Engine Electrical System

PREHEATING SYSTEM	EE -	-40
STARTING SYSTEM	EE -	-29
CHARGING SYSTEM		
IGNITION SYSTEM (DOHC)	EE.	- 6
GENERAL	EE ·	- 2

GENERAL

SPECIFICATIONS EBUC0010

IGNITION

	2.4 14
Type Primary coil resistance Secondary coil resistance	0.86 ± 10% (Ω) 12.1 ± 15% ($K\Omega$)

SPARK PLUG

	2.4 14
Type Champion NGK	RN10PYP4
Plug gap	1.0-1.1 mm (0.039-0.043 in.)

STARTER MOTOR

	2.4 14	Diesel
Type Voltage Output	Reduction drive (with planetary gear) 12V 1.2KW	Reduction drive (with planetary gear) 12V 2.0KW
No-load characteristics Terminal voltage Amperage Speed	11V 90A or below 2,800 RPM	11V 90A or below 2,800 RPM
Number of pinion teeth	8	13
Pinion gap	0.5-2.0 mm (0.0197-0.079 in.)	0.5-2.0 mm (0.0197-0.079 in.)

GENERATOR

	2.4 14	Diesel
Type Rated output	Battery voltage sensing	Battery voltage sensing
Voltage regulator type	Electronic built-in type	Electronic built-in type
Regulator setting voltage Temperature compensated	14.4 ± 0.3 V -10 ± 3 mV / °C	14.4 ± 0.3 V -10 ± 3 mV / °C

BATTERY

	All Engines
Туре	MF 68 AH, MF 90 AH
Ampere hours	
5HR	55 AH or more
Cold cranking [at -17.8°C (0°F)]	540 AH or more
Reverse capacity	122 min.
Specific gravity [at 25°C (77°F)]	1.280 ± 0.01



COLD CRANKING AMPERAGE is the amperage a battery can deliver for 30 seconds and maintain a terminal voltage of 7.2 or greater at a specified temperature. REVERSE CAPACITY RATING is the amount of time a battery can deliver 25A and maintain a minimum terminal voltage of 10.5 at 26.7°C (80°F).

TIGHTENING TORQUE

Items	Nm	Kg⋅cm	lb·ft .
Generator terminal (B+)	5-7	50-70	3.6-5.1
Starter motor terminal (B+)	10-12	100-120	7.3-8.8
Battery terminal	4-6	40-60	2.9-4.3
Spark plug	20-30	200-300	15-22

TROUBLESHOOTING EBUC0030

IGNITION SYSTEM

Trouble symptom	Probable cause	Remedy
Engine will not start or is hard	Ignition lock switch faulty	Replace ignition lock switch
to start (Cranks OK)	Ignition coil faulty	Inspect ignition coil
	Power transistor faulty	Inspect power transistor
	Spark plugs faulty	Replace plugs
	Ignition wiring disconnected or broken	Inspect wiring
14:10	Spark plugs faulty	Replace plugs
Rough idle or stalls	Ignition wiring faulty	Inspect wiring
	Ignition coil faulty	Inspect ignition coil
	Spark plug cable faulty	Inspect spark plug cable
Engine hesitates/poor	Spark plugs faulty	Replace plugs
acceleration	Ignition wiring faulty	Inspect ignition coil
Poor mileage	Spark plugs faulty	Replace plugs

CHARGING SYSTEM

Trouble symptom	Probable cause	Remedy
Charging warning indicator does	Fuse blown	Check fuses
not light with ignition switch "ON" and engine off	Light burned out	Replace light
ON and engine on	Wiring connection loose	Tighten loose connections
	Electronic voltage regulator faulty	Replace voltage regulator
Charging warning indicator	Drive belt loose or worn	Adjust tension or replace drive belt
does not go out with engine running (Battery requires	Battery cables loose, corroded or worn	Repair or replace cables
frequent recharging)	Fuse blown	Check fuses
	Fusible link blown	Replace fusible link
	Electronic voltage regulator or generator faulty	Test generator
	Wiring faulty	Repair wiring
Engine hesitates/poor	Drive belt loose or worn	Adjust tension or replace drive belt
acceleration Overcharge	Wiring connection loose or open circuit	Tighten loose connection or repair wiring
·	Fusible link blown	Replace fusible link
	Poor grounding	Repair
	Electronic voltage regulator or generator faulty	Test generator, if faulty, repair or replace.
	Worn battery	Replace battery
	Electronic voltage regulator faulty	Replace voltage regulator
	Voltage sensing wire faulty	Repair wire

STARTING SYSTEM

Trouble symptom	Probable cause	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 faulty (Vehicle with automatic transaxle only)	Adjust or replace switch
	Fusible link blown	Replace fusible link
	Starter motor faulty	Repair starter motor
	Ignition switch faulty	Replace ignition switch
	Ignition lock switch faulty	Replace ignition lock switch
Engine cranks slowly	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn out	Repair or replace cables
	Starter motor faulty	Repair starter motor
Starter keeps running	Starter motor faulty	Repair starter motor
	Ignition switch faulty	Replace ignition switch
Starter spins but engine	Short in wiring	Repair wiring
will not crank	Pinion gear teeth broken or starter motor faulty	Repair starter motor
	Ring gear teeth broken	Replace flywheel ring gear or torque converter

GLOW CONTROL SYSTEM (DIESEL)

Trouble symptom	Probable cause	Remedy
Engine will not start below 50°C	Wiring connection loose or bad wiring	Repair or replace wiring
	ECT sensor malfunction	Replace ECT sensor
	Glow plug malfunction	Repair or replace glow plug
	Glow plug control unit failed	Replace glow control unit
After first combustion, engine	Wiring connection loose or bad wiring	Repair or replace wiring
stall or rough idle below 50°C	Glow plug malfunction	Check the resistance of glow plug and replace, if necessary
	Glow plug relay malfunction	Check the relay and replace, if necessary
	Glow plug control unit failed	Check the control unit and replace, if necessary
Yellow glow lamp will not turn-ON	Open lamp	Replace lamp
	Wiring connection loose or bad wiring	Repair or replace wiring
	Shorted wiring	Repair or replace wiring
	Glow plug control unit failed	Replace control unit, if necessary

IGNITION SYSTEM (DOHC)

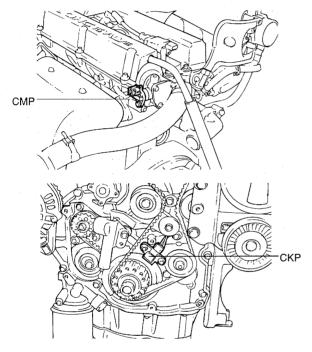
GENERAL INFORMATION EBA90040

Ignition timing is controlled by the Engine control module (ECM). The ignition timing data for the engine operating conditions are programmed in the memory of the ECM.

Engine operating conditions (speed, load, warm-up condition, etc.) are detected by the various sensors. Based upon these sensor signals and the data stored in the ECM, signals to interrupt the primary current are sent to the power transistor. The ignition coil is activated and timing is controlled at the optimum point.

*CKP: Crankshaft Position

*CMP: Camshaft Position



EBA9004A

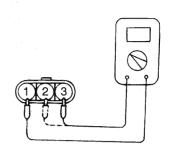
IGNITION COIL (14: POWER TRANSISTOR BUILT-IN) EBJB5070

Measurement of the primary coil resistance

Connect the negative (-) terminal of a 3V power supply to terminal 2 of the power transistor; then check whether there is continuity between terminal 3 and terminal 2 when terminal 1 and the positive (+) terminal are connected and disconnected.

Terminal 3 and (+) terminal	Terminal 1 and (+) terminal 2
Connected	Continuity (Approximately 0.86Ω)
Disconnected	Non continuity

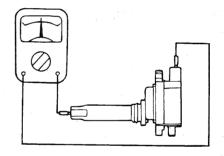
Replace the power transistor if there is malfunction.



EBHA007A

Measurement of the secondary coil resistance Measure the resistance between the high-voltage terminals of the ignition coil.

Standard value: Approximately 12.1 k Ω



EBA9009D

REMOVAL AND INSTALLATION

- Disconnect the negative battery terminal.
- Remove the air bag module.

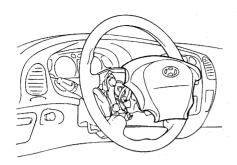


/!\ CAUTION

The SRS system is designed to retain enough power to deploy air bag for about 30 seconds even after battery has been disconnected, so serious injury may result from unintended air bag deployment if service is done on the SRS system immediately after battery cable is disconnected.

- Loosen the tapping screw and lift up horn pad and remove it.
- Remove the lock nut and the washer.

