General Information

Specifications

Starting System

Items			
Starter	Rated voltage		12 V, 2.2 kW
	No. of pinion teeth		10
	No-load characteristics	Voltage	11 V
		Ampere	130A, MAX
		Speed	3,600 rpm, MIN

Preheating System

Items		Specification
Glow plug	Nominal voltage	4.3~4.5V
	Initial current at 11V	less than 27.0A
	Operating current after 5 sec.	less than 9.0A
	Operating current after 60 sec.	less than 8.0A
	Time to 1000℃	less than 3 seconds
	Resistance(at 18~22℃)	410±110mΩ

Charging System

Items		Specification
Alternator	Rate voltage	12 V, 150A
	Speed in use	1,000 ~ 18,000 rpm
	Voltage regulator	IC Regulator built-in type
	Regulator setting voltage	14.55 ± 0.2 V
	Temperature compensation	-7 ± 3 mV / ˚C
Battery	Type	80-33 FL
	Cold cranking amperage [at -18˚C(-0.4˚F)]	850 A
	Reserve capacity	182 min
	Specific gravity [at 20˚C(68˚F)]	1.280 ± 0.01

NOTICE

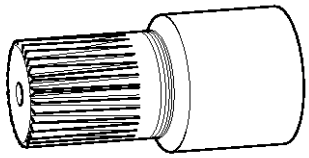
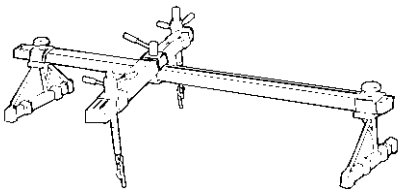
- *COLD CRANKING AMPERAGE is the amperage a battery can deliver for 30 seconds and maintain a terminal voltage of 7.2V or greater at a specified temperature.*
- *RESERVE CAPACITY RATING is amount of time a battery can deliver 25A and maintain a minimum terminal voltage of 10.5V at 26.7˚C(80.1˚F).*

- Battery type notation: □□ - □□ □ □
  ① ② ③ ④

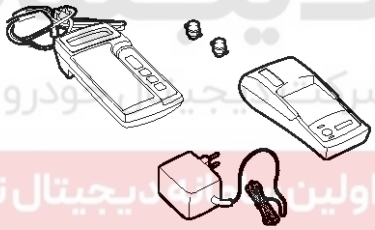
① : 5HR capacity
② : Battery length
③ : Battery width
④ : Terminal location

SGKEE8100N

Special Service Tools

Tool (Number and name)	Illustration	Use
Alternator pulley remover wrench (09373-27000)	 EBDD700A	Removal and installation of alternator pulley
Engine support fixture and adapter (09200-38001,09200-1C000)	 AMJF002B	Fixing the engine

Reference Service Tools

Tool (Number and name)	Illustration	Use
Micro-570 Battery checker	 LBLG001A	(Using with Thermal Printer_182-003A)

Troubleshooting

Starting System

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

Charging System

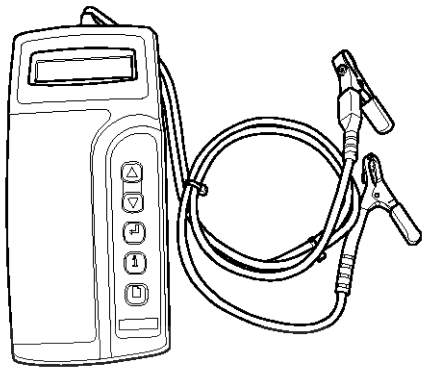
Symptom	Suspect area	Remedy
Charging warning indicator does not light with ignition switch "ON" and engine off.	Fuse blown	Check fuses
	Light burned out	Replace light
	Wiring connection loose	Tighten loose connection
	Electronic voltage regulator	Replace voltage regulator
Charging warning indicator does 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
	Fuse blown	Check fuses
	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
	Fuse blown	Check fuses
	Electronic voltage regulator or alternator	Replace voltage regulator or alternator
	Poor grounding	Inspect ground or repair
	Worn battery	Replace battery

The Micro 570 Analyzer

The Micro 570 Analyzer provides the ability to test the charging and starting systems, including the battery, starter and alternator.

⚠CAUTION

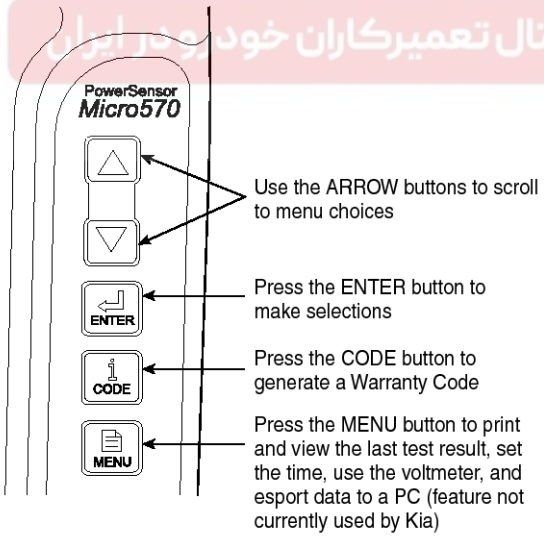
Because of the possibility of personal injury, always use extreme caution and appropriate eye protection when working with batteries.



EBKD001A

Keypad

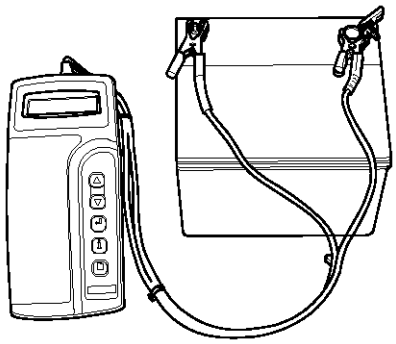
The Micro 570 button on the key pad provide the following functions :



LBGE012A

Battery Test Procedure

1. Connect the tester to the battery.
   - Red clamp to battery positive (+) terminal.
   - Black clamp to battery negative (-) terminal.

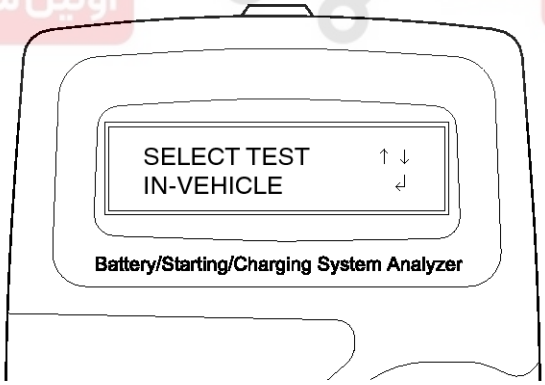


EBKD001C

⚠CAUTION

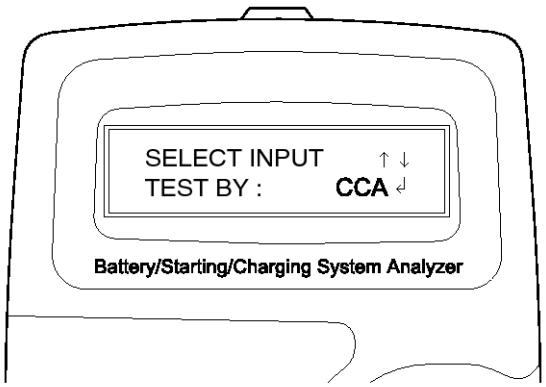
Connect clamps securely. If "CHECK CONNECTION" message is displayed on the screen, reconnect clamps securely.

2. The tester will ask if the battery is connected "IN-VEHICLE" or "OUT-OF-VEHICLE". Make your selection by pressing the arrow buttons; then press ENTER.



SXMEE9129D

3. Select CCA and press the ENTER button.

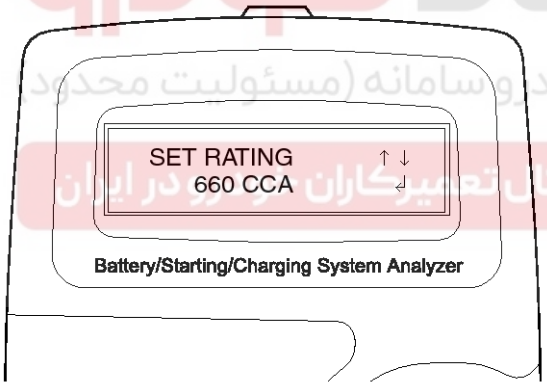


SXMEE9130D

NOTICE

CCA : Cold cranking amps, is an SAE specification for cranking batteried at -0.4˚F (-18˚C).

4. Set the CCA value displayed on the screen to the CCA value marked on the battery label by pressing up and down buttons and press ENTER.

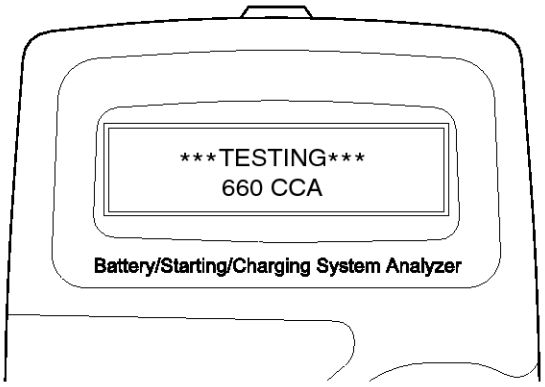


EBKD001F

NOTICE

The battery ratings(CCA) displayed on the tester must be identical to the ratings marked on battery label.

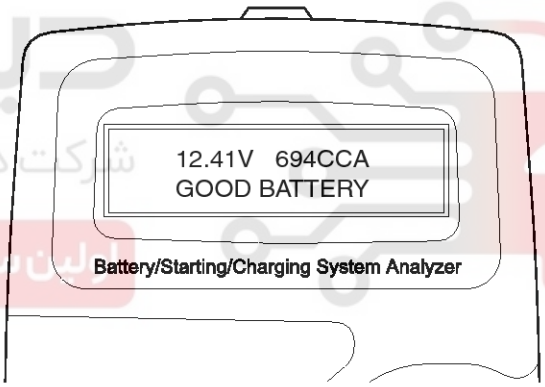
5. The tester will conduct battery test.



SXMEE9131D

6. The tester displays battery test results including voltage and battery ratings.

   Refer to the following table and take the appropriate action as recommended by the Micro 570.



SXMEE9132D

Battery Test Results

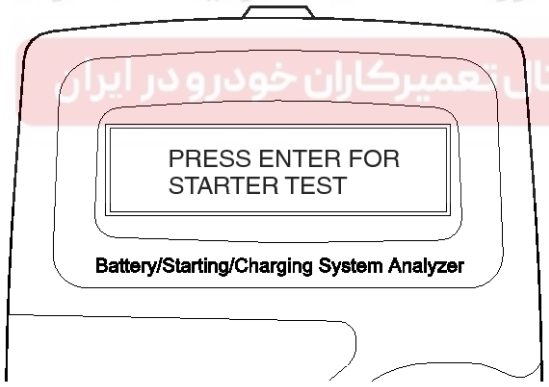
Result On Printer	Remedy
GOOD BATTERY	No action is required
GOOD RECHARGE	Battery is in a good state Recharge the battery and use
CHARGE & RETEST	Battery is not charged properly - Charge and test the battery again. (Failure to charge the battery fully may read incorrect measurement value)
REPLACE BATTERY	Replace battery and recheck the charging system. - Improper connection between battery and vehicle cables may cause "REPLACE BATTERY", retest the battery after removing cables and connecting the tester to the battery terminal directly prior to replacing the battery.
BAD CELL-REPLACE	Charge and retest the battery. - If the Micro 570 recommends "REPLACE BATTERY", replace the battery and recheck the charging system.

WARNING

Whenever filing a claim for battery, the print out of the battery test results must be attached.

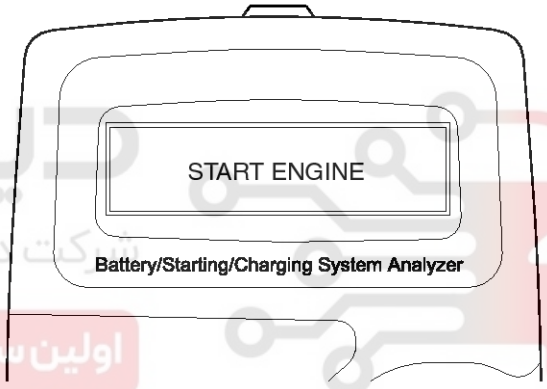
Starter Test Procedure

7. After the battery test, press ENTER immediately for the starter test.



EBKD001H

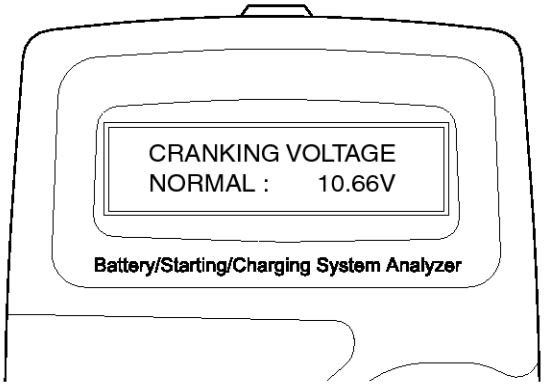
8. Start the engine.



EBKD001I

9. Cranking voltage and starter test results will be displayed on the screen.

   Refer to the following table and take the appropriate action as recommended by the Micro 570.



SXMEE9133D

Starter Test Results

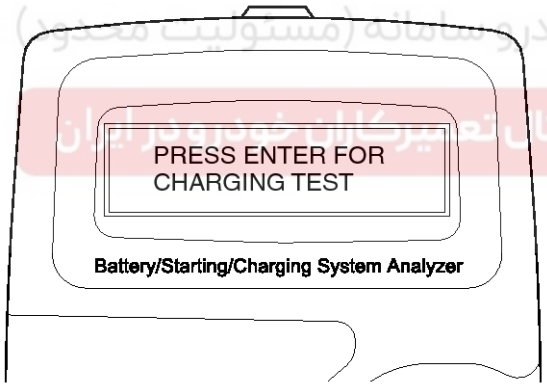
Result On Printer	Remedy
CRANKING VOLTAGE NORM-AL	System shows a normal starter draw
CRANKING VOLTAGE LOW	Cranking voltage is lower than normal level - Check starter
CHARGE BATTERY	The state of battery charge is too low to test - Charge the battery and retest
REPLACE BATTERY	Replace battery - If the vehicle is not started though the battery condition of "GOOD BATTERY" is di-splayed, check wiring for open circuit, battery cable connection, starter and repair or replace as necessary. - If the engine does crank, check fuel system.

