

ENGINE ELECTRICAL

CONTENTS

| | | | |
|---|----|--|----|
| CHARGING SYSTEM | 2 | Secondary Coil Resistance Check | 11 |
| GENERAL | 2 | Primary Coil and Power Transistor Continuity Check | 11 |
| Outline of Change | 2 | Waveform Check Using an Analyzer | 11 |
| GENERAL INFORMATION | 2 | IGNITION SYSTEM | 12 |
| Alternator Specifications | 2 | CAMSHAFT POSITION SENSOR AND CRANK ANGLE SENSOR | 12 |
| SERVICE SPECIFICATIONS | 2 | GLOW SYSTEM | 13 |
| ON-VEHICLE SERVICE | 3 | GENERAL | 13 |
| Alternator Output Line Voltage Drop Test ... | 3 | Outline of Changes | 13 |
| Output Current Test | 4 | GENERAL INFORMATION | 13 |
| Regulated Voltage Test | 6 | SERVICE SPECIFICATIONS | 14 |
| ALTERNATOR | 8 | ON-VEHICLE SERVICE | 14 |
| IGNITION SYSTEM | 10 | Glow System Check | 14 |
| GENERAL | 10 | Glow Plug Relay (Glow Relay Box) Check | 16 |
| Outline of Changes | 10 | Glow Plug Check | 17 |
| GENERAL INFORMATION | 10 | Check at the Engine-ECU Terminals | 17 |
| SERVICE SPECIFICATIONS | 11 | GLOW PLUG | 18 |
| ON-VEHICLE SERVICE | 11 | | |
| Ignition Coil (with Built-in Power Transistor) Check | 11 | | |

CHARGING SYSTEM

GENERAL

OUTLINE OF CHANGES

- The 6B model specifications have been added as one of the 4G92-SOHC engines.
- The service procedure for the alternator has been added to correspond to the addition of the diesel-powered vehicle.
Applicable models: 1900D

GENERAL INFORMATION

ALTERNATOR SPECIFICATIONS

<Petrol-powered vehicle>

| | | |
|-------------------|--|--|
| Items | 1600-M/T <Except cold area for Europe> | 1600-M/T <Cold area for Europe>, 1600 <6B model>, 1800 |
| Type | Battery voltage sensing | Battery voltage sensing |
| Rated output V/A | 12/70 | 12/90 |
| Voltage regulator | Electronic built-in type | Electronic built-in type |

<Diesel-powered vehicle>

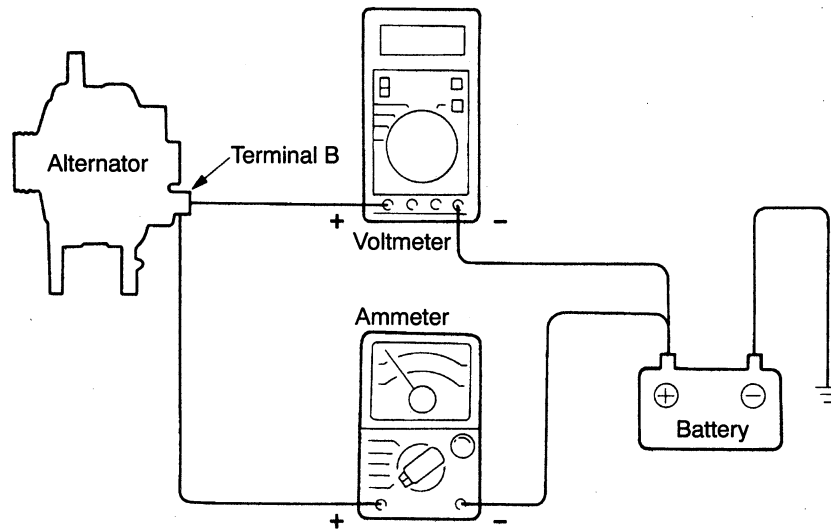
| | | |
|-------------------|---------------------------|--------------------------|
| Items | Diesel engine without A/C | Diesel engine with A/C |
| Type | Battery voltage sensing | Battery voltage sensing |
| Rated output V/A | 12/80 | 12/110 |
| Voltage regulator | Electronic built-in type | Electronic built-in type |

SERVICE SPECIFICATIONS

| Items | | Standard value | Limit |
|--|-------|----------------|------------------------------|
| Alternator output line voltage drop (at 30A) V | | - | max. 0.3 |
| Regulated voltage ambient temp. at voltage regulator V | -20°C | 14.7 - 15.3 | - |
| | 20°C | 14.4 - 14.7 | - |
| | 60°C | 13.9 - 14.4 | - |
| | 80°C | 13.7 - 14.2 | - |
| Output current | | - | 70% of normal output current |

ON-VEHICLE SERVICE <Diesel-powered vehicle>

ALTERNATOR OUTPUT LINE VOLTAGE DROP TEST



5EL0015

This test determines whether the wiring from the alternator "B" terminal to the battery (+) terminal (including the fusible line) is in a good condition or not.

