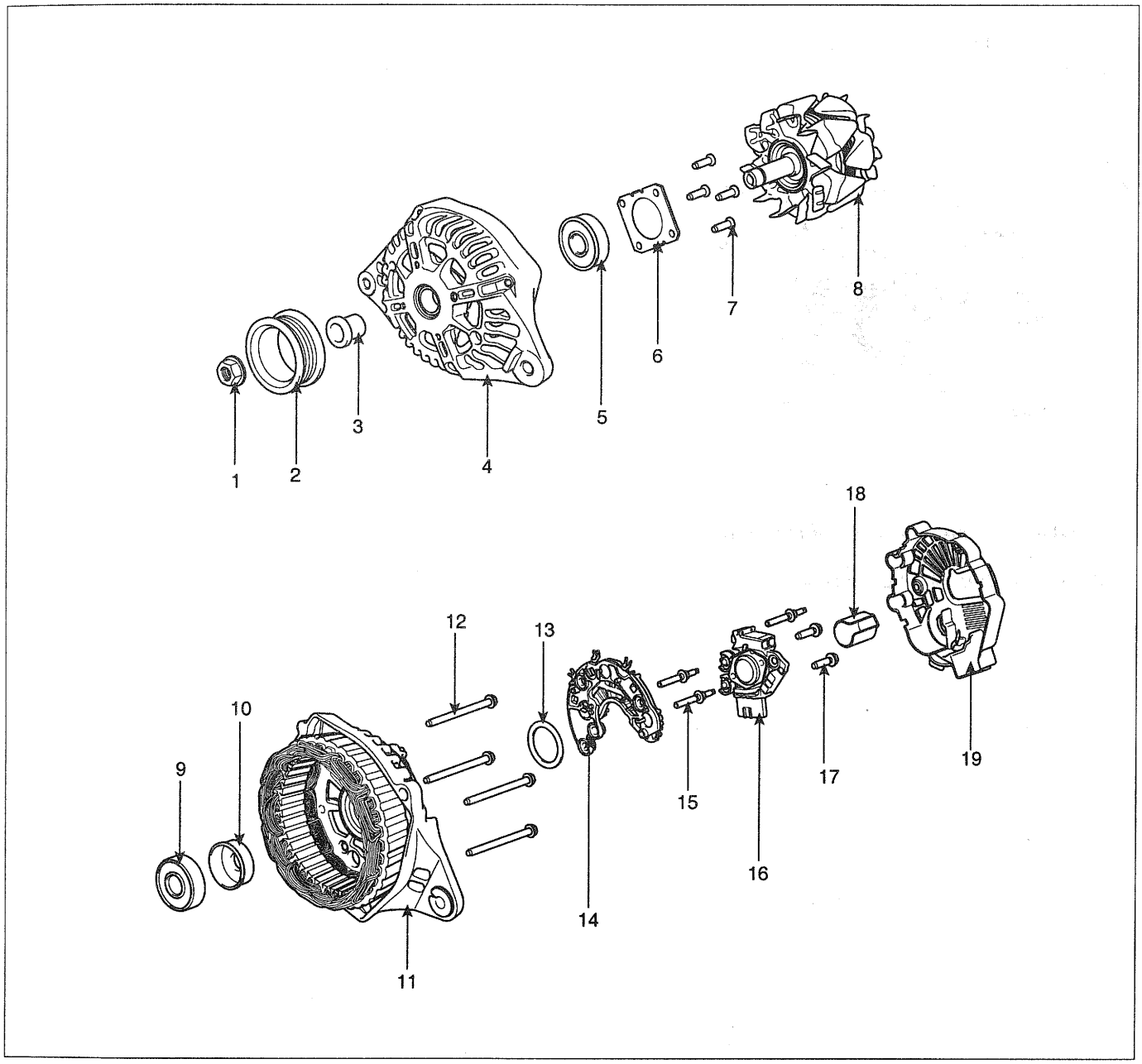


KBPF002A

6. Installation is the reverse order of removal.

7. Adjust the alternator belt tension after installation.

COMPONENT E3F8E95F

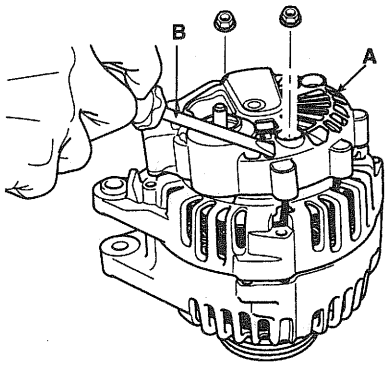


1. Nut
2. Pulley
3. Spacer
4. Front cover assembly
5. Front bearing
6. Bearing cover
7. Bearing cover bolts
8. Rotor coil
9. Rear bearing
10. Bearing cover
11. Rear cover
12. Bolts
13. Seal
14. Rectifier assembly
15. Stud bolts
16. Brush holder assembly
17. Brush holder bolts
18. Slip ring guide
19. Cover