NOTICE

When testing the vehicle with old diesel engines, the test result will not be favorable if the glow plug is not heated. Conduct the test after warming up the engine for 5 minutes.

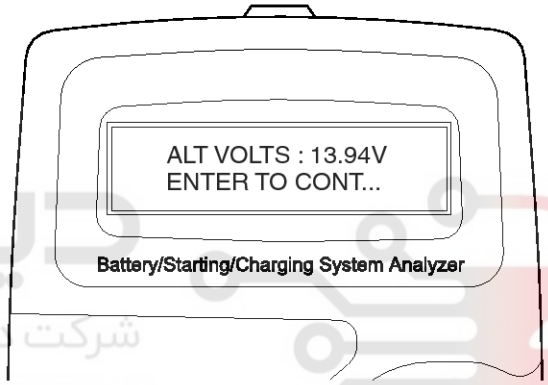
Charging System Test Procedure

10. Press ENTER to begin charging system test.



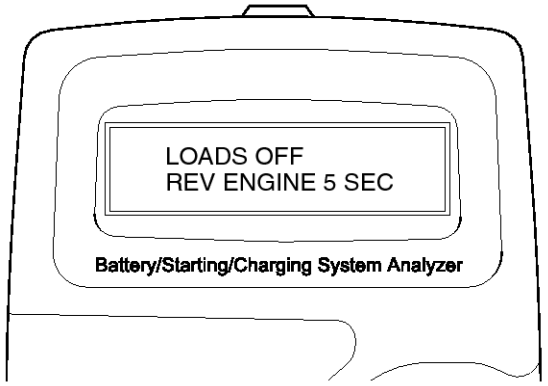
EBKD001K

11. The tester displays the actual voltage of alternator. Press ENTER to continue.

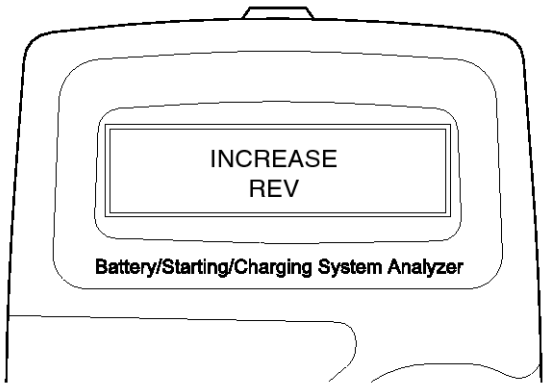


EBKD001L

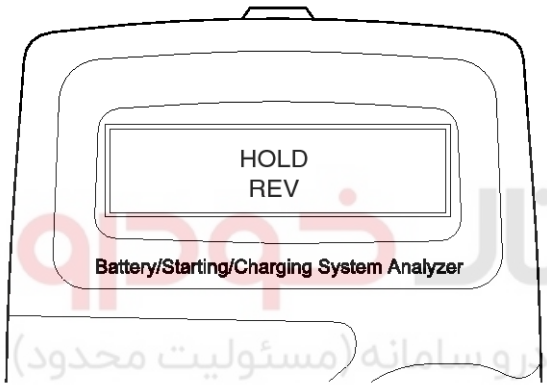
12. Turn off all electrical load and rev engine for 5 seconds with pressing the accelerator pedal. (Follow the instructions on the screen)



EBKD001M

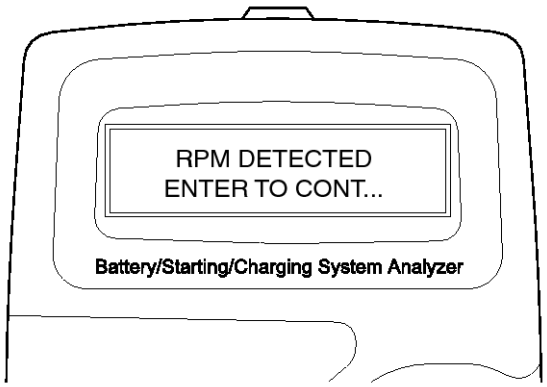


SXMEE9134D



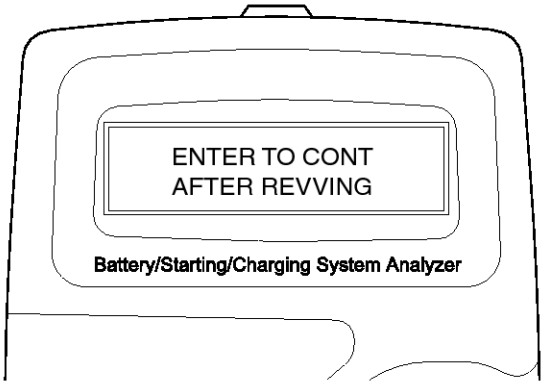
SXMEE9135D

13. The message that engine RPM is detected will be displayed on the screen. Press ENTER to continue.



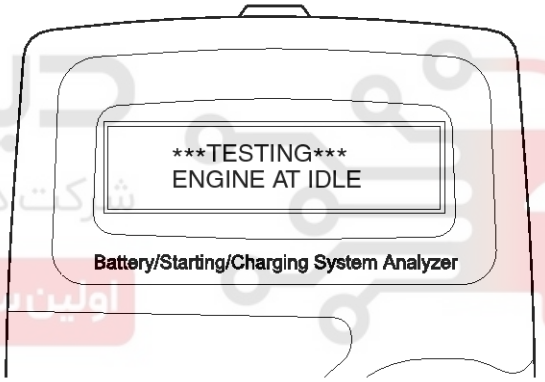
SXMEE9136D

14. If the engine RPM is not detected, press ENTER after revving engine.

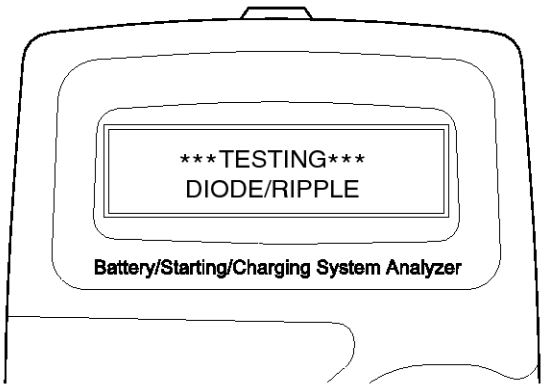


SXMEE9137D

15. The tester will conduct charging system test during loads off.

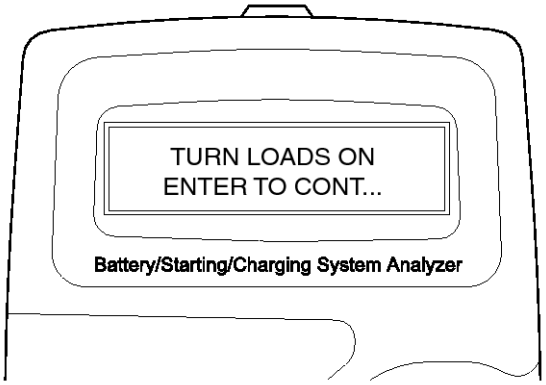


EBKD001O



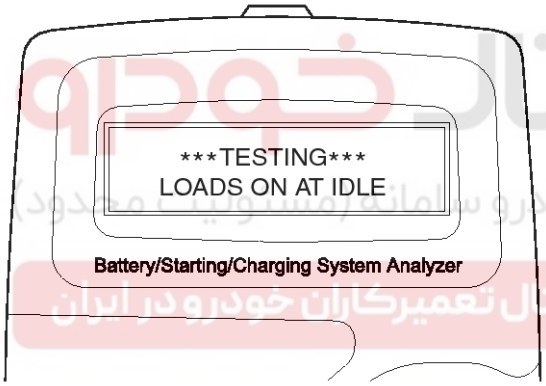
SXMEE9138D

16. Turn on electrical loads (air conditioner, lamps, audio and etc). Press ENTER to continue.



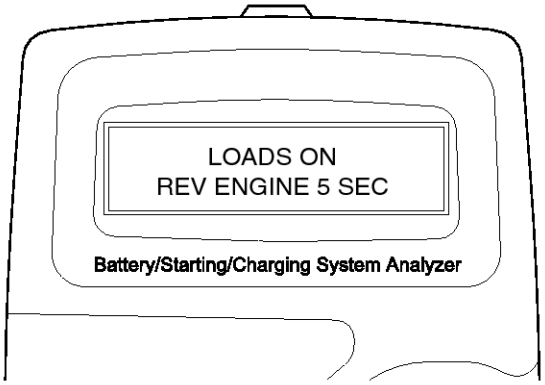
SXMEE9139D

17. The tester will conduct charging system test during loads on.

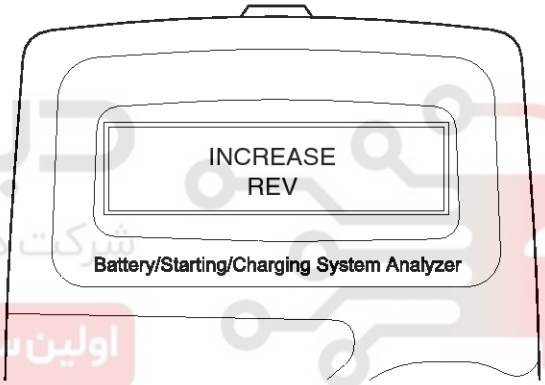


SXMEE9140D

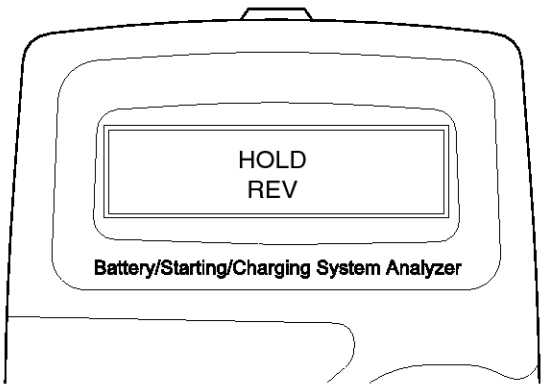
18. Rev engine for 5 seconds with pressing the accelerator pedal. (Follow the instructions on the screen)



SXMEE9141D

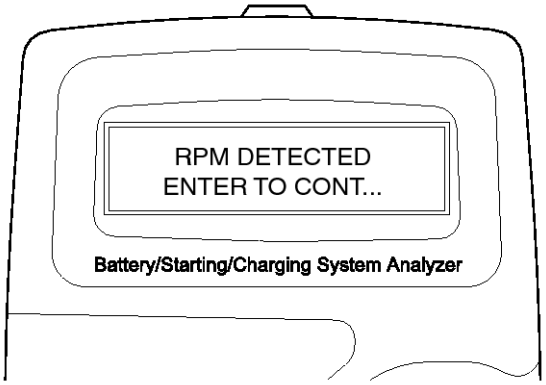


SXMEE9142D



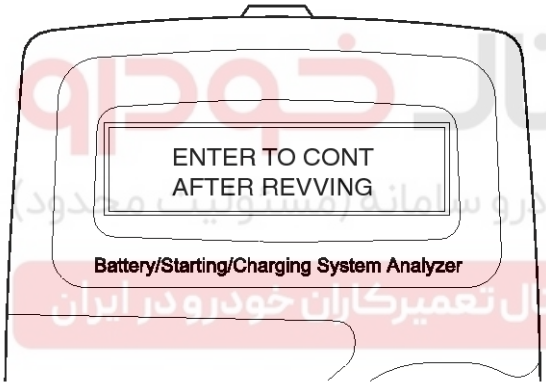
SXMEE9143D

19. The message that engine RPM is detected will be displayed on the screen. Press ENTER to continue.



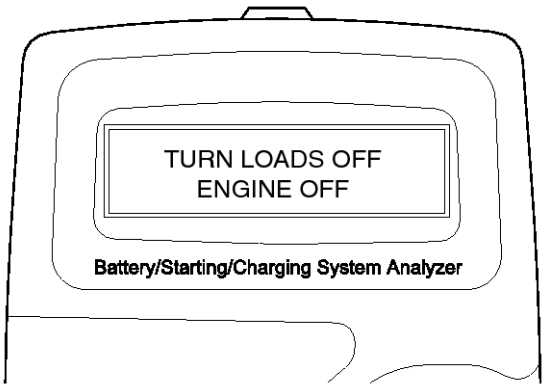
SXMEE9144D

20. If the engine RPM is not detected, press ENTER after revving engine.



SXMEE9145D

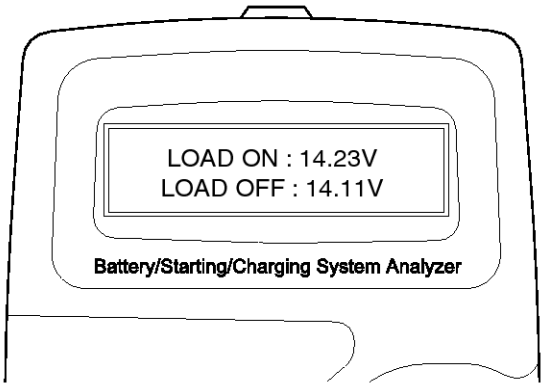
21. Turn off electrical loads (air conditioner, lamps, audio and etc). Turn the engine off.



