ENGINE ELECTRICAL

CONTENTS

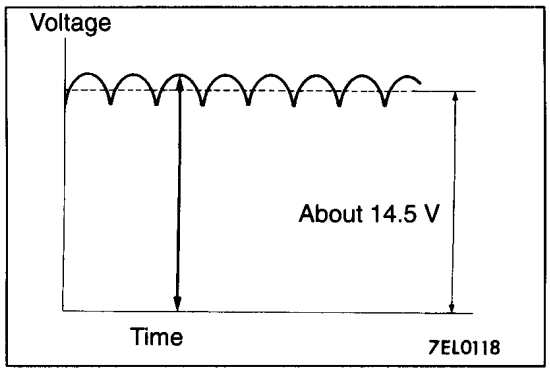
120002525

CHARGING SYSTEM

120002526

GENERAL INFORMATION

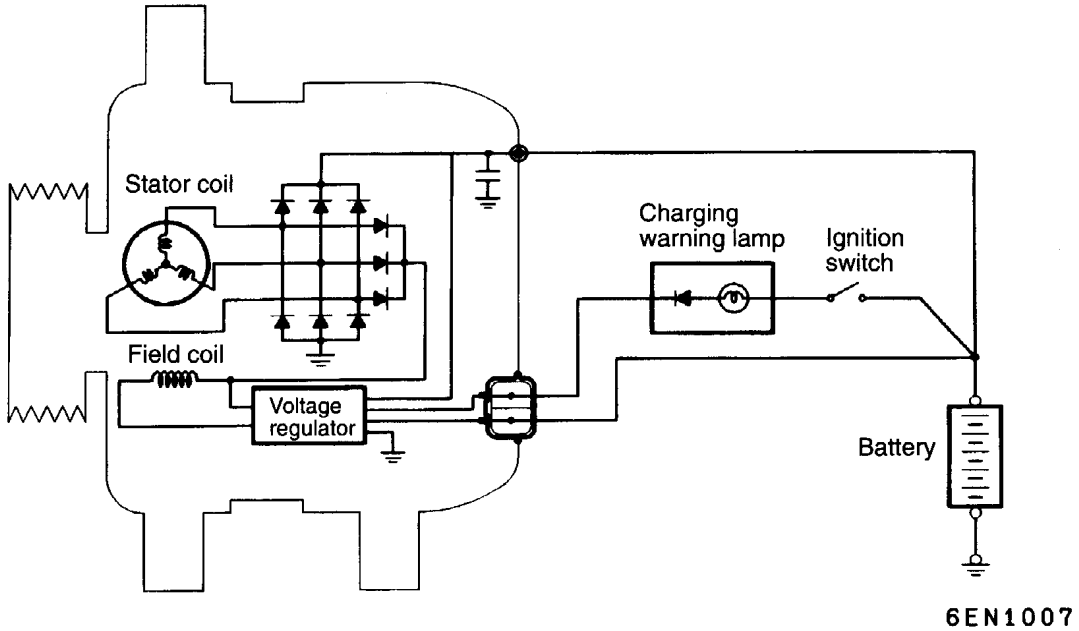
The charging system uses the alternator output to keep the battery charged at a constant level under various electrical loads.



OPERATION

Rotation of the excited field coil generates AC voltage in the stator.
This alternating current is rectified through diodes to DC voltage having a wave-form shown in the illustration at left. The average output voltage fluctuates slightly with the alternator load condition.

When the ignition switch is turned on, current flows in the field coil and initial excitation of the field coil occurs.
When the stator coil begins to generate power after the engine is started, the field coil is excited by the output current of the stator coil.
The alternator output voltage rises as the field current increases and it falls as the field current decreases. When the battery voltage (alternator S terminal voltage) reaches a regulated voltage of approx. 14.4 V, the field current is cut off. When the battery voltage drops below the regulated voltage, the voltage regulator regulates the output voltage to a constant level by controlling the field current.
In addition, when the field current is constant, the alternator output voltage rises as the engine speed increases.



ALTERNATOR SPECIFICATIONS

<4G63, 4G64>

Items	4G63 – Carburettor	4G63 – MPI	4G64
Type	Battery voltage sensing	Battery voltage sensing	Battery voltage sensing
Rated output V/A	12/70	12/75, 90*	12/90
Voltage regulator	Electronic built-in type	Electronic built-in type	Electronic built-in type

*: Vehicles for cold climate zone

<4D56>

Items	Panel van and window van	Wagon
Type	Battery voltage sensing	Battery voltage sensing
Rated output V/A	12/65, 75*	12/75, 90*
Voltage regulator	Electronic built-in type	Electronic built-in type

*: Vehicles for cold climate zone

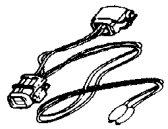
SERVICE SPECIFICATIONS

120000952

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	14.2 – 15.4	–
	20°C	13.9 – 14.9	–
	60°C	13.4 – 14.6	–
	80°C	13.1 – 14.5	–
Output current		–	70% of normal output current

SPECIAL TOOL

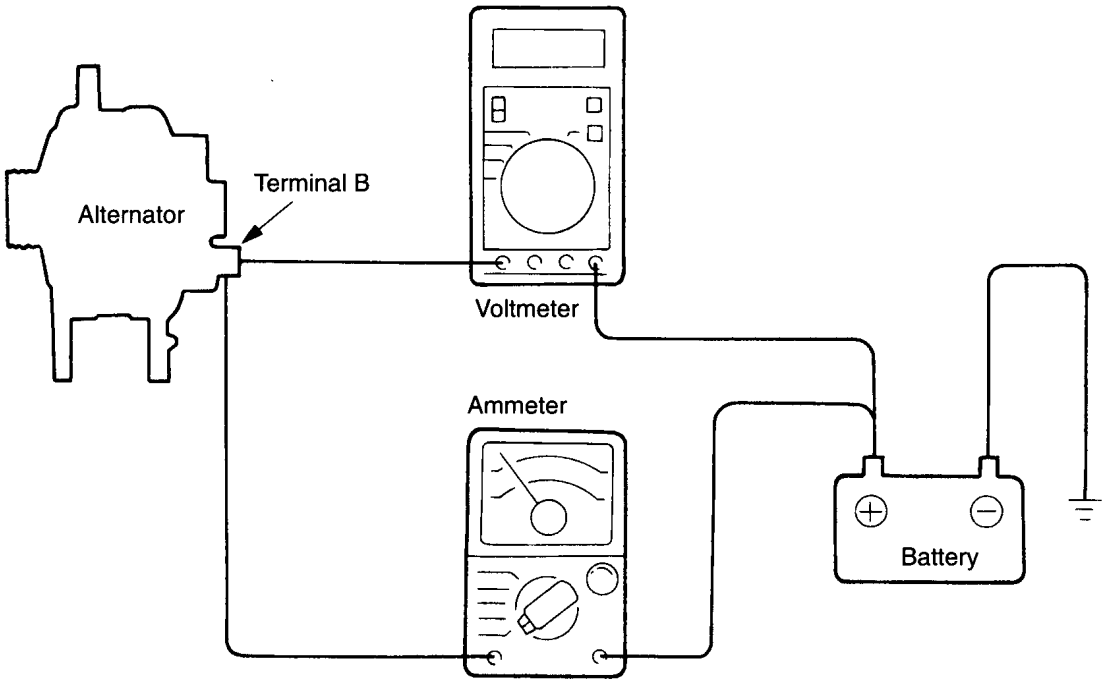
120000953

Tool	Number	Name	Use
	MD998467	Alternator harness connector	Checking the alternator (S terminal voltage)

SERVICE ADJUSTMENT PROCEDURES

120000954

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 link) 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 11 – Service Adjustment Procedures.)
- 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 then connect the (–) lead of the voltmeter to the battery (+) cable.)

(6) Connect a tachometer. (For the procedure for connecting the tachometer, refer to GROUP 11 – Service Adjustment Procedures.)
(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.

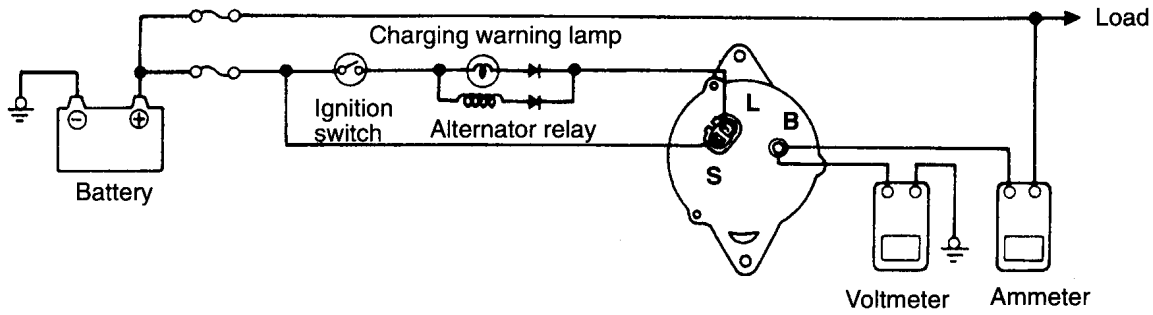
Limit: Max. 0.3 V

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 switch off.
(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

120000955



16P0482

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 11 – Service Adjustment Procedures.)
- 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. (For the procedure for connecting the tachometer, refer to GROUP 11 – Service Adjustment Procedures.)
(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.

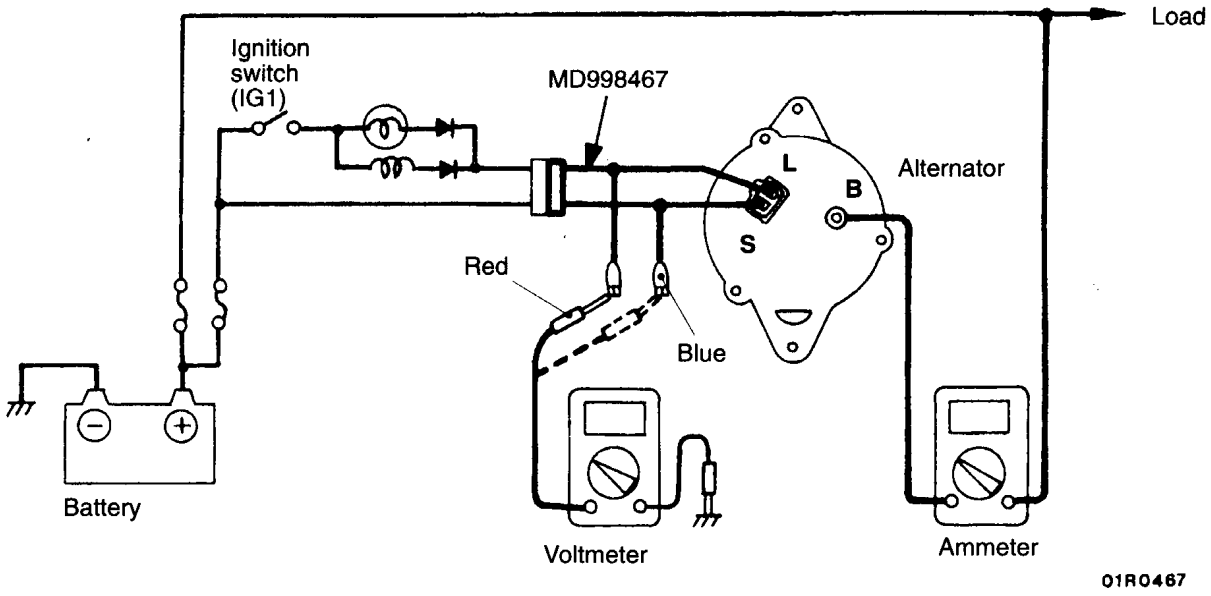
Limit: 70% of normal current output

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

120000956



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 11 – Service Adjustment Procedures.)
- 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 "S" terminal and the earth. (Connect the (+) lead of the the voltmeter to the "S" 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. (Refer to GROUP 11 – Service Adjustment Procedures.)
(8) Reconnect the negative battery cable.
(9) Turn the ignition switch to the ON position and 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 "S" terminal and the battery (+) terminal.