5. Pulling the dynamic damper forward, lift it up and remove it.



KPLA011A

6. Install the special tool (09561–11001) and remove the steering wheel.

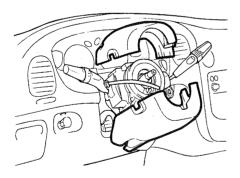


Do not hammer on the steering wheel to remove it.



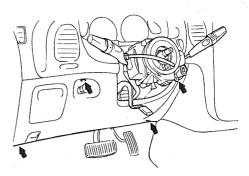
EBA9010B

7. Remove the steering column lower and upper shrouds.



KPLA012A

8. Remove the lower cover.



KPLA013A

9. Disconnect the connectors and remove the multifunction switch.



KPLA014A

10. Remove the mounting bolts and separate ignition switch from steering column.

INSPECTION EBUC0070

- Separate the connector located under the steering column.
- 2. Inspect the switch continuity between the terminals.
- If continuity is not as specified, replace the switch

Terminal		Ignition switch				s	oor warning switch and y illumination			Lo	ock		
Position	Key	1	2	3	4	5	6	1	2	3	4	RO	RE
	Removed				-					O*	0	L	L
LOCK												L	F
ACC	,			Ŏ	province so, construct	os e ritu esçoca	0					F	F
ON	Inserted		O-	þ	Ò		0	-				F	F
START					O-	þ	Q					F	F

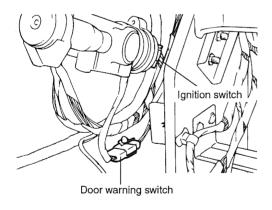
NOTE

o indicates that there is continuity between the terminal.

RO: Round the locking bar RE: Return the locking bar

L: Lock F: Free

EBUC007A









Door warning switch

EBUC007B

HINTS

If the engine won't crank determine whether the condition exists with the transaxle range switch in the "PARK" or in the "NEUTRAL" position.

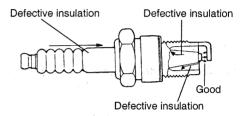
If the "NO-CRANK" condition occurs in one shift lever position but not another, a more probable cause is the transaxle range switch.

SPARK PLUG TEST EBUC0080

- Remove the spark plug and connect to the spark plug cable.
- 2. Ground the spark plug outer electrode, and crank the engine.
- Check to be sure that there is an electrical discharge between the electrodes at this time.



When replacing the spark plug, should use the genuine parts having resistance.



FBA9009F

SPARK PLUG CABLES TEST

Disconnect, one at a time each of the spark plug cables while the engine is idling to check whether the engine's running performance changes or not.



Wear rubber gloves while doing so.

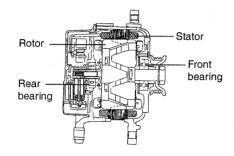
- If the engine performance does not change, check theresistance of the spark plug, and check the spark plug itself.
- Check the cap and outer shell for cracks.
- Measure the resistance.

CHARGING SYSTEM

GENERAL INFORMATION EBBB0120

The charging system included a battery, an generator with a built-in regulator, and the charging indicator light and wire. The generator has six built-in diodes (three positive and three negative), each rectifying AC current to DC current. Therefore, DC current appears at generator "B" terminal.

In addition, the charging voltage of this generator is regulated by the battery voltage detection system. The generator is regulated by the battery voltage detection system. The main components of the generator are the rotor, stator, rectifier, capacitor brushes, bearings and V-ribbed belt pulley. The brush holder contains a built-in electronic voltage regulator.



EBA9130A

INSPECTION EBBB0130

VOLTAGE DROP TEST OF GENERATOR OUTPUT WIRE

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

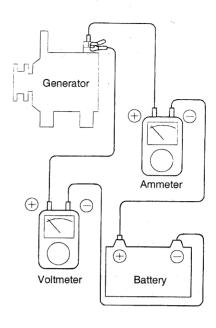
PREPARATION

Turn the ignition switch to "OFF".

NOTE

To find abnormal conditions of the connection, actions should not be taken on the two terminals and each connection during the test.

2. Connect a digital ammeter between the generator "B" terminal and battery (+). Connect the (+) lead wire of the voltmeter to the "B" terminal and the (-) lead wire to the battery (-) terminal.



EBBB013A

CONDITIONS FOR THE TEST

- 1. Start the engine.
- 2. Switch on the headlamps, blower motor and so on. And then, read the voltmeter under this condition.

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 generator "B" terminal to the fusible link to the battery (+) terminal. Check for loose connections, color change due to an overheated harness, etc. Correct them before testing again.
- Upon completion of the test, set the engine speed at idle. Turn off the head lamps, blower motor and the ignition switch.

OUTPUT CURRENT TEST

This test determines whether or not the generator gives an output current that is equivalent to the nominal 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 in good condition. The battery checking method is described in "BATTERY".

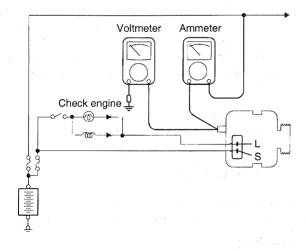
The battery that is used to test the output current should be one that has been partially discharged. With a fully charged battery, the test may not be conducted correctly due to an insufficient load.

- Check the tension of the generator drive belt.
 The belt tension check method is described in the section "EM".
- 2. Turn off the ignition switch.
- 3. Disconnect the battery ground cable.
- 4. Disconnect the generator output wire from the generator "B" terminal.
- Connect a DC ammeter (0 to 100A) 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 generator "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.



EBBB013B

TEST

- 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 the generator "B" terminal and battery (-) terminal, a blown fusible link or poor grounding is suspected.
- 2. Start the engine and turn on the headlights.
- Set the headlights 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 starts up, the charging current quickly drops. Therefore, the above operation must be done quickly to read the maximum current value correctly.

RESULT

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

Limit value (95A generator): 63A min.

NOTE

- The nominal output current value is shown on the nameplate affixed to the generator body.
- The output current value changes with the electrical load and the temperature of the generator itself. Therefore, the nominal output current may not be obtained. If such is the case, keep the headlights 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 generator 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 generator output wire to the generator "B" terminal.

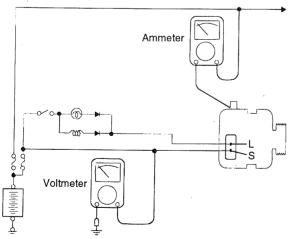
6. Connect the battery ground cable.

REGULATED VOLTAGE TEST

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

PREPARATION

- Prior to the test, check the following items and correct if necessary.
 - Check that the battery installed on the vehicle is fully charged. For battery checking method, see "BATTERY."
 - 2) Check the generator drive belt tension. For belt tension check, see "EM" section.
- 2. Turn ignition switch to "OFF."
- Disconnect the battery ground cable.
- Connect a digital voltmeter between the "S(L)" terminal of the generator and ground. Connect the (+) lead of the voltmeter to the "S(L)" terminal of the generator. Connect the (-) lead to good ground or the battery (-) terminal.
- Disconnect the generator output wire from the generator "B" terminal.
- 6. Connect a DC ammeter (0 to 100A) in series between the "B" terminal and the disconnected output wire. Connect the (-) lead wire of the ammeter to the disconnected output wire.
- Attach the engine tachometer and connect the battery ground cable.



EBBB013C

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 generator "S(L)" terminal and the battery and the battery (+), or the fusible link is blown.

- 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 generator output current drops to 10A or less.

RESULT

 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 generator is faulty.

REGULATING VOLTAGE TABLE

Voltage r tempe	egulator a erature °C	Regulating voltage (V)	
	-20 (-4)		14.2-15.4
4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	20 (68)	J. 1. 18	13.9-14.9
() () () () () () () () () ()	30 (140)		13.4-14.6
3	30 (176)		13.1-14.5

- 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 generator output wire to the generator "B" terminal.
- 6. Connect the battery ground cable.

GENERATOR OUTPUT LINE VOLTAGE DROP TEST EBBB0140

This test determines the condition of the wiring from the generator "B" terminal to the battery (+) terminal (including the fusible link).

- 1. Be sure to check the following before testing:
 - · Generator installation and wiring connections
 - · Generator drive belt tension
 - · Fusible link
 - Abnormal noise from the generator while the engine is running.
- 2. Turn the ignition switch to the OFF position.
- 3. Disconnect the negative battery cable.
- 4. Disconnect the generator output wire from the generator "B" terminal. Connect a DC test ammeter with a range of 0-100A in series between the "B" terminal and the disconnected output wire. (Connect the (+) lead of the ammeter to the "B" terminal. Connect the (-) lead of the ammeter to the disconnected output wire.)

NOTE

An inductive-type ammeter which enables measurements to be taken without disconnecting the generator output wire is recommended. Using this equipment will lessen the possibility of a voltage drop caused by a loose "B" terminal connection.