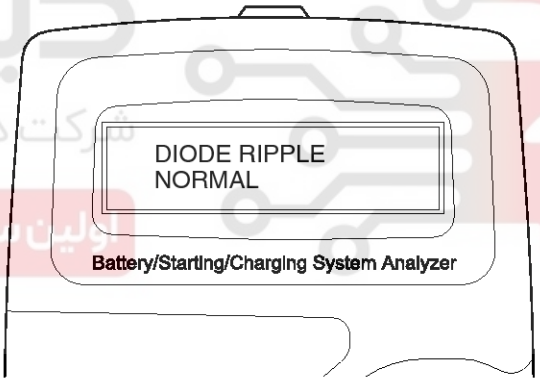
SXMEE9146D

22. Charging voltage and charging system test results will be displayed on the screen.

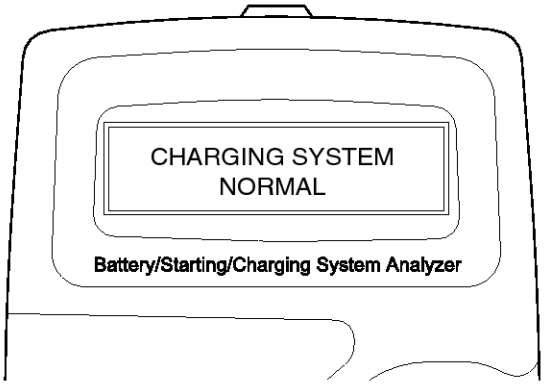
Shut off engine end disconnect the tester clamps from the battery. Refer to the following table and take the appropriate action as recommended by the Micro 570.



SXMEE9147D



EBKD001P



SXMEE9148D

Charging System Test Results

Result On Printer	Remedy
CHARGING SYSTEM NORMAL / DIODE RIPPLE NORMAL	Charging system is normal
NO CHARGING VOLTAGE	Alternator does not supply charging current to battery - Check belts, connection between alternator and battery and replace belts or cable or alternator as necessary
LOW CHARGING VOLTAGE	Alternator does not supply charging current to battery and electrical load to system fully - Check belts and alternator and replace as necessary
HIGH CHARGING VOLTAGE	The voltage from alternator to battery is higher than normal limit during voltage regulating. - Check connection and ground and replace regulator as necessary - Check electrolyte level in the battery
EXCESS RIPPLE DETECTED	One or more diodes in the alternator is not functioning properly - Check alternator mounting and belts and replace as necessary

Charging System

Description

The charging system included a battery, an alternator with a built-in regulator, and the charging indicator light and wire.

The Alternator has six 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.

On-vehicle Inpection

⚠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 The Battery Terminals And Fuses

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

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.

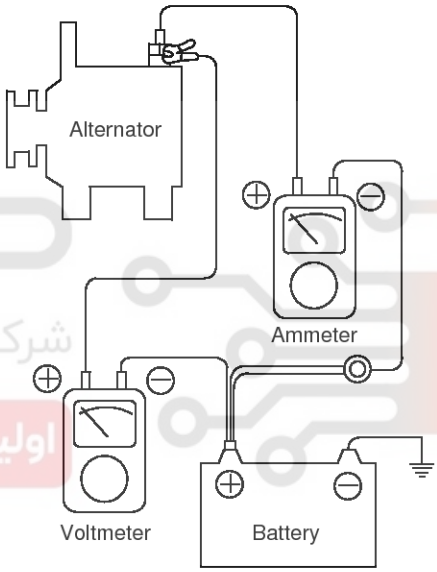
Inspect Charging System

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 th e 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.

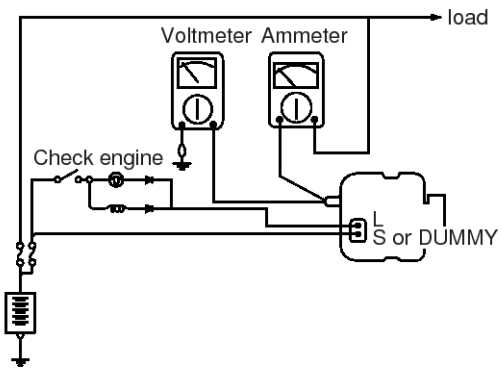
   Check the battery installed in the vehicle to ensure that it is good condition. The battery checking method is described in the section "Battery".

   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.

   NOTICE

   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.



LBGF002A

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.

   NOTICE

   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 (150A alternator) : 75A min.

NOTICE

- *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.

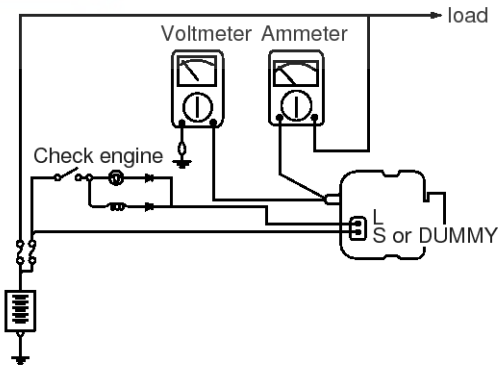
Preparation

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.



LBGF002A

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.

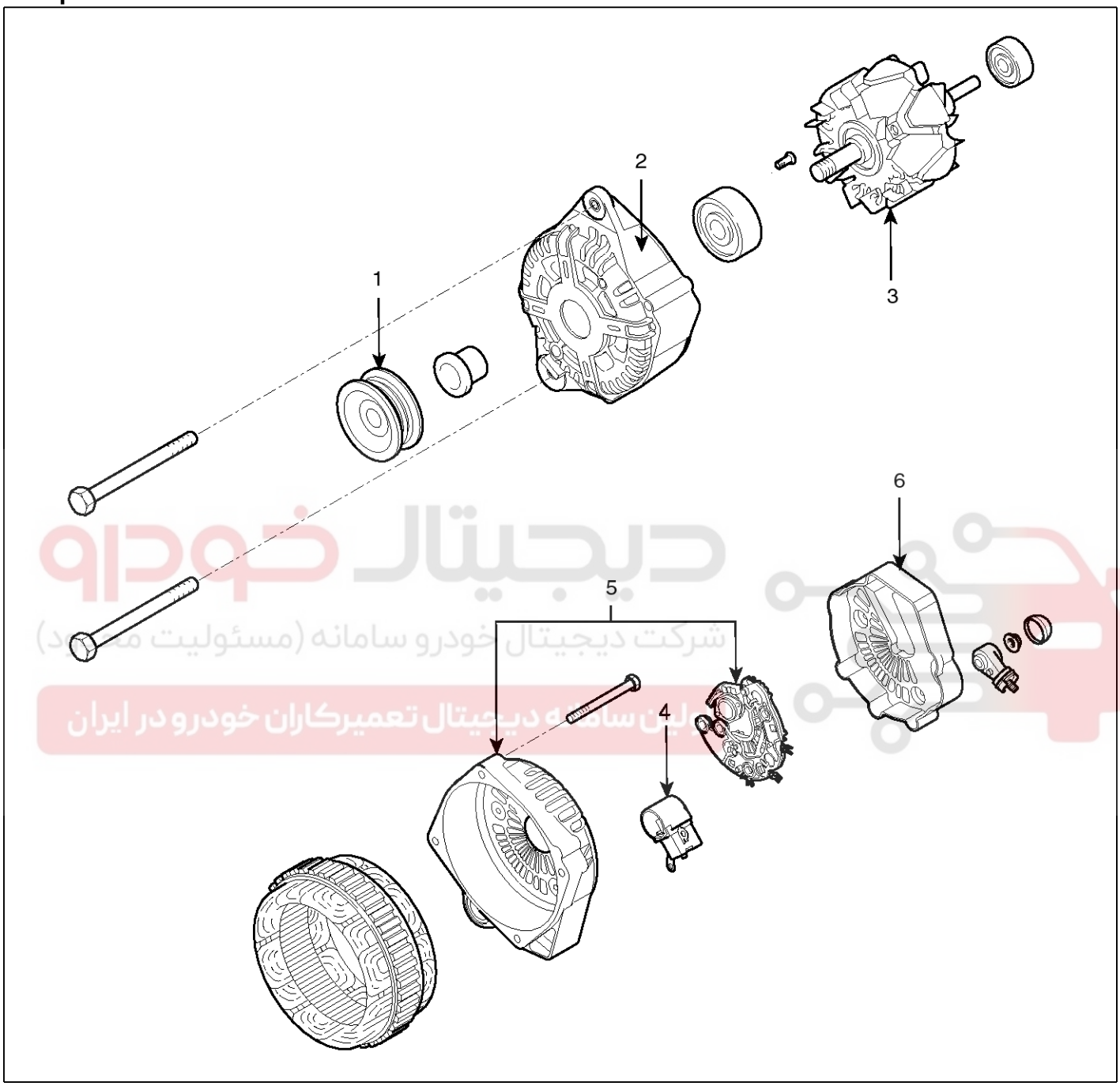
2. Start the engine. Keep all lights and accessories off.
3. Run the engine at a speed of about 2,500 rpm and read the voltmeter when the alternator output current drops to 10A or less

Result

1. If the voltmeter reading dosen't agree with the standard value, the voltage regulator or the alternator is faulty.
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

Components

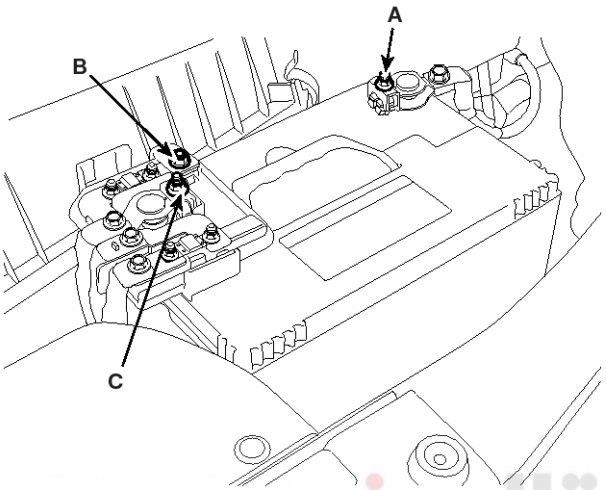


SENEE9002L

1. Overrunning Alternator Pulley(OAP)
2. Front housing complete
3. Rotor assembly
4. Regulator
5. Rectifier assembly
6. Cover

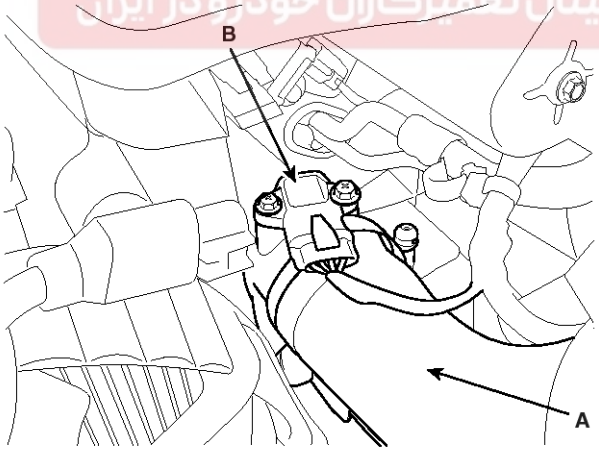
Replacement

1. Remove the nut(A) from the (-) terminal of the battery.
2. Remove the nut(B) from the (+) terminal of the battery.
3. Remove the nut(C) from the (+) terminal and the battery.



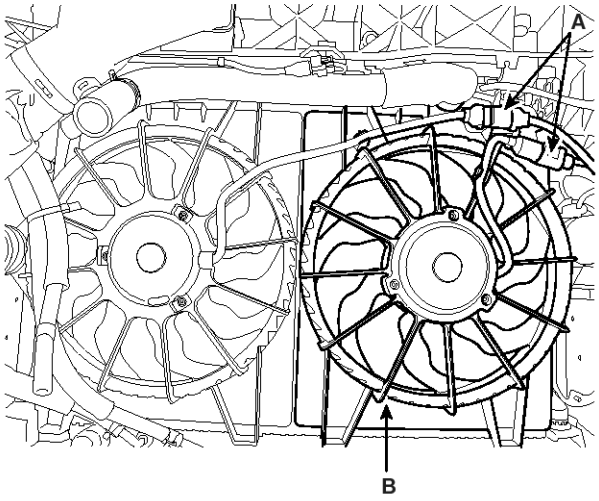
SENEM7069D

4. Remove the inlet upper manifold assemlby.
5. After disconnecting the BPS(Booster Pressure Sensor) connector(B), remove the passenger side intercooler hose(A).



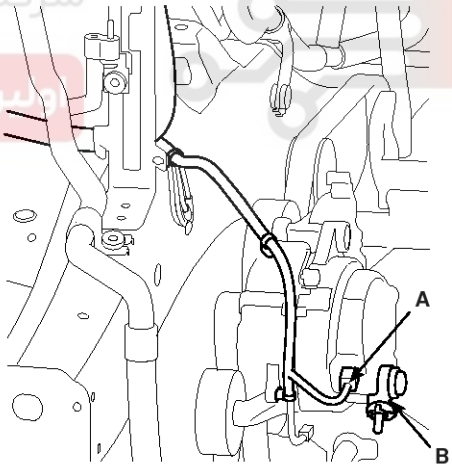
SENEM7087D

6. Remove the cooling fan shroud(A).



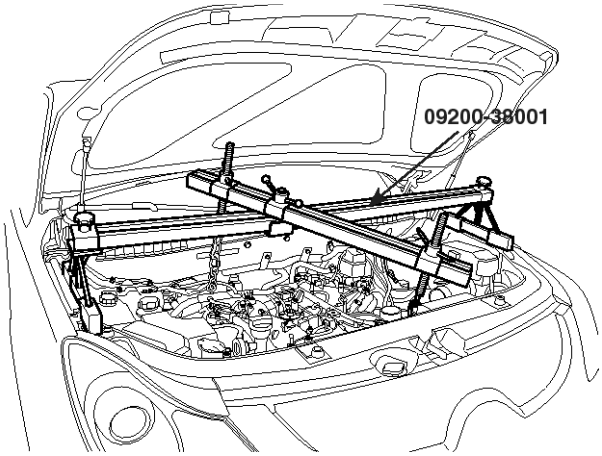
SENEE7002D

7. Remove the passenger side wheel and tire and then its side cover, too.
8. After pressing the auto-tensioner with a wrench, remove the drive belt.
9. After disconnecting the alternator connector(A), disconnect the cable(B) from the 'B' terminal fo the alternator.



