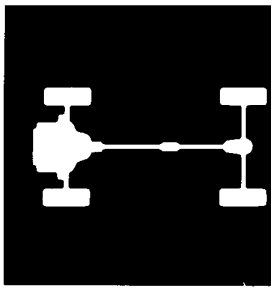
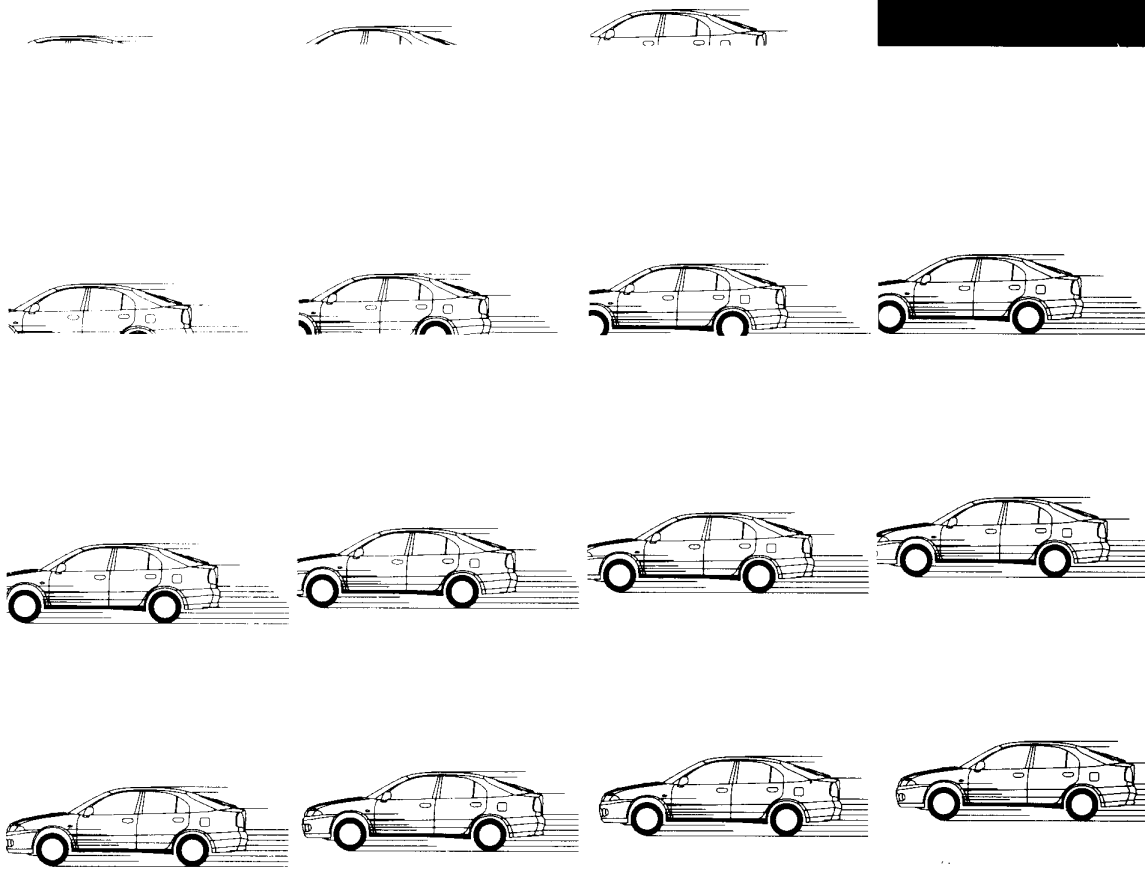
MITSUBISHI MOTORS

Workshop Manual

chassis

CARISMA '98 GDI





Pub. No. PWDE9502-C

CARISMA

WORKSHOP MANUAL
SUPPLEMENT

FOREWORD

This manual outlines changes in servicing procedures related to the chassis including vehicle inspections, adjustments and improvements in the newly equipped models. Use the following manuals in combination with this manual as required.

TECHNICAL INFORMATION MANUAL	
	PYGE95E1
	PYGE95E1-A (Supplement)
	PYGE95E1-B (Supplement)
WORKSHOP MANUAL	
ENGINE GROUP	PWEE□□□□ (Looseleaf edition)
CHASSIS GROUP	PWDE9502
	PWDE9502-A (Supplement)
	PWDE9502-B (Supplement)
ELECTRICAL WIRING	PHDE9501
	PHDE9501-A (Supplement)
	PHDE9501-B (Supplement)
	PHDE9501-C (Supplement)
BODY REPAIR MANUAL	PBGE95E1
	PBGE95E1-A (Supplement)
PARTS CATALOGUE	N606C006D□

All information, illustrations and product descriptions contained in this manual are current as at the time of publication. We, however, reserve the right to make changes at any time without prior notice or obligation.

MITSUBISHI MOTOR SALES
Europe B.V.