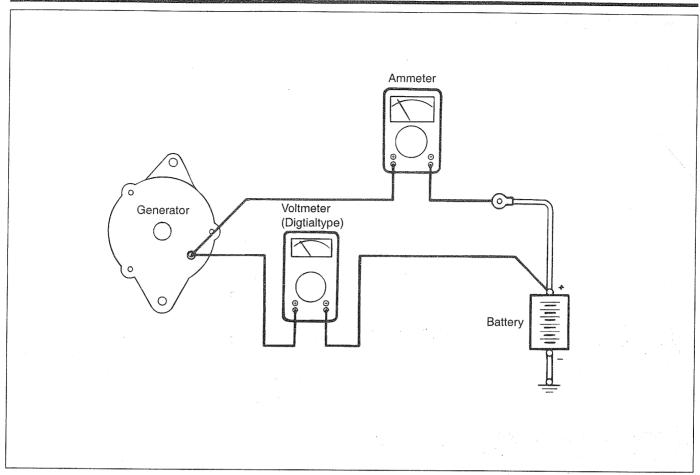
- 5. Connect a digital-type voltmeter between the generator "B" terminal and the battery (+) terminal. (Connect the (+) lead of the voltmeter to the "B" terminal. Connect the (-) lead of the voltmeter to the battery (+) cable.)
- 6. Reconnect the negative battery cable.
- 7. Connect a tachometer or the scan tool.
- 8. Start the engine.
- With the engine running at approx. 2500 r/min, turn the headlights and other lights on and off to adjust the generator load on the ammeter slightly above 30A.

Limit: max. 0.3V

NOTE

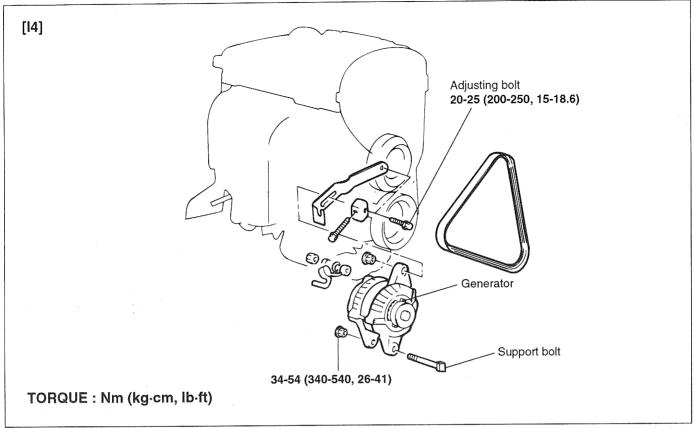
When the generator output is high and the value displayed on the ammeter does not decrease to 30A, set the value to 40A. Read the value displayed on the voltmeter. In this case the limit becomes max. 0.4V.

- 10. If the value displayed on the voltmeter is still above the limit, a malfunction in the generator output wire may exist. Check the wiring between the generator "B" terminal and the battery (+) terminal (including fusible link). If a terminal is not sufficiently tight or if the harness has become discolored due to overheating, repair, the test again.
- 11. After the test, run the engine at idle.
- 12. Turn off all lights and turn the ignition switch to the OFF position.
- 13. Disconnect the tachometer or the scan tool.
- 14. Disconnect the negative battery cable.
- 15. Disconnect the ammeter and voltmeter.
- Connect the generator output wire to the generator "B" terminal.
- 17. Connect the negative battery cable.



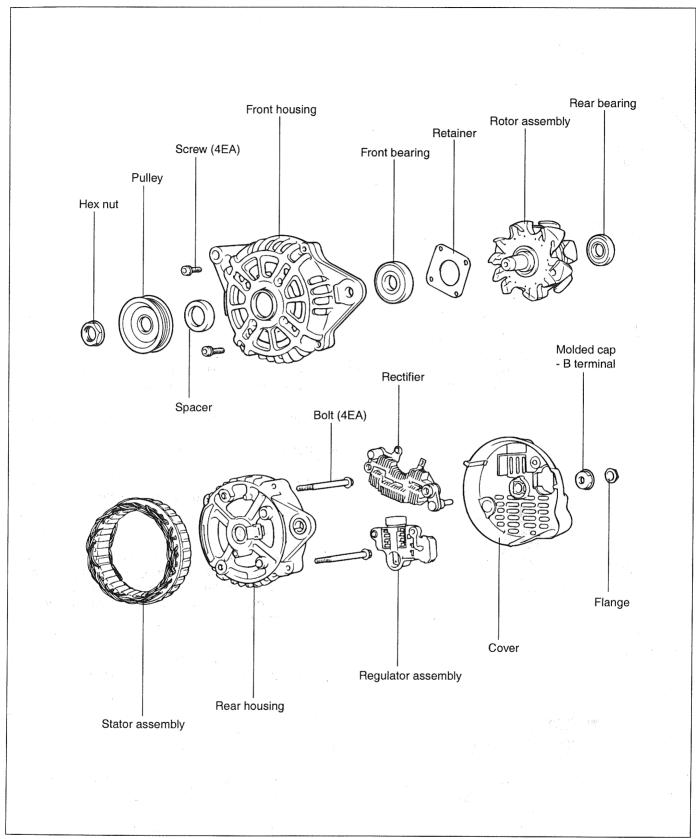
EBA9020C

REMOVAL AND INSTALLATION EBUC0150



EBUC015A

DISASSEMBLY AND REASSEMBLY EBBB0160



EBA9030A

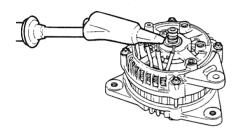
DISASSEMBLY

EBUC0180

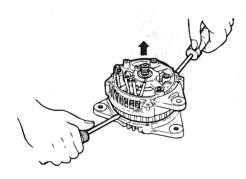
- Remove the four through bolts.
- Insert a flat screwdriver between the front bracket and 2. stator core, and pry downward.

CAUTION

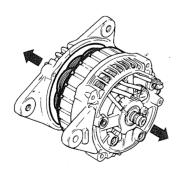
- 1. Do not insert the screwdriver too deeply, as there is a danger of damaging the stator coil.
- The rear cover may be hard to remove because a ring is used to lock the outer race of the rear bearing. To facilitate removal of rear cover, heat just the bearing box section with a 200-watt soldering iron. Do not use a heat gun as it may damage the diode assembly.



KFW2018A



KFW2017A

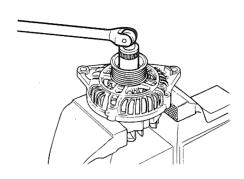


KFW2019A

Secure the rotor in a soft-jaw vise with the pulley side up.

CAUTION

Be careful that the vise jaws do not damage the rotor.



KFW2020A

- Remove the pulley nut, spring washer, pulley, and spacer.
- Remove the front bracket and two seals.
- Remove the rotor from the vise.
- Remove the brush holder screws, rectifier screws, and nut from the "B" terminal.
- Remove the stator assembly from the rear bracket.
- Detach the slinger from the brush holder.
- 10. If the stator is to be removed, unsolder the three stator leads to the main diodes on the rectifier.



/!\ CAUTION

- When soldering or unsoldering, make sure that heat from soldering iron is not transmitted to the diodes for a long period.
- Do not exert excessive force on the leads of the diodes.
- 11. When separating the rectifier from the brush holder, unsolder the two plates soldered to the rectifier.

INSPECTION

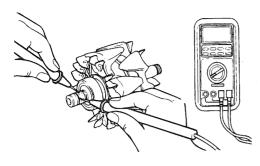
EBUC0190

ROTOR

Check the rotor coil for continuity. Make sure there is continuity between the slip rings.

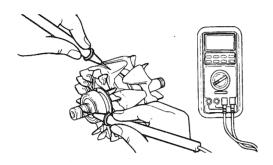
If resistance is extremely low, there is a short. If there is no continuity or if there is a short circuit, replace the rotor assembly.

Resistance value : Approx. 3.1Ω



KFW2021A

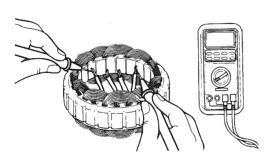
Check the rotor coil for a ground. Check that there is no continuity between the slip ring and the core. If there is continuity, replace the rotor assembly.



KFW2022A

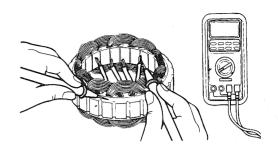
STATOR

1. Make a continuity check on the stator coil. Check that there is continuity between the coil leads. If there is no continuity, replace stator assembly.



KFW2023A

Check the coil for grounding. Check that there is no continuity between the coil and the core. If there is continuity, replace the stator assembly.