SENEE7003D

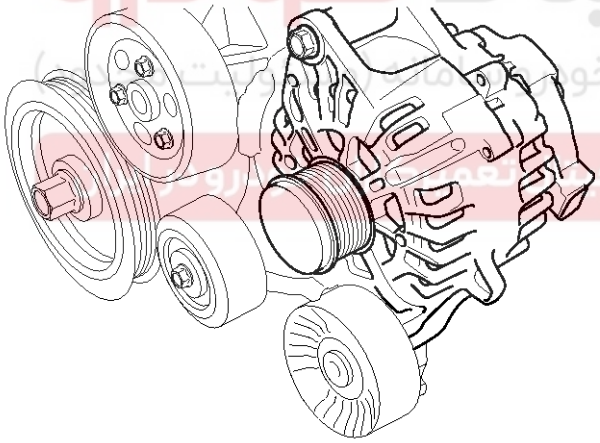
10. Using the SST(09200-38001, 09200-1C000) for supporting the engine assembly, remove the engine mounting bracket.



SENAT7010D

11. With tilting the engine assembly a little, remove the two alternator mounting bolts.

Tightening torque :
29.4 ~ 41.2Nm (3.0 ~ 4.2kgf.m, 21.7 ~ 30.4lb-ft) - alternator

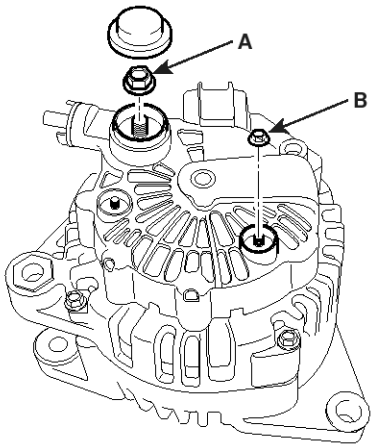


SENEE7004D

12. Installation is in the reverse order of removal.

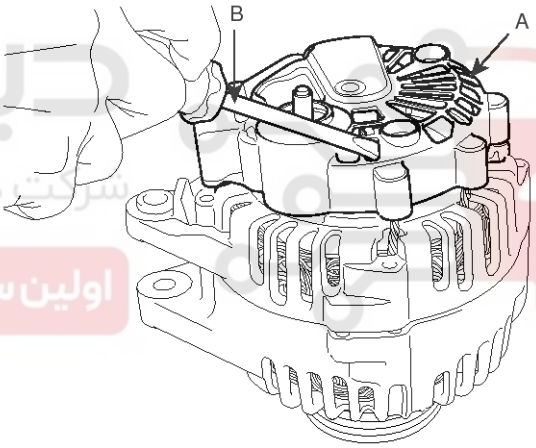
Disassembly

1. Remove the B terminal mounting nut(A) and rear cover nut(B).



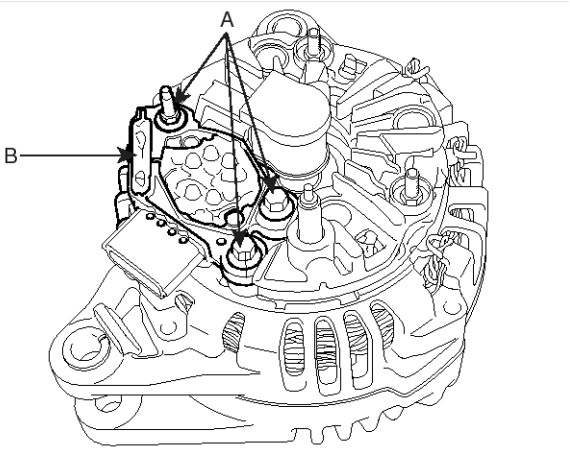
LCGF120A

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



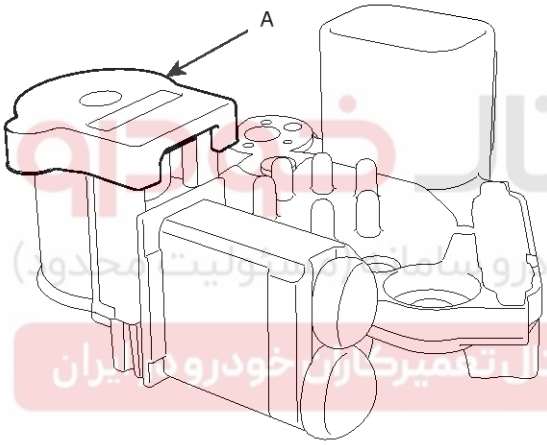
SUNEE6001D

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



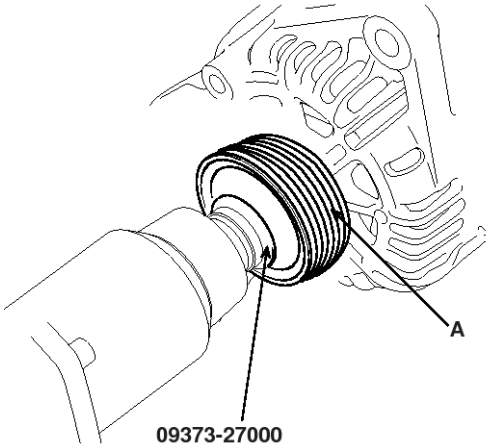
SUNEE6002D

4. Remove the slip ring guide(A).



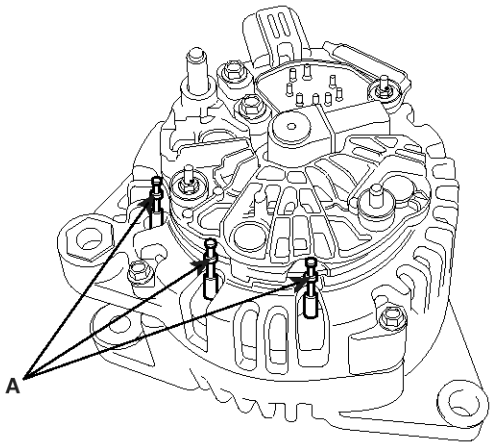
SUNEE6003D

5. Remove the pulley(A) using the SST(09373-27000).



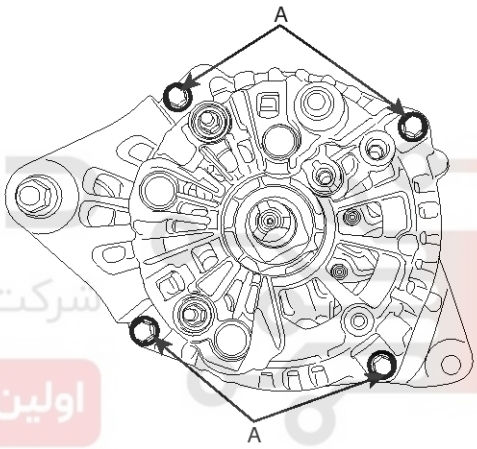
SHDEB6002D

6. Unsolder the 3 stator leads(A).



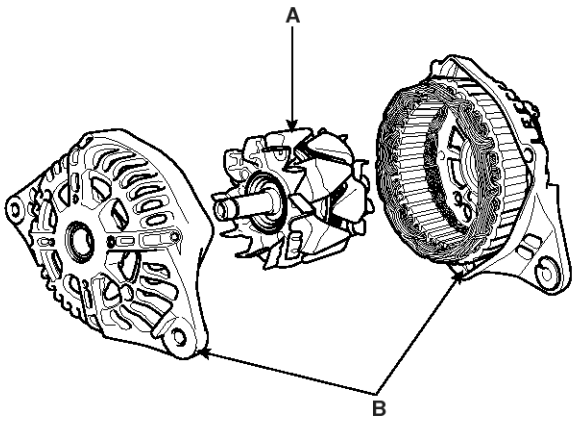
LCGF121A

7. Loosen the 4 through bolts(A).



SUNEE6005D

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



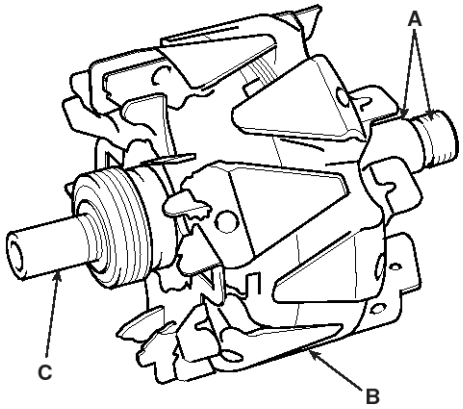
SUNEE6006D

9. Reassembly is the reverse order of disassembly.

Inspection

Rotor

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

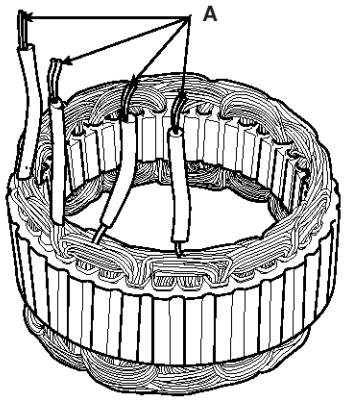


LBGF009A

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.

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.

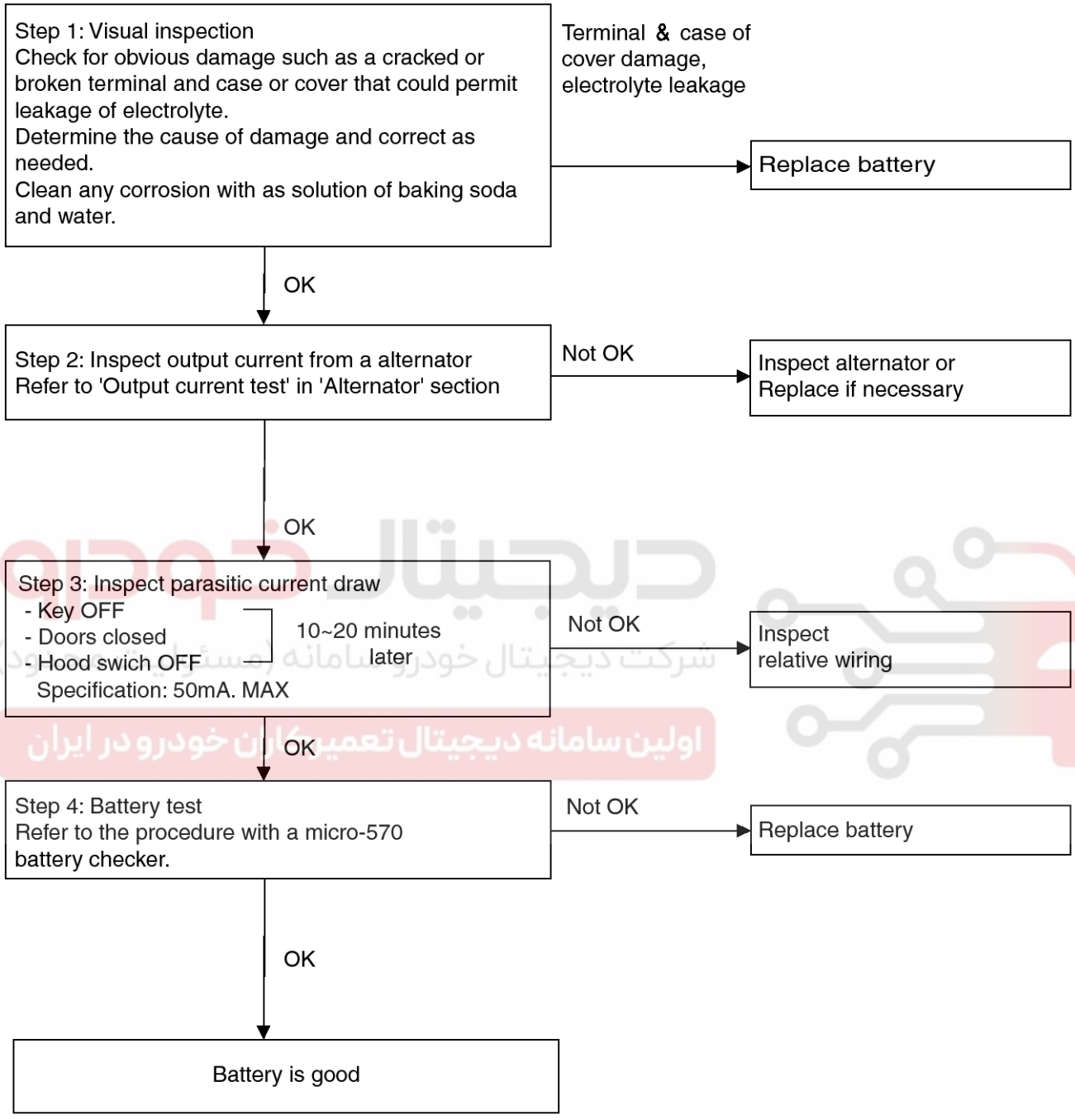
Battery

Description

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.

Inspection

Battery Diagnostic Flow



SXMEE9150L

Vehicle parasitic current inspection

1. Turn the all electric devices OFF, and then turn the ignition switch OFF.
2. Close all doors except the engine hood, and then lock all doors.
   1) Disconnect the hood switch connector.
   2) Close the trunk lid.
   3) Close the doors or remove the door switches.
3. Wait a few minutes until the vehicle's electrical systems go to sleep mode.

   NOTICE

   For an accurate measurement of a vehicle parasitic current, all electriacl systems should go to sleep mode. (It takes at least one hour or at most one day.) However, an approximate vehicle parasitic current can be measured after 10~20 minutes.
4. Connect an ammeter in series between the battery (-) terminal and the ground cable, and then disconnect the clamp from the battery (-) terminal slowly.

   CAUTION

   Be careful that the lead wires of an ammeter do not come off from the battery (-) terminal and the ground cable to prevent the battery from being reset. In case the battery is reset, connect the battery cable again, and then start the engine or turn the ignition switch ON for more than 10 sec. Repeat the procedure from No. 1.

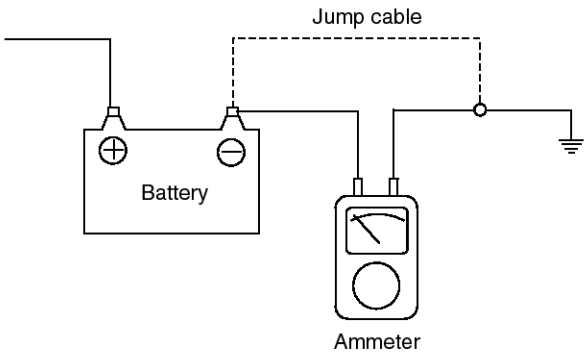
   To prevent the battery from being reset during the inspection,

   a. Connect a jump cable between the battery (-) terminal and the ground cable.

   b. Disconnect the ground cable from the battery (-) terminal.

   c. Connect an ammeter between the battery (-) terminal and the ground cable.

   d. After disconnecting the jump cable, read the current value of the ammeter.