LBGE008A

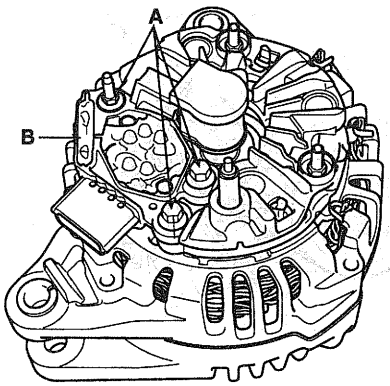
DISASSEMBLY E43E1C51

1. Remove the alternator cover(A) using a screw driver(B).



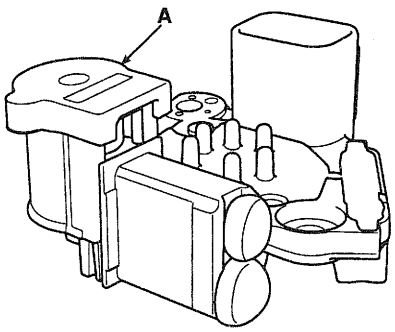
ABJF004A

2. Loosen the mounting bolts(A) and disconnect the brush holder assembly(B).



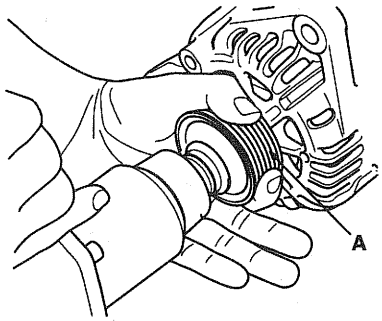
EBKD301B

3. Remove the slip ring guide(A).



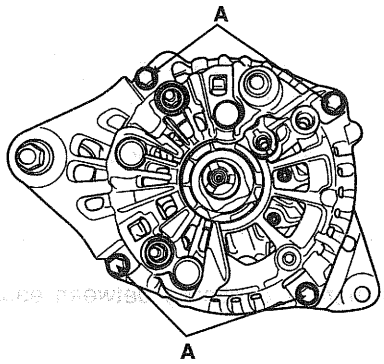
EBKD301C

4. Remove the nut, pulley(A) and spacer.



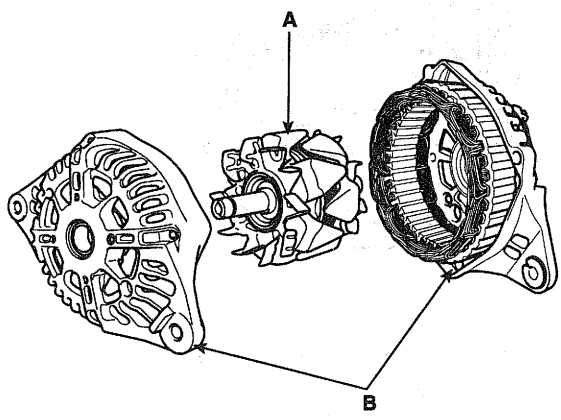
EBKD301D

5. Loosen the 4 through bolts(A).



EBKD301E

6. Disconnect the rotor(A) and cover(B).



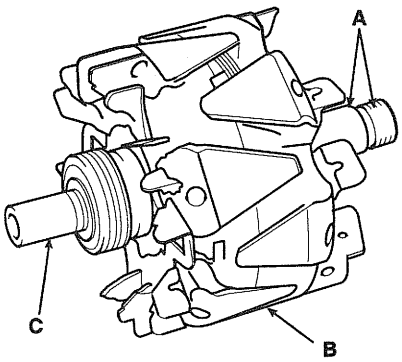
EBKD301G

7. Reassembly is the reverse of disassembly.

INSPECTION EECF033F

INSPECT ROTOR

1. Check that there is continuity between the slip rings (A).

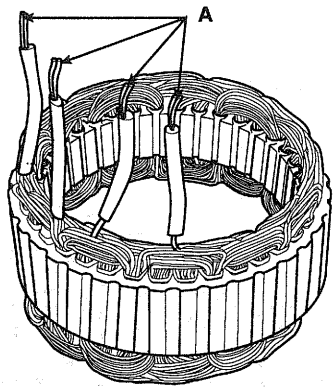


EBKD008A

2. Check that there is no continuity between the slip rings and the rotor (B) or rotor shaft (C).
3. If the rotor fails either continuity check, replace the alternator.

INSPECT STATOR

1. Check that there is continuity between each pair of leads (A).



EBKD008B

2. Check that there is no continuity between each lead and the coil core.
3. If the coil fails either continuity check, replace the alternator.

ALTERNATOR BELT INSPECTION AND ADJUSTMENT

NOTE

When using a new belt, first adjust the deflection or tension to the values for the new belt, then readjust the deflection or tension to the value for the used belt after running engine for five minutes.

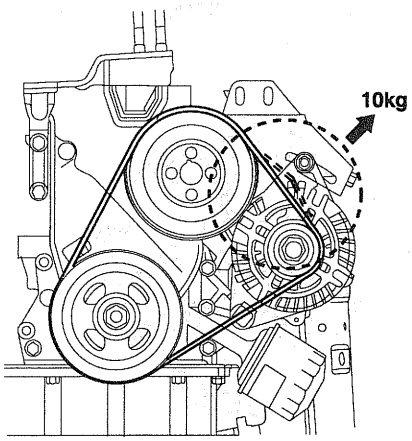
DEFLECTION METHOD:

Apply a force of 98N (10kg, 22lb), and measure the deflection between the alternator and the water pump pulley.

Deflection
Used belt: 4.2 ~ 4.7 mm (0.1654 ~ 0.1850 in)
New belt: 3.3 ~ 3.7 mm (0.1299 ~ 0.1457 in)

NOTE

If the belt is worn or damaged, replace it.



ABJF002A

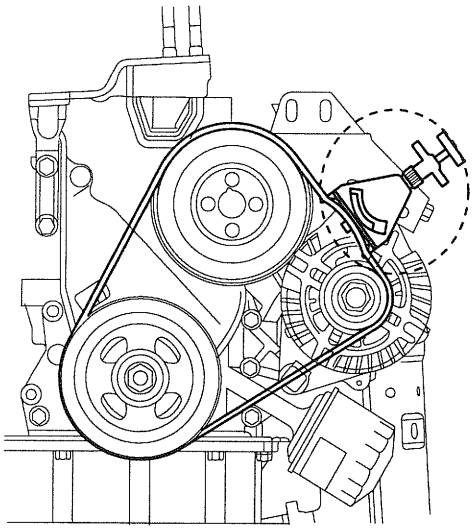
BELT TENSION GAUGE METHOD:

Attach the belt tension gauge to the belt and measure the tension. Follow the gauge manufacturer's instructions.

Tension
Used belt: 392.3 ~ 490.3N (40 ~ 50kg, 88.2 ~ 110.2lb)
New belt: 637.4 ~ 735.5N (65 ~ 75kg, 143.3 ~ 165.3lb)

NOTE

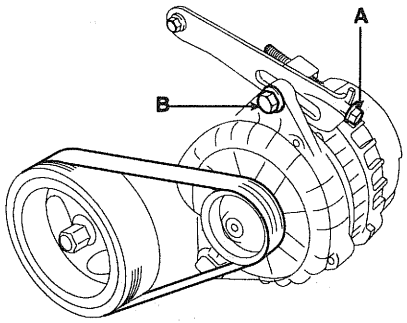
If the belt is worn or damaged, replace it.