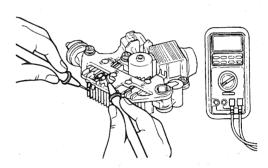


KFW2024A

RECTIFIERS

Positive rectifier test

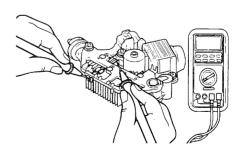
Check for continuity between the positive rectifier and stator coil lead connection terminal with an ohmmeter. The ohmmeter should read continuity in only one direction. If there is continuity in both directions, a diode is shorted. Replace the rectifier assembly.



KFW2025A

Negative rectifier test

Check for continuity between the negative rectifier and the stator coil lead connection terminal. The ohmmeter should read continuity in only one direction. If there is continuity in both directions, the diode is shorted, and the rectifier assembly must be replaced.

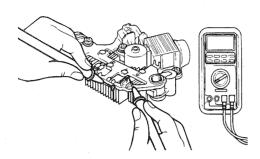


KFW2026A

Diode trio test

Check the three diodes for continuity by connecting an ohmmeter to both ends of each diode. Each diode should have continuity in only one direction.

If continuity is present in both directions, the diode is defective and the heatsink assembly must be replaced.

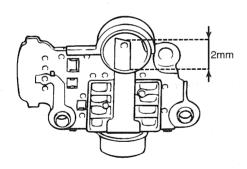


KFW2027A

BRUSH REPLACEMENT

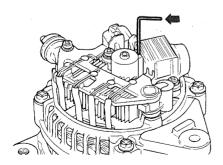
 Measure the length of the brush protrusion shown in the illustration, and replace the brush if the measured value is below the limit value.

Limit: 2mm (0.8 in.) or less



EBA9030E

2. The brush can be removed if the solder of the brush lead wire is removed.



KFW2029A

3. When installing a new brush, insert the brush into the holder, and then solder the lead wire.

REASSEMBLY EBBBO

Reassembly is the reverse of disassembly. Pay attention to the following:

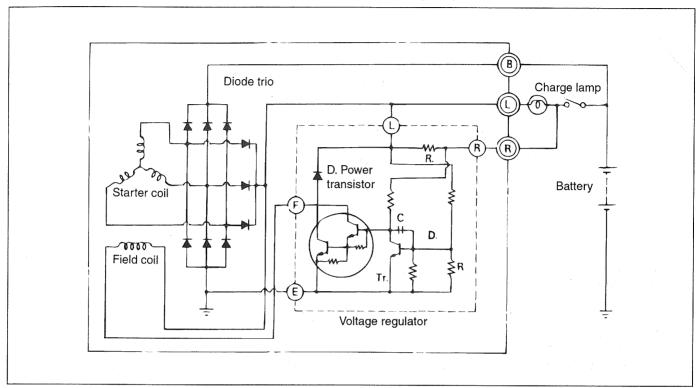
Before the rotor is attached to the rear bracket, insert a wire through the small hole in the rear bracket to hold the brush. After the rotor has been installed, the wire can be removed.

GENERATOR (DIESEL) EBMB0200

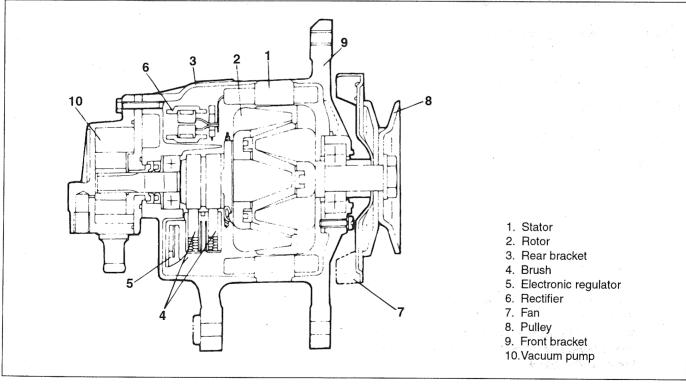
The conventional internal voltage detection type alternator controls the charging voltage regardless of the battery condition and according to the external load change so

that it sometimes causes battery under or overcharging or causes flickering of meters and lamps due to ripples of generated voltage resulting from load fluctuation.

The figure below show the internal circuits of the alternator and voltage regulator.



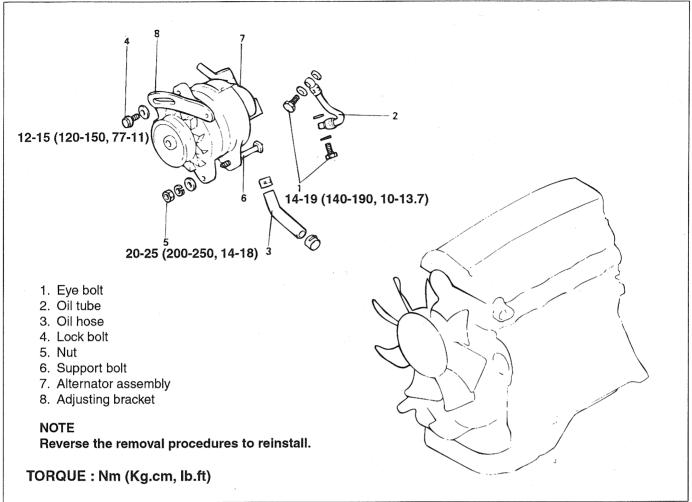
B7AD7415



B7AD7400

REMOVAL AND INSTALLATION

(DIESEL) EBMB0210



B7AD7395

INSTALLATION

ALTERNATIOR ASSEMBLY

For belt tension, refer to Group EM Engine-Service adjustment procedures.



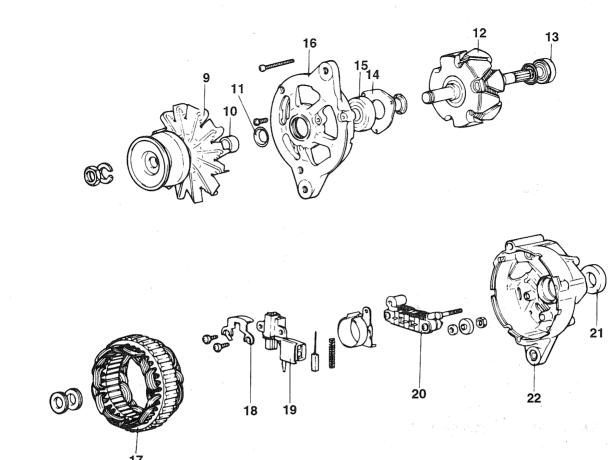
CAUTION

· Install the oil hose to the alternator in advance.

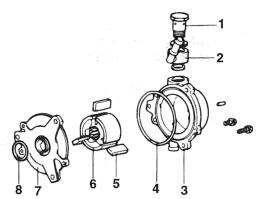
When the alternator is installed, connect the oil hose to the nipple on the oil pan side. Clamp the hose clip at the straight portion of the nipple.

· When the oil tube is installed, do not take a sharp bend nor bring the tube in contact with the cylinder block.

DISASSEMBLY AND REASSEMBLY EBMB0230



- 1. Check valve
- 2. Nipple
- 3. Vacuum pump housing
- 4. O-ring
- 5. Rotor
- 6. Vane
- 7. Vacuum pump plate
- 8. O-ring
- 9. Pulley fan
- 10.Spacer
- 11.Seal
- 12.Rotor assembly
- 13.Rear bearing
- 14.Bearing retainer
- 15.Front bearing
- 16.Front bracket
- 17.Stator assembly
- 18.Plate
- 19.Regulator & brush holder
- 20.Rectifier Assembly
- 21.Oil seal
- 22.Rear bracket



NOTE

Reverse the disassembly procedures to reassemble.

DISASSEMBLY

FBMB0240

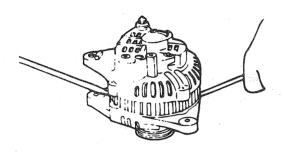
FRONT BRACKET

- With a screwdriver blade inserted between the front bracket and stator core, pry it to separate the stator and the front bracket.
- 2. If they are hard to separate, lightly strike the bracket with a plastic hammer while prying with the screwdriver.



/! CAUTION

Do not insert the screwdriver too deep as the stator core could be damaged.

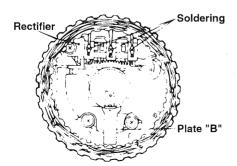


STATOR ASSEMBLY, REGULATOR AND BRUSH **HOLDER**



/!\ CAUTION

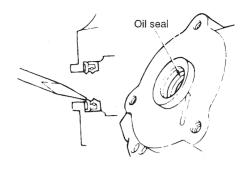
- · When soldering or unsoldering, use care not to expose the diode to soldering iron heat for extended time.
 - Complete soldering or unsoldering in as short a time as possible.
- · Do not overstress the diode leads.
- When removing the stator, unsolder the three stator leads from the main diodes.
- When removing the rectifier from the brush holder, unsolder two soldered points.