SVQEE0002L

5. Read the current value of the ammeter.
   - If the parasitic current is over the limit value, search for abnormal circuit by removing a fuse one by one and checking the parasitic current.
   - Check the parasitic current again, and search for suspected unit by removing a unit connected with the abnormal circuit one by one.

Limit value (after 10~20 min.) : Below 50mA

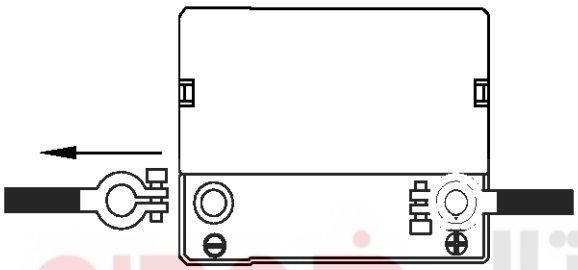
Cleaning

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.



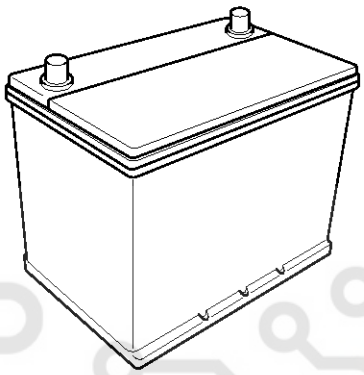
EBJD008B

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 from battery.



EBJD008A

Starting System

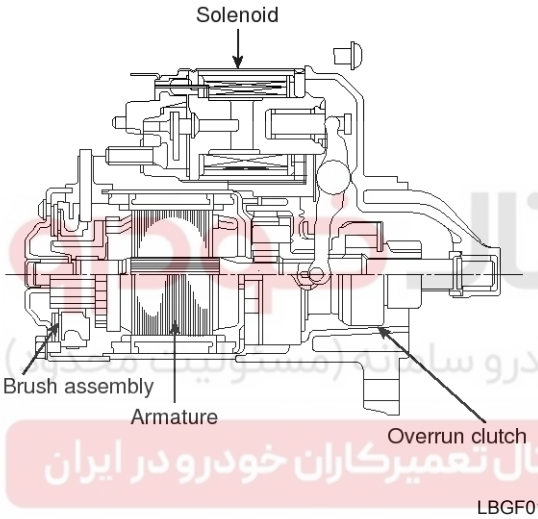
Description

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.



LBGF012A

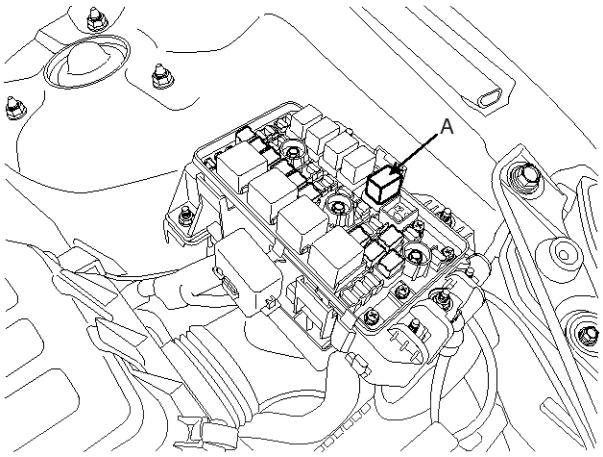
Troubleshooting

Starter Circuit

NOTICE

The battery must be in good condition and fully charged.

1. Remove the fuel pump relay(A) from the fuse box.



SENEE7005D

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.

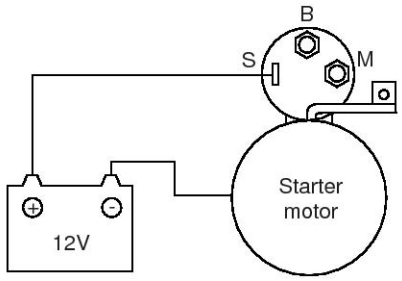
   If the starter cranks the engine, go to next step.

   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.

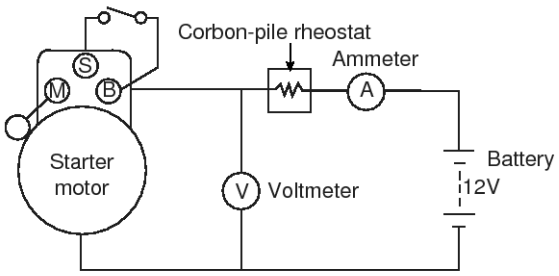
   If the pinion does not move, replace the solenoid.
5. Diconnect the field coil wire from the M-terminal.
6. If the pinion has moved out, the hold-in coil of the solenoid is working properly.

   If the pinion moves in, replace the solenoid.

Starting System EE-29

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.



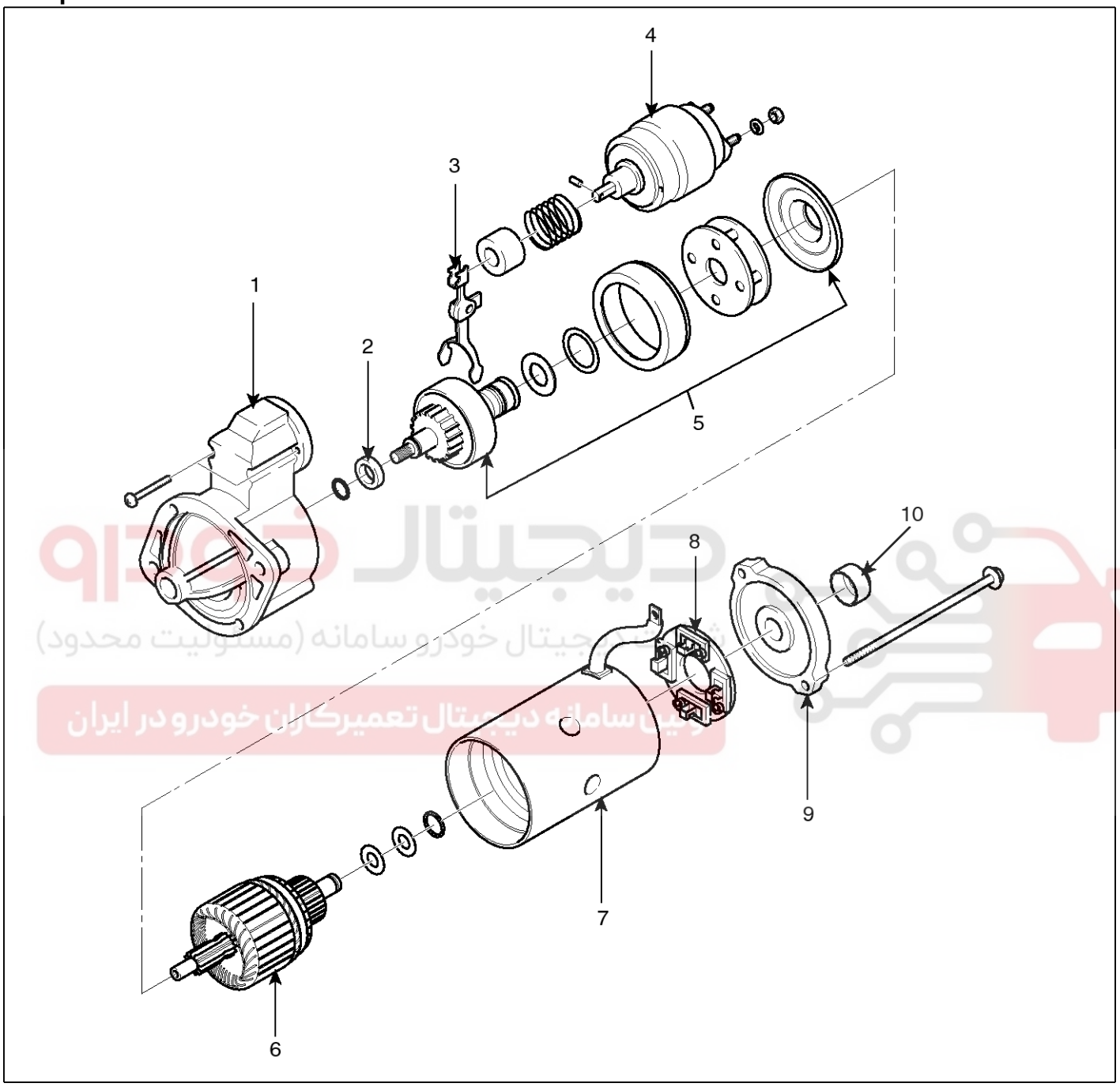
BBGE005A

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 : 130A max
Speed : 3,600 rpm

Starter

Components

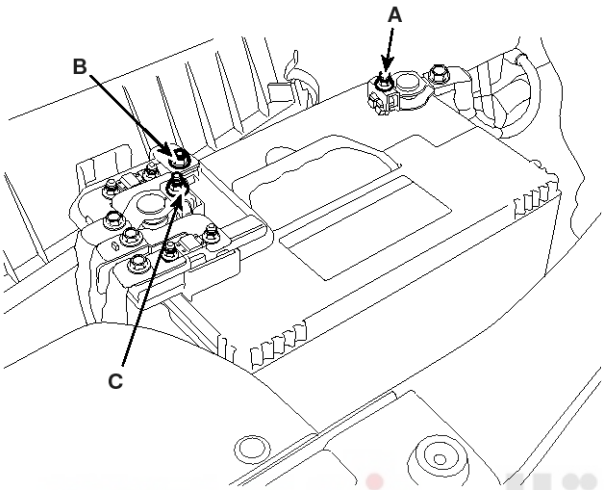


SENEE9001L

1. Front bracket
2. Spaceer
3. Lever
4. Magnetic switch
5. Overrunning clutch
6. Amature assembly
7. York assembly
8. Brush holder assembly
9. Rear bracket
10. Cover

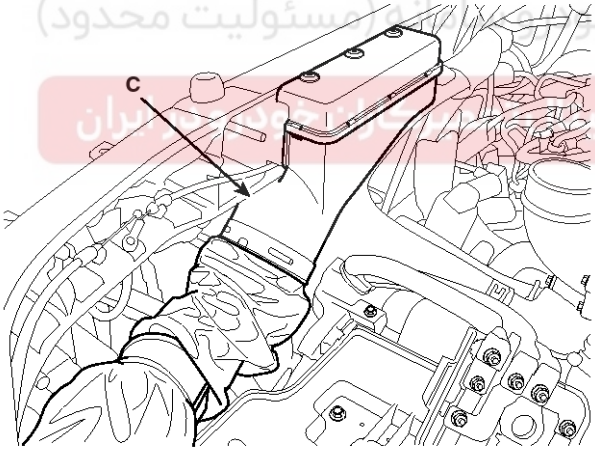
Replacement

1. Remove the nut(A) from the (-) terminal of the battery.
2. Remove the nut(B) from the (+) terminal of the battery.
3. Remove the nut(C) from the (+) terminal and the battery.



SENEM7069D

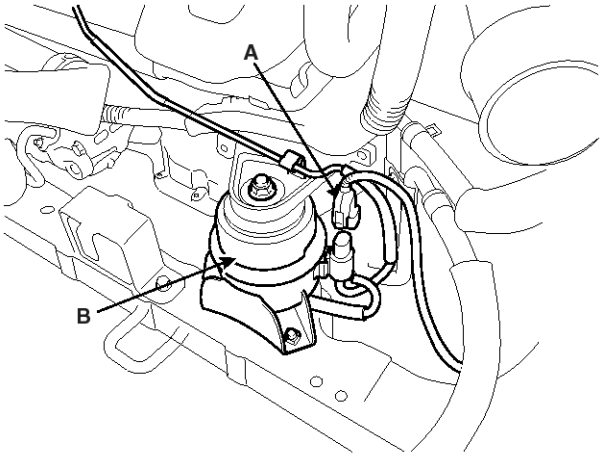
4. Remove the air duct (A).



SENEM7085D

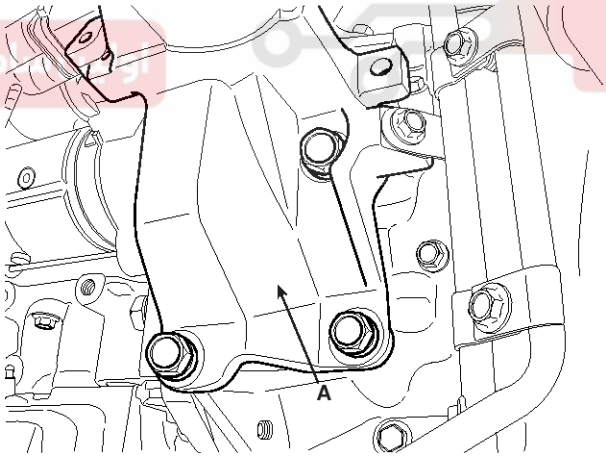
5. Remove the front roll stopper under mounting bolts and disconnect the electric controlled mounting(ECM) solenoid connector(A).

Tightening torque :
49.0 ~ 63.7Nm (5.0 ~ 6.5kgf.m, 36.2 ~ 47.0lb-ft)



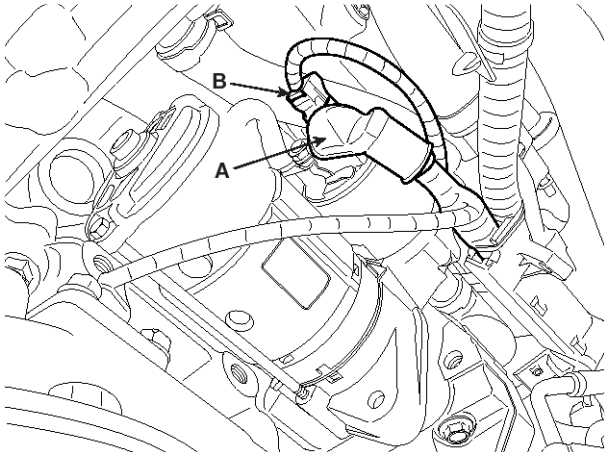
SENEM7081D

6. Remove the sub frame front mounting bolts and tilt the front of the frame down a little.
7. Remove the front roll stopper mounting upper bolts and then the stopper.
8. Remove the front engine bracket(A).