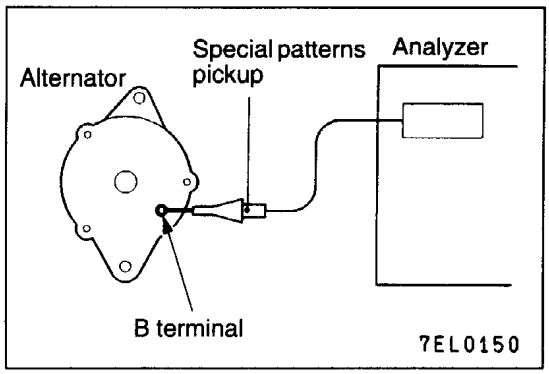
(10) Turn all lamps and accessories off.
(11) Start the engine.
(12) Increase the engine speed to 2,500 r/min.
(13) Read the value displayed on the voltmeter when the alternator output current becomes 10 A or less.

(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 "S"	–20	14.2–15.4
	20	13.9–14.9
	60	13.4–14.6
	80	13.1–14.5



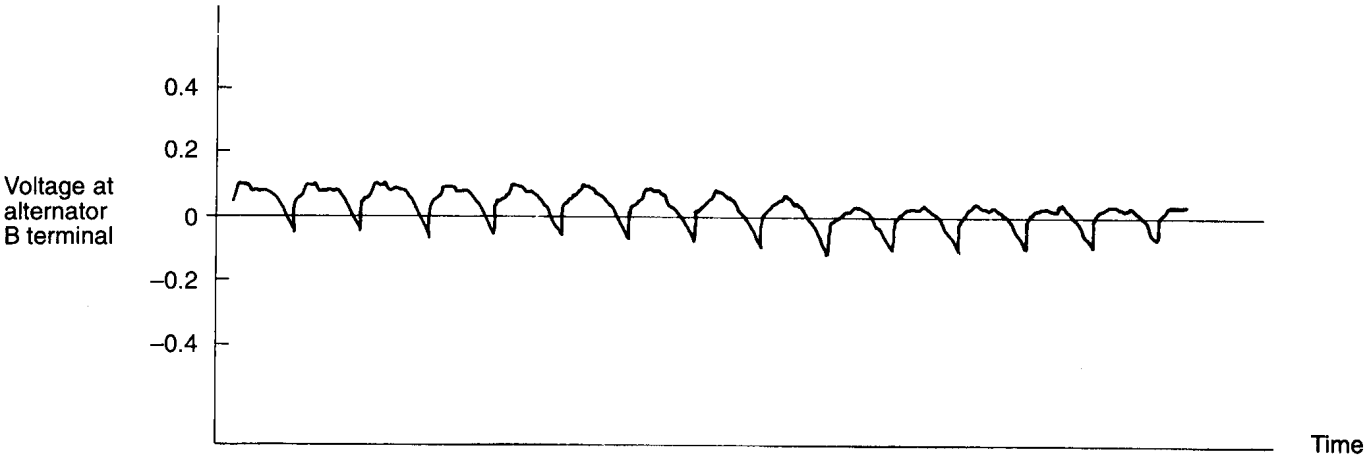
CHECKING WITH AN ANALYZER 120000957

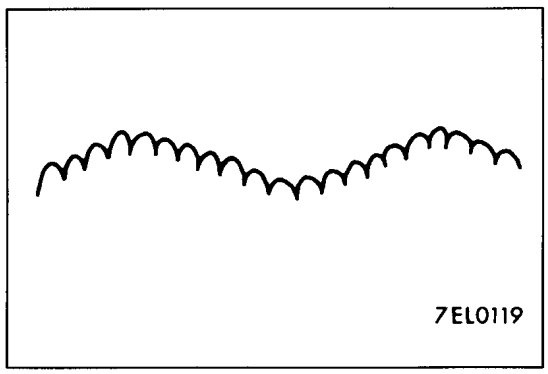
MEASUREMENT METHOD

Connect the analyzer special patterns pick-up to the alternator B terminal.

STANDARD WAVE-FORM
Observation Conditions

FUNCTION	SPECIAL PATTERNS
PATTERN HEIGHT	VARIABLE
VARIABLE knob	Adjust while viewing the wave-form.
PATTERN SELECTOR	RASTER
Engine speed	Curb idle speed

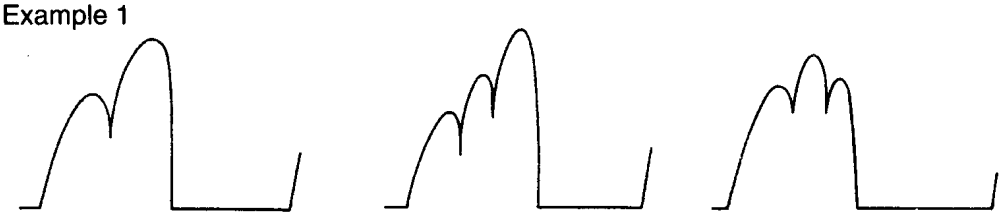
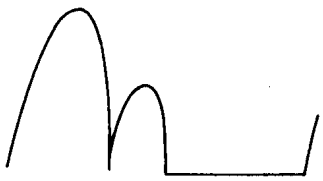




NOTE
The voltage wave-form of the alternator B terminal can undulate as shown at left. This wave-form is produced when the regulator operates according to fluctuations in the alternator load (current), and is normal for the alternator.

EXAMPLES OF ABNORMAL WAVE-FORMS

NOTE
1. The size of the wave-form patterns differs largely, depending on the adjustment of the variable knob on the analyzer.
2. Identification of abnormal wave-forms is easier when there is a large output current (regulator is not operating). (Wave-forms can be observed when the headlamps are illuminated.)
3. Check the conditions of the charging warning lamp (illuminated/not illuminated). Also, check the charging system totally.

Abnormal wave-forms	Problem cause
Example 1  7EL0120	• Open diode
Example 2  7EL0121	• Short in diode
Example 3  7EL0122	• Broken wire in stator coil
Example 4  7EL0123	• Short in stator coil
Example 5  NOTE: At this time, the charging warning is illuminated. 7EL0124	• Open supplementary diode

ALTERNATOR

120002181

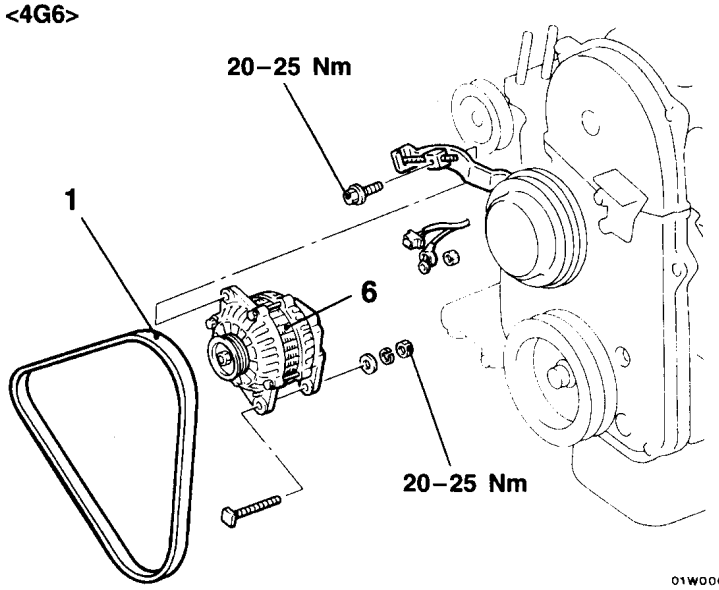
REMOVAL AND INSTALLATION

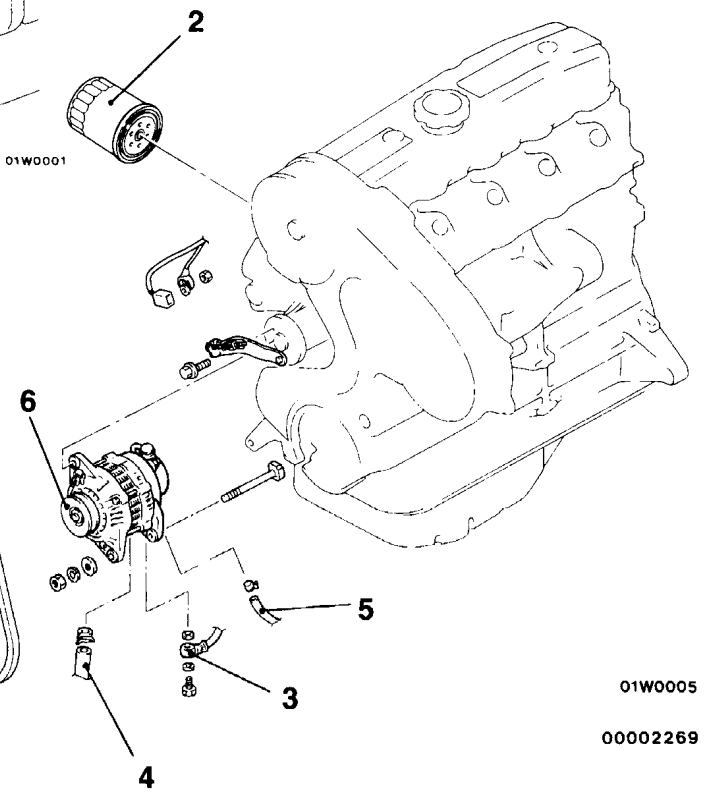
<4G6, 4D56>

Pre-removal Operation
- Under Cover Removal
  (Refer to GROUP 42 – Under Cover.)

Post-installation Operation
(1)Drive Belt Tension Adjustment (Refer to GROUP 11 – Service Adjustment Procedures.)
(2)Under Cover Installation
(Refer to GROUP 42 – Under Cover.)