B7AD7430

OIL SEAL

Push out and remove the oil seal using a screwdriver.



B7AD7435

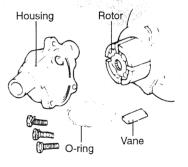
INSPECTION

VACUUM PUMP

Check the following and replace if defective.

FBMB0250

- Check the rotor ends for streaks and damage.
- Check the housing surface in contact with the rotor for streaks and damage.
- Check the vanes for damage and break.



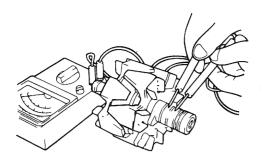
B7AD7440

ROTOR

Check the rotor coil continuity. Make sure that there is continuity between slip rings.

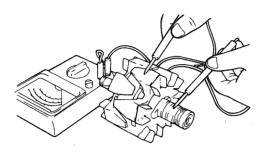
Measure the rotor resistance. If it is excessively small, it indicates a shorted rotor, If without continuity or shorted, replace the rotor assembly.

Standard value: 3 - 5 ohms



B7ZN0440

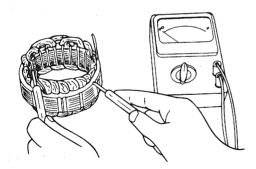
Check the rotor coil grounding. Make sure that there is no continuity between the slip ring and core. Replace the rotor assembly if there is continuity.



B7ZN0450

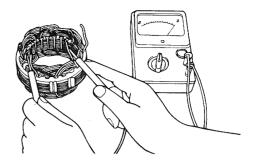
STATOR

 Check the stator continuity. Make sure that there is continuity between coil leads. Replace the stator assembly if there is no continuity



B7ZN0470

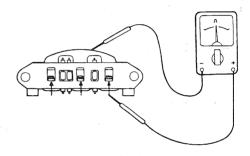
Check the coil grounding. Make sure that there is no continuity between the coil and core. Replace the stator assembly if there is continuity.



B7ZN0460

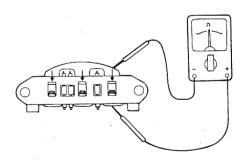
RECTIFIER

Inspection of (+) Heat Sink Assembly
 Using a circuit tester, check continuity between the
 (+) heat sink and the stator coil lead connection terminals. If there is continuity in both directions, the diode is shorted. Then, replace the rectifier assembly.



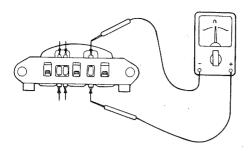
B7ZN0480

 Inspection of (-) Heat Sink Assembly Check continuity between the (-) heat sink and the stator coil lead connection terminals. If there is continuity in both directions the diode is shorted. Then, replace the rectifier assembly.



B7ZN0490

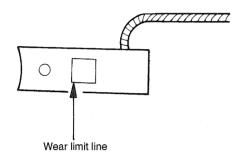
Inspection of Diode Trio
 With a circuit tester connected to both ends of each
 diode, check continuity of the three diodes. If there is
 continuity or no continuity in both directions, the diode
 is damaged. Then, replace the rectifier assembly.



B7ZN0500

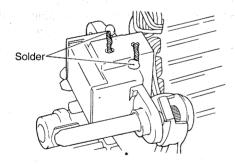
BRUSH

 The brush must be replaced if worn to the wear limit line.



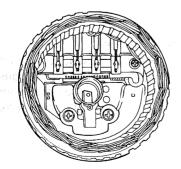
B7ZN0510

Unsolder the brush lead wires, and the brush and spring will come out.



B7ZN0520

3. When installing a new brush, push the brush into the holder as illustrated and solder the leads.



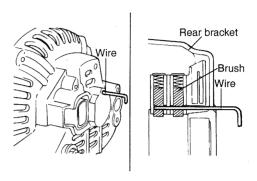
EBMB025A

REASSEMBLY EB

EBMB0260

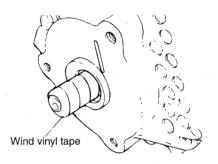
ROTOR ASSEMBLY

 Before installing the rotor on the rear bracket, thread a steel wire through the small hole provided in the rear bracket to lift up the brush. After rotor installation, remove the steel wire.



EBLB022A

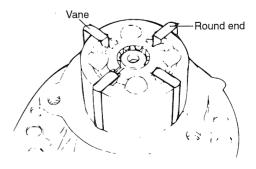
When installing the rotor on the alternator rear bracket, wind vinyl tape round the splined shaft to prevent damage to the oil seal



B7AD7500

ROTOR AND VANES

- 1. Check well the housing, rotor, etc. for chips and foreign matter. Then, apply engine oil and install.
- 2. Install the vanes with round end facing outward.
- 3. Apply grease to the O-ring and fit in the housing groove when the bolts are tightened.



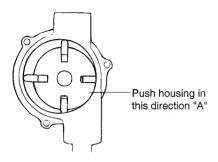
B7AD7505

4. When tightening the housing, lightly push it in the direction of arrow so as to minimize the clearance at "A" and tighten the bolts uniformly.

NOTE

After the assembly, be sure to conduct the performance test to check to see that the ultimate vacuum is as specified below.

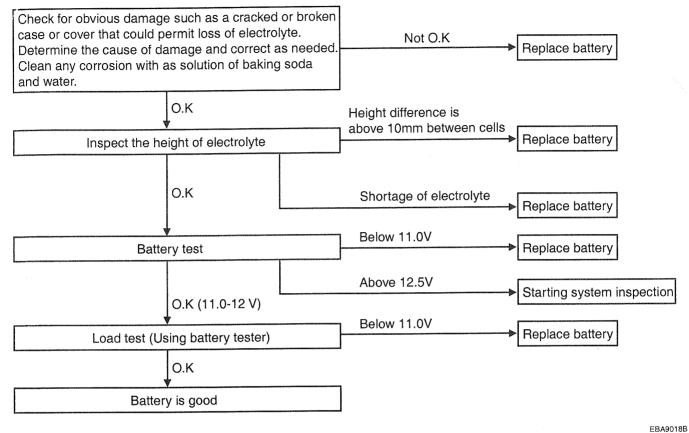
Standard value of ultimate vacuum : 600 mmHg or better at 3,000 rpm



B7AD7510

BATTERY VISUAL INSPECTION (1) EBBB0201

1. CHECKING FLOW



EBA9018B

CHARGING SYSTEM EE -27

2. CHECKING SHEET

	T la la	0	Domandu	Re	sponsibility
Item	Trouble	Cause	Remedy	User	Manufacturer
1. Visual inspection	* Battery terminal	* Carelessness			
	damage	* Over tightening the battery cable	Replace	0	
	Cover Breakage	* Carelessness	Replace	0	
	* Electrolyte leakage				
	- Cover breakage	* Carelessness	Replace	0	
	- Cover leakage	* Bad cover seal	Replace		0
2. Electrolyte height inspection	* Electrolyte height between cells is over 10mm	* Cell shorted electrically * Vaporization caused by excessive temperature	Replace Replace	0	Ο
	* Shortage of electrolyte	* Electrolyte loss caused by over-charge	Replace	0	
3. Voltage inspection	Battery voltage >13.2V	1. Over charge	Replace * Check the electric system	0	
	2. 12.5V < Battery voltage < 12.9	2. Normal			
	3. 12.0V < Battery voltage < 12.4V (Simple discharge)	Insufficient charge	* Battery Load Test (Refer to Load Test below)	0	
	4. 11.0 V <battery (over="" <12.0="" discharge)<="" td="" voltage=""><td>2. Internal failure</td><td></td><td>O 1</td><td>7</td></battery>	2. Internal failure		O 1	7
	5. Battery voltage : 11.0V or less	Charge condition failure	Replace	0	
		Battery discharged for a long period		O 1	
		3. Internal circuit open			0

3. LOAD TEST

 When discharging the battery during 15 seconds at half currency of Cold Cranking Power (CCP), the voltage of the battery should be as shown below.

REGULATING VOLTAGE TABLE

Ambient Temperature	Voltage
above 20°C	9.6V
~ 18°C	9.5V
~ 10°C	9.4V
~ 4°C	9.3V
~ -1°C	9.1V
~ -7°C	8.9V
~ -12°C	8.7V

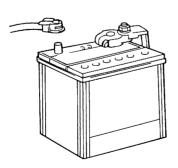
- 2. When the voltage is not within specification, repeat the load test again, and re-charge.
- If the battery is left alone for 2 hours after re-charging and its output is over 12.5V, and the voltage after a load test is over the standard value, the battery can be used.