- (1) Always be sure to check the following before the test.
 - Alternator installation
 - Alternator drive belt tension (Refer to GROUP 11B - On-vehicle Service.)
 - Fusible link
 - Abnormal noise from the alternator while the engine is running
- (2) Turn the ignition switch off.
- (3) Disconnect the negative battery cable.
- (4) Disconnect the alternator output wire from the alternator "B" terminal and connect a DC test ammeter with a range of 0-100 A in series between the "B" terminal and the disconnected

output wire. (Connect the (+) lead of the ammeter to the "B" terminal, and then 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 alternator output wire should be 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 alternator "B" terminal and the battery (+) terminal. (Connect the (+) lead of the voltmeter to the "B" terminal and the connect the (-) lead of the voltmeter to the battery (+) cable.)

- (6) Connect a tachometer.
- (7) Reconnect the negative battery cable.
- (8) Leave the hood open.
- (9) Start the engine.
- (10) With the engine running at 2,500 r/min, turn the headlamps and other lamps on and off to adjust the alternator load so that the value displayed on the ammeter is slightly above 30 A.
Adjust the engine speed by gradually decreasing it until the value displayed on the ammeter is 30 A. Take a reading of the value displayed on the voltmeter at this time.

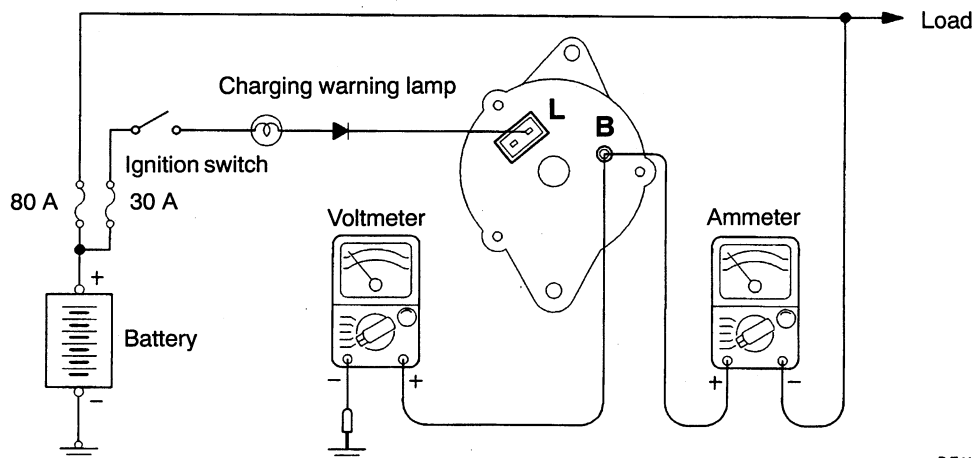
Limit: max. 0.3 V

NOTE

When the alternator output is high and the value displayed on the ammeter does not decrease until 30 A, set the value to 40 A. Read the value displayed on the voltmeter at this time.

- (11) If the value displayed on the voltmeter is above the limit value, there is probably a malfunction in the alternator output wire, so check the wiring between the alternator "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 and then test again.
- (12) After the test, run the engine at idle.
- (13) Turn all lamps and the ignition at idle.
- (14) Disconnect the negative battery cable.
- (15) Disconnect the ammeter, voltmeter and tachometer.
- (16) Connect the alternator output wire to the alternator "B" terminal.
- (17) Connect the negative battery cable.

OUTPUT CURRENT TEST



REN0141

This test determines whether the alternator output current is normal.

- (1) Before the test, always be sure to check the following.
 - Alternator installation
 - Battery (Refer to GROUP 54 - Battery.)

NOTE

The used battery should be slightly discharged. The load needed by a fully-charged battery is insufficient for an accurate test.

- Alternator drive belt tension (Refer to GROUP 11B - On-vehicle Service.)
- Fusible link
- Abnormal noise from the alternator while the engine is running.

- (2) Turn the ignition switch off.
- (3) Disconnect the negative battery cable.
- (4) Disconnect the alternator output wire from the alternator "B" terminal. Connect a DC test ammeter with a range of 0–100 A 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.)

Caution

Never use clips but tighten bolts and nuts to connect the line. Otherwise loose connections (e.g. using clips) will lead to a serious accident because of high current.

NOTE

An inductive-type ammeter which enables measurements to be taken without disconnecting the alternator output wire should be recommended.

- (5) Connect a voltmeter with a range of 0–20 V between the alternator "B" terminal and the earth. (Connect the (+) lead of the voltmeter to the "B" terminal, and then connect the (–) lead of the voltmeter to the earth.)
- (6) Connect a tachometer.
- (7) Connect the negative battery cable.
- (8) Leave the hood open.
- (9) Check that the reading on the voltmeter is equal to the battery voltage.

NOTE

If the voltage is 0 V, the cause is probably an open circuit in the wire or fusible link between the alternator "B" terminal and the battery (+) terminal.