GROUP 00
GENERAL

HOW TO USE THIS MANUAL

MODEL INDICATIONS

The following abbreviations are used in this manual for classification of model types.
1800: Indicates models equipped with the 1,834 mℓ <4G93> petrol engine.
MPI: Indicates the multipoint injection, or engines equipped with the multipoint injection.
DOHC: Indicates an engine with the double overhead camshaft, or a model equipped with such an engine.
GDI: Indicates the gasoline direct injection

VEHICLE IDENTIFICATION

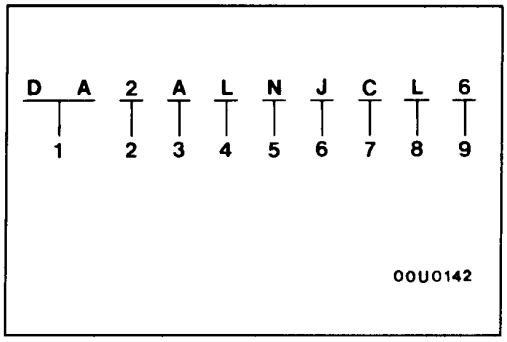
MODELS

<HATCHBACK>

Model code		Engine model	Transmission models	Fuel supply system
DA2A	LNPCL6/R6	4G93-DOHC-GDI (1834 mℓ)	F5M42 (2WD – 5M/T)	GDI
	LNJCL6/R6			
	LNDCL6/R6			
	LRPCL6/R6		F4A42 (2WD – 4A/T)	
	LRJCL6/R6			
	LRDCL6/R6			

<SEDAN>

Model code		Engine model	Transmission models	Fuel supply system
DA2A	SNPCL6/R6	4G93-DOHC-GDI (1834 mℓ)	F5M42 (2WD – 5M/T)	GDI
	SNJCL6/R6			
	SNDCL6/R6			
	SRPCL6/R6		F4A42 (2WD – 4A/T)	
	SRJCL6/R6			
	SRDCL6/R6			

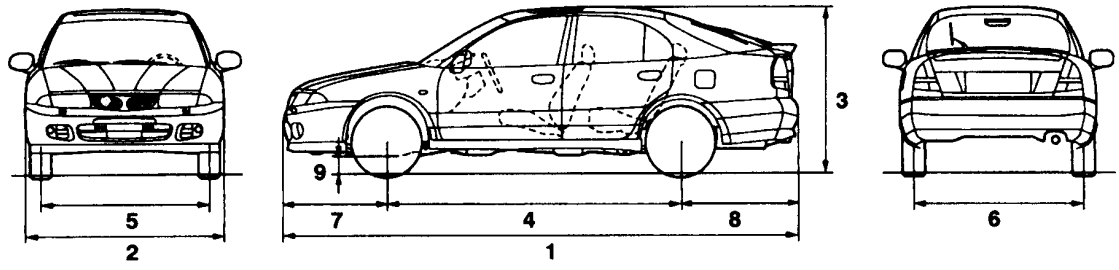


MODEL CODE

No.	Items	Contents
1	Development	DA: MITSUBISHI CARISMA
2	Engine type	2: 1,834 mℓ petrol engine
3	Sort	A: Passenger car
4	Body style	S: 4-door sedan
		L: 5-door hatchback
5	Transmission type	N: 5-speed manual transmission
		R: 4-speed automatic transmission
6	Trim level	D: L
		J: LX
		P: LS
7	Specified engine feature	C: MPI-DOHC-GDI
8	Steering wheel location	L: Left hand
		R: Right hand
9	Destination	6: For Europe

MAJOR SPECIFICATIONS

HATCHBACK



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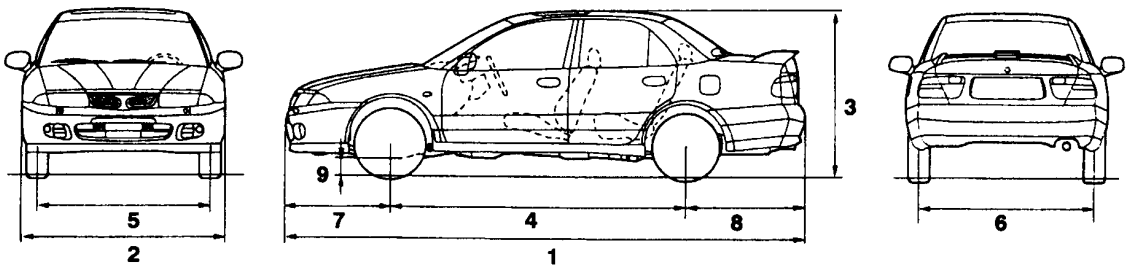
<DA2A>