EBKD008D

IF ADJUSTMENT IS NECESSARY:

1. Loosen adjusting bolt (A) and the lock bolt (B).
2. Move the alternator to obtain the proper belt tension, then retighten the nuts.



EBKD008E

3. Recheck the deflection or tension of the belt.

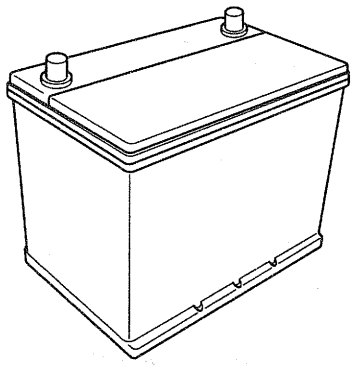
NOTE

For the power steering pump belt and A/C compressor belt adjustments, refer to ST group - power steering pump and HA group - air compressor.

BATTERY

DESCRIPTION EFAA5B7B

1. The maintenance-free battery is, as the name implies, totally maintenance free and has no removable battery cell caps.
2. Water never needs to be added to the maintenance-free battery.
3. The battery is completely sealed, except for small vent holes in the cover.

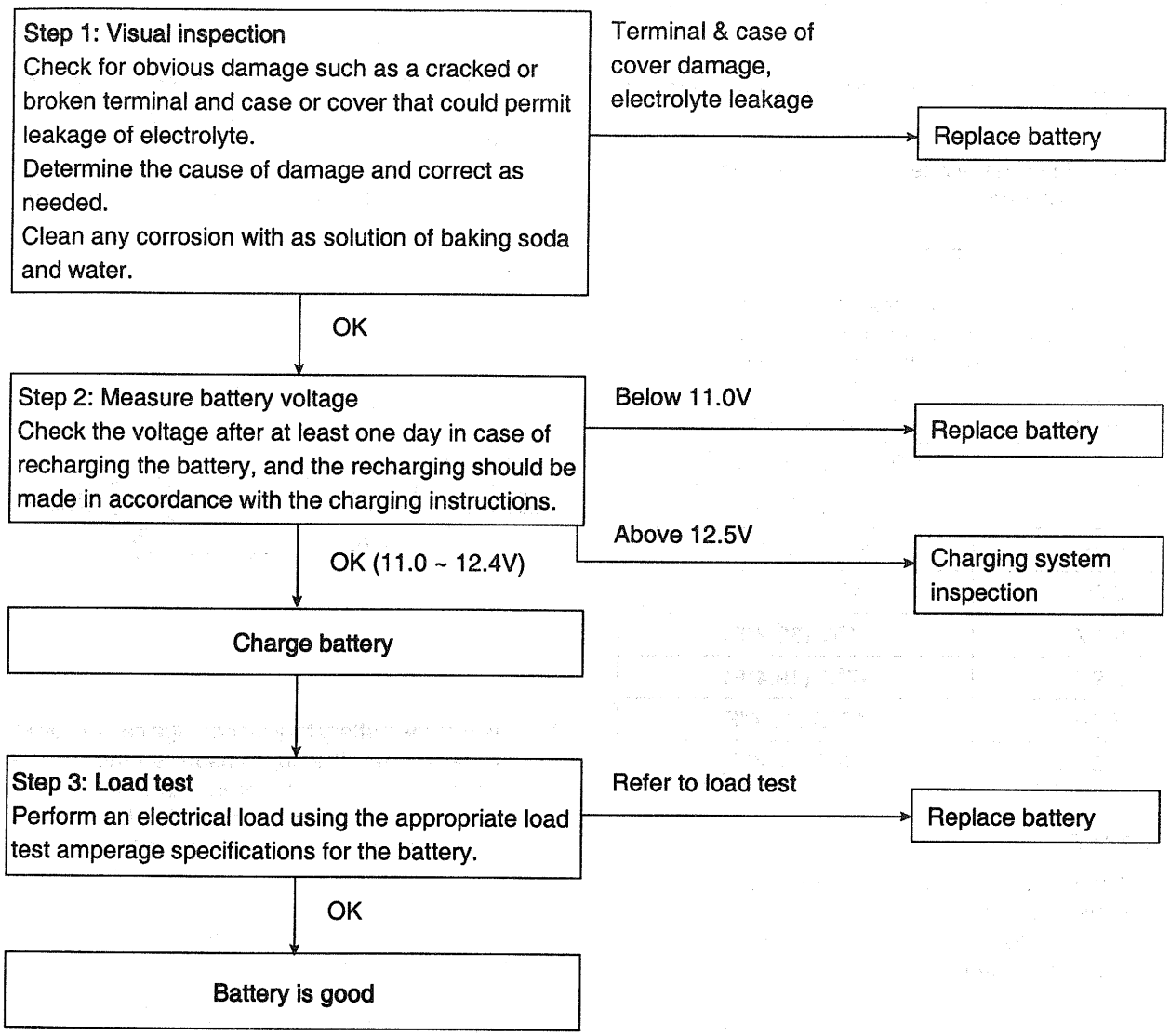


EBJD008A

INSPECTION EFCD68F1

BATTERY DIAGNOSTIC TEST (1)

CHECKING FLOW



BBGE007A

LOAD TEST

1. Perform the following steps to complete the load test procedure for maintenance free batteries.
2. Connect the load tester clamps to the terminals and proceed with the test as follow:
   1) If the battery has been on charge, remove the surface charge by connect a 300ampere load for 15 seconds.
   2) Connect the voltmeter and apply the specified load.
   3) Read the voltage after the load has been applied for 15 seconds.
   4) Disconnect the load.
   5) Compare the voltage reading with the minimum and replace the battery if battery test voltage is below that shown in the voltage table.