SENEE7008D

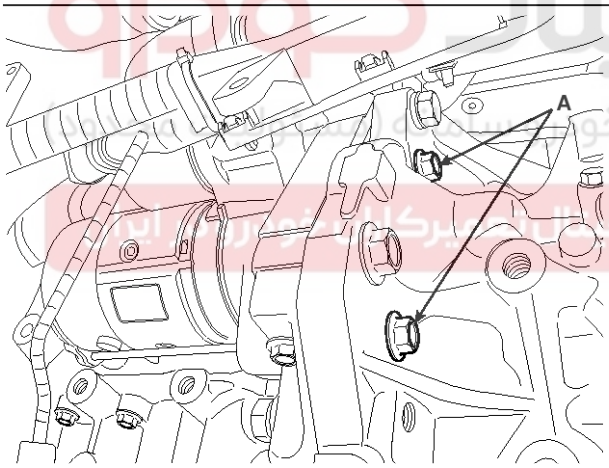
9. Disconnect the starter motor cable(A) from the 'B' terminal of the solenoid and the connector(B) from the 'S' terminal.



SENEE7009D

10. Remove the starter by loosening the two starter mounting bolts(A).

Tightening torque :
42.2 ~ 53.9Nm (4.3 ~ 5.5kgf.m, 31.1 ~ 39.8lb-ft)



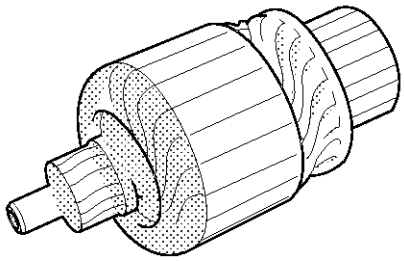
SENEE7010D

11. Installation is in the reverse order of removal.

Inspection

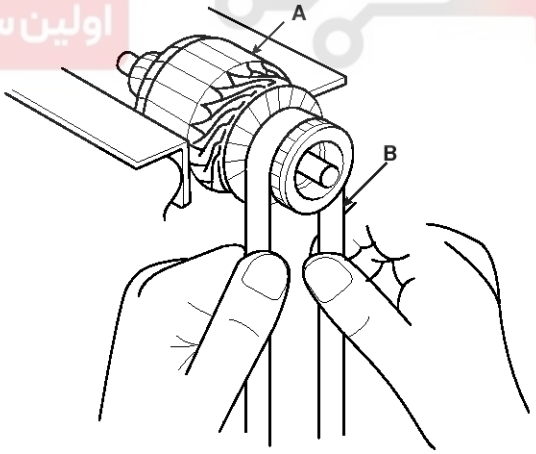
Armature

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.



LBGF026A

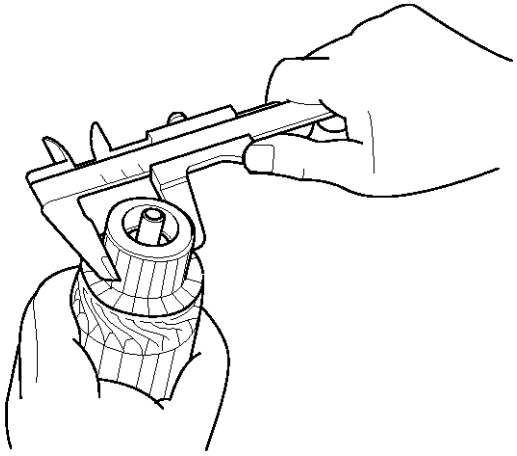
4. Check the commutator(A) surface. If the surface is dirty or burnt, resurface with emery cloth or a lathe within the following specifications, or recondition with #500 or #600 sandpaper(B).



LBGF027A

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

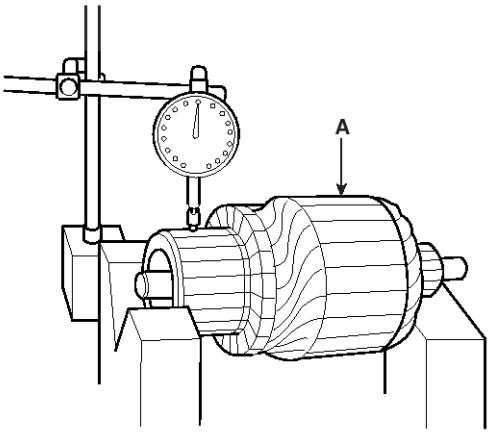
Commutator diameter
Standard (New) : 30.0 mm (1.1811 in)
Service limit : 29.2 mm (1.1496 in)



LBGF028A

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.

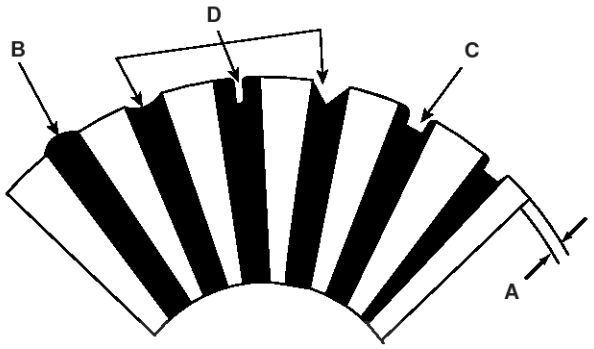
Commutator runout
Standard (New) : 0.02mm (0.0008in.) max
Service limit : 0.05mm (0.0020in.)



LBGF029A

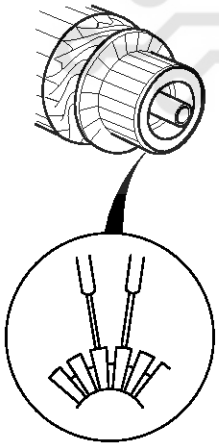
7. Check the mica depth(A). If the mica is too high(B), undercut the mica with a hacksaw blade to the proper depth. Cut away all the mica(C) between the commutator segments. The undercut should not be too shallow, too narrow, or v-shaped(D).

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



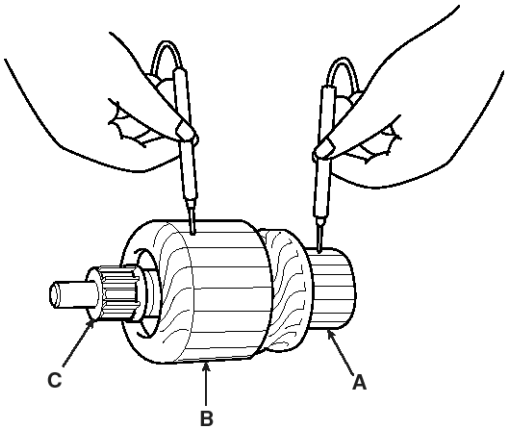
LBGF030A

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



LBGF031A

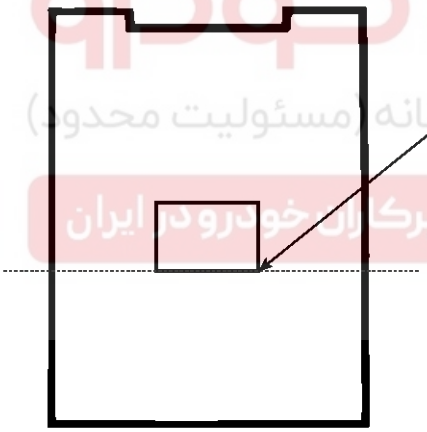
9. Check with an ohmmeter that no continuity exists between the commutator(A) and armature coil core(B), and between the commutator and armature shaft(C). If continuity exists, replace the armature.



EBKD012G

Inspect Starter Brush

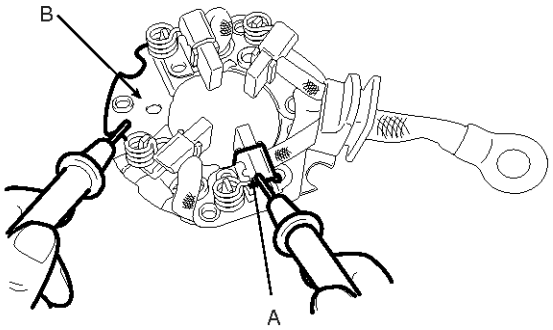
Brushes that are worm out, or oil-soaked, should be replaced.



LBGF033A

Starter Brush Holder

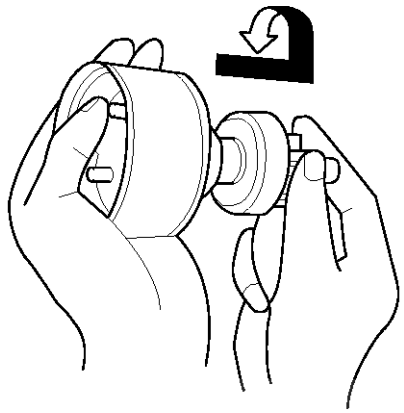
Check that there is no continuity between the (+) brush holder(A) and (-) plate(B). If there is continuity, replace the brush holder assembly.



EBBD330A

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.



LBGF034A

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.

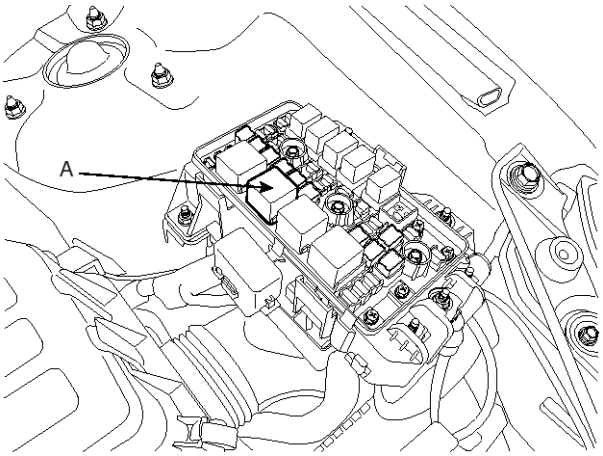
Cleaning

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 sol-vent 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

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

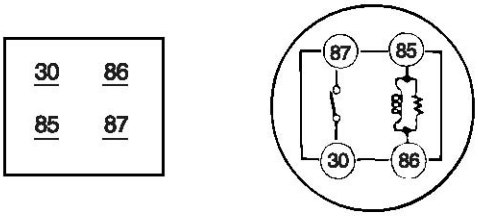


SENEE7007D

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.

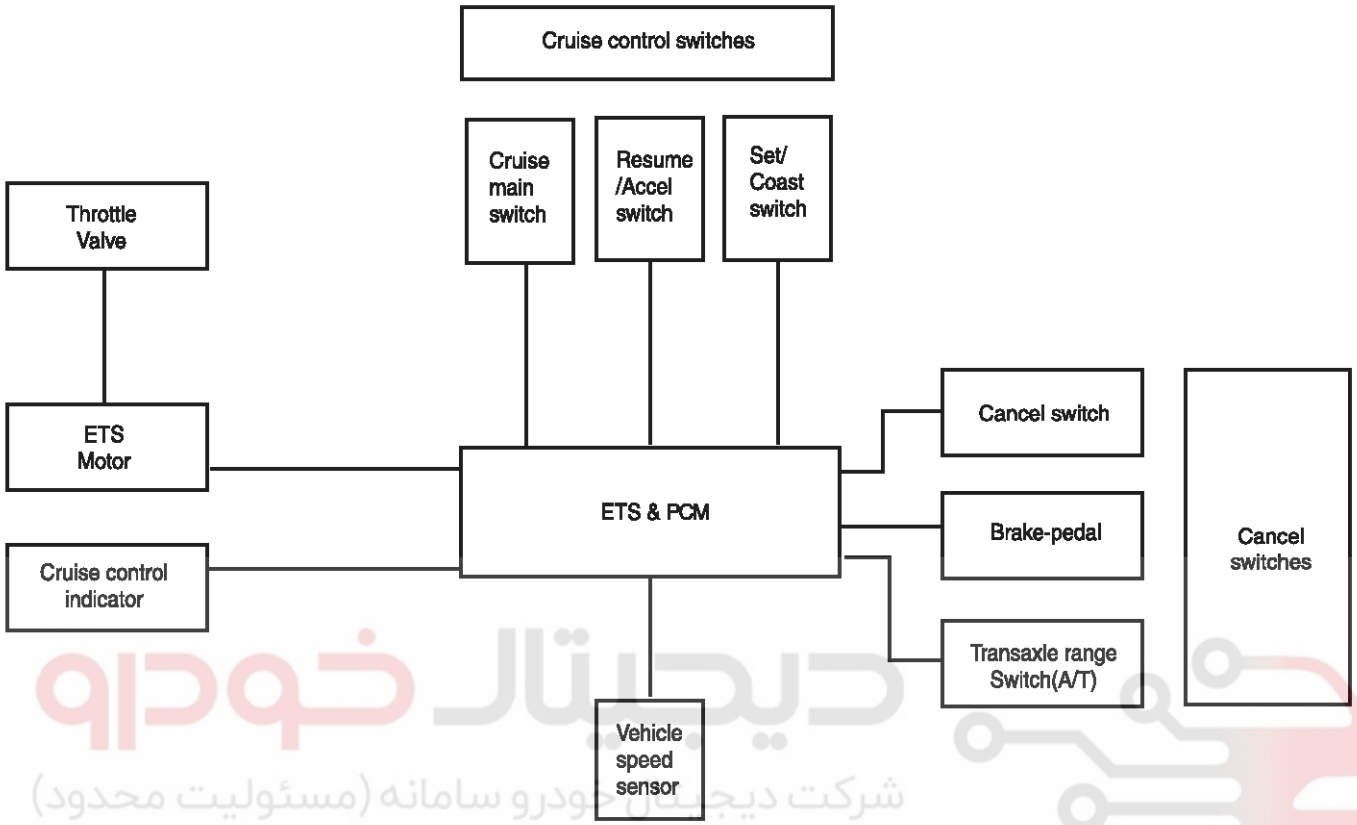


LDAD510B

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

Cruise Control System

System Block Diagram



Component Parts And Function Outline

Component part		Function
Vehicle-speed sensor		Converts vehicle speed to pulse.
Power control module (PCM)		Receives signals from sensor and control switches;
Cruise control indicator		Illuminate when CRUISE main switch is ON (Built into cluster)
Cruise Control switches	CRUISE main switch	Switch for automatic speed control power supply.
	Resume/Accel switch	Controls automatic speed control functions by Resume/Accel switch (Set/Coast switch)
	Set/Coast switch	
Cancel switch	Cancel switch	Sends cancel signals to PCM
	Brake-pedal switch	
	Transaxle range switch (A/T) Clutch switch (M/T)	
ETS motor		Regulates the throttle valve to the set opening by PCM.