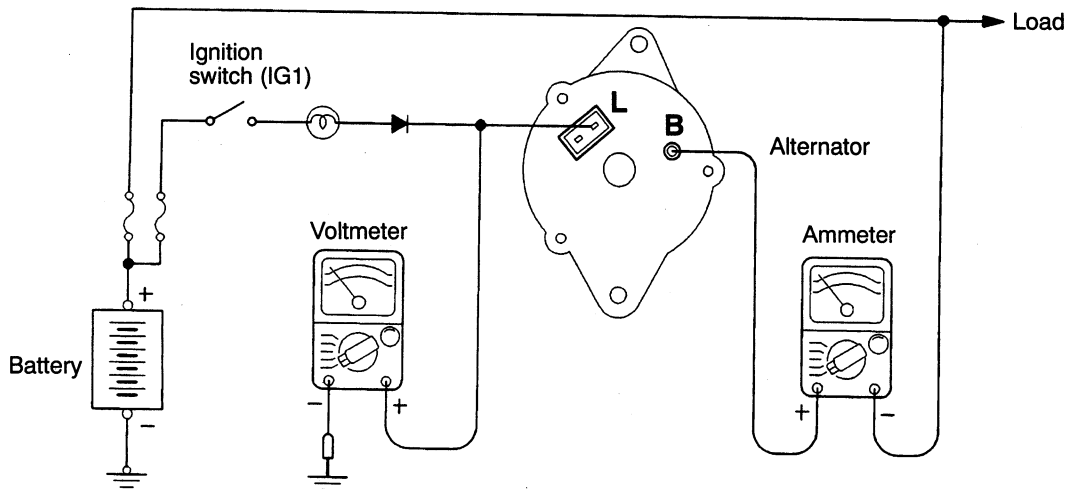
- (10) Turn the light switch on to turn on headlamps and then start the engine.
- (11) Immediately after setting the headlamps to high beam and turning the heater blower switch to the high revolution position, increase the engine speed to 2,500 r/min and read the maximum current output value displayed on the ammeter.

Limit: 70% of normal current output

NOTE

- For the nominal current output, refer to the Alternator Specifications.
 - Because the current from the battery will soon drop after the engine is started, the above step should be carried out as quickly as possible in order to obtain the maximum current output value.
 - The current output value will depend on the electrical load and the temperature of the alternator body.
 - If the electrical load is small while testing, the specified level of current may not be output even though the alternator is normal. In such cases, increase the electrical load by leaving the headlamps turned on for some time to discharge the battery or by using the lighting system in another vehicle, and then test again.
 - The specified level of current also may not be output if the temperature of the alternator body or the ambient temperature is too high. In such cases, cool the alternator and then test again.
- (12) The reading on the ammeter should be above the limit value. If the reading is below the limit value and the alternator output wire is normal, remove the alternator from the engine and check the alternator.
 - (13) Run the engine at idle after the test.
 - (14) Turn the ignition switch off.
 - (15) Disconnect the negative battery cable.
 - (16) Disconnect the ammeter, voltmeter and tachometer.
 - (17) Connect the alternator output wire to the alternator "B" terminal.
 - (18) Connect the negative battery cable.

REGULATED VOLTAGE TEST



REN0142

This test determines whether the voltage regulator is correctly controlling the alternator output voltage.

(1) Always be sure to check the following before the test.

- Alternator installation
- Check that the battery installed in the vehicle is fully charged. (Refer to GROUP 54 - Battery.)
- Alternator drive belt tension (Refer to GROUP 11B - On-vehicle Service.)
- Fusible link
- Abnormal noise from the alternator while the engine is running

- (2) Turn the ignition switch to the OFF position.
- (3) Disconnect the negative battery cable.
- (4) Connect a digital-type voltmeter between the alternator "L" terminal and the earth. (Connect the (+) lead of the voltmeter to the "L" terminal, and then connect the (-) lead of the voltmeter to a secure earth or to the battery (-) terminal.)
- (5) Disconnect the alternator output wire from the alternator "B" terminal.

- (6) Connect a DC test ammeter with a range of 0-100 A 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.)
- (7) Connect a tachometer.
- (8) Reconnect the negative battery cable.
- (9) Turn the ignition switch to the ON position and check that the reading on the voltmeter is 2 - 5 V.

NOTE

If the voltage is 0 V, the cause is probably an open circuit in the wire or fusible link between the alternator "L" terminal and the battery (+) terminal.

- (10) Turn all lamps and accessories off.
- (11) Start the engine.
- (12) Increase the engine speed to 2,500 r/min.
- (13) Read the value displayed on the voltmeter when the alternator output current alternator becomes 10 A or less.

- (14) If the voltage reading conforms to the value in the voltage regulation, then the voltage regulator is operating normally.
If the voltage is not within the standard value, there is a malfunction of the voltage regulator or of the alternator.
- (15) After the test, lower the engine speed to the idle speed.

- (16) Turn the ignition switch off.
- (17) Disconnect the negative battery cable.
- (18) Disconnect the ammeter, voltmeter and tachometer.
- (19) Connect the alternator output wire to the alternator "B" terminal.
- (20) Connect the negative battery cable.

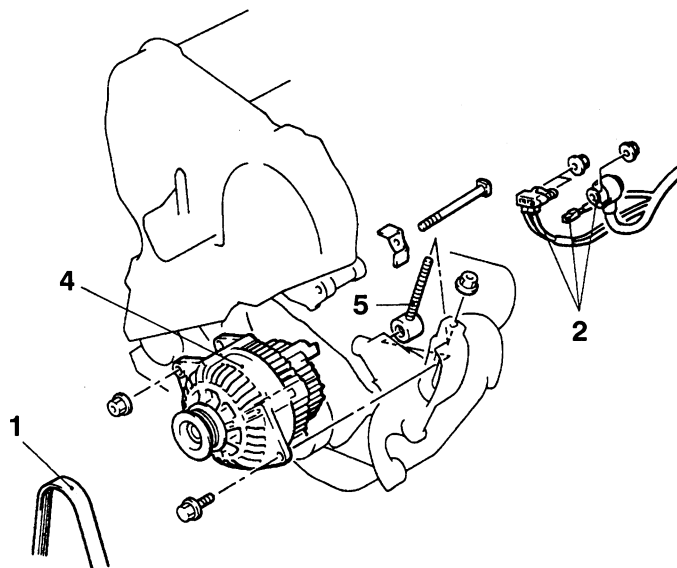
Voltage Regulation Table

Standard value:

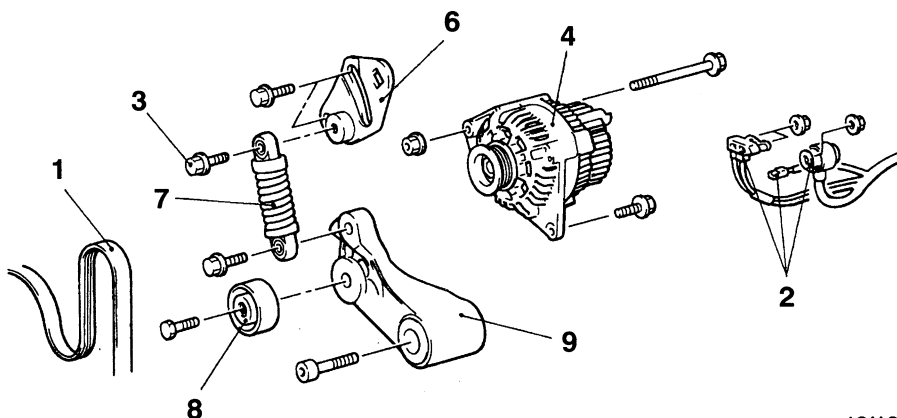
| Inspection terminal | Voltage regulator ambient temperature °C | Voltage V |
|---------------------|--|-------------|
| Terminal "L" | -20 | 14.7 - 15.3 |
| | 20 | 14.4 - 14.7 |
| | 60 | 13.9 - 14.4 |
| | 80 | 13.7 - 14.2 |

ALTERNATOR**REMOVAL AND INSTALLATION****Post-installation Operation**

- Drive Belt Tension Adjustment
(Refer to GROUP 11B - On-vehicle Service.)

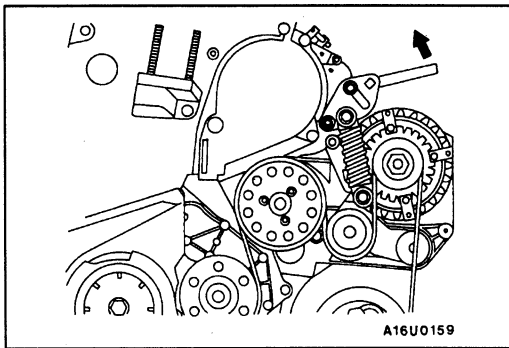
Vehicles without A/C

16U0161

Vehicles with A/C16U0162
00005144**Removal steps**

1. Drive belt
2. Alternator connector
3. Bolt
4. Alternator
5. Bolt

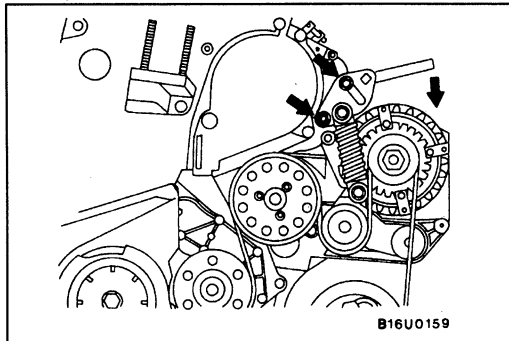
6. Alternator brace
7. Spring
8. Pulley
9. Tensioner



REMOVAL SERVICE POINT

◀A▶ DRIVE BELT REMOVAL <Vehicles with A/C>

- (1) Place a ratchet spanner in the alternator brace.
- (2) Maintain pressure on the ratchet spanner and slacken the bolts.
- (3) Slowly reduce the drive belt tension and then remove the belt.



INSTALLATION SERVICE POINT

▶A◀ DRIVE BELT INSTALLATION <Vehicles with A/C>

- (1) Place the drive belt around the pulleys.
- (2) Insert the ratchet spanner in the alternator brace and tension the drive belt, checking that the belt is properly fitted in the grooves.
- (3) Tighten the two bolts.