Voltage	Temperature
9.6V	20°C (68.0°F) and above
9.5V	16°C (60.8°F)
9.4V	10°C (50.0°F)
9.3V	4°C (39.2°F)
9.1V	-1°C (30.2°F)
8.9V	-7°C (19.4°F)
8.7V	-12°C (10.4°F)
8.5V	-18°C (-0.4°F)

NOTE

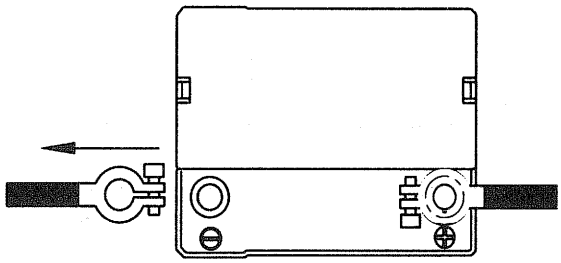
- *If the voltage is greater shown in the table, the battery is good.*
- *If the voltage is less than shown in the table, replace the battery.*

BATTERY DIAGNOSTIC TEST (2)

1. Make sure the ignition switch and all accessories are in the OFF position.
2. Disconnect the battery cables (negative first).
3. Remove the battery from the vehicle.

CAUTION

Care should be taken in the event the battery case is cracked or leaking, to protect your skin from the electrolyte.
Heavy rubber gloves (not the household type) should be wore when removing the battery.



EBJD008B

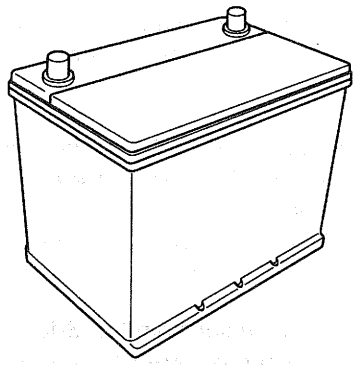
4. Inspect the battery tray for damage caused by the loss of electrolyte. If acid damage is present, it will be necessary to clean the area with a solution of clean warm water and baking soda. Scrub the area with a stiff brush and wipe off with a cloth moistened with baking soda and water.
5. Clean the top of the battery with the same solution as described above.
6. Inspect the battery case and cover for cracks. If cracks are present, the battery must be replaced.
7. Clean the battery posts with a suitable battery post tool.
8. Clean the inside surface of the terminal clamps with a suitable battery cleaning tool. Replace damaged or frayed cables and broken terminal clamps.
9. Install the battery in the vehicle.
10. Connect the cable terminals to the battery post, making sure tops of the terminals are flush with the tops of the posts.

11. Tighten the terminal nuts securely.

12. Coat all connections with light mineral grease after tightening.

⚠ ***CAUTION***

When batteries are being charged, an explosive gas forms beneath the cover of each cell. Do not smoke near batteries being charged or which have recently been charged. Do not break live circuit at the terminals of batteries being charged. A spark will occur when the circuit is broken. Keep open flames away form battery.

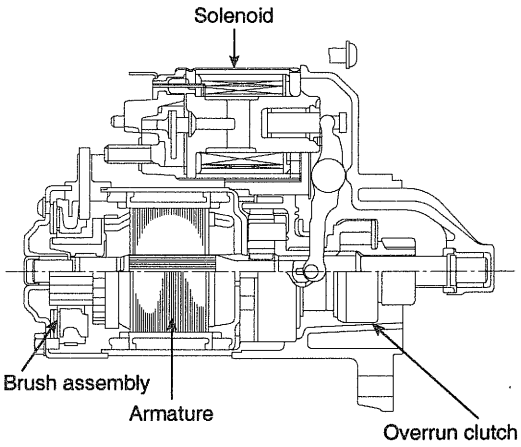


EBJD008A

STARTING SYSTEM

DESCRIPTION E16E5DEF

The starting system includes the battery, starter, solenoid switch, ignition switch, inhibitor switch (A/T), ignition lock switch, connection wires and the battery cable.
When the ignition key is turned to the start position, current flows and energizes the starter motor's solenoid coil.
The solenoid plunger and clutch shift lever are activated, and the clutch pinion engages the ring gear.
The contacts close and the starter motor cranks. In order to prevent damage caused by excessive rotation of the starter armature when the engine starts, the clutch pinion gear overruns.



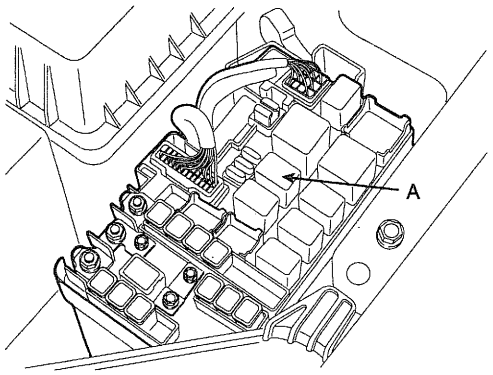
EBKD010A

STARTER CIRCUIT TROUBLESHOOTING E0F08581

NOTE

The battery must be in good condition and fully charged.

1. Remove the fuel pump relay from the fuse box.



ABJF010A

2. With the shift lever in N or P (A/T) or clutch pedal pressed (M/T), turn the ignition switch to "START"

   If the starter normally cranks the engine, starting system is OK. If the starter will not crank the engine at all, go to next step.

   If it won't disengage from the ring gear when you release key, check for the following until you find the cause.

   - Solenoid plunger and switch malfunction.
   - Dirty pinion gear or damaged overrunning clutch.

3. Check the battery condition. Check electrical connections at the battery, battery negative cable connected to the body, engine ground cables, and the starter for looseness and corrosion. Then try starting the engine again.

   If the starter cranks normally the engine, repairing the loose connection repaired the problem. The starting system is now OK.
   If the starter still does not crank the engine, go to next step.

4. Disconnect the connector from the S-terminal of solenoid. Connect a jumper wire from the B-terminal of solenoid to the S-terminal of solenoid.

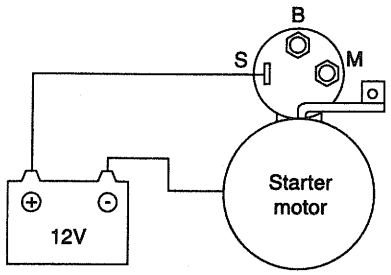
   If the starter cranks the engine, go to next step.
   If the starter still does not crank the engine, remove the starter, and repair or replace as necessary.

5. Check the following items in the order listed until you find the open circuit.

   - Check the wire and connectors between the driver's under-dash fuse/relay box and the ignition switch, and between the driver's under-dash fuse/relay box and the starter.
   - Check the ignition switch (Refer to BE group - ignition system)
   - Check the transaxle range switch connector or ignition lock switch connector.
   - Inspect the starter relay.