* ETS : Electronic Throttle System

Cruise Control

Cruise control system is engaged by the "ON/OFF" main switch located on right of steering wheel column. The system has the capability to cruise, coast, resume speed, and accelerate, and raise "tab-up" or lower "tab-down" set speed.

It also has a safety interrupt, engaged upon depressing brake or shifting select lever.

The ECM is the control module for this system.

The main components of cruise control system are mode control switches, transaxle range switch, brake switch, vehicle speed sensor, ECM and ETS motor that connect throttle body.

The ECM contains a low speed limit which will prevent system engagement below a minimum speed of 40km/h (25mph).

The operation of the controller is controlled by mode control switches located on steering wheel.

Transaxle range switch and brake switch are provided to disengage the cruise control system. When the brake pedal is depressed or select lever shifted, the cruise control system is electrically disengaged and the throttle is returned to the idle position.

Cruise main switch

Cruise control system is engaged by pressing the "ON/OFF" push button. Releasing the "ON/OFF" push button will release throttle, clears cruise memory speed, and puts vehicle in a non-cruise mode.

Coast/Set switch

COAST/SET switch located on right of steering wheel column has two positions - "Normal" and "Depressed". The set position - With COAST/SET switch depressed and then released the cruise speed will be set at the speed the vehicle was going when COAST/SET switch was released. The coast position - With COAST/SET switch fully depressed, driver can lower cruise speed. To decrease cruise speed, COAST/SET switch is held in, disengaging cruise control system. When vehicle has slowed to required cruise speed, releasing COAST/SET switch will re-engage system at new selected speed.

The tab down - To lower vehicle speed, cruise must be engaged and operating. Tab down is done by quickly pressing and releasing COAST/SET switch. Do not hold COAST/SET switch in depressed position.

Tab down is a function in which vehicle speed is decrease by 1 mph (1.6km/h)

Resume/Accel switch

RES/ACCEL switch located on right of steering wheel column has two positions - "Normal" and "Depressed".

The resume position - With RES/ACCEL switch depressed and then release, this switch also returns cruise control operation to last speed (Which is temporarily disengaged by Cancel switch or Brake pedal), setting when momentarily operating RES/ACCEL switch by constant acceleration.

The accel position - With RES/ACCEL switch depressed and held in, disengaging cruise control system, when vehicle has accelerated to required cruise speed, releasing RES/ACCEL switch will re-engage speed at new selected speed.

The tab up - To increase vehicle speed, the cruise must be engaged and operating.

Tab up is done by quickly pressing and releasing RES/ACCEL switch less than 0.5 second. Do not hold RES/ACCEL switch in depressed position. Tab up is a function in which cruise speed can be increased by 1mph (1.6km/h).

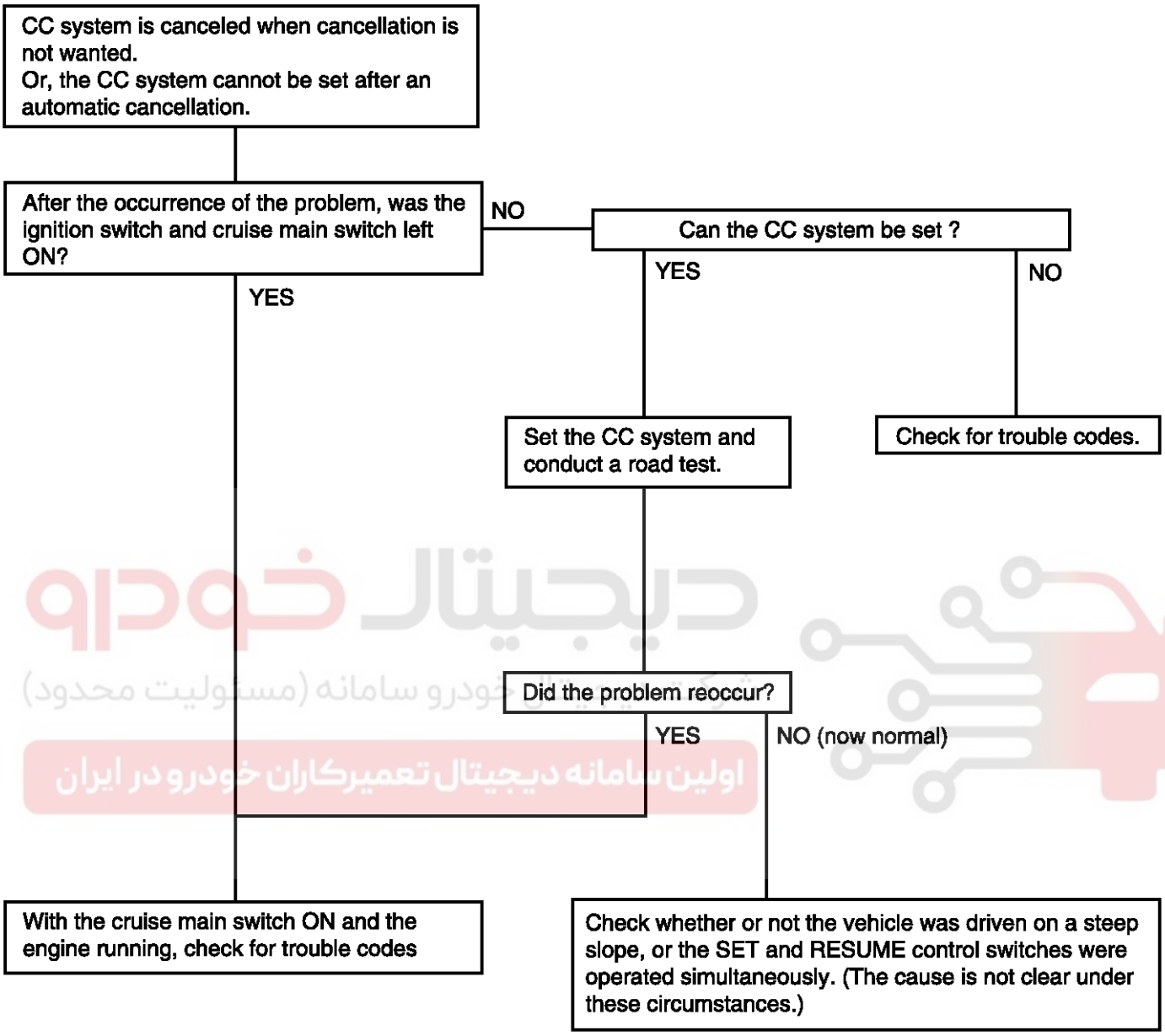
Cancel switch

Cruise control system is temporarily disengaged by pressing "CANCEL" switch.

Cruise speed canceled by this switch will be recovered by RES/ACCEL switch

Trouble Symptom Charts

Trouble Symptom 1



CC : Cruise Control
ECM : Engine Control Module

SCMEE6006N

Trouble Symptom 2

Trouble symptom	Probable cause	Remedy
The set vehicle speed varies greatly upward or downward "Surging" (repeated alternating acceleration and deceleration) occurs after setting	Malfunction of the vehicle speed sensor circuit	Repair the vehicle speed sensor system, or replace the part
	Malfunction of PCM	Check input and output signals at PCM

Trouble Symptom 3

Trouble symptom	Probable cause	Remedy
The CC system is not canceled when the brake pedal is depressed	Damaged or disconnected wiring of the brake pedal switch	Repair the harness or replace the brake pedal switch
	Malfunction of the PCM signals	Check input and output signals at PCM

Trouble Symptom 4

Trouble symptom	Probable cause	Remedy
The CC system is not canceled when the shift lever is moved to the "N" position (It is canceled, however, when the brake pedal is depressed	Damaged or disconnected wiring of inhibitor switch input circuit	Repair the harness or repair or replace the inhibitor switch
	Improper adjustment of inhibitor switch	
	Malfunction of the PCM signals	Check input and output signals at PCM

Trouble Symptom 5

Trouble symptom	Probable cause	Remedy
Cannot decelerate (coast) by using the SET switch	Temporary damaged or disconnected wiring of SET switch input circuit	Repair the harness or replace the SET switch
	Malfunction of the PCM signals	Check input and output signals at PCM

Trouble Symptom 6

Trouble symptom	Probable cause	Remedy
Cannot accelerate or resume speed by using the RESUME switch	Damaged or disconnected wiring, or short circuit, or RESUME switch input circuit	Repair the harness or replace the RESUME switch
	Malfunction of the PCM signals	Check input and output signals at PCM

Trouble Symptom 7

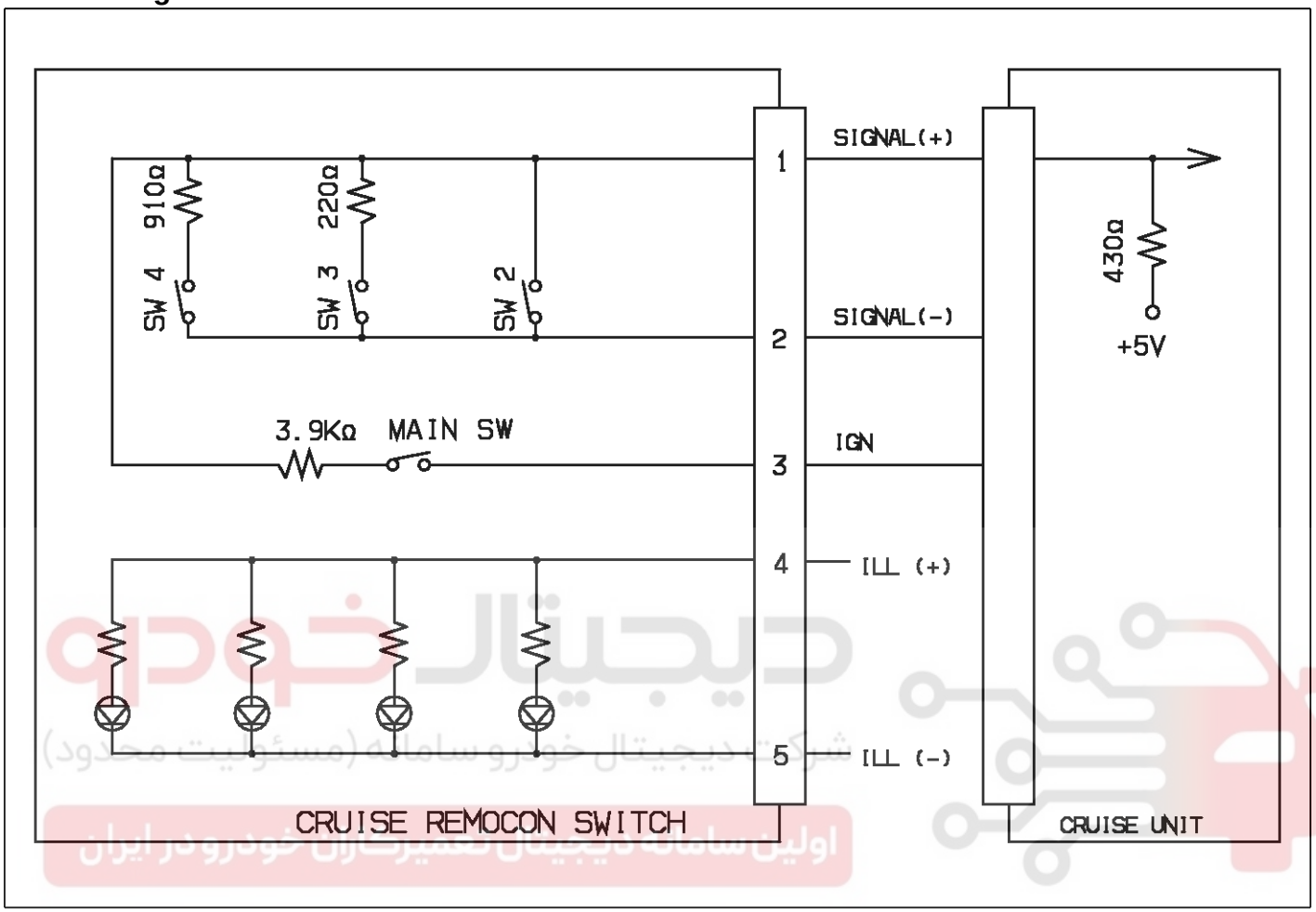
Trouble symptom	Probable cause	Remedy
CC system can be set while driving at a vehicle speed of less than 40km/h (25mph), or there is no automatic cancellation at that speed	Malfunction of the vehicle-speed sensor circuit	Repair the vehicle speed sensor system, or replace the part
	Malfunction of the PCM signals	Check input and output signals at PCM

Trouble Symptom 8

Trouble symptom	Probable cause	Remedy
The cruise main switch indicator lamp does not illuminate (But CC system is normal)	Damaged or disconnected bulb of cruise main switch indicator lamp	Repair the harness or replace the part.
	Harness damaged or disconnected	