IGNITION SYSTEM

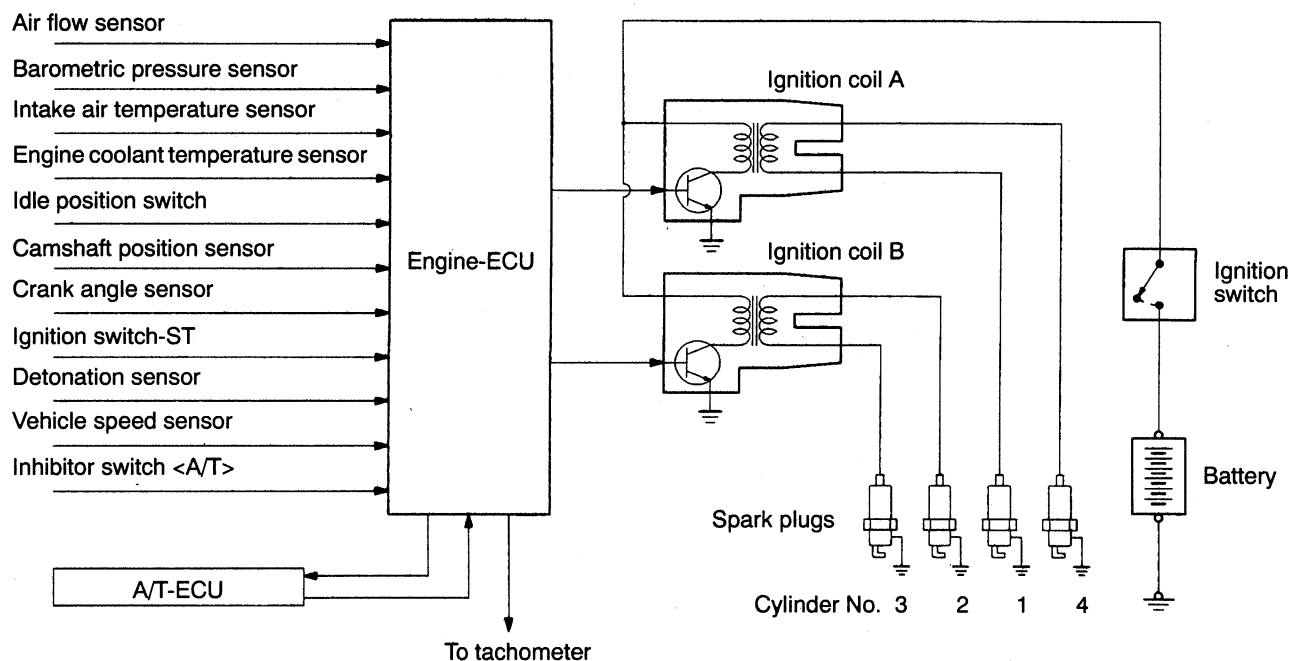
GENERAL

OUTLINE OF CHANGES

- The following service procedures have been added to correspond to the use of the distributorless 2-coil ignition distribution method.
Applicable models: 1600, 1800-SOHC
 - General information
 - On-vehicle Service
 - Removal and installation of the ignition coil
 - Removal and installation of the cam position sensor
 - Removal and installation of the crank angle sensor
- The following service procedures have been changed to correspond to the change of the cam position sensor.
Applicable models: 1800-DOHC
 - Removal and installation of the cam position sensor
 - Removal and installation of the crank angle sensor

GENERAL INFORMATION

SYSTEM DIAGRAM



9FU0629

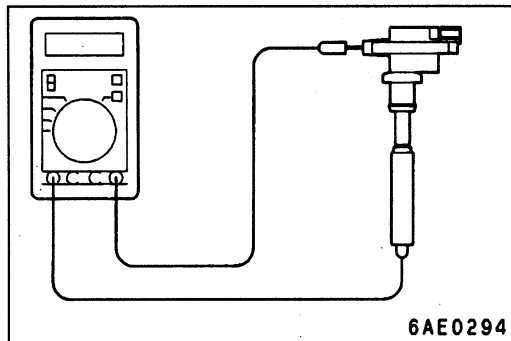
IGNITION COIL SPECIFICATIONS

| | |
|-------|---------------|
| Items | SOHC, DOHC |
| Type | Molded 2-coil |

SERVICE SPECIFICATIONS

IGNITION COIL

| | | |
|-------------------------------------|---------|---------|
| Items | SOHC | DOHC |
| Secondary coil resistance $k\Omega$ | 15 - 21 | 17 - 23 |



ON-VEHICLE SERVICE

IGNITION COIL (WITH BUILT-IN POWER TRANSISTOR) CHECK

Check by the following procedure, and replace if there is a malfunction.

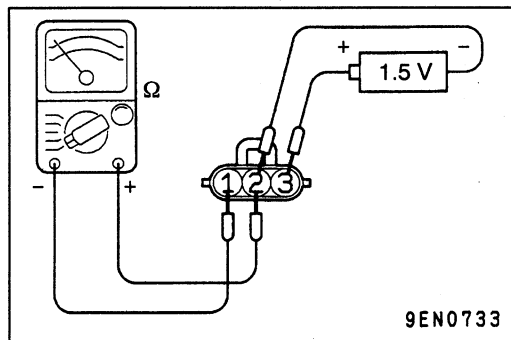
SECONDARY COIL RESISTANCE CHECK

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

Standard value:

15 - 21 $k\Omega$ <SOHC>

17 - 23 $k\Omega$ <DOHC>



PRIMARY COIL AND POWER TRANSISTOR CONTINUITY CHECK

NOTE

An analog-type circuit tester should be used.

| Voltage: 1.5 V | Terminal No. | | |
|-----------------------------|--------------|---|---|
| | 1 | 2 | 3 |
| When current is flowing | ○ | ⊖ | ⊕ |
| When current is not flowing | | | |