STATER SOLENOID TEST

1. Disconnect the field coil wire from the M-terminal of solenoid switch.
2. Connect a 12V battery between S-terminal and the starter body.



BBGE004A

3. Connect the field coil wire to the M-terminal.

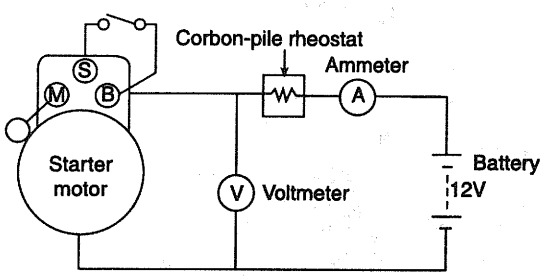
⚠ ***CAUTION***

This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

4. If the pinion moves out, the pull-in coil of solenoid is working properly.
   If the pinion does not move, replace the solenoid.
5. Diconnect the field coil wire from the M-terminal.
6. If the pinion has moved out, the hold-in coil of the solenoid is working properly.
   If the pinion moves in, replace the solenoid.

FREE RUNNING TEST

1. Place the starter motor in a vise equipped with soft jaws and connect a fully-charged 12-volt battery to starter motor as follows.
2. Connect a test ammeter (100-ampere scale) and carbon pile rheostats shown is the illustration.
3. Connect a voltmeter (15-volt scale) across starter motor.



BBGE005A

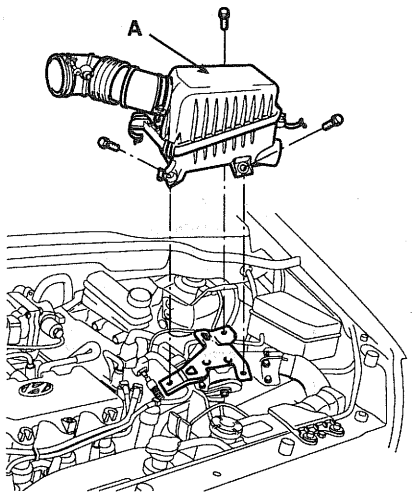
4. Rotate carbon pile to the off position.
5. Connect the battery cable from battery' s negative post to the starter motor body.
6. Adjust until battery voltage shown on the voltmeter reads 11volts.
7. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely.

Current : 60A max
Speed : 5,500 rpm

STARTER

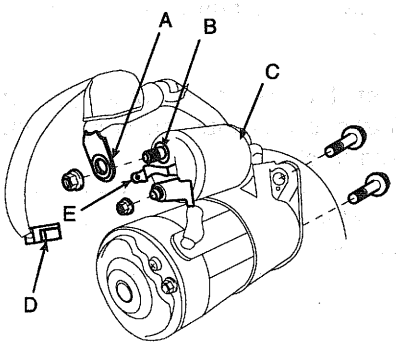
REPLACEMENT E2F9D550

1. Disconnect the battery negative cable.
2. Remove the air cleaner assembly.



KCPF036A

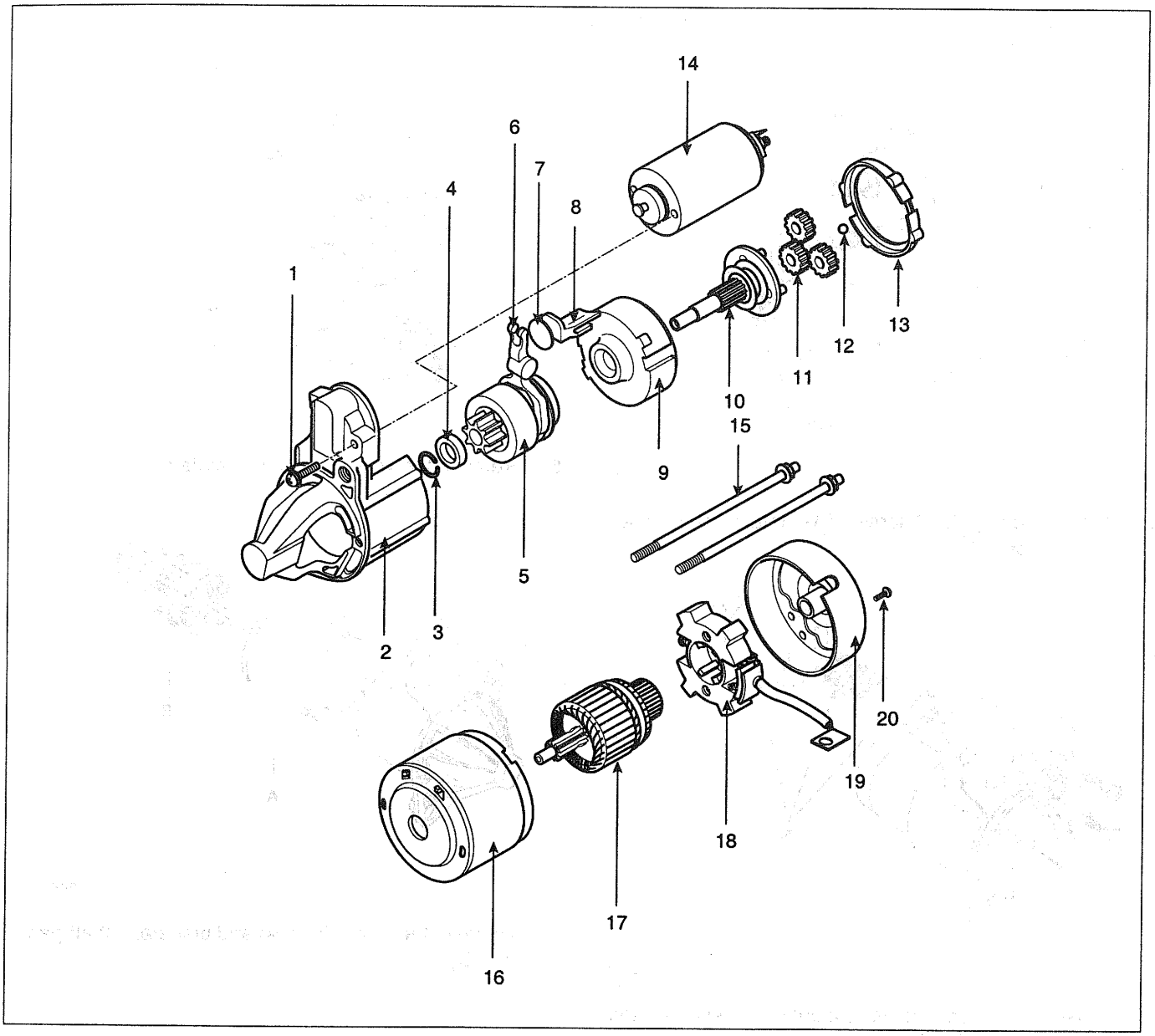
3. Disconnect the starter cable (A) from the B terminal (B) on the solenoid (C), then disconnect the connector (D) from the S terminal (E).