BATTERY VISUAL INSPECTION (2) EBBB0210

- 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 worn when removing the battery.

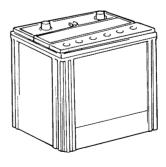


EBA9018C

- 4. Inspect the battery carrier 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 in Step(4).
- 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.
- Connect the cable terminals to the battery post, making sure the 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.



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 circuits at the terminals of batteries being charged. A spark will occur when the circuit is broken. Keep open flames away from the battery.



EBA9018D

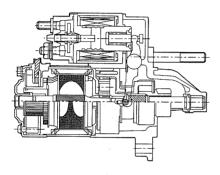
STARTING SYSTEM

GENERAL INFORMATION EBBB0290

The starting system includes the battery, starter motor, solenoid switch, ignition switch, inhibitor switch (A/T only), connection wires and the battery cables.

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.

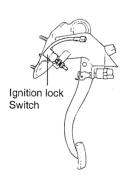


EBBB029A

EBHA0200

CHECK CLUTCH PEDAL (M/T)

Check that pedal height, pedal freeplay and clutch pedal clevis pin play are correct. (Refer to clutch group)



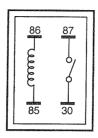
EBA9020D

CHECK STARTER RELAY

Remove the starter relay and check continuity between the terminals. If the continuity is not as specified, replace the relay.

Terminal No.	85	86	87	30
When de-energized	0—			
When energized	0—	\multimap	0-	0

EBA9020E



Fore	Re	lay	
-	30	86	
	85	87	
America	THE PERSON NAMED IN COLUMN TWO		

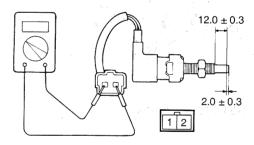
EBA9020F

CHECK IGNITION LOCK SWITCH

Remove the ignition lock switch and check continuity between the terminals. If the continuity is not as specified, replace the switch.

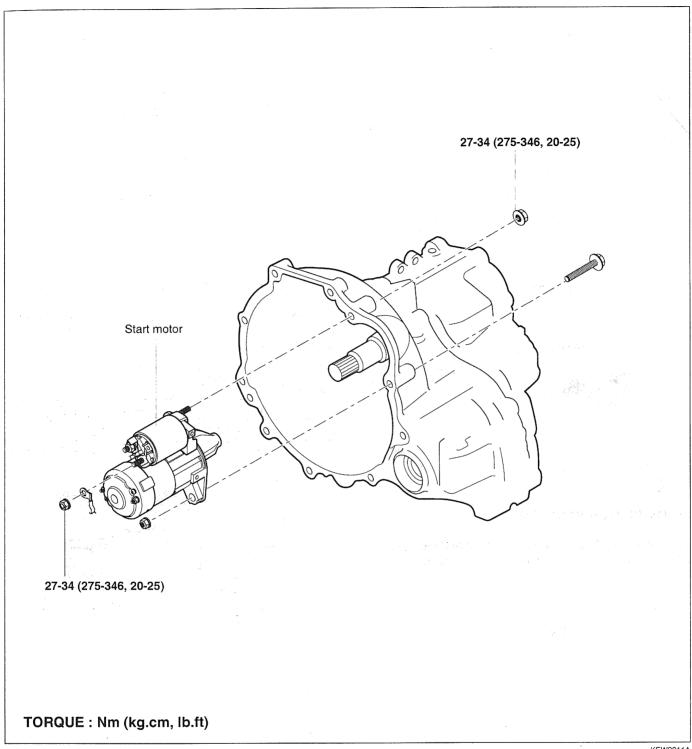
Terminal Condition	1	2
Pushed	0	
Free		

EBA9020G



EBHA020A

REMOVAL AND INSTALLATION EBHA0210

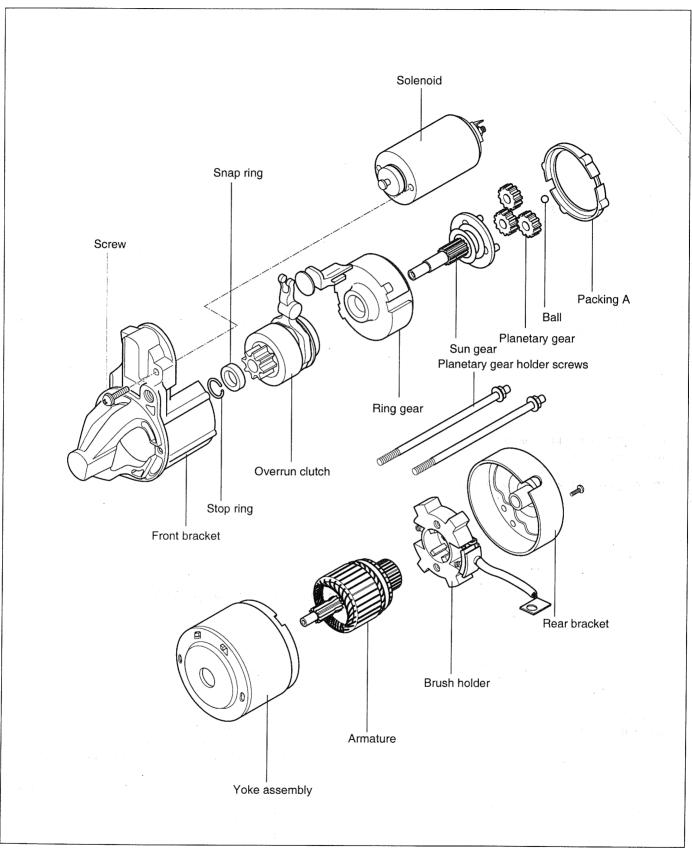


KFW2011A

- Disconnect the battery ground cable. 1.
- 2. Remove the speedometer cable and the shift cable.
- 3. Disconnect the starter motor connector and terminal.
- Remove the starter motor assembly.

5. Installation is the reverse of removal.

COMPONENTS EBHA0220



EBHA306A

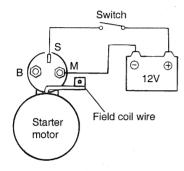
CHECKING FOR OPERATION FBHA0230

SERVICE ADJUSTMENT PROCEDURES FOR PINION GAP ADJUSTMENT

- Disconnect the field coil wire from the M-terminal of the solenoid.
- Connect a 12V battery the S-terminal and the M-ter-
- The pinion should move out.



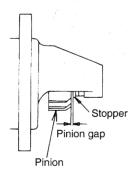
This test must be performed quickly (in less than 10 seconds) to prevent the coil from overheating.



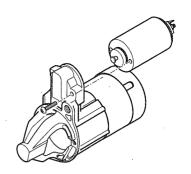
FBA9023A

Check the pinion for stopper clearance (pinion gap) with a feeler gauge.

Pinion gap: 0.5-2.0 mm (0.02-0.079 in.)



If the pinion gap is out of specification, adjust by adding or removing gaskets between the solenoid and the front bracket.



EBHA306D

MAGNETIC SWITCH PULL-IN TEST

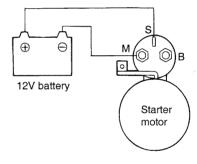
- Disconnect the field coil wire from the M-terminal of the magnetic switch.
- Connect a 12V battery between the S-terminal and the M- terminal.



/ CAUTION

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

If the pinion moves out, then the pull-in coil is good. If it doesn't move out, replace the magnetic switch.



EBA9023D

MAGNETIC SWITCH HOLD-IN TEST

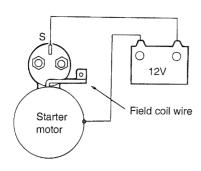
- Disconnect the field coil wire from the M-terminal of the magnetic switch.
- Connect a 12V battery between the S-terminal and the body.



/!\ CAUTION

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

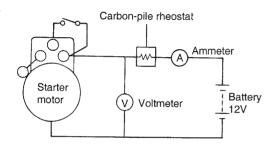
If the pinion moves out, everything is in order. If the pinion moves back and forth repeatedly, the hold-in circuit is open. If it is open, replace the magnetic switch.



EBA9023E

FREE RUNNING TEST

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



EBA9023F

- 3. Connect a voltmeter (15-volt scale) across the starter motor.
- 4. Rotate the carbon pile to the off position.
- 5. Connect the battery cable from battery's negative post to the starter motor body.
- 6. Adjust the carbon pile until battery voltage reads 11 volts.
- 7. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely:

Current: Max. 90 Amps

Speed: Min. 3,000 rpm

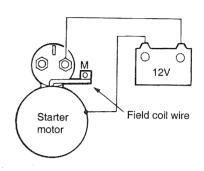
MAGNETIC SWITCH RETURN TEST

- Disconnect field coil wire from the M-terminal of the magnetic switch.
- Connect a 12V battery between M-terminal and the body.