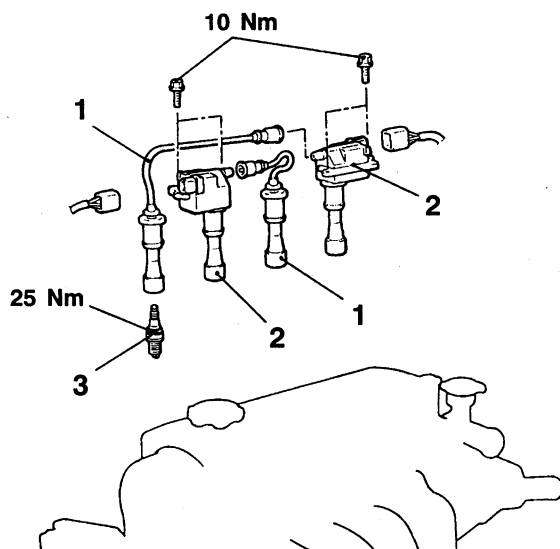
WAVEFORM CHECK USING AN ANALYZER

Ignition Secondary Voltage Check

The checking procedure for the SOHC engine has become the same as for the DOHC engine.

Ignition Primary Voltage Waveform Check

The checking procedure for the SOHC engine has been deleted.

IGNITION SYSTEM**REMOVAL AND INSTALLATION**

A16U0153

Removal steps

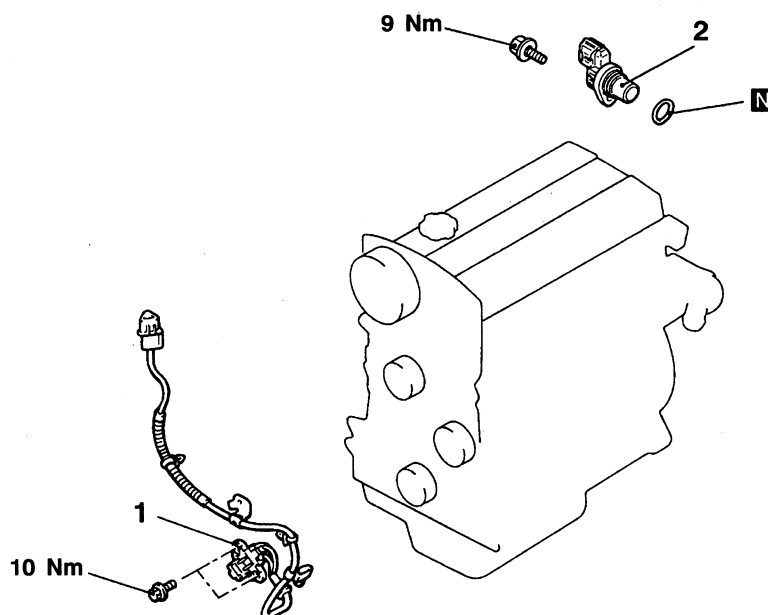
1. Spark plug cable assembly
2. Ignition coil assembly
3. Spark plug

CAMSHAFT POSITION SENSOR AND CRANK ANGLE SENSOR

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation

- Timing Belt Removal and Installation



A16U0154

1. Crank angle sensor
2. Camshaft position sensor

GLOW SYSTEM

GENERAL

OUTLINE OF CHANGE

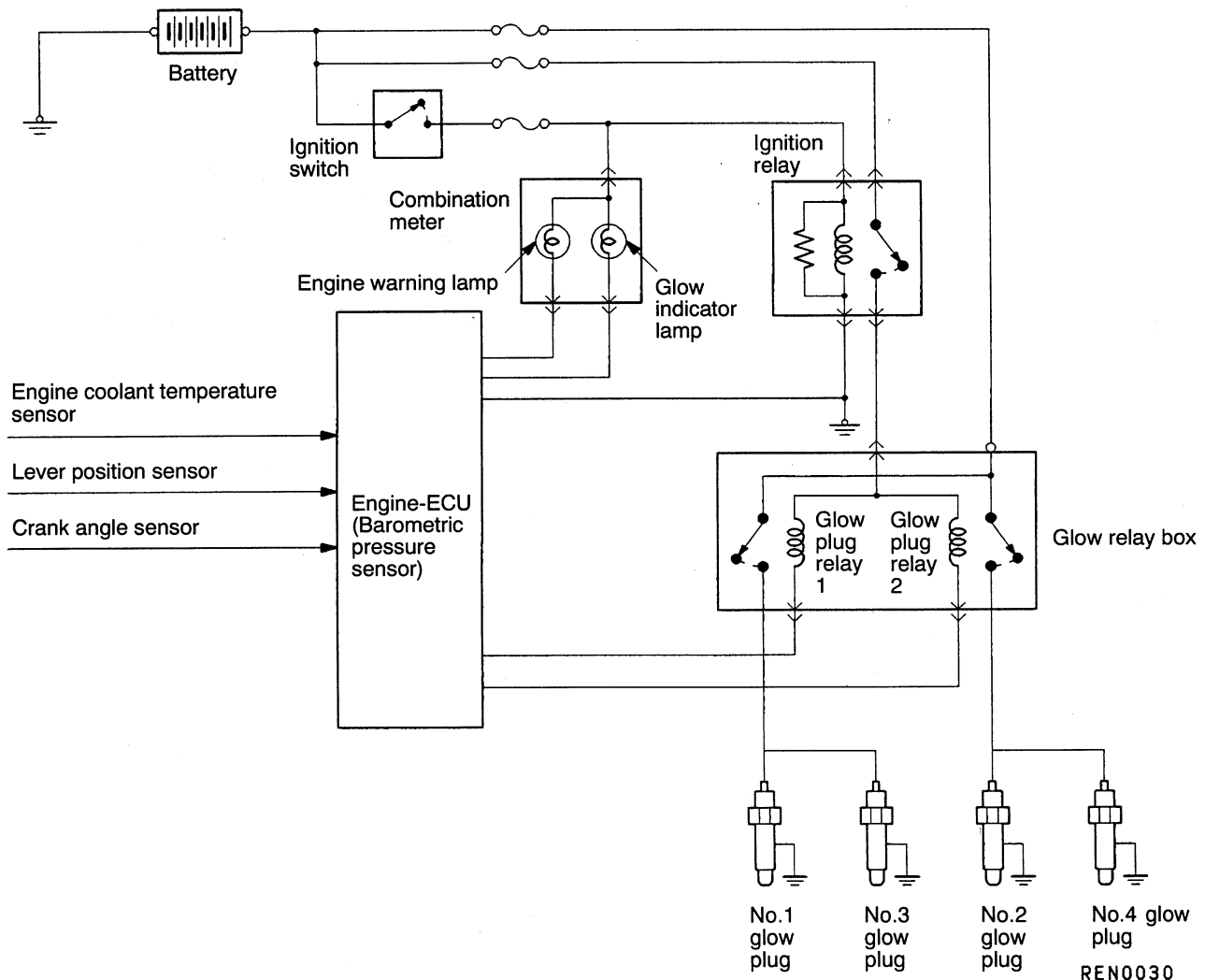
- The following service procedures have been added to correspond to the adoption of the F8QT engine.
Applicable models: 1900D