ABGE024A

4. Remove the 2 bolts holding the starter, then remove the starter.
5. Installation is the reverse of removal.
6. Connect the battery negative cable to the battery.

COMPONENT EB04E4D2

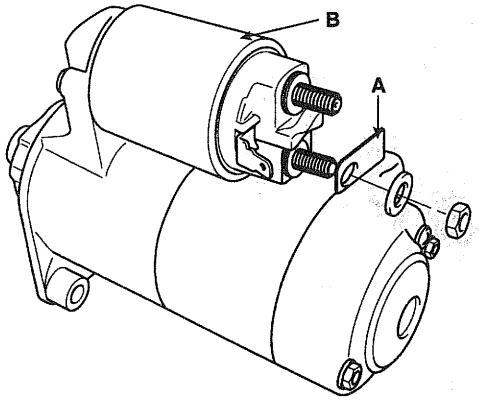


1. Screw
2. Front bracket assembly
3. Stop ring
4. Stopper
5. Overrun clutch assembly
6. Lever
7. Plate
8. Lever packing
9. Internal gear assembly
10. Planet shaft assembly
11. Planetary gear assembly
12. Steel ball
13. Packing
14. Magnet switch assembly
15. Through bolt
16. Yoke assembly
17. Armature assembly
18. Brush holder assembly
19. Rear bracket
20. Screw