Items			DA2A LNPCL6, LNPCR6	DA2A LNJCL6, LNJCR6	DA2A LNDCL6, LNDCR6	DA2A LRPCL6, LRPCR6	DA2A LRJCL6, LRJCR6	DA2A LRDCL6, LRDCR6
Vehicle dimensions mm	Overall length	1	4,435	4,435	4,435	4,435	4,435	4,435
	Overall width	2	1,695	1,695	1,695	1,695	1,695	1,695
	Overall height (unladen)	3	1,405	1,405	1,405	1,405	1,405	1,405
	Wheelbase	4	2,550	2,550	2,550	2,550	2,550	2,550
	Track-front	5	1,455	1,455	1,455	1,455	1,455	1,455
	Track-rear	6	1,475	1,475	1,475	1,475	1,475	1,475
	Overhang-front	7	880	880	880	880	880	880
	Overhang-rear	8	1,005	1,005	1,005	1,005	1,005	1,005
	Ground clearance (unladen)	9	155	155	155	150	150	150
Vehicle weight kg	Kerb weight		1,185	1,165	1,160	1,250	1,185	1,180
	Max. gross vehicle weight rating		1,625	1,620	1,615	1,645	1,640	1,635
	Max. axle weight rating-front		851	846	846	876	871	871
	Max. axle weight rating-rear		774	774	769	769	769	764
Seating capacity			5					
Engine	Model No.		4G93					
	Total displacement mℓ		1,834					
Transmission	Model No.		F5M42			F4A42		
	Type		5-speed manual			4-speed automatic		
Fuel system	Fuel supply system		Electronic controlled multipoint fuel injection (MPI)/Gasoline direct injection (GDI)					

SEDAN



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<DA2A>

Items			DA2A SNPCL6, SNPCR6	DA2A SNJCL6 SNJCR6	DA2A SNDCL6, SNDCR6	DA2A SRPCL6 SRPCR6	DA2A SRJCL6, SRJCR6	DA2A SRDCL6 SRDCR6
Vehicle dimensions mm	Overall length	1	4,435	4,435	4,435	4,435	4,435	4,435
	Overall width	2	1,695	1,695	1,695	1,695	1,695	1,695
	Overall height (unladen)	3	1,405	1,405	1,405	1,405	1,405	1,405
	Wheelbase	4	2,550	2,550	2,550	2,550	2,550	2,550
	Track-front	5	1,455	1,455	1,455	1,455	1,455	1,455
	Trakt-rear	6	1,475	1,475	1,475	1,475	1,475	1,475
	Overhang-front	7	880	880	880	880	880	880
	Overhang-rear	8	1,005	1,005	1,005	1,005	1,005	1,005
	Ground clearance (unladen)	9	155	155	155	150	150	150
Vehicle weight kg	Kerb weight		1,165	1,145	1,140	1,185	1,165	1,160
	Max. gross vehicle weight rating		1,605	1,600	1,595	1,625	1,620	1,615
	Max. axle weight rating-front		856	851	851	881	876	876
	Max. axle weight rating-rear		749	749	744	744	744	739
Seating capacity			5					
Engine	Model No.		4G93					
	Total displacement mℓ		1,834					
Transmission	Model No.		F5M42			F4A42		
	Type		5-speed manual			4-speed automatic		
Fuel system	Fuel supply system		Electronic controlled multipoint fuel injection (MPI)/Gasoline direct injection (GDI)					

ENGINE

CONTENTS

GENERAL INFORMATION

Items			4G93
Total displacement mℓ			1,834
Bore × Stroke mm			81.0 ×89.0
Compression ratio			12.5
Combustion chamber			Pentroof + ball-in-piston
Camshaft arrangement			DOHC
Number of valve	Intake		8
	Exhaust		8
Valve timing	Intake	Opening	BTDC 15°
		Closing	ABDC 56°
	Exhaust	Opening	BBDC 55°
		Closing	ATDC 15°
Fuel system			Electronically controlled multipoint fuel injection
Rocker arm			Roller type
Auto-lash adjuster			Equipped

SERVICE SPECIFICATIONS

Items			Standard value	Limit
Alternator drive belt tension	Vibration frequency Hz	When checked	151–195	–
		When a used belt is installed	163–185	–
		When a new belt is installed	195–230	–
	Tension N	When checked	294–490	–
		When a used belt is installed	343–441	–
		When a new belt is installed	490–686	–
	Deflection (Reference value) mm	When checked	8.0–10.5	–
		When a used belt is installed	8.5–10.0	–
		When a new belt is installed	7.0–8.0	–
Power steering oil pump and A/C compressor drive belt tension	Tension N	When checked	392–588	–
		When a used belt is installed	441–539	–
		When a new belt is installed	637–833	–
	Deflection mm	When checked	10.0–12.0	–
		When a used belt is installed	10.0–11.0	–
		When a new belt is installed	7.0–9.0	–
Basic ignition timing			5° BTDC ± 3°	–
Ignition timing			Approx. 16°BTDC	–

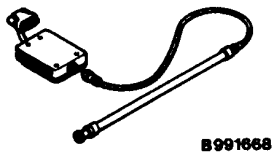
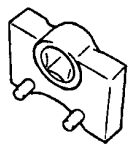
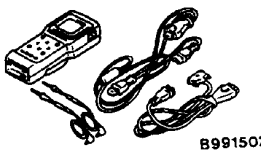
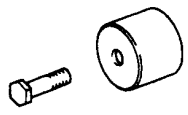
Items		Standard value	Limit
Idle speed r/min	M/T	600 ± 50 – 800 ± 50*	–
	A/T	650 ± 50	–
CO contents %		0.5 or less	–
HC contents ppm		100 or less	–
Compression pressure kPa – r/min		1,569 – 300	1,334 – 300
Compression pressure difference of all cylinder kPa		–	Max. 100
Intake manifold vacuum kPa		–	Min. 37
Cylinder head bolt shank length mm		–	99.4
Timing belt tension torque Nm (Reference value)		2.5	–
Auto-tensioner rod protrusion amount mm		3.8 – 4.5	–

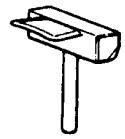
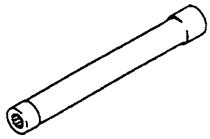
*: Varies depending on the transmission oil temperature. For details, refer to P. 11A-9.