NOTE

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

3. Pull the pinion out and release it. If the pinion returns quickly to its original position, everything is in order. If it doesn't, replace the magnetic switch.



EBA9023G

INSPECTION

EBHA0240

CHECKING THE COMMUTATOR

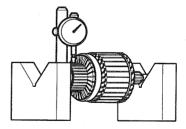
1. Place the armature on a pair of V-blocks, and check the run - out by using a dial gauge.

Standard value

Armature run - out: 0.05 mm (0.002 in.)

Limit

Armature run - out: 0.1 mm (0.0039 in.)



KFW2033A

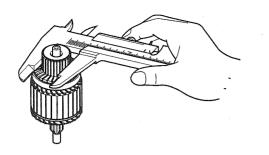
Check the outer diameter of the commutator.

Standard value

Outer diameter of the commutator: 29.4 mm (1.157 in.)

Limit

Outer diameter of the commutator: 28.4 mm (1.118 in.)



KFW2034A

3. Check the depth of the undercut between segments.

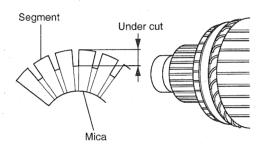
Standard value

Depth of the undercut between segments: 0.5mm (0.020 in.)

Limit

Depth of the undercut between segments

: 0.2mm (0.079 in.)

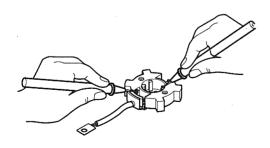


KFW2035A

BRUSH HOLDER

Check for continuity between the brush holder plate and the brush holder.

The normal condition is no continuity.



KFW2036A

OVERRUNNING CLUTCH

- While holding the clutch housing, rotate the pinion.
 The drive pinion should rotate smoothly in one direction, but should not rotate in the opposite direction.
 If the clutch does not function properly, replace the overrun clutch assembly.
- 2. Inspect the pinion for wear or burrs. If the pinion is worn or burred, replace the overrun clutch assembly. If the pinion is damaged, also inspect the ring gear for wear or burrs.



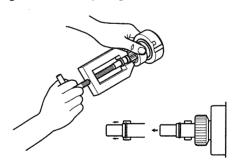
EBA9024E

FRONT AND REAR BRACKET BUSHING

Inspect the bushing for wear or burrs. If the bushing is worn or burred, replace the front bracket assembly or the rear bracket assembly.

REASSEMBLY OF THE STOP RING AND SNAP RING EBHA0250

Using a suitable pulling tool, pull the overrunning clutch stop ring over the snap ring.



KFW2043A

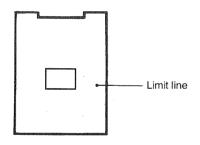
CLEANING THE STARTER MOTOR

PARTS EBA90260

- Do not immerse parts in cleaning solvent. Immersing the yoke and field coil assembly and/or armature will damage the insulation. Wipe these parts with a cloth only.
- 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.

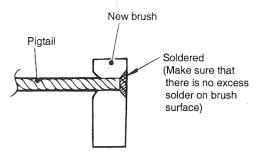
REPLACEMENT OF BRUSHES AND SPRINGS FRA90270

- Brushes that are worn out, or oil-soaked, should be replaced.
- When replacing field coil brushes, crush worn out brushes with pliers, taking care not to damage the pigtail.



EBA9027A

- Sand the pigtail end with sandpaper to ensure good soldering.
- Insert the pigtail into the hole provided in the new brush and solder it. Make sure that the pigtail and excess solder do not come out onto the brush surface.
- When replacing the ground brush, slide the brush from the brush holder by prying the retaining spring back.



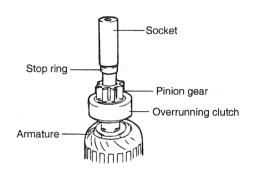
EBA9027B

DISASSEMBLY

EBA90280

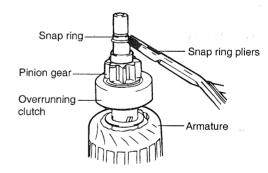
REMOVAL OF SNAP RING AND STOP RING

 Press the stop ring to the snap ring side using a socket wrench, to the snap ring side.



EBA9028A

2. After removing the snap ring (using snap-ring pliers), remove the stop ring and the overrunning clutch.

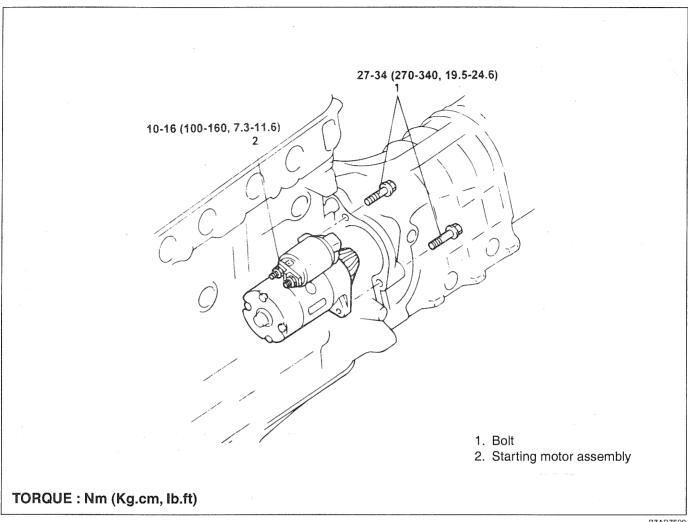


EBA9028B

REMOVAL AND INSTALLATION

(DIESEL) EBMB0290

COMPONENTS



B7AD7520

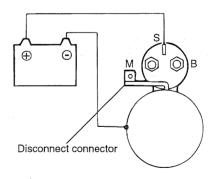
EBMB0300

PINION GAP ADJUSTMENT

- Disconnect the field coil wire from the terminal M of the magnetic switch.
- Connect a battery between the terminal S and starting motor body. (Connect the positive terminal of battery to the terminal S.)



This test must be performed quickly within 10 seconds to prevent the switch coil from burning.

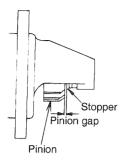


EBMB030A

3. When the battery is connected, the pinion moves out. Now, push back the pinion with a finger and measure the pinion stroke (the travel along which the pinion is pushed back).

This is the pinion gap.

 If the pinion gap is not up to specification, adjust by adding or removing fiber washers between the magnetic switch and front bracket. Using more washers makes the gap smaller.



B7ZN0700

EBMB0310

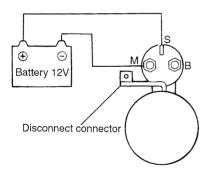
PULL-IN TEST OF MAGNETIC SWITCH

The pull-in coil is in good condition if the plunger is pulled in to cause the pinion to move out when a battery is connected between the terminals S and M of the magnetic switch. If the pinion does not move out, replace the magnetic switch.



The connector must be disconnected from terminal M for this test.

The test must be finished within 10 seconds.



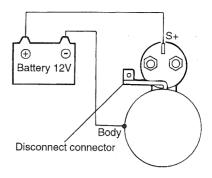
EBMB031A

HOLD-IN TEST OF MAGNETIC SWITCH

With a battery connected between the terminal S and body of magnetic, manually pull the pinion up to the pinion stopper. The hold-in coil is in good condition if the pinion remains out when releasing it.



This test must be completed with 10 seconds.



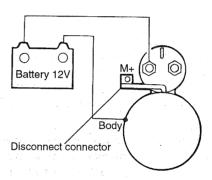
EBMB031B

RETURN TEST OF MAGNETIC SWITCH

With a battery connected between the terminal M and body of the magnetic switch, manually pull the pinion out to the pinion stopper. Body coils are fully operational if the pinion returns immediately when releasing it.



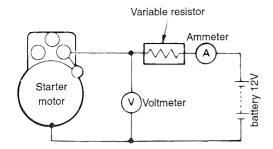
This test must be completed within 10 seconds.