BBGE006A

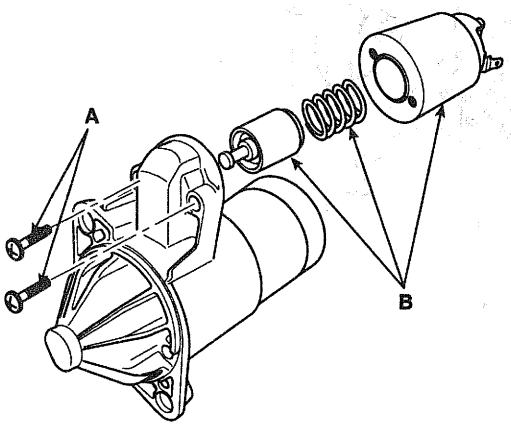
DISASSEMBLY EEA12C44

1. Disconnect the M-terminal (A) on the magnet switch assembly (B).



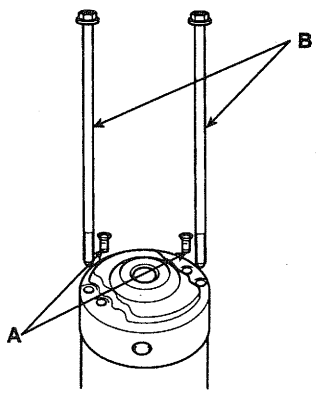
EBKD011C

2. After loosening the 2 screws (A), detach the magnet switch assembly (B).



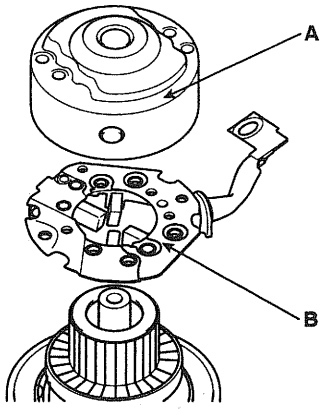
EBKD011D

3. Loosen the brush holder mounting screw (A) and through bolts (B).



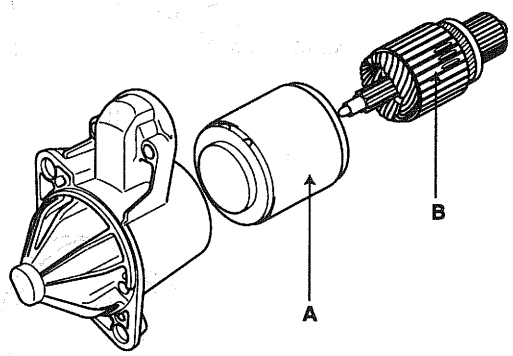
EBKD011E

4. Remove the rear bracket (A) and brush holder assembly (B).



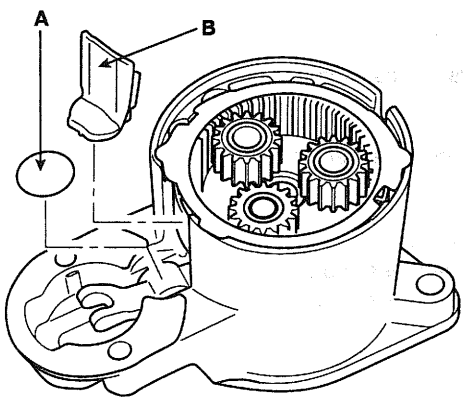
EBKD011F

5. Remove the yoke (A) and armature (B).



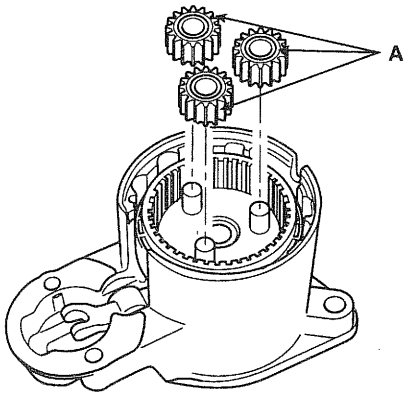
EBKD011G

6. Remove the lever plate (A) and planetary shaft packing (B).



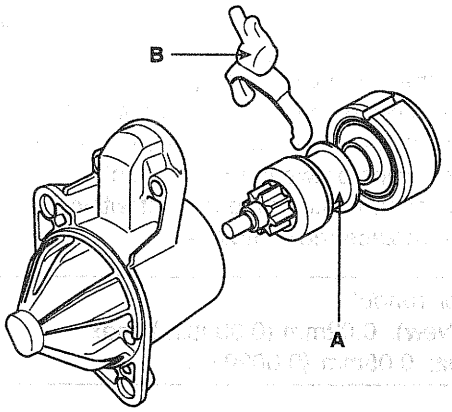
EBKD011H

7. Disconnect the planetary gear(A).



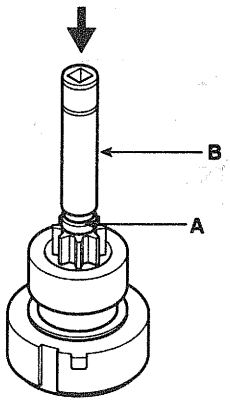
EBKD011I

8. Disconnect the planetary shaft assembly and lever(B).



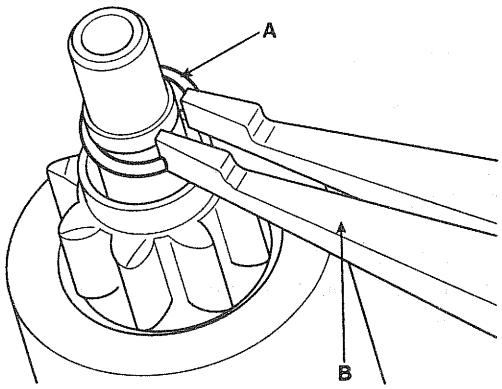
EBKD011J

9. Press the stop ring (A) using a socket (B).



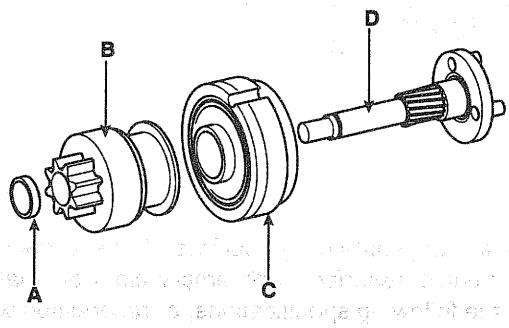
EBKD011K

10. After removing the stopper (A) using stopper pliers (B).



EBKD011L

11. Disconnect the stop ring(A), overruning clutch(B), internal gear(C) and planet shaft(D).

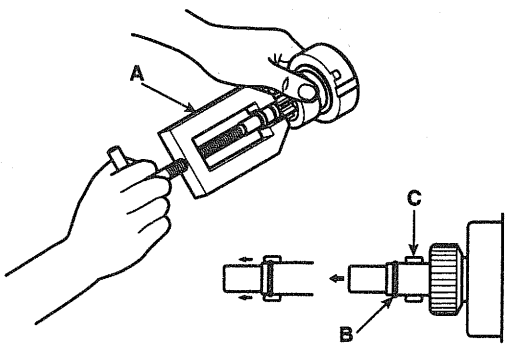


EBKD011M

12. Reassembly is the reverse of disassembly.

NOTE

Using a suitable pulling tool (A), pull the overrunning clutch stop ring (B) over the stopper (C).

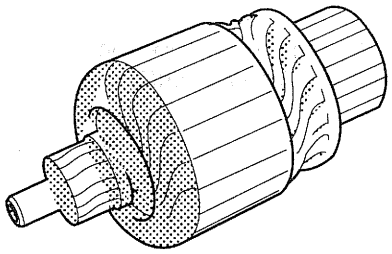


EBKD011O

INSPECTION E6B30AA7

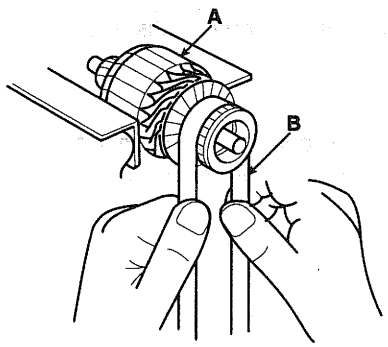
ARMATURE INSPECTION AND TEST

1. Remove the starter.
2. Disassemble the starter as shown at the beginning of this procedure.
3. Inspect the armature for wear or damage from contact with the permanent magnet. If there is wear or damage, replace the armature.



EBKD012A

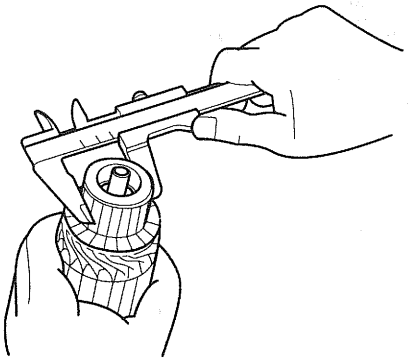
4. Check the commutator (A) surface. If the surface is dirty or burnt, resurface with emery cloth or a lathe within the following specifications, or recondition with #500 or #600 sandpaper (B).



EBKD012B

5. Check the commutator diameter. If the diameter is below the service limit, replace the armature.

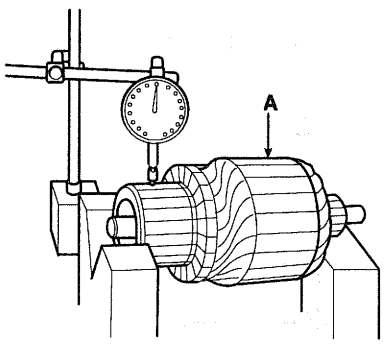
Commutator diameter
Standard (New) : 33.0 mm (1.2992 in)
Service limit : 32.4 mm (1.2756 in)



EBKD012C

6. Measure the commutator (A) runout.
   - If the commutator runout is within the service limit, check the commutator for carbon dust or brass chips between the segments.
   - If the commutator run out is not within the service limit, replace the armature.