SEALANTS

Items	Specified sealants	Remarks
Oil pan Thermostat case Cam position sensor support	MITSUBISHI GENUINE PART MD970389 or equivalent	Semi-drying sealant

SPECIAL TOOLS

Tool	Number	Name	Use
	MB991668	Belt tension meter set	Measuring the drive belt tension (used together with the MUT-II)
	MD998767	Tension pulley socket wrench	Timing belt tension adjustment
	MB991502	MUT-II sub assembly	• Measuring the drive belt tension • Checking the ignition timing • Checking the idle speed • Erasing diagnosis code
	MD998713	Camshaft oil seal installer	Press-in of the camshaft oil seal

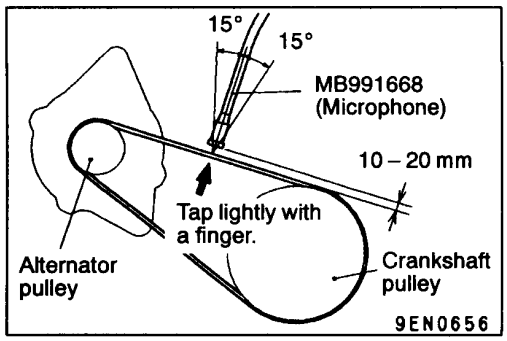
Tool	Number	Name	Use
	MD998727	Oil pan remover	Removal of oil pan
	MB991653	Cylinder head bolt wrench	Cylinder head bolt removal and installation

ON-VEHICLE SERVICE

DRIVE BELT TENSION CHECK AND ADJUSTMENT

ALTERNATOR DRIVE BELT TENSION CHECK

Check the drive belt tension by the following procedure.

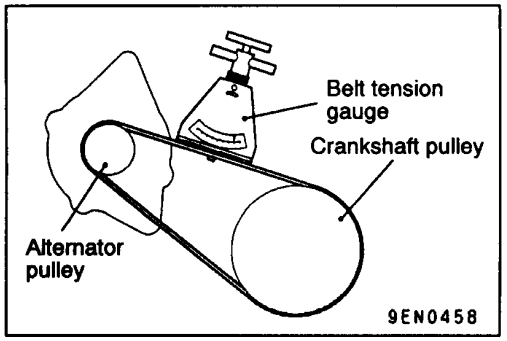


<When using the MUT-II>

1. Connect the special tool (belt tension meter kit) to the MUT-II.
2. Connect the MUT-II to the diagnosis connector.
3. Turn the ignition switch to ON and select "Belt Tension Measurement" from the menu screen.
4. Hold the microphone to the middle of the drive belt between the pulleys (at the place indicated by the arrow), about 10 – 20 mm away from the rear surface of the belt and so that it is perpendicular to the belt (within an angle of ± 15°).
5. Gently tap the middle of the belt between the pulleys (the place indicated by the arrow) with your finger as shown in the illustration, and check that the vibration frequency of the belt is within the standard value.

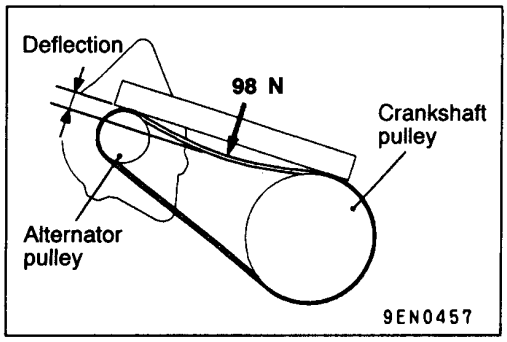
Caution

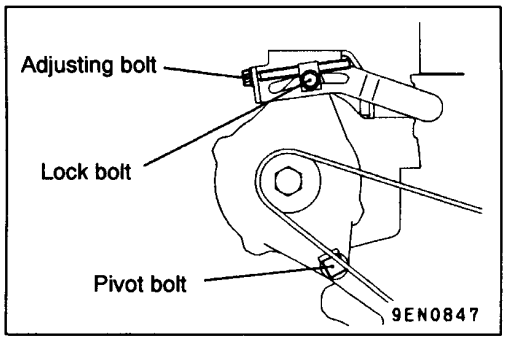
(1) The temperature of the surface of the belt should be as close as possible to normal temperature.
(2) Do not let any contaminants such as water or oil get onto the microphone.
(3) If strong gusts of wind blow against the microphone or if there are any loud sources of noise nearby, the values measured by the microphone may not correspond to actual values.
(4) If the microphone is touching the belt while the measurement is being made, the values measured by the microphone may not correspond to actual values.
(5) Do not take the measurement while the vehicle's engine is running.