<4G6>





Removal steps

1. Drive belt (Alternator)
2. Oil filter (Refer to GROUP 12 – Service Adjustment Procedures.)
3. Oil pipe connection
4. Oil return hose connection
5. Vacuum hose connection
6. Alternator

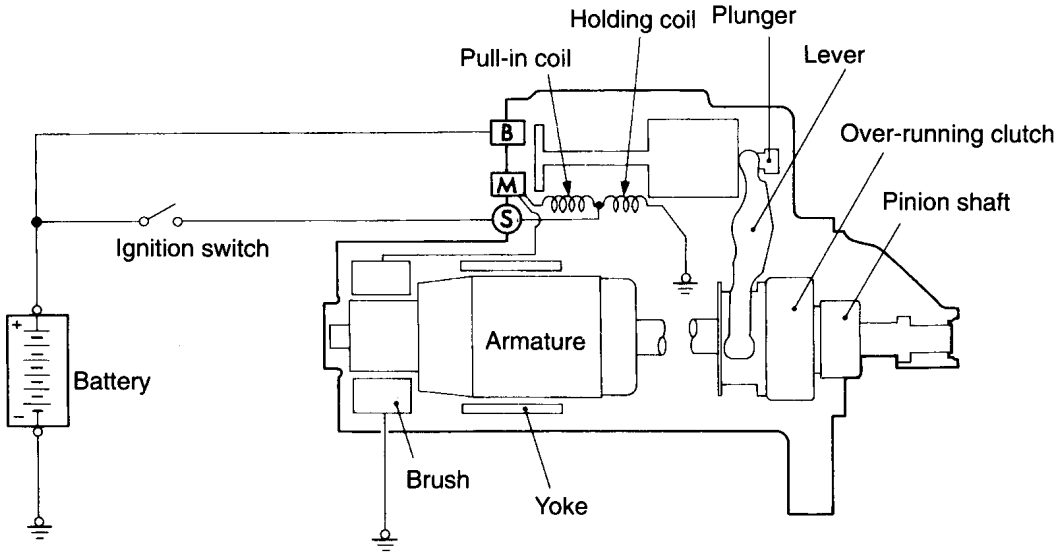
STARTING SYSTEM

120002527

GENERAL INFORMATION

If the ignition switch is turned to the "START" position, current flows in the Pull-in and Holding coils inside magnetic switch, attracting the plunger. When the plunger is attracted, the lever connected to the plunger engages the starter clutch.
On the other hand, attracting the plunger will turn on the magnetic switch, allowing the B terminal and M terminal to conduct. Thus, current flows to engage the starter motor.

When the ignition switch is returned to the "ON" position after starting the engine, the starter clutch is disengaged from the ring gear.
An over-running clutch is provided between the pinion and the armature shaft, to prevent damage to the starter.



6EN0939

STARTER MOTOR SPECIFICATIONS

<4G63, 4G64>

Items	4G63 – Standard and M/T	4G63 – Cold climate zone and A/T, 4G64
Type	Direct drive	Reduction drive with planetary gear
Rated output kw/V	0.9/12	1.2/12
No. of pinion teeth	8	8

<4D56>

Items	Standard	Cold climate zone
Type	Reduction drive with planetary gear	Reduction drive with planetary gear
Rated output	2.0	2.2
No. of pinion teeth	10	10

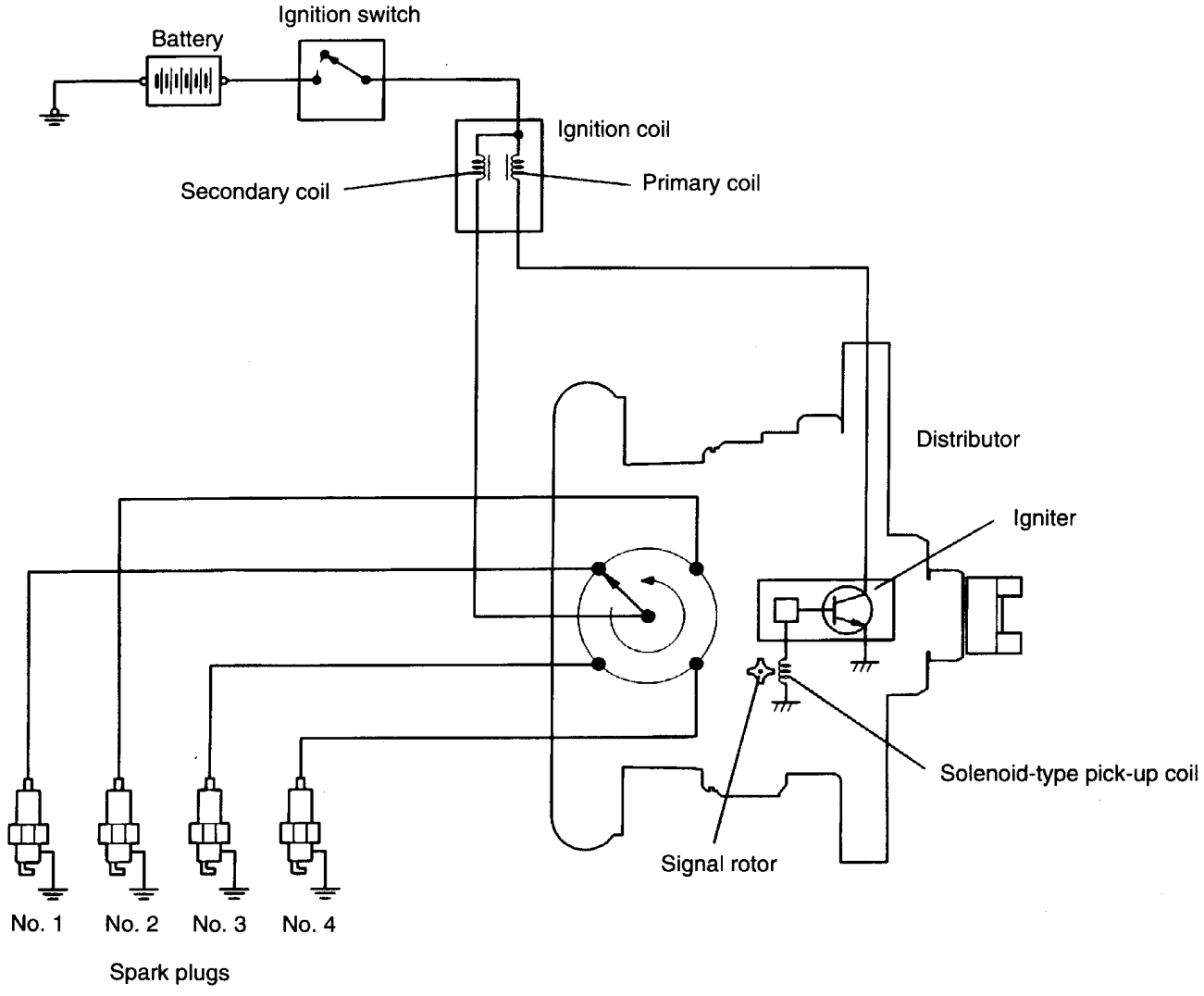
IGNITION SYSTEM

120002528

GENERAL INFORMATION

<CARBURETTOR>

When the primary current stops suddenly in the ignition coil, high voltage appears in the secondary side of the coil. The distributor supplies the high voltage to the applicable spark plug. The engine firing order is 1-3-4-2 cylinders.
The high voltage ignites the compressed air fuel mixture in the combustion chamber through the spark plugs.
A signal rotor is installed to the distributor shaft. When the distributor shaft (signal rotor) rotates, an electromotive force is generated in a solenoid-type pick-up coil in accordance with the rotation.
The igniter turns a power transistor built into the igniter ON and OFF in accordance with this electromotive force, thereby stops the ignition coil primary current suddenly.
The ignition timing is controlled by a centrifugal-type spark advance device and a load-type spark advance device in accordance with the engine speed and engine load condition.

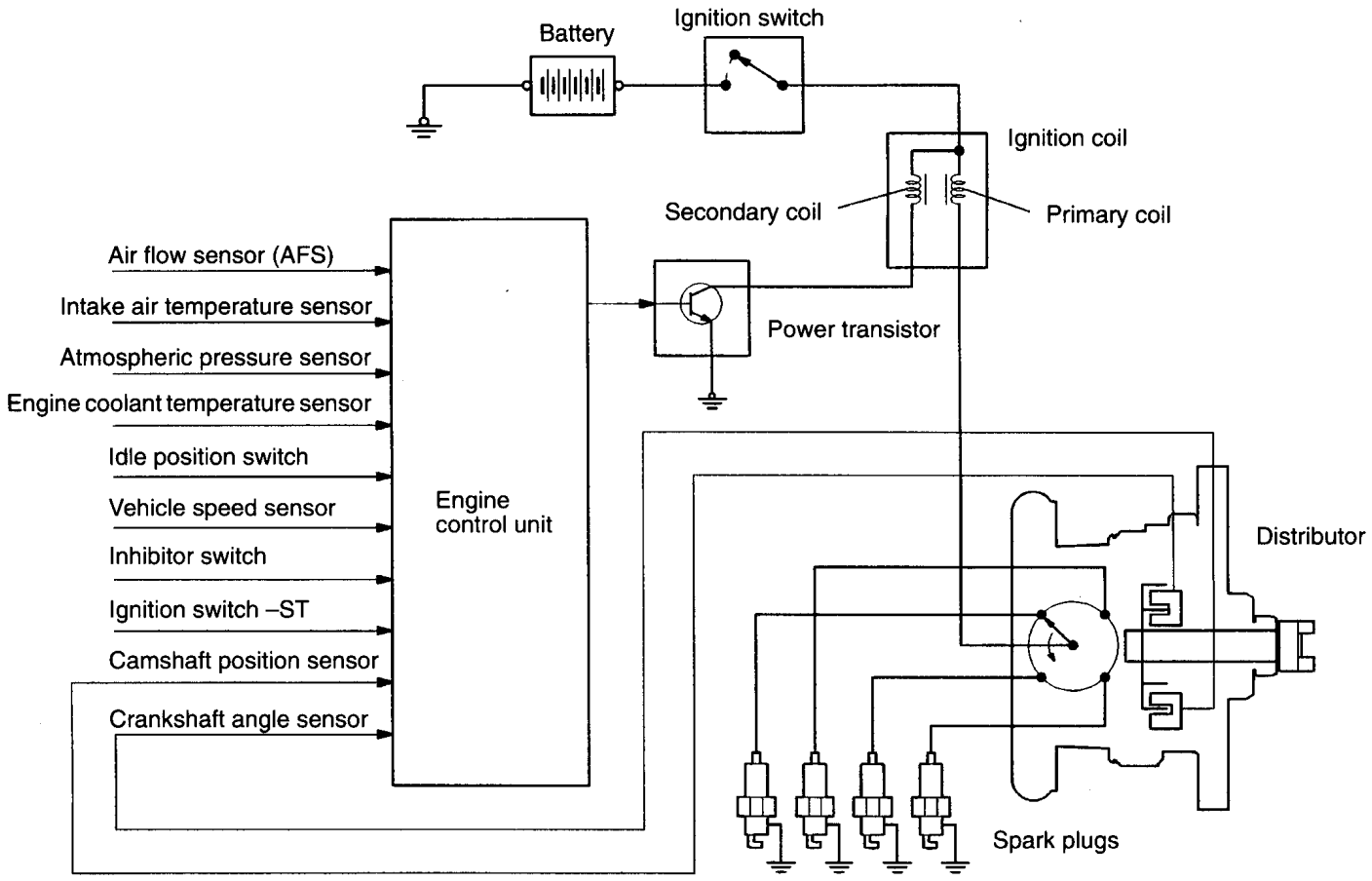


6EN1008

<MPI>

When the primary current stops suddenly in the ignition coil, high voltage appears in the secondary side of the coil. The distributor supplies the high voltage to the applicable spark plug. The engine firing order is 1-3-4-2 cylinders.
The high voltage ignites the compressed air fuel mixture in the combustion chamber through the spark plugs.
The engine control unit makes and breaks the primary current of the ignition coil to regulate the ignition timing.