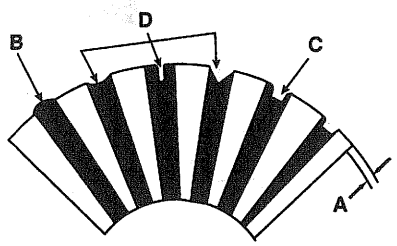
Commutator runout
Standard (New): 0.02mm (0.0008in.) max
Service limit: 0.05mm (0.0020in.)



EBKD012D

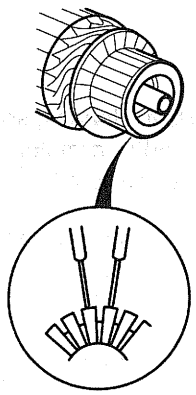
7. Check the mica depth (A). If the mica is too high (B), undercut the mica with a hacksaw blade to the proper depth. Cut away all the mica (C) between the commutator segments. The undercut should not be too shallow, too narrow, or v-shaped (D).

Commutator mica depth Standard (New) : 0.5 mm (0.0197 in.) Limit : 0.2mm (0.0079 in.)



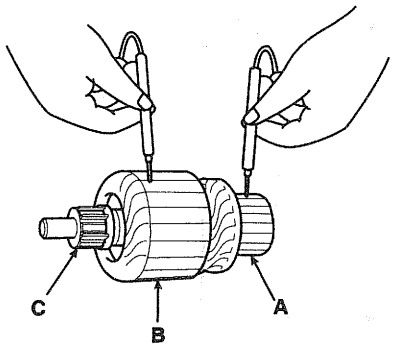
EBKD012E

8. Check for continuity between the segments of the commutator. If an open circuit exists between any segments, replace the armature.



EBKD012F

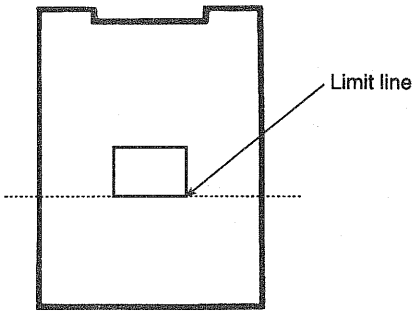
9. Check with an ohmmeter that no continuity exists between the commutator (A) and armature coil core (B), and between the commutator and armature shaft (C). If continuity exists, replace the armature.



EBKD012G

INSPECT STARTER BRUSH

Brushes that are worm out, or oil-soaked, should be replaced.



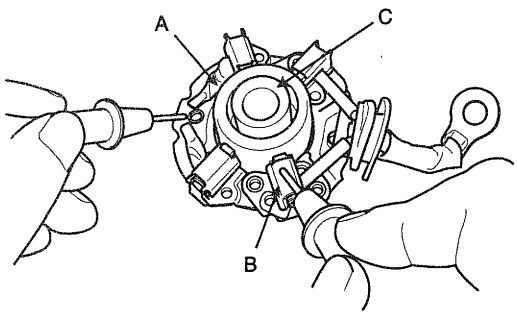
BBGE008A

NOTE

To seat new brushes, slip a strip of #500 or #600 sandpaper, with the grit side up, between the commutator and each brush, and smoothly rotate the armature. The contact surface of the brushes will be sanded to the same contour as the commutator.

STARTER BRUSH HOLDER TEST

1. Check that there is no continuity between the (+) brush holder (A) and (-) brush holder (B). If there is no continuity, replace the brush holder assembly.



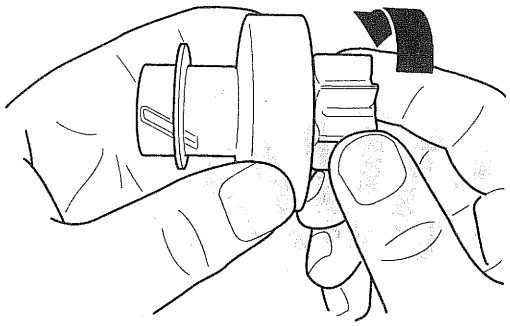
ABHE012A

NOTE

Use a pipe (C) of suitable size for the brushes not to get removed from the brush holder.

INSPECT OVERRUNNING CLUTCH

1. Slide the overrunning clutch along the shaft. Replace it if does not slide smoothly.
2. Rotate the overrunning clutch both ways. Does it lock in one direction and rotate smoothly in reverse? If it does not lock in either direction of it locks in both directions, replace it.



ABHE013A

3. If the starter drive gear is worn or damaged, replace the overrunning clutch assembly. (the gear is not available separately).
   Check the condition of the flywheel or torque converter ring gear if the starter drive gear teeth are damaged.

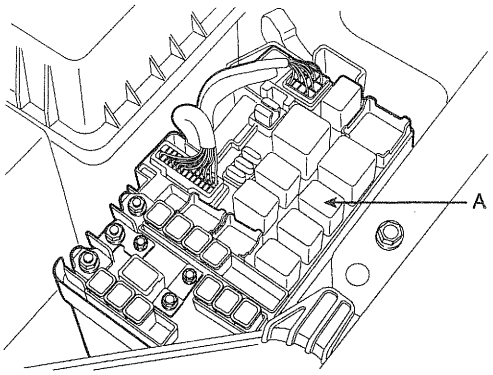
CLEANING

1. Do not immerse parts in cleaning solvent. Immersing the yoke assembly and/or armature will damage the insulation. Wipe these parts with a cloth only.
2. Do not immerse the drive unit in cleaning solvent. The overrun clutch is pre-lubricated at the factory and solvent will wash lubrication from the clutch.
3. The drive unit may be cleaned with a brush moistened with cleaning solvent and wiped dry with a cloth.

STARTER RELAY

INSPECTION E553B0B9

1. Remove the fuse box cover.
2. Remove the starter relay (A).

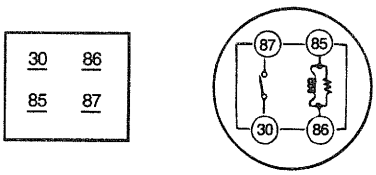


ABJF011A

3. Using an ohmmeter, check that there is continuity between each terminal.

Terminal	Continuity
30 - 87	NO
85 - 86	YES

4. Apply 12V to terminal 85 and ground to terminal 86. Check for continuity between terminals 30 and 87.



LDAD510B

5. If there is no continuity, replace the starter relay.
6. Install the starter relay.
7. Install the fuse box cover.