<When using a tension gauge>

Use a belt tension gauge to check that the belt tension is within the standard value.





<Belt deflection check>

Apply 98 N of force to the middle of the drive belt between the pulleys (at the place indicated by the arrow) and check that the amount of deflection is within the standard value.

Standard value:

Vibration frequency Hz	151 – 195
Tension N	294 – 490
Deflection (Reference value) mm	8.0 – 10.5

ALTERNATOR DRIVE BELT TENSION ADJUSTMENT

1. Loosen the nut of the alternator pivot bolt.
2. Loosen the lock bolt.
3. Use the adjusting bolt to adjust the belt tension and belt deflection to the standard values.

   Standard value:

Items	When a used belt is installed	When a new belt is installed
Vibration frequency Hz	163 – 185	195 – 230
Tension N	343 – 441	490 – 686
Deflection (Reference value) mm	8.5 – 10.0	7.0 – 8.0

   NOTE
   Refer to P.11A-5 concerning the measurement procedure of the alternator drive belt tension.

4. Tighten the nut of the alternator pivot bolt.

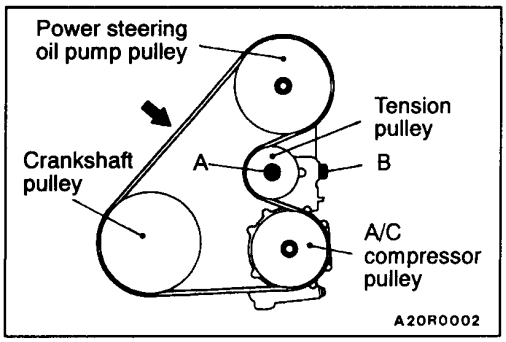
   Tightening torque: 44 Nm

5. Tighten the lock bolt.

   Tightening torque: 22 Nm

6. Tighten the adjusting bolt.

   Tightening torque: 10 Nm



POWER STEERING OIL PUMP AND AIR CONDITIONER COMPRESSOR DRIVE BELT TENSION CHECK AND ADJUSTMENT

1. Check the drive belt tension by the following procedure.

<When using the MUT-II>

Gently tap the middle of the belt between the pulleys (the place indicated by the arrow) with your finger as shown in the illustration, and check that the vibration frequency of the belt is within the standard value range.

NOTE
Refer to P.11A-5 for details on the method of measuring the vibration frequency using the MUT-II.

<When using a tension gauge>

Use a belt tension gauge to check that the belt tension is within the standard value.

<Belt deflection check>

Apply 98 N of force to the middle of the drive belt between the pulleys (at the place indicated by the arrow) and check that the amount of deflection is within the standard value.

Standard value:

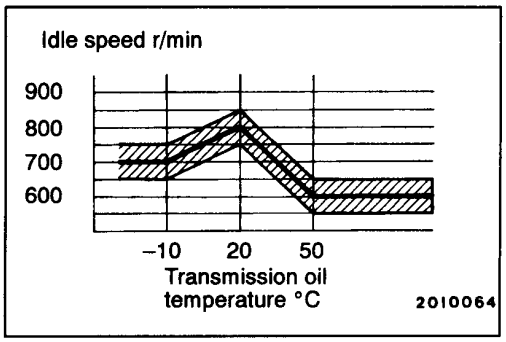
Items	When checked	When a used belt is installed	When a new belt is installed
Vibration frequency Hz	114 – 139	121 – 133	145 – 166
Tension N	392–588	441–539	637–833
Deflection mm	10.0–12.0	10.0–11.0	7.0–9.0

2. If outside the standard value, adjust by the following procedure.
   (1) Loosen the tensioner pulley fixing bolt A.
   (2) Adjust the amount of belt deflection using adjusting bolt B.
   (3) Tighten the fixing bolt A

   Tightening torque: 25 Nm

   (4) Check the belt deflection amount and tension, and readjust if necessary.

   Caution
   Check after turning the crankshaft once or more clockwise (right turn).



IGNITION TIMING CHECK

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Connect the MUT-II to the diagnosis connector.
3. Set up a timing light.
4. Start the engine and run at idle.
5. Check that engine idle speed is within the standard value.

   Standard value:

Items	Idle speed r/min
M/T	600±50 – 800±50*
A/T	650±50

   NOTE
   (1) *: The idle speed in vehicles with manual transmission varies as shown in the table above in accordance with the transmission oil temperature.
   (2) After 4 minutes or more have passed in the idle running condition, the idle speed will become 750 r/min.

6. Select No.17 of the MUT-II Actuator test.

   NOTE
   At this time, the engine speed will become approximately 750 r/min.