The engine control unit detects the crankshaft position by the crankshaft position sensor incorporated in the distributor to ignite at the most appropriate timing for the engine operating condition.
When the engine is cold or operated at a high altitude, the ignition timing is slightly advanced for optimum performance.



6EN1009

DISTRIBUTOR SPECIFICATIONS

Items	Carburettor	MPI
Type	Contact pointless	Contact pointless
Advance mechanism	Centrifugal + Vacuum	Electronic
Firing order	1-3-4-2	1-3-4-2

IGNITION COIL SPECIFICATION

Items	Carburettor	MPI
Type	Moulded single-coil	Moulded single-coil
Identification No.	FA-0004	FA-0005

SPARK PLUG SPECIFICATION

Items		Specifications
Model	NGK	BKR5E-11
	NIPPON DENSO	K16PR-U11

SERVICE SPECIFICATIONS

120002529

Items			Standard value	Limit
Distributor <Caburettor>	Centrifugal advance (at 6,000 r/min)		26–35 °BTDC	–
	Vacuum advance (at 45 kPa)		15–26 °BTDC	–
Ignition coil	Primary coil resistance Ω	Carburettor	1.08–1.32	–
		MPI	0.67–0.81	–
	Secondary coil resistance kΩ	Carburettor	22.1–29.9	–
		MPI	11.3–15.3	–
Spark plug gap mm			1.0–1.1	–
Resistive cord resistance kΩ			–	Max. 22

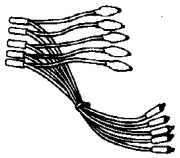
LUBRICANT

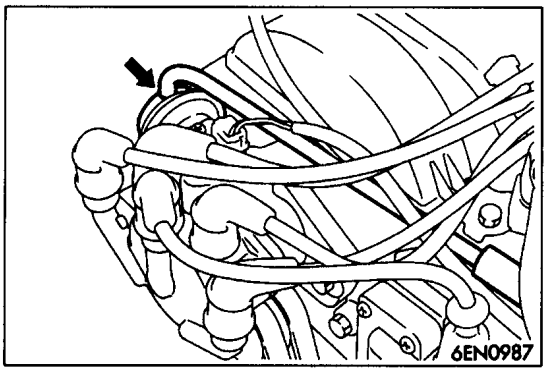
120002530

Items	Specified lubricant	Quantity
Distributor cupping	Multipurpose grease SAE J310, NLGI No. 3	2 g

SPECIAL TOOL

120000971

Tool	Number	Name	Use
	MB991348	Test harness set	Inspection of ignition primary voltage (power transistor connection)



SERVICE ADJUSTMENT PROCEDURES

120002531

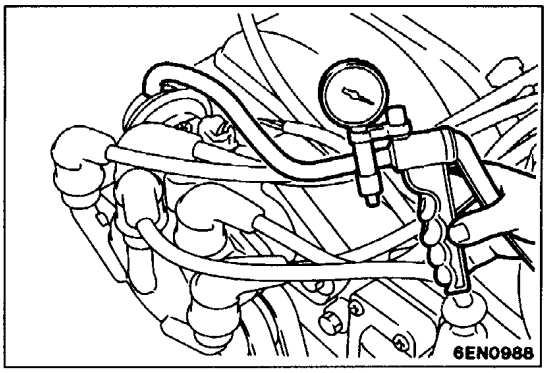
CENTRIFUGAL ADVANCE CONTROL DEVICE INSPECTION <Carburettor>

(1) Start the engine and run it at idle.
(2) Disconnect the vacuum hose from the vacuum controller. Plug the disconnected vacuum hose.
(3) Increase the engine speed gradually and check the ignition timing. At this time, check that the ignition timing advances smoothly as the engine speed increases.

Standard value: 26–35 °BTDC (at 6,000 r/min)

(4) If any of the following symptoms occur, disassemble the distributor and check it.

Symptom	Possible cause
Excessive advance	Worn or damaged governor spring
Start-up advance too sudden	Damaged spring
Inadequate advance or excessive hysteresis	Malfunction of governor weight or cam



VACUUM ADVANCE CONTROL DEVICE INSPECTION <Carburettor>

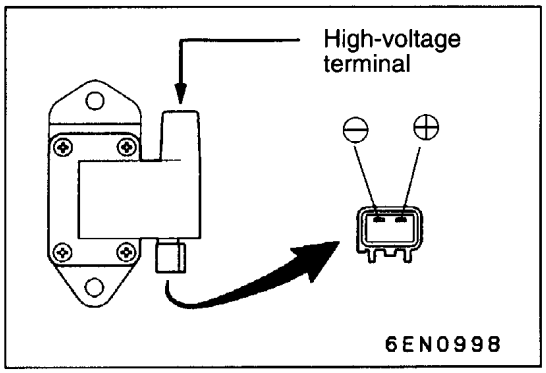
120002532

(1) Start the engine and run it at idle.
(2) Disconnect the vacuum hose from the vacuum controller. Plug the disconnected vacuum hose. Connect a vacuum pump to the nipple.
(3) Gradually increase the negative pressure with the hand vacuum pump, and check the ignition timing.
At this time, check that the ignition timing advances smoothly as the negative pressure increases.

Standard value: 15–26 °BTDC (at 45 kPa)

(4) If any of the following symptoms occur, disassemble the distributor and check it.

Symptom	Possible cause
Excessive advance	Worn or damaged vacuum controller spring
Start-up advance too sudden	Damaged spring
Inadequate advance or excessive hysteresis	Breaker base malfunction
Not advancing	Damaged diaphragm



IGNITION COIL INSPECTION

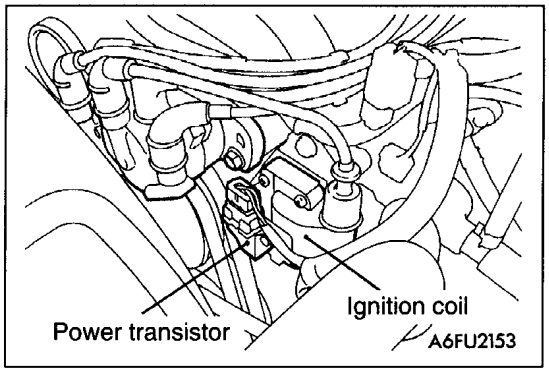
120002533

1. Measurement of the primary coil resistance
Measure the resistance between (+) terminal and (–) terminal

Standard value:
Carburettor 1.08–1.32 Ω
MPI 0.67–0.81 Ω

2. Measurement of the secondary coil resistance
Measure the resistance between the high-voltage terminal and (+) terminal.

Standard value:
Carburettor 22.1–29.9 kΩ
MPI 11.3–15.3 kΩ

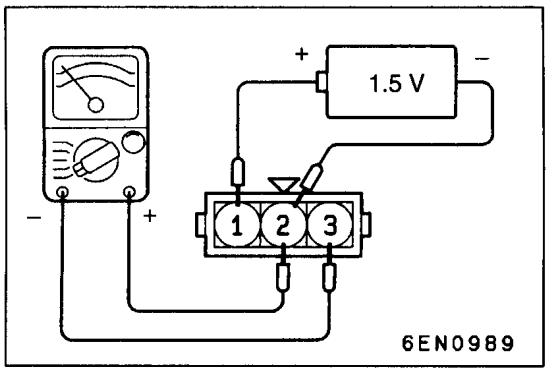


POWER TRANSISTOR INSPECTION <MPI>

120002534

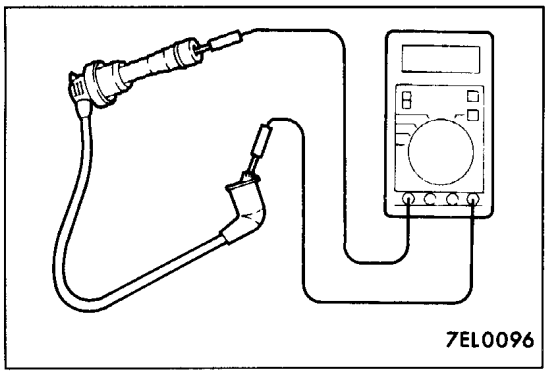
1. Disconnect the power transistor connector and check the continuity between terminals (2) and (3).

   NOTE
   An analog-type ohmmeter should be used.



1.5 V Voltage	Terminal No.		
	1	2	3
Applied	⊕ - - - -	- - - ⊖	○ ——— ○
Not applied			

2. Replace the power transistor if there is a malfunction.



RESISTIVE CODE INSPECTION 120000978

Measure the resistance of the all spark plug leads.

1. Check cap and coating for cracks.
2. Measure resistance.

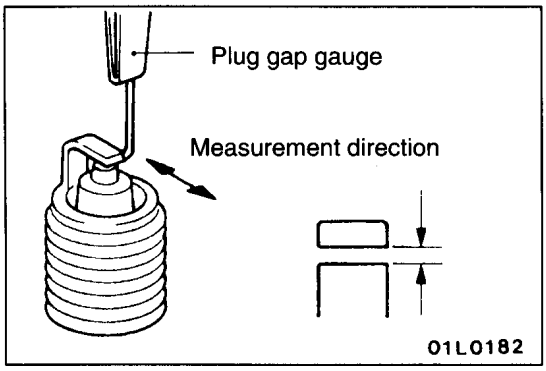
   Limit: Max. 22 kΩ

SPARK PLUG CHECK AND CLEANING 120002535

1. Remove the spark plug cables.

   Caution
   When pulling off the spark plug cable from the plug, always hold the cable cap, not the cable.

2. Remove the spark plugs.
3. Check for burned out electrode or damaged insulator. Check for even burning.
4. Remove carbon deposits with wire brush or plug cleaner. Remove sand from plug screw with compressed air.



5. Use a plug gap gauge to check that the plug gap is within the standard value range.

   Standard value: 1.0–1.1 mm

   If the plug gap is not within the standard value range, adjust by bending the earth electrode.
6. Clean the engine plug holes.

   Caution
   Do not let foreign matter enter cylinders.