GENERAL INFORMATION

The glow system reduces the time required for starting at low temperatures to provide a degree of starting and operation that is identical to petrol-engine vehicles by pre-heating the glow plugs at super-quick speed.

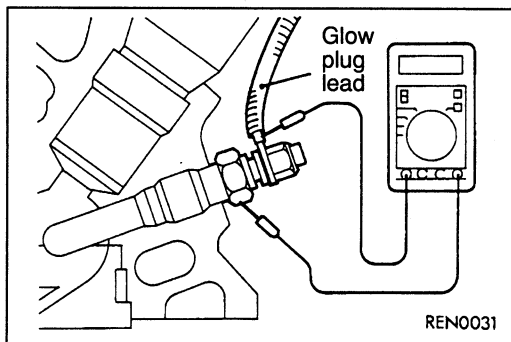
The engine-ECU controls both the time during which current is supplied to the glow plugs after the ignition switch is turned to the ON position and also the glow indicator lamp illumination time in accordance with the engine coolant temperature.

SYSTEM DIAGRAM



SERVICE SPECIFICATION

| Items | | Standard value |
|--|---|---|
| Resistance between glow plug lead and glow plug body (parallel resistance for 2 glow plugs) Ω | | Approx. 0.3 |
| Voltage between glow plug lead and glow body V | Immediately after ignition switch is turned to ON (without starting the engine) | 9 – 11 (Drops to 0 V after 11 – 22 seconds have passed) |
| | While engine is cranking | 6 or more |
| | While engine is warming up | 12 – 15 (Drops to 0 V when if 10 – 220 seconds have passed since the engine was started) |
| Glow plug resistance Ω | | 0.45 – 0.55 |
| Glow plug relay coil resistance Ω | | 27 – 35 |



ON-VEHICLE SERVICE

GLOW SYSTEM CHECK

1. Check that battery voltage is 11 – 13 V.
2. Check that the engine coolant temperature is 40°C or less.
3. Measure the resistance between the glow plug lead and the glow plug body (earth).

Standard value: Approx. 0.3

NOTE

The resistance value is the parallel resistance value for the two plugs (No.1 – No.3 or No.2 – No.4).

4. Check the voltages on the side of glow plug relay 1 (No.1 – No.3 glow plug) and on the side of glow plug relay 2 (No.2 – No.4 glow plug).
 - When checking the side of glow plug relay 1, connect the ohmmeter between the glow plug lead on the side of No.3 cylinder and No.3 glow plug body (earth).
 - When checking the side of glow plug relay 2, connect the ohmmeter between the glow plug lead on the side of No.4 cylinder and No.4 glow plug body (earth).
5. Measure the voltage immediately after the ignition switch is turned to ON (without starting the engine).

Standard value:

9 – 11 V (Drops to 0 V after 11 – 22 seconds have passed)

In addition, check to be sure that the glow indicator lamp illuminates immediately after the ignition switch is turned to ON.

NOTE

The voltage generated time (continuity time) varies depending on the engine coolant temperature when the ignition switch is ON.