EBMB031C

NO-LOAD TEST

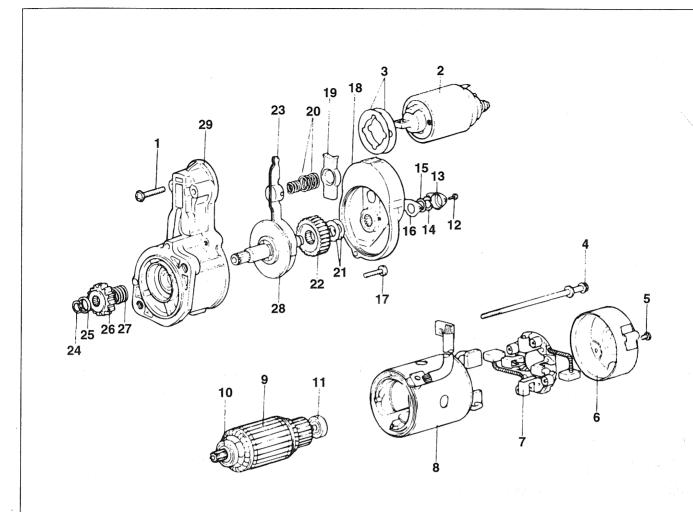
- Set up a circuit as shown which connects a starter motor, battery, ammeter, voltmeter, and variable resistance.
- 2. The starting motor should be in good condition if it turns smoothly and steadily when the switch is turned ON with a maximum variable resistance value. Adjust the variable resistor so that the voltmeter reads 11.5V. If the current and rpm are out of specification after this adjustment, troubleshoot according to the table below and take remedial action as required.



B7AD7550

Symptom	Possible cause
Large current with low rpm (torque also being small)	Contaminated bearing Armature coil rubbing pole piece Armature and field coil grounding Armature coil shorting
Large current with no rotation	Solenoid switch grounding Armature and field coil grounding Seized bearing
No current flowing with no rotation	Broken armature and field coils Broken brush and pigtail Improper contact between brush and commutator
Small current with low rpm (torque also being small)	Improper field coil connection (Note, however, that open or improperly connected shunt coil only will result in high rpm.)
Large current with high rpm (torque being small)	Shorted field coil

DISASSEMBLY AND REASSEMBLY EBMB0320



- 1. Screw
- 2. Magnetic
- 3. Fiber
- 4. Screw
- 5. Screw
- 6. Rear bracket
- 7. Brush holder assembly
- 8. Yoke assembly
- 9. Armature
- 10.Front bearing
- 11.Rear bearing
- 12. Screw
- 13.Cover
- 14.Snap ring
- 15.Washer
- 16.Plate

- 17.Screw
- 18.Center bracket
- 19.Packing
- 20.Lever spring
- 21.Washer
- 22.Gear
- 23.Lever
- 24.Snap ring
- 25.Stop ring 26.Pinion gear
- 27.Spring
- 28. Pinion shaft assembly
- 29.Front bracket

NOTE

Reverse the disassembly procedures to reassemble

PREHEATING SYSTEM

GLOW SYSTEM EBMB0330

SPECIFICATIONS

SERVICE SPECIFICATIONS

Items	Auto glow system
Water temperature sensor resistance [at 20°C (68°F)] k	2.92 - 3.58
Glow plug resistance [at 20°C (68°C)] m	250

TORQUE SPECIFICATIONS

Items	Nm	kg·cm	lb·ft
Water temperature sensor	8 - 10 15 - 20	80 - 100 150 - 200	6 - 7 11 - 14
Glow plug Glow plug plate attaching nut	1 - 1.5	10 - 15	0.7 - 1.1

SEALANTS AND ADHESIVES

Items	Specified sealant and Adhesive
Water temperature sensor	3M Adhesive Nut Locking 4171 or equivalent

SERVICE ADJUSTMENT PROCEDURES EBMB0340

INSPECTION OF GLOW SYSTEM OPERATION

Conditions before inspection: Battery voltage: 12V

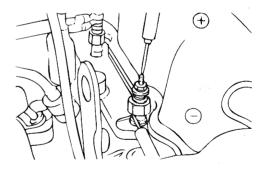
- Connect voltmeter between glow plug plate and plug body (ground).
- Check indicated value on voltmeter with ignition switch ON.
- Check that preheat indication lamp lights for about 6 seconds and indicates battery voltage (about 9V or over) for about 36 seconds immediately after ignition switch is turned on. [At cooling water temperature 20°C (68°F)]



Continuity time varies depending upon cooling water temperature.

- After checking 3, set ignition switch at START position.
- 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°F)]

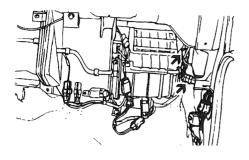
6. When the voltage or continuity time is not normal, check the terminal voltage in glow control unit, and single parts.



B7AD7645

INSPECTION OF GLOW CONTROL UNIT

Check terminal voltage in glow control unit and continuity on harness side.



H7EE020A



C007F001



C002F003

EBLB039A

 Check with glow control unit connector connected. (M14)

Terminal	Connect area or measuring part	Measuring item	Tester connec- tion	Check conditions	Standard value
1	Glow plug relay	Voltage	1 - ground	Ignition switch ON	Indicates battery voltage for about 30 seconds after ON

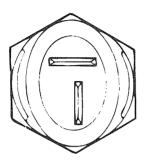
2. Remove glow control unit connector. Check with harness side connector. (M13)

Terminal	Connect area or measuring part	Measuring item	Tester connection	Check conditions	Standard value
1	Ignition switch	Voltage	1 - ground	During engine cranking	Battery voltage
2	Preheat indication lamp	Voltage	2 - ground	Constantly	Battery voltage
3	Ignition switch (IG1 power source)	Voltage	3 - ground	Ignition switch ON	Battery voltage
4	Water temperature sensor	Resistance	4 - ground	-20°C (-4°F) 0°C (30°F) 20°C (68°F) 40°C (104°F)	$24.8 \pm 2.5 \text{ k}\Omega$ $8.62 \text{ k}\Omega$ $3.25 \text{ k}\Omega$ $1.05 \text{ k}\Omega$
5	Vacant terminal	-	-	-	-
6	Control unit earth	Continuity	6 - ground	Constantly	Continuity
7	Generator L terminal	Voltage	7 - ground	Ignition Switch On	1 - 4 V

INSPECTION OF ENGINE COOLANT **TEMPERATURE SENSOR** EBMB0350

- Remove ECT sensor from intake manifold.
- Check that ECT sensor resistance is within the stan-2. dard value.

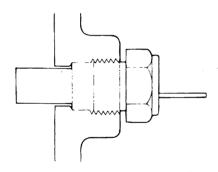
Standard value : $3.25k\Omega$ [at 20° C (68° F)]



B7AD7655

After checking, apply specified adhesive to coolant temperature sensor screw area to install intake man-

Specified adhesive: 3M Adhesive Nut Locking 4171 or equivalent



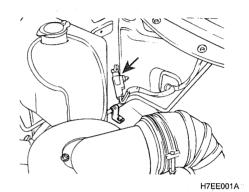
B7AD7660

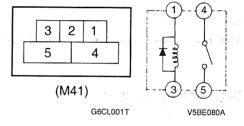
INSPECTION OF STARTER RELAY

EBMB0360

- Remove starter relay from relay bracket.
- Connect battery power source to terminal 1. Check continuity between terminals with terminal 3 grounded.

With power	Between terminals 4 and 5	Continuity	
Without	Between terminals 1 and 3	Continuity	
power	Between terminals 4 and 5	No Continuity	

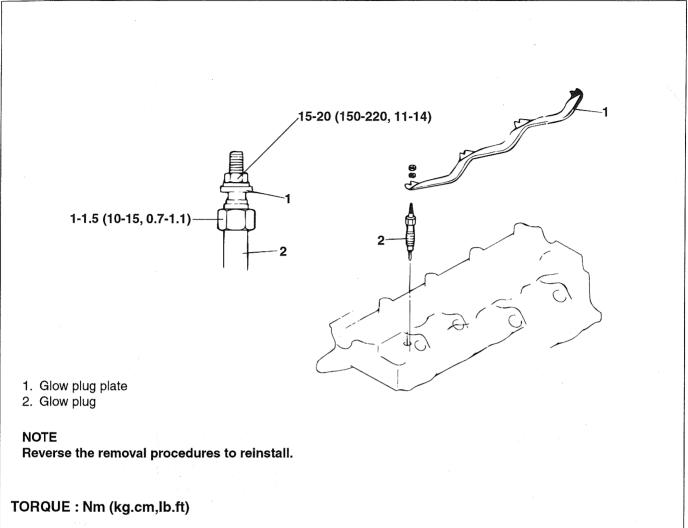




EBLB041A

REMOVAL AND INSTALLATION EBMB0370

COMPONENTS



EMBM037A

INSPECTION

EBMB0380

GLOW PLUG

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

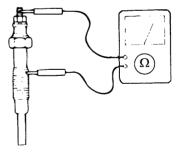
Standard value : 0.25Ω



/ CAUTION

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

- Check for rust on glow plug plate.
- Check glow plug for damage.



EBMB038A