7. Install the spark plugs.

WAVE-FORM INSPECTION USING AN ANALYZER (Ignition Primary and Secondary Voltage wave-forms) 120002536

Ignition Secondary Voltage Inspection

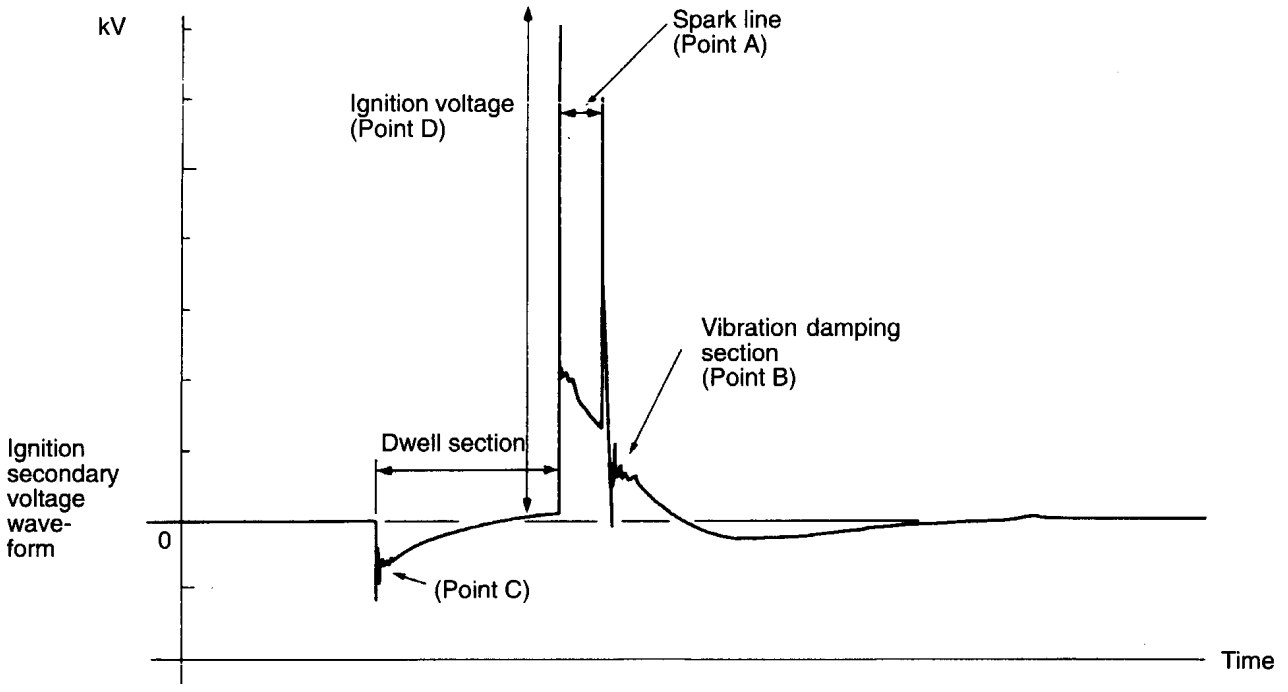
MEASUREMENT METHOD

1. Clamp the high-tension cable with the secondary pickup.
2. Clamp the spark plug cable with the trigger pickup. (Basically, clamp the spark plug cable of the No. 1 cylinder.)

NOTE
The wave-form of the cylinder clamped to the trigger pickup appears at the left edge of the screen.

STANDARD WAVE-FORM
Observation conditions

FUNCTION	SECONDARY
PATTERN HEIGHT	HIGH (or LOW)
PATTERN SELECTOR	RASTER
Engine speed	Curb idle speed



7EL0128

WAVE-FORM OBSERVATION POINTS

Point A: The height, length and slope of the spark line (refer to abnormal wave-form Examples 1, 2, 3 and 4) show the following trends.

Spark line		Plug gap	Condition of electrode	Compression force	Concentration of air mixture	Ignition timing	Spark plug cable
Length	Long	Small	Normal	Low	Rich	Advanced	Leak
	Short	Large	Large wear	High	Lean	Retarded	High resistance
Height	High	Large	Large wear	High	Lean	Retarded	High resistance
	Low	Small	Normal	Low	Rich	Advanced	Leak
Slope		Large	Plug is fouled	–	–	–	–

Point B: Number of vibration in reduction vibration section (Refer to abnormal wave-form Example 5.)

Number of vibrations	Coil and condenser
Three or more	Normal
Except above	Abnormal

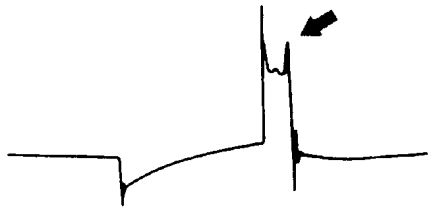
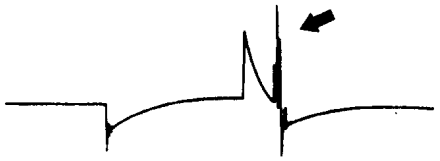
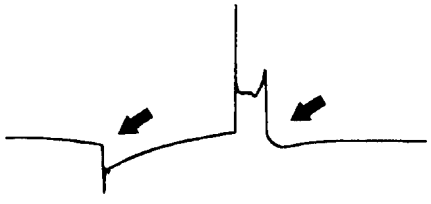
Point C: Number of vibrations at beginning of dwell section (Refer to abnormal wave-form Example 5.)

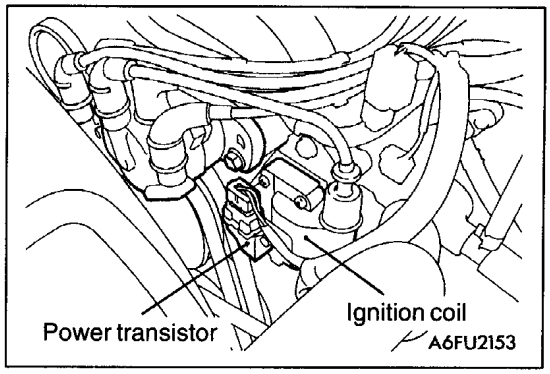
Number of vibrations	Coil
5 – 6 or higher	Normal
Except above	Abnormal

Point D: Ignition voltage height (distribution per each cylinder) shows the following trends.

Ignition voltage	Plug gap	Condition of electrode	Compression force	Concentration of air mixture	Ignition timing	Spark plug cable
High	Large	Large wear	High	Lean	Retarded	High resistance
Low	Small	Normal	Low	Rich	Advanced	Leak

EXAMPLES OF ABNORMAL WAVE-FORMS

Abnormal wave-form	Wave characteristics	Cause of problem
Example 1  01P0215	Spark line is high and short.	Spark plug gap is too large.
Example 2  01P0216	Spark line is low and long, and is sloping. Also, the second half of the spark line is distorted. This could be a result of misfiring.	Spark plug gap is too small.
Example 3  01P0217	Spark line is low and long, and is sloping. However, there is almost no spark line distortion.	Spark plug gap is fouled.
Example 4  01P0218	Spark line is high and short. Difficult to distinguish between this and abnormal wave-form example 1.	Spark plug cable is nearly falling off. (Causing a dual ignition)
Example 5  01P0219	No waves in wave damping section	Short in ignition coil.

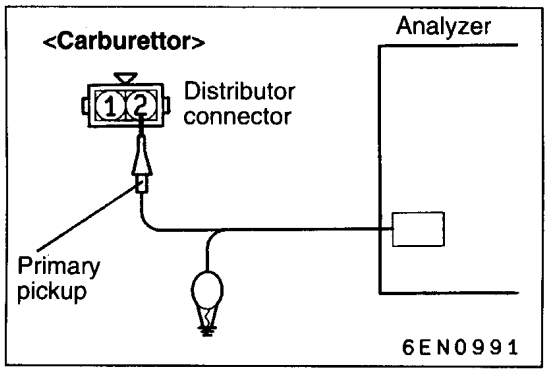


Ignition Primary Voltage Wave-form Check

120002537

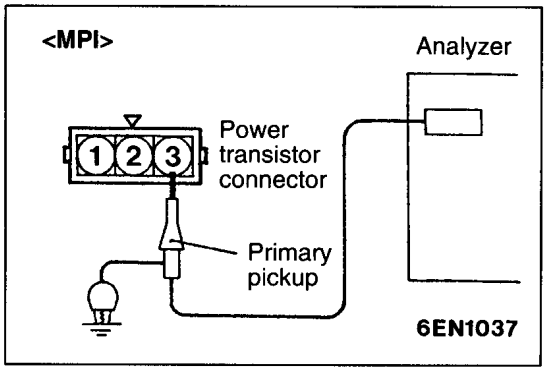
MEASUREMENT METHOD

1. Disconnect the distributor connector <Carburettor> or the power transistor connector <MPI>, and connect the special tool (test harness: MB991348) between the connector terminals. (All terminals should be connected.)



2. **<For Carburettor>**

   Connect the analyzer primary pickup to the distributor connector terminal 2.



<For MPI>

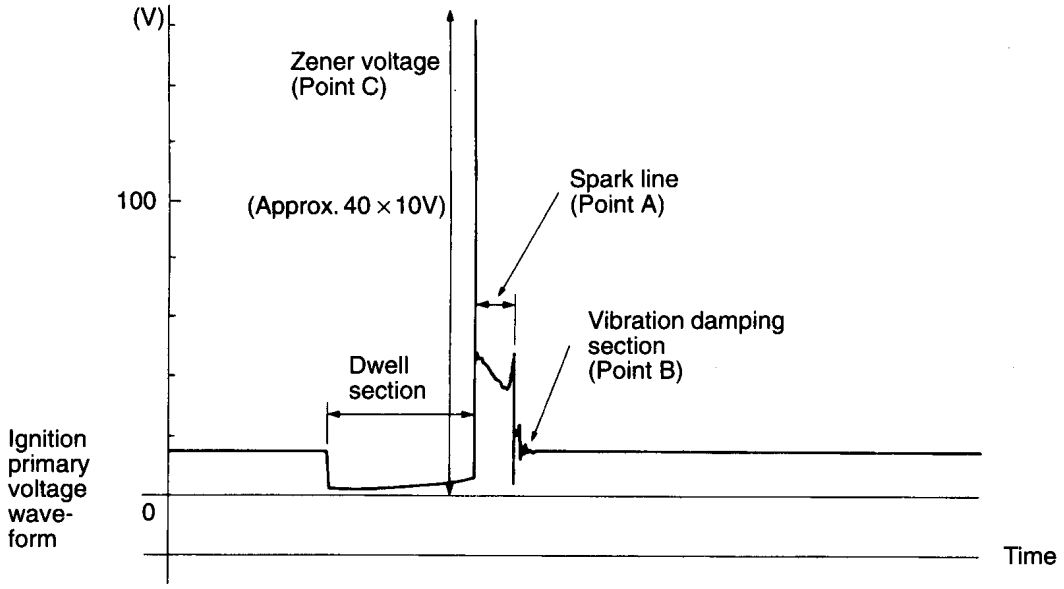
Connect the analyzer primary pickup to the power transistor connector terminal 3.