7. Check that basic ignition timing is within the standard value.

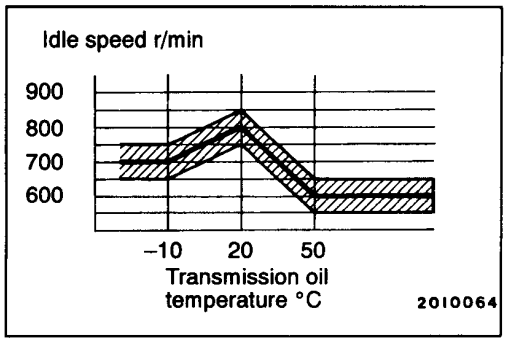
   Standard value: 5° BTDC±3°

8. If the basic ignition timing is outside the standard value, inspect the GDI system while referring to GROUP 13J – Troubleshooting.
9. Press the MUT-II clear key (Select a forced driving cancel mode) to release the Actuator test.

   Caution
   If the test is not cancelled, a forced driving will continue for 27 minutes. Driving under this condition may damage the engine.

10. Check that ignition timing is at the standard value.

    Standard value: approx. 6°BTDC



IDLE SPEED CHECK

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Connect the MUT-II to the diagnosis connector.
3. Check the basic ignition timing.

   NOTE
   Refer to P.11A-8 concerning the check procedure of the basic ignition timing.

   Standard value: 5° BTDC±3°
4. Run the engine at idle for 2 minutes.
5. Check the idle speed. Select item No. 22 and take a reading of the idle speed.

   Standard value:

Items	Idle speed r/min
M/T	600±50 – 800±50*
A/T	650±50

   NOTE
   (1) *: The idle speed in vehicles with manual transmission varies as shown in the table above in accordance with the transmission oil temperature.
   (2) After 4 minutes or more have passed in the idle running condition, the idle speed will become 750 r/min.
   (3) The idle speed is controlled automatically adjusted by the idle speed control (ISC) system.
6. If the idle speed is outside the standard value, inspect the GDI components by referring to GROUP 13J – Troubleshooting.

IDLE MIXTURE CHECK

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Connect the MUT-II to the diagnosis connector.
3. Check that the basic ignition timing is within the standard value.

   NOTE
   Refer to P.11A-8 concerning the check procedure of the basic ignition timing.

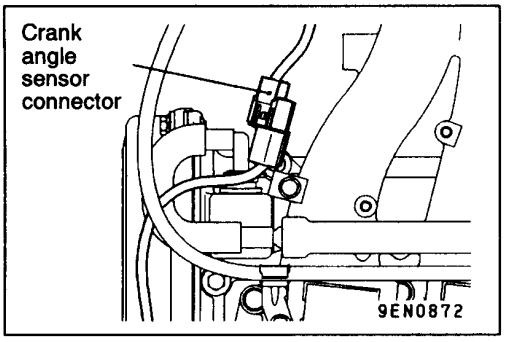
   Standard value: 5° BTDC±3°
4. Run the engine at 2,500 r/min for 2 minutes.
5. Set the CO, HC tester.
6. Check the CO contents and the HC contents at idle.

   NOTE
   This measurement should be performed in less than approximately 4 minutes since the engine speed become the idle speed.

   Standard value
   CO contents: 0.5% or less
   HC contents: 100 ppm or less

7. If there is a deviation from the standard value, check the following items:
   - Diagnosis output
   - Fuel pressure
   - Injector
   - Ignition coil, spark plug
   - Leak in the EGR system and in the EGR control servo
   - Evaporative emission control system
   - Compression pressure

   NOTE
   Replace the three way catalyst when the CO and HC contents are not within the standard value, even though the result of the inspection is normal on all items.



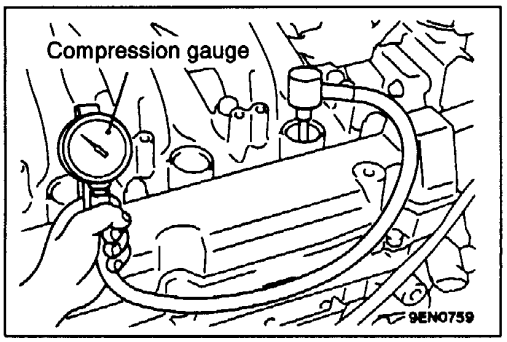
COMPRESSION PRESSURE CHECK

1. Before inspection, check that the engine oil, starter and battery are normal. In addition, set the vehicle to the pre-inspection condition.
2. Remove all of the ignition coils and spark plugs.
3. Disconnect the crank angle sensor connector.

   NOTE
   Doing this will prevent the engine-ECU from carrying out ignition and fuel injection.

4. Cover the spark plug hole with a shop towel etc., and after the engine has been cranked, check that no foreign material is adhering to the shop towel.

   Caution
   (1) Keep away from the spark plug hole when cranking.
   (2) If compression is measured with water, oil, fuel, etc., that has come from cracks inside the cylinder, these materials will become heated and will gush out from the spark plug hole, which is dangerous.



5. Set compression gauge to one of the spark plug holes.
6. Crank the engine with the throttle valve fully open and measure the compression pressure.