Cruise Control Switch

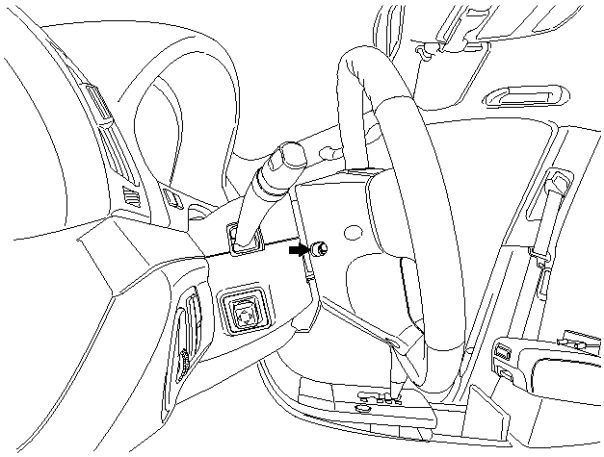
Circuit Diagram



SENEA7000L

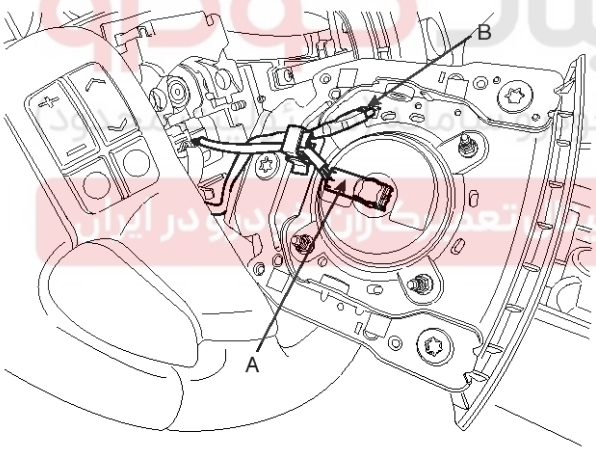
Removal

1. Disconnect the battery (-) terminal.
2. Remove the two bolts from the both sides of the wheel.



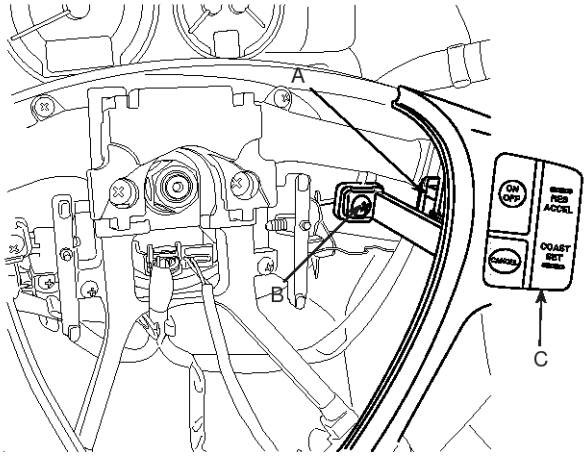
SENST7002D

3. Remove the driver side air bag module (C) after disconnecting the air-bag connector (A) and the horn connector (B).



SENST7003D

4. Disconnect the cruise control switch connector (A) and then remove the cruise control switch (C) with two screws (B).



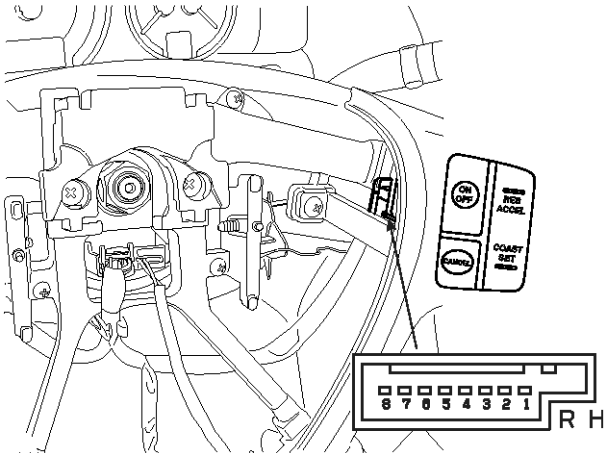
SENEA7003L

5. Installation is the reverse of removal.

Inspection

Measuring Resistance

1. Disconnect the cruise control switch connector from the control switch.



SENEA7002L

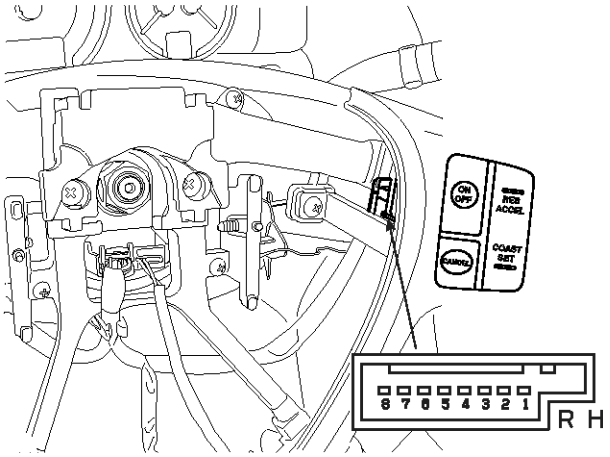
2. Measure resistance between terminals on the control switch when each function switch is ON (switch is depressed).

Function switch	Terminal	Resistance
Cruise Main	1-3	3.9kΩ ± 5%
Cancel	1-2	0Ω ± 5%
Set/Coast	1-2	220Ω ± 5%
Resume/Accel	1-2	910Ω ± 5%

3. If not within specification, replace switch.

Measuring Voltage

1. Connect the cruise control switch connector to the control switch.



SENEA7002L

2. Measure voltage between terminals on the harness side connector when each function switch is ON (switch is depressed).

Function switch	Terminal	Voltage
Cruise Main	1-3	3.780 ~ 4.220V
Cancel	1-2	0.0V ~ 0.220V
Set/Coast	1-2	1.280 ~ 1.720V
Resume/Accel	1-2	2.780V ~ 3.220V

3. If not within specification, replace switch.

Preheating System

Inspection

Preheating System

Conditions before inspection :

Battery voltage : 12V

Cooling water temperature : Below 30℃ (86˚F)

(Disconnect the water temperature sensor connector).

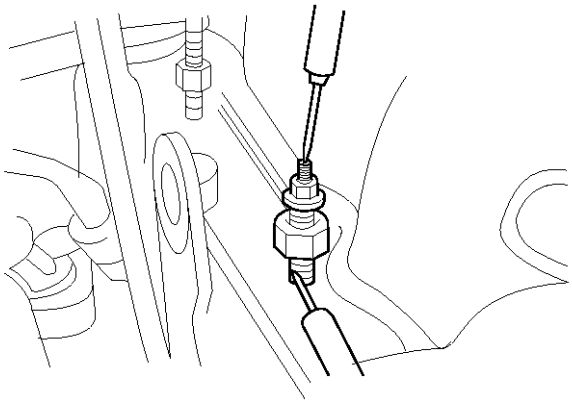
⚠CAUTION

Reconnect the water temperature sensor connector after inspection.

1. Connect voltmeter between glow plug plate and plug body (ground).
2. Check indicated value on voltmeter with ignition switch ON.
3. Check that preheat indication lamp lights for about 6 seconds and indicates battery voltage (about 9V or over) for about 36 seconds immediately after ignition switch is turned on. [At cooling water temperature 20˚C (68.0˚F)]

   NOTICE

   Continuity time varies depending upon cooling water temperature.
4. After checking 3, set ignition switch at START position.
5. The system is normal if battery voltage (about 9V or over) is generated for about 6 seconds during engine cranking and after start operation. [at cooling water temperature 20˚C (68.0˚F)]
6. When the voltage or continuity time is not normal, check the terminal voltage in glow control unit, and single parts.



EBKD300O

Glow Plug

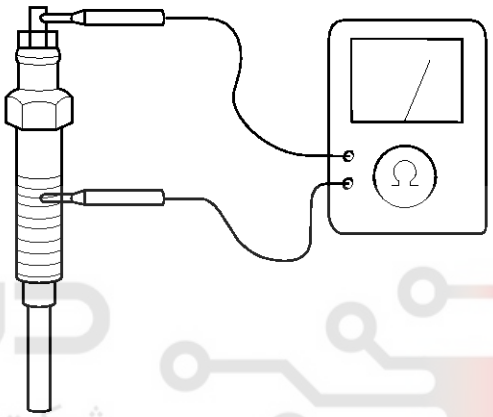
1. Check the continuity between the terminal and body as illustrated. Replace if discontinuity or with large resistance.

Standard value : 0.25Ω

⚠CAUTION

Remove oil from plug before measuring as glowplug resistance is very small.

2. Check for rust on glow plug plate.
3. Check glow plug for damage.



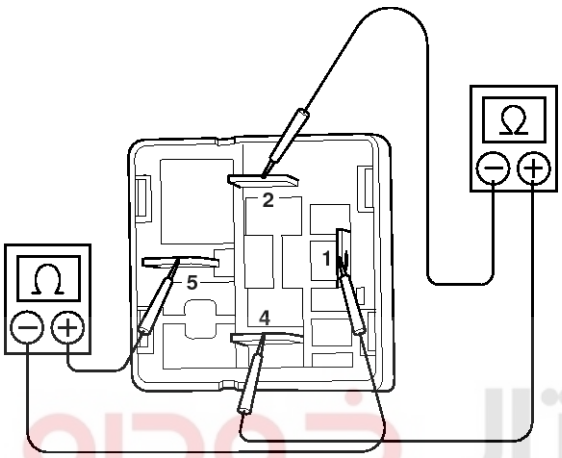
EBKD300P

Glow Plug Relay

1. Remove the glow plug relay.
2. Inspect the relay continuity.
   - Using an ohmmeter, check that there is continuity between terminals 2 and 4.

     If there is no continuity, replace the relay.
   - Check that there is no continuity between terminals 1 and 5.

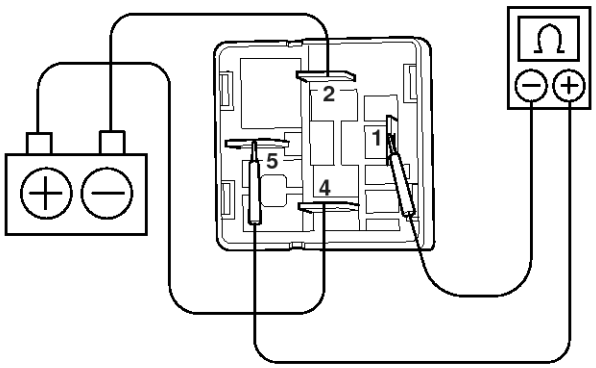
     If there is continuity, replace the relay.



LBGF035A

3. Inspect the relay operation.
   - Apply battery positive voltage across terminals 2 and 4.
   - Using an ohmmeter, check that there is continuity between terminals 1 and 5.

     If there is no continuity, replace the relay.



LBGF036A

4. Install the glow plug relay.

Glow Plug

Description

Structure

The glow plug mainly consists of a housing in which a heating pin is pressed in. In the heating pin there are the heating spiral and the sensor spiral, both are connected in series and embedded in a ceramic mass.

Purpose

- Prior to engine starting : To make quickly available a hot surface of approximately 850℃(1562˚F), where the air-fuel mixture evaporizes and ignites during the compression stroke.
- While engine starting : To support the engine run-up.
- After engine starting : To improve the idle running and to reduce the emissions of blue smoke, pollutants and noise.

Inspection

The specified electrical data below are related to the nominal voltage and to an ambient temperature of 22.5~23.5℃(72.5~74.3˚F) on new glow plugs.

Current Consumption

Initial current at 11V : less than 27.0A
Operating current after 5 sec : less than 9.0A
Operating current after 60 sec : less than 8.0A

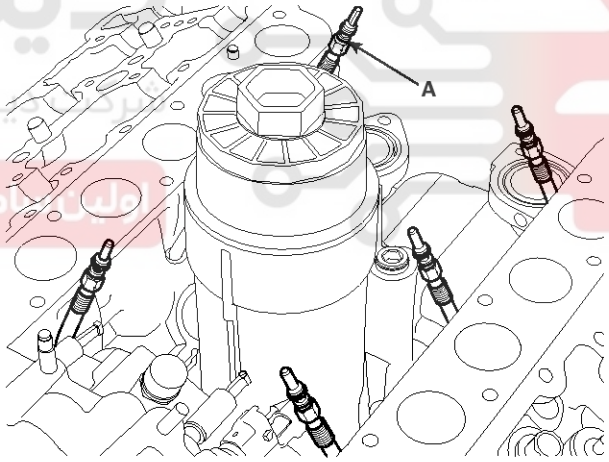
Cold Resistance

The measured values are valid for 4 minutes at nominal voltage or for 10 minutes at 980℃(1796˚F) pre-oxidized glow lugs.

Glow plug resistance at 18~22℃(64.4~71.6˚F) : 410±110mΩ

Removal

1. Remove the inlet lower and upper manifold assembly.(Refer to Intake manifold in this Group)
2. Remove the glow plugs (A).



SENEM7042D

Glow Control Unit

Description

Unlike the self-controlling standard glow plugs, the new instant-start glow plugs require a voltage-controlled activation. The voltage at the glow plug is controlled by pulse wide modulation of the on-board voltage. In pulse wide mode(PWM) operation, the glow plugs are not all switched on and off simultaneously but one after another whenever possible to minimize the influence on the vehicle electrical system due to periodic switching on and off of very high currents. ISS ECU receives the current engine speed and fuel quantity per injection via the CAN bus. Based on this information, the Glow Plug Control Unit(GPCU) increases or decreases the electrical power fed to the glow plug.

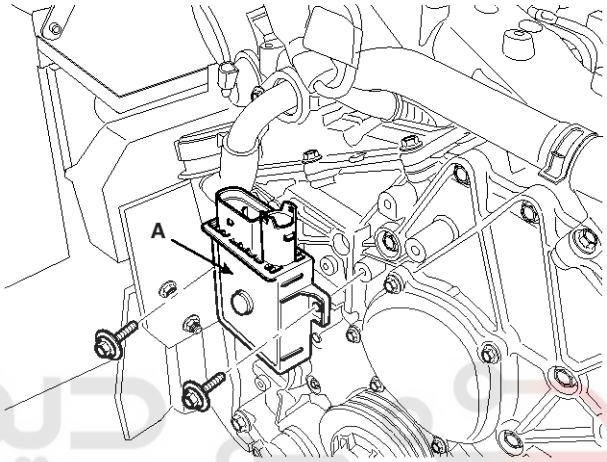
Removal

1. Remove the front cover assemlby.

Tighting torque :
7.8 ~ 11.8Nm (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft)

2. Remove the glow plug control unit(A).

Tightening torque :
6.9 ~ 10.8Nm (0.7 ~ 1.1kgf.m, 5.1 ~ 8.0lb-ft)



SENEM7104D