3. Connect the primary pickup earth terminal.
4. Clamp the spark plug cable with the trigger pickup.

NOTE
The wave-form of the cylinder clamped to the trigger pickup will appear at the left edge of the screen.

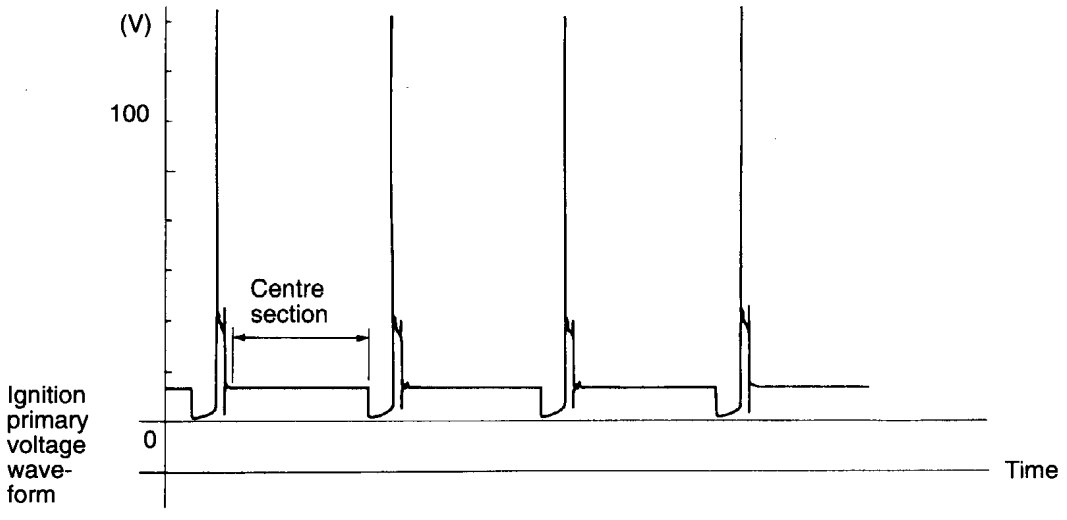
STANDARD WAVE-FORM
Observation conditions

FUNCTION	SECONDARY
PATTERN HEIGHT	HIGH (or LOW)
PATTERN SELECTOR	RASTER
Engine speed	Curb idle speed



Observation conditions
(Only the pattern selector shown below changes from the previous conditions)

PATTERN SELECTOR	DISPLAY



WAVE-FORM OBSERVATION POINTS

Point A: The height, length and slope of the spark line (refer to abnormal wave-form Examples 1, 2, 3 and 4) show the following trends.

Spark line		Plug gap	Condition of electrode	Compression force	Concentration of air mixture	Ignition timing	High tension cable
Length	Long	Small	Normal	Low	Rich	Advanced	Leak
	Short	Large	Large wear	High	Lean	Retarded	High resistance
Height	High	Large	Large wear	High	Lean	Retarded	High resistance
	Low	Small	Normal	Low	Rich	Advanced	Leak
Slope		Large	Plug fouled	–	–	–	–

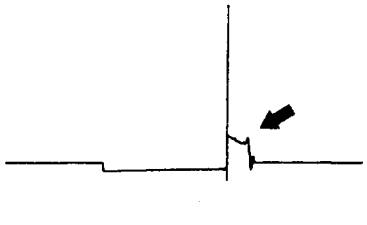
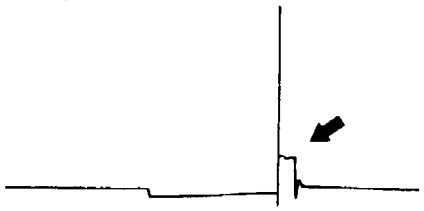
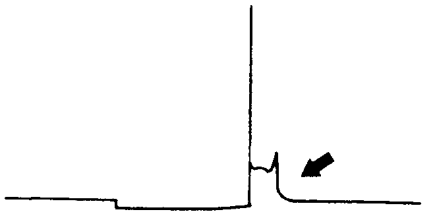
Point B: Number of vibration in reduction vibration section (Refer to abnormal wave-form Example 5.)

Number of vibrations	Coil, condenser
3 or higher	Except above
Normal	Abnormal

Point C: Height of Zener voltage

Height of Zener voltage	Probable cause
High	Problem in Zener diode
Low	Abnormal resistance in primary coil circuit

EXAMPLES OF ABNORMAL WAVE-FORMS

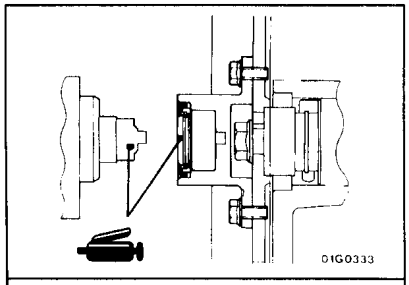
Abnormal wave-form	Wave characteristics	Cause of problem
Example 1  01P0210	Spark line is high and short.	Spark plug gap is too large.
Example 2  01P0211	Spark line is low and long, and is sloping. Also, the second half of the spark line is distorted. This could be a result of misfiring.	Spark plug gap is too small.
Example 3  01P0212	Spark line is low and long, and is sloping. However, there is almost no spark line distortion.	Spark plug gap is fouled.
Example 4  01P0213	Spark line is high and short.	Spark plug cable is nearly falling off. (Causing a dual ignition)
Example 5  01P0214	No waves in wave damping section	Short in ignition coil

DISTRIBUTOR

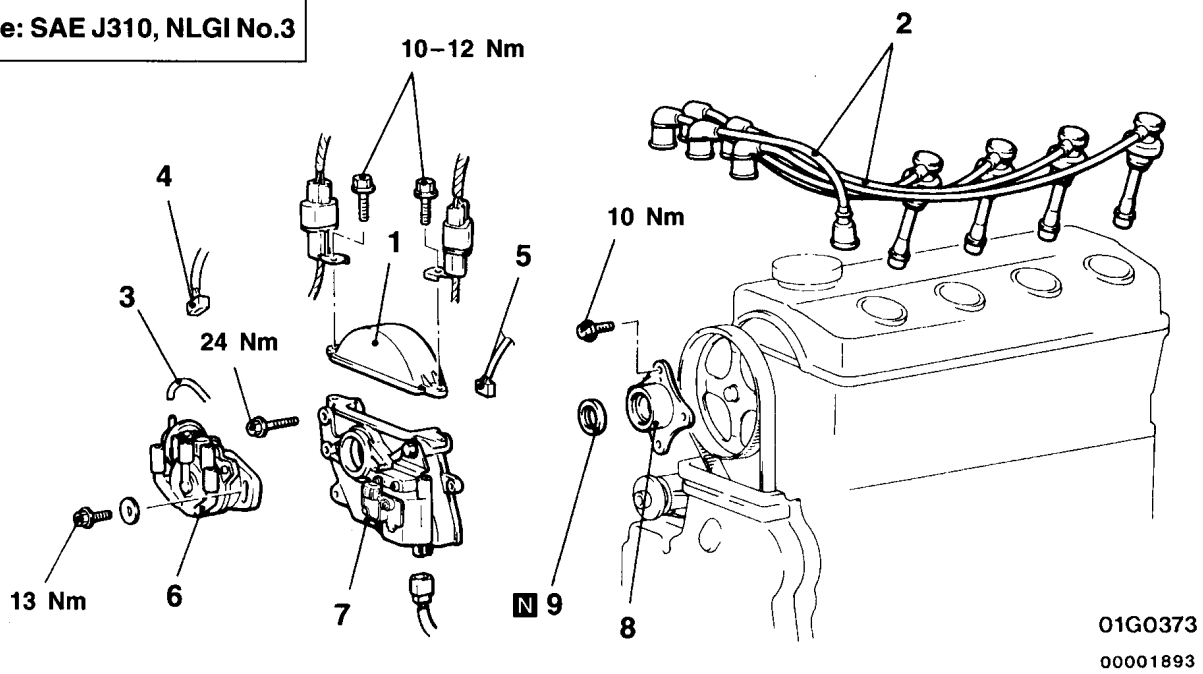
120002538

REMOVAL AND INSTALLATION

Post-installation Operation
- Engine Adjustment (Refer to GROUP 11D – Service Adjustment Procedures.)



Grease: SAE J310, NLGI No.3



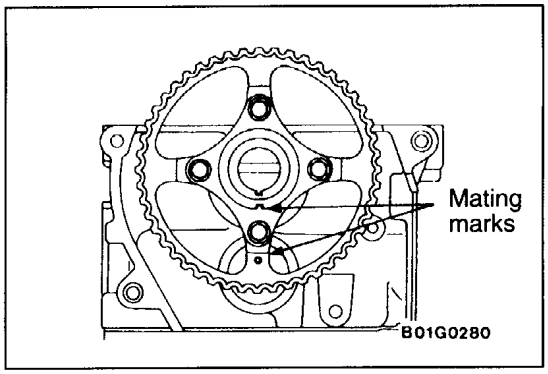
Removal Steps

1. Timing belt upper cover
2. Spark plug cable and high tension cable
3. Vacuum hose connection <Carburettor>
4. Distributor connector
5. Power transistor connector <MPI>
- ▶C◀ 6. Distributor assembly
7. Distributor bracket
- ▶B◀ 8. Camshaft sprocket spacer
- ▶A◀ 9. Oil seal

INSTALLATION SERVICE POINTS

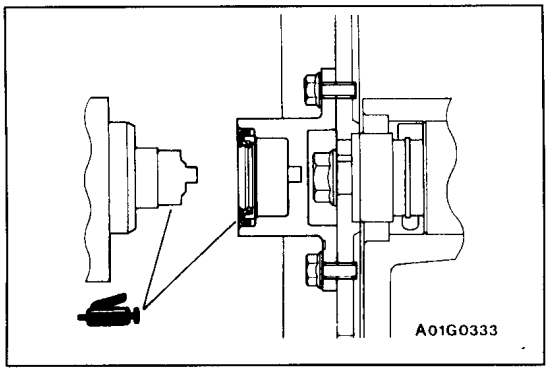
▶A◀ OIL SEAL INSTALLATION

Tap in the oil seal until it is flush with the camshaft sprocket spacer.



▶B◀ CAMSHAFT SPROCKET SPACER INSTALLATION

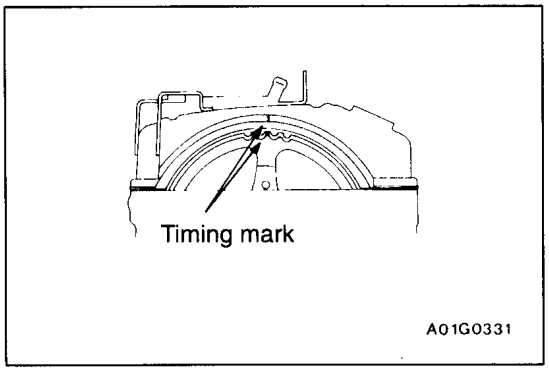
Install the camshaft sprocket spacer so that the mating marks on the camshaft sprocket spacer and the camshaft sprocket are aligned.