   Standard value (at engine speed of 300 r/min):
   1,569 kPa

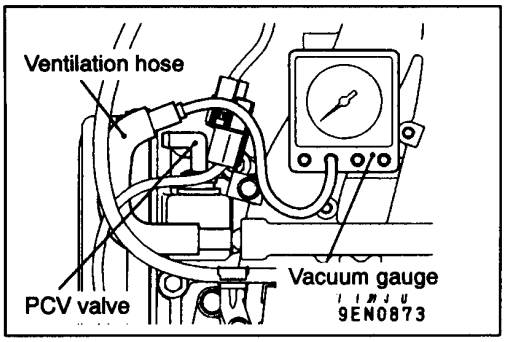
   Limit (at engine speed of 300 r/min):
   Min. 1,334 kPa

7. Measure the compression pressure for all the cylinders, and check that the pressure differences of the cylinders are below the limit.

   Limit: Max. 100 kPa

8. If there is a cylinder with compression or a compression difference that is outside the limit, pour a small amount of engine oil through the spark plug hole, and repeat the operations in steps 6 and 7.
   (1) If the compression increases after oil is added, the cause of the malfunction is a worn or damaged piston ring and/or cylinder inner surface.
   (2) If the compression does not rise after oil is added, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket.
9. Connect the crank angle sensor connector.
10. Install the spark plugs and ignition coils.
11. Use the MUT-II to erase the diagnosis codes.

    NOTE
    This will erase the diagnosis code resulting from the crank angle sensor connector being disconnected.



MANIFOLD VACUUM CHECK

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Connect the MUT-II to the diagnosis connector.
3. Disconnect the ventilation hose from the positive crankcase ventilation (PCV) valve, and then connect a vacuum gauge to the ventilation hose.
4. Check that the idle speed is approximately 600 r/min <M/T> or approximately 650 r/min <A/T>.
5. Check the intake manifold negative pressure while the engine is idling.

   Limit: Min. 37 kPa

LASH ADJUSTER CHECK

If an abnormal noise (knocking) that seems to be coming from the lash adjuster is heard after starting the engine and does not stop, carry out the following check.

NOTE
(1) The abnormal noise which is caused by a problem with the lash adjusters is generated after the engine is started, and will vary according to the engine speed. However, this noise is not related to the actual engine load.
Because of this, if the noise does not occur immediately after the engine is started, if it does not change in accordance with the engine speed, or if it changes in accordance with the engine load, the source of the noise is not the lash adjusters.
(2) If there is a problem with the lash adjusters, the noise will almost never disappear, even if the engine has been run at idle to let it warm up.
The only case where the noise might disappear is if the oil in the engine has not been looked after properly and oil sludge has caused the lash adjusters to stick.

1. Start the engine.
2. Check that the noise occurs immediately after the engine is started, and that the noise changes in accordance with changes in the engine speed.
If the noise does not occur immediately after the engine is started, or if it does not change in accordance with the engine speed, the problem is not being caused y the lash adjusters, so check for some other cause of the problem. Moreover, if the noise does not change in accordance with the engine speed, the cause of the problem is probably not with the engine. (In these cases, the lash adjusters are normal.)
3. While the engine is idling, check that the noise level does not change when the engine load is varied (for example, by shifting from N → D).
If the noise level changes, the cause of the noise is probably parts striking because of worn crankshaft bearings or connecting rod bearings. (In such cases, the lash adjusters are normal.)
4. After the engine has warmed up, run it at idle and check if any noise can be heard.
If the noise has become smaller or has disappeared, the cause of the noise was probably that oil sludge had caused the lash adjusters to become stuck. If this happens, carry out the following check. If the noise level does not change, go to step 5.
(1) Let the engine cool down sufficiently.
(2) Turn the crankshaft two full revolutions.

(3) Carry out lash adjuster simple check. (Refer to P.11A-14.)
- If any of the rocker arms can be pushed down easily during the lash adjuster simple check, replace the corresponding lash adjusters.
- If the lash adjuster simple check has been carried out but all lash adjusters are normal (if none of the rocker arms could be pushed down easily), check for some other cause of the problem.

NOTE
You can check whether the lash adjusters are normal or not by carrying out a leak-down test. (Refer to the Engine Workshop Manual.)

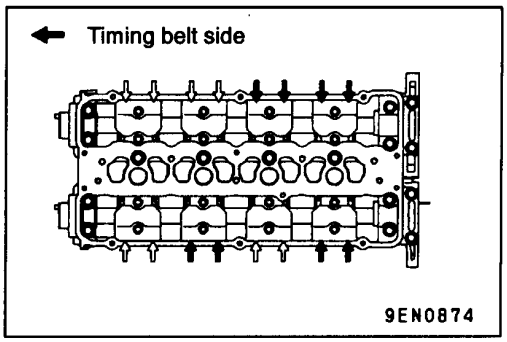
Caution
Make sure that the air has been fully bled before installation of a new lash adjuster. (Refer to the Engine Workshop Manual.)