6. Measure the voltage while the engine is cranking.

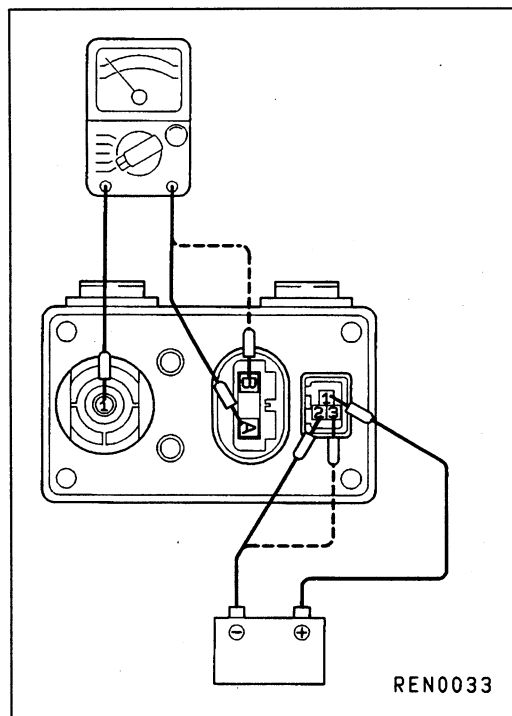
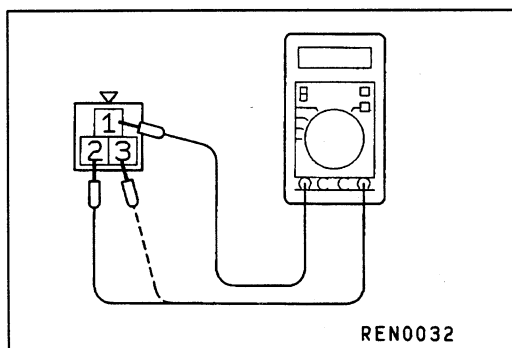
Standard value: 6 V or more

7. Start the engine and measure the voltage while the engine is warming up.

The voltage always drops to 0 V when 10 – 220 seconds have passed after starting the engine.

Standard value: 12 – 15 V**NOTE**

The voltage generated time (continuity time) varies depending on the engine coolant temperature when the ignition switch is ON.



GLOW PLUG RELAY (GLOW RELAY BOX) CHECK

1. Disconnect the glow plug leads and all connectors from the glow plug relay.
2. Measure the resistance between terminals 1 - 2 and 1 - 3 of the glow plug relay 3 pin connector.

Standard value: 27 - 35 Ω

NOTE

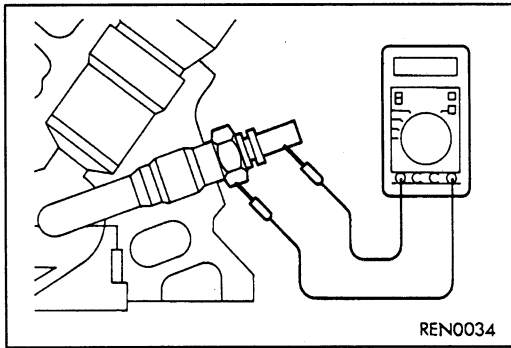
- 1 - 2: Side of glow plug relay 1 (No.1 - No.3 glow plug)
- 1 - 3: Side of glow plug relay 2 (No.2 - No.4 glow plug)

3. Check the operation of the glow plug relay.
 - When checking the side of glow plug relay 1, connect the battery (+) terminal to terminal 1 of the 3-pin connector, and connect the battery (-) terminal to terminal 2.
 - When checking the side of glow plug relay 2, connect the battery (+) terminal to terminal 1 of the 3-pin connector, and connect the battery (-) terminal to terminal 3.

Caution

1. The terminals of the disconnected harness must not be shorted to earth.
2. When connecting the jumper cables, be very careful not to make a mistake in connecting the terminals, as this will cause damage to the relay.
4. Check the continuity between each terminal when the jumper cable of the battery (+) terminal side is connected, and then when it is disconnected.
 - When checking the side of glow plug relay 1, connect the ohmmeter between terminals 1 and A (No.1 - No.3 glow plug leads) of the 1-pin connector.
 - When checking the side of glow plug relay 2, connect the ohmmeter between terminals 1 and B (No.2 - No.4 glow plug leads) of the 1-pin connector.

| Cable at battery (+) terminal | Continuity between terminal |
|-------------------------------|-----------------------------|
| Connected | Continuity (0 Ω) |
| Disconnected | No continuity |



GLOW PLUG CHECK

1. Remove the glow plug leads.
2. Measure the resistance between the glow plug terminals and the body.

Standard value: 0.45 – 0.55 Ω

CHECK AT THE ENGINE-ECU TERMINALS

TERMINAL VOLTAGE CHECK CHART

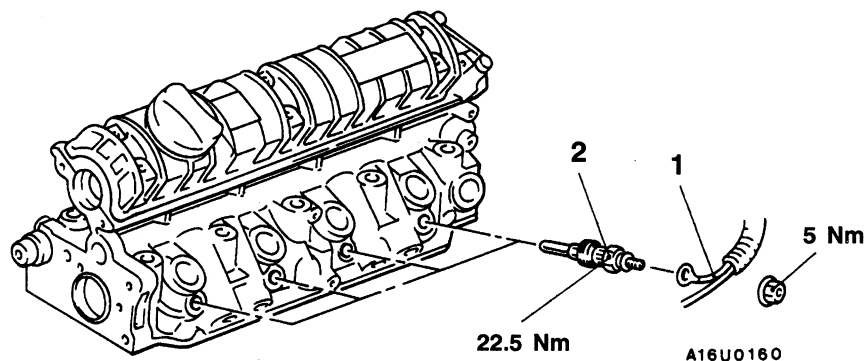
Refer to GROUP 13E – Troubleshooting.

GLOW PLUG

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation

- Fuel Injection Nozzle Removal and Installation
(Refer to GROUP 13E.)

**Removal steps**

1. Harness connector
2. Glow plug