▶C◀ DISTRIBUTOR ASSEMBLY INSTALLATION

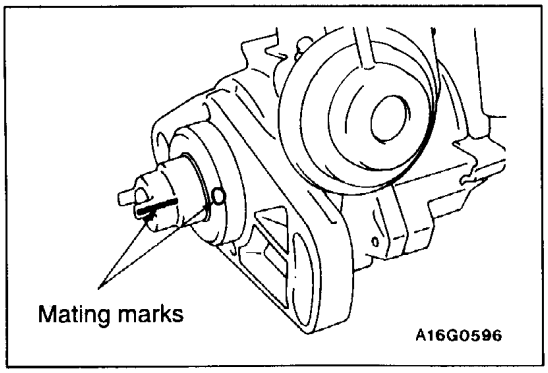
(1) Apply 2 grams of grease in the places shown in the illustration.

Specified grease: Multipurpose grease SAE J310, NLGI No. 3



(2) Turn the crankshaft clockwise to align the timing marks.

NOTE
The No. 1 cylinder will be at compression top dead centre if the timing mark on the camshaft sprocket is aligned with the timing mark on the cylinder head.



(3) Align the mating mark on the distributor housing side with the mating mark on the coupling side.
(4) Install the distributor to the engine while aligning the distributor fixing bolt with the oblong hole on the distributor mounting flange.

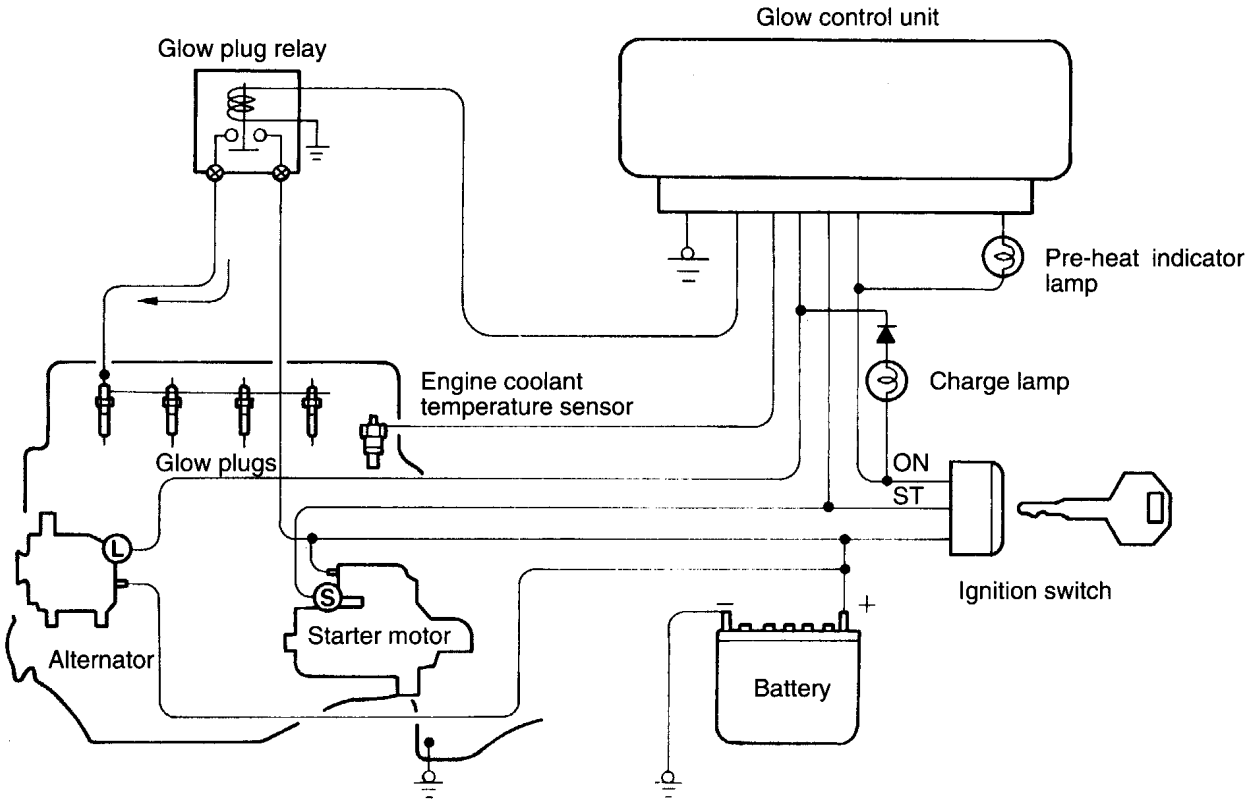
GLOW SYSTEM

120001412

GENERAL INFORMATION

SELF-REGULATING GLOW SYSTEM

The self-regulating 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 preheating the glow plugs at super-quick speed.
The glow control unit 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. The resistances of the heating coils which are built into the glow plugs increase as the glow plug temperatures become higher. As a result of this, the flow of current gradually decreases, thus stabilising the glow plug temperature at the specified temperature.



DEN0062

SERVICE SPECIFICATIONS

120001413

Item		Standard value
Resistance between glow plug plate and glow plug body (parallel resistance for 4 glow plugs) (at 20°) Ω		0.10–0.15
Voltage between glow plug plate and glow plug body V	Immediately after ignition switch is turned to ON (without starting the engine)	9–11 (Drops to 0 V after 4–8 seconds have passed)
	While engine is cranking	6 or more
	While engine is warming up	12–15 (Drops to 0 V when the engine coolant temperature increases to 60° or more or if 180 seconds have passed since the engine was started)
Glow plug resistance (at 20°) Ω		0.4–0.6

SEALANT

120001414

Item	Specified sealant	Remark
Engine coolant temperature sensor	3M Nut Locking Part No. 4171 or equivalent	Drying sealant

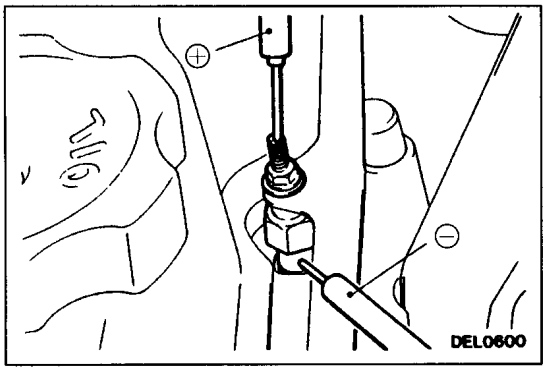
SERVICE ADJUSTMENT PROCEDURES

120001415

SELF-REGULATING GLOW SYSTEM INSPECTION

1. Check that the battery voltage is 11–13 V.
2. Check that the engine coolant temperature is 40°C or less.

   NOTE
   If the engine coolant temperature is too high, disconnect the engine coolant temperature sensor connector.



3. Measure the resistance between the glow plug plate and the glow plug body (earth).

   Standard value: 0.10–0.15 Ω (at 20°C)

   NOTE
   The resistance value is the parallel resistance value for the four glow plugs.
4. Connect a voltmeter between the glow plug plate and the 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 4–8 seconds have passed)

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

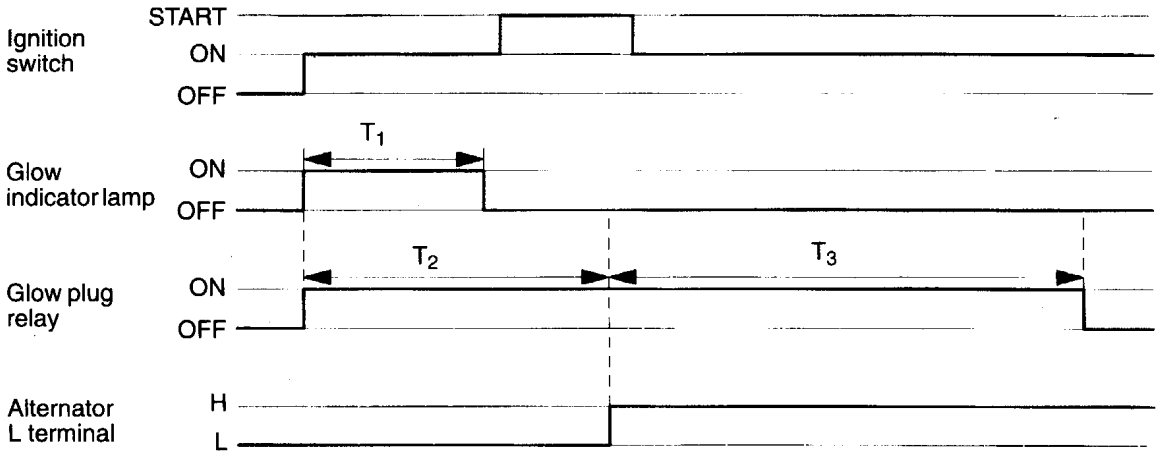
   NOTE
   The time during which the voltage appears (energizing time) will depend on the engine coolant temperature.
6. Measure the voltage while the engine is cranking.

   Standard value: 6 V or more
7. Start the engine and measure the voltage while the engine is warming up.
   However, if the engine coolant temperature rises above 60°C or when 180 seconds have passed since the engine was started, the voltage will always return to 0 V. (Refer to the Glow Plug Energization Timing Chart.)

   Standard value: 12–15 V

<Reference>

Glow Plug Energization Timing Chart



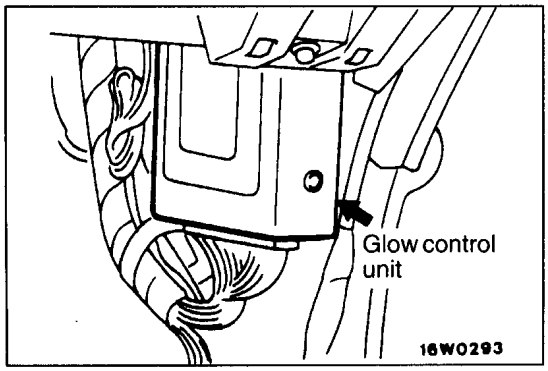
T_1: Glow indicator lamp
T_2: Glow plug relay drive time after ignition switch is turned ON
T_3: Glow plug relay drive time after engine starts (afterglow)

DEN0063

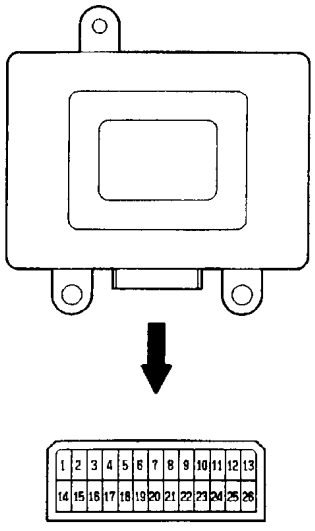
NOTE
After glow time T3 becomes longer as the engine coolant temperature drops.

GLOW CONTROL UNIT INSPECTION

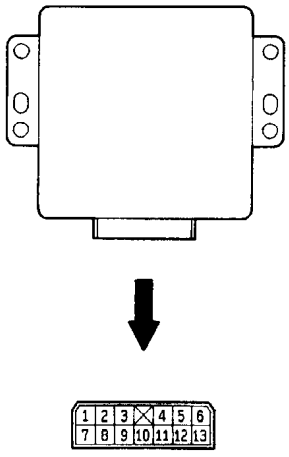
120002539



Vehicles with EGR



Vehicles without EGR



DEN0821
00003260

1. Measure the voltage at the control unit terminals.

   NOTE
   1. Inspect with the control unit connector connected.
   2. When measuring the voltage, connect the control unit terminal (26) (terminal (10) for vehicles without EGR) to the earth.

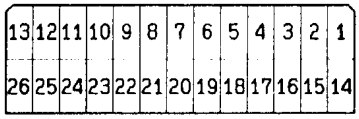
Terminal Voltage Reference Table

Inspection terminal	Inspection item	Inspection condition		Standard value
5 13*	Engine coolant temperature sensor (Engine coolant temperature detection)	Ignition switch "ON" → "OFF"	Engine coolant temperature: –20°C	4.3–4.5 V
			Engine coolant temperature: 0°C	3.7–3.9 V
			Engine coolant temperature: 20°C	2.8–3.0 V
			Engine coolant temperature: 40°C	1.9–2.1 V
			Engine coolant temperature: 80°C	0.5–0.7 V
12 2*	Ignition switch (power supply)	Ignition switch "OFF" → "START"		8 V or more
14 7*	Glow plug relay (glow time control)	Ignition switch "OFF" → "ON" Engine coolant temperature: 40°C (104°F) or less (Pre-glow function inspection)		9–12 V 0–0.5 V after approx. 8 sec. (when engine coolant temperature is 20°C)
17 3*	Glow indicator lamp	Ignition switch "OFF" → "ON" Engine coolant temperature: 40°C (104°F) or less		0–1 V 11–13 V after approx. 1 sec. (when engine coolant temperature is 20°C)
23 6*	Alternator charging signal ("L" terminal)	Ignition switch "OFF" → "ON"		1–4 V
		Engine is idling		11 V or more
26 10*	Earth	–		–

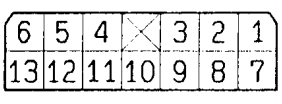
*: indicates vehicles without EGR

Glow control unit harness-side connector as seen from the terminal side

Vehicles with EGR



Vehicles without EGR

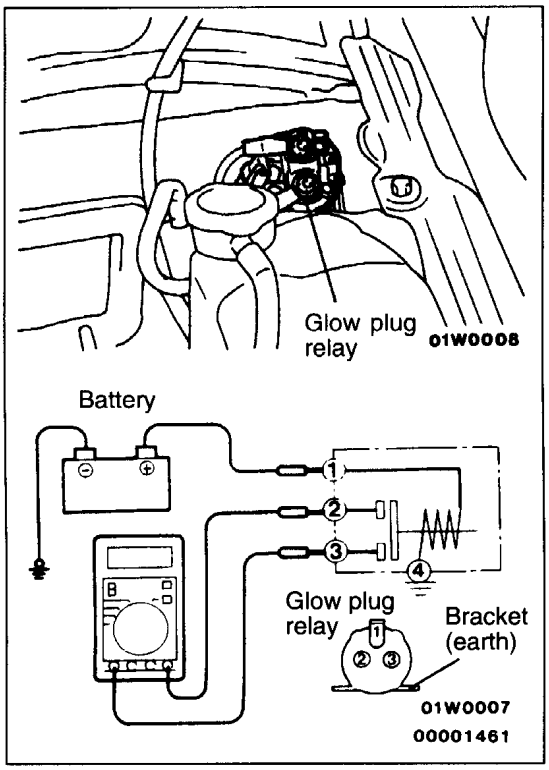


DEN0822

2. Remove the control unit connector and check the continuity between the harness-side connector terminals.

Inspection terminal	Inspection item	Continuity (resistance value)
14–26 7–10*	Glow plug relay	Continuity (approx. 3 Ω)

*: indicates vehicles without EGR

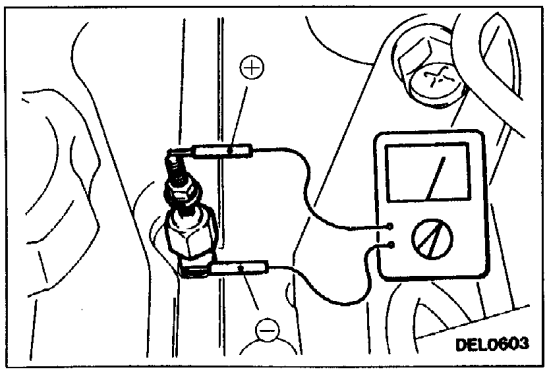


GLOW PLUG RELAY INSPECTION 120002540

1. Check to be sure that there is continuity (approx. 3 Ω) between glow plug relay terminal (1) and the bracket (earth).
2. Use jumper cables to connect terminal (1) of the glow plug relay to the battery (+) terminal and the bracket to the battery (–) terminal.

   Caution
   (1) Always be sure to disconnect the harnesses connected to glow plug relay terminals (2) and (3) before using the jumper cables.
   (2) The terminals of the disconnected harnesses must not be shorted to earth.
   (3) 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.
3. Check the continuity between glow plug relay terminals (2) and (3) while disconnecting and connecting the jumper cable at the battery (+) terminal.

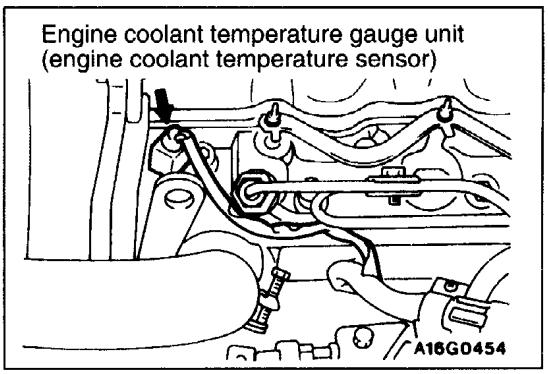
Jumper cable at battery (+) terminal	Continuity between terminals (2) – (3)
Connected	Continuity (0.01 Ω or less)
Disconnected	No continuity (∞ Ω)



GLOW PLUG INSPECTION 120001418

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

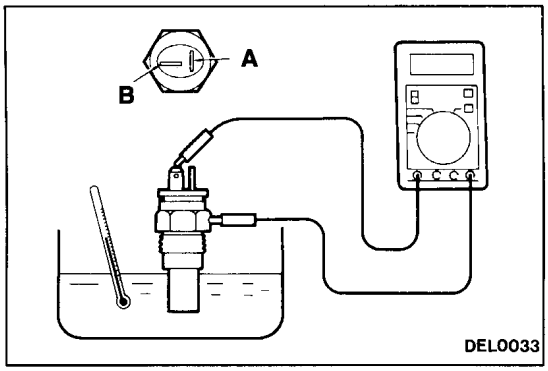
   Standard value: 0.4–0.6 Ω (at 20°C)



ENGINE COOLANT TEMPERATURE SENSOR INSPECTION

120001419

1. Remove the engine coolant temperature sensor.



2. While the sensor section of the engine coolant temperature sensor is submerged, measure the resistance between (B) terminal and the body.

Temperature (°C)	Resistance value (kΩ)
0	8.6
20	3.25±0.33
40	1.5
80	0.3

3. After applying specified sealant to the threaded portion, tighten to the specified torque.

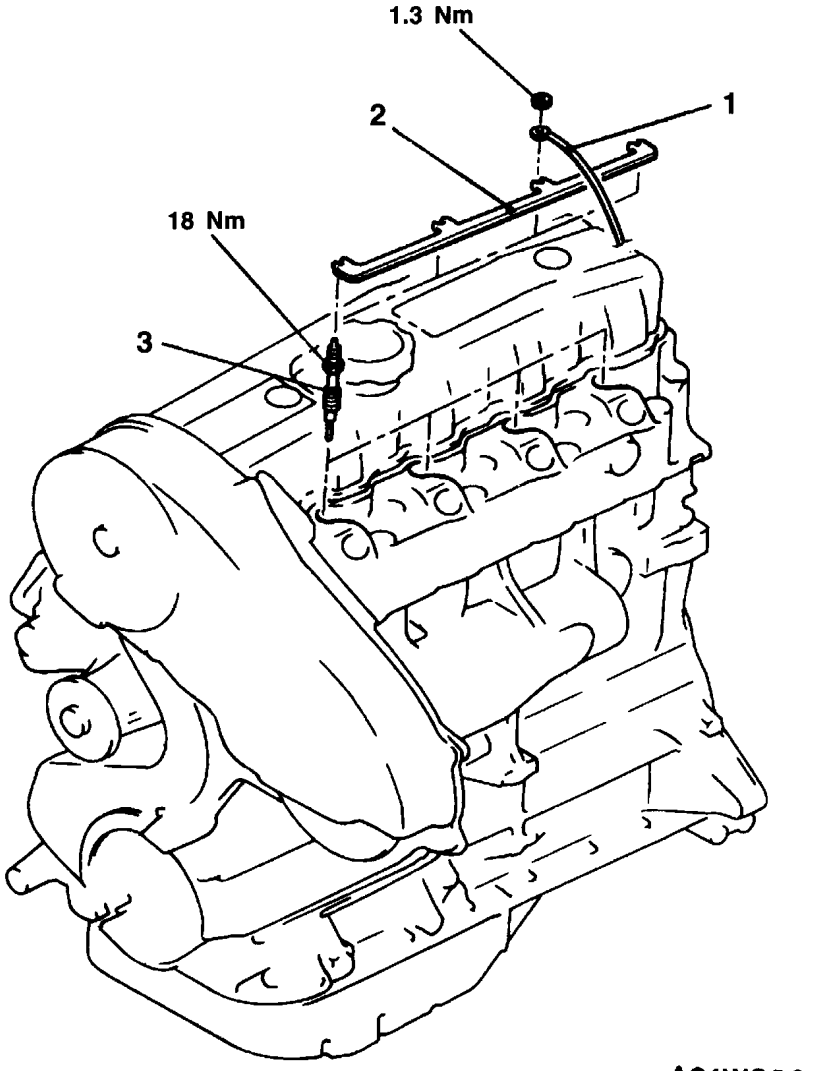
   Specified sealant: 3M Nut Locking Part No. 4171 or equivalent

   Tightening torque: 35 Nm

GLOW PLUG

120002182

REMOVAL AND INSTALLATION



Removal steps

1. Connector connection
2. Glow plug plate

◀A▶ 3. Glow plug

REMOVAL SERVICE POINT

◀A▶ GLOW PLUG REMOVAL

Remove glow plug by hand after loosening with tool as its ceramic part is fragile.

INSPECTION

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

Caution
Do not use a plug that has been dropped from a height of 10 cm or more.