5. Bleed the air from the lash adjusters. (Refer to P.11A-14.)
6. If the noise does not disappear even after the air has been bled from the lash adjusters, carry out the following check.
   Carry out lash adjuster simple check. (Refer to P.11A-14.)
   - If one of the rocker arms can be pushed down easily during the lash adjuster simple check, replace the corresponding lash adjuster.
   - If two or more of the rocker arms can be pushed down easily during the lash adjuster simple check, the cause may be that the oil passage to the cylinder head is blocked.
     Check for blockages in the oil passage, and clear the blockages if any are found. If there are no blockages, replace the lash adjusters.
   - If the lash adjuster simple check has been carried out but all lash adjusters are normal (if none of the rocker arms could be pushed down easily), check for some other cause of the problem.

   NOTE
   You can check whether the lash adjusters are normal or not by carrying out a leak-down test. (Refer to the Engine Workshop Manual.)

   Caution
   Make sure that the air has been fully bled before installation of a new lash adjuster. (Refer to the Engine Workshop Manual.)

7. Start the engine and check that the abnormal noise has disappeared. If necessary, bleed the air from the lash adjusters. (Refer to P.11A-14.)

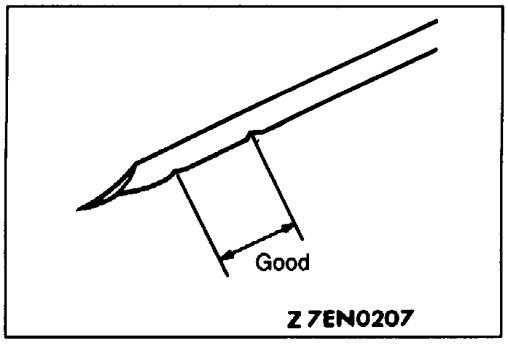


<LASH ADJUSTER SIMPLE CHECK>

1. Stop the engine.
2. Remove the rocker cover.
3. Set the No.1 cylinder to the compression top dead centre position.
4. Check the rocker arms indicated by white arrows in the illustration by the procedures given below.
   Check whether the rocker arm moves downwards when the part of the rocker arm which touches the top of the lash adjuster is pushed.
   - If the rocker arm moves down easily when it is pushed, make a note of which is the corresponding lash adjuster.
   - If the rocker arm feels extremely stiff when it is pushed and does not move down, the lash adjuster is normal, so check for some other cause of the problem.
5. Slowly turn the crankshaft 360° in the clockwise direction.
6. Check the rocker arms indicated by black arrows in the illustration in the same way as explained in step 4.

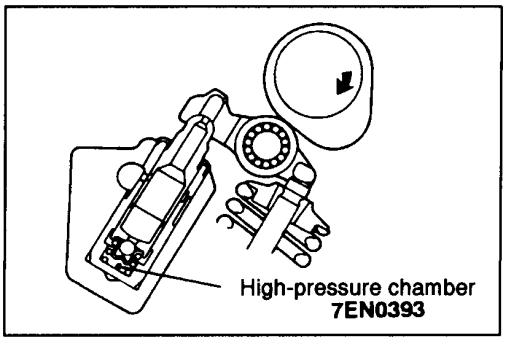
<LASH ADJUSTER AIR BLEEDING>

NOTE
(1) If the vehicle is parked on a slope for a long period of time, the amount of oil inside the lash adjuster will decrease, and air may get into the high pressure chamber when starting the engine.
(2) After parking the vehicle for long periods, the oil drains out of the oil passage, and it takes time for the oil to be supplied to the lash adjuster, so air can get into the high pressure chamber.
(3) If either of the above situations occur, the abnormal noise can be eliminated by bleeding the air from inside the lash adjusters.

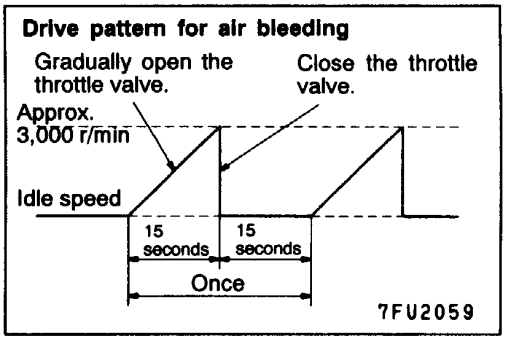


1. Check the engine oil and replenish or replace the oil if necessary.

   NOTE
   (1) If there is a only small amount of oil, air will be drawn in through the oil screen and will get into the oil passage.
   (2) If the amount of oil is greater than normal, then the oil will being mixed by the crankshaft and a large amount of air may get mixed into the oil.
   (3) If the oil is degenerated, air and oil will not separate easily in oil, and the amount of air mixed into the oil will increase.



(4) If the air which has been mixed in with the oil due to any of the above reasons gets into the high pressure chamber of the lash adjuster, the air inside the high pressure chamber will be compressed when the valve is open and the lash adjuster will over-compress, resulting in abnormal noise when the valve closes. This is the same effect as if the valve clearance is adjusted to be too large by mistake. If the air inside the lash adjusters is then released, the operation of the lash adjusters will return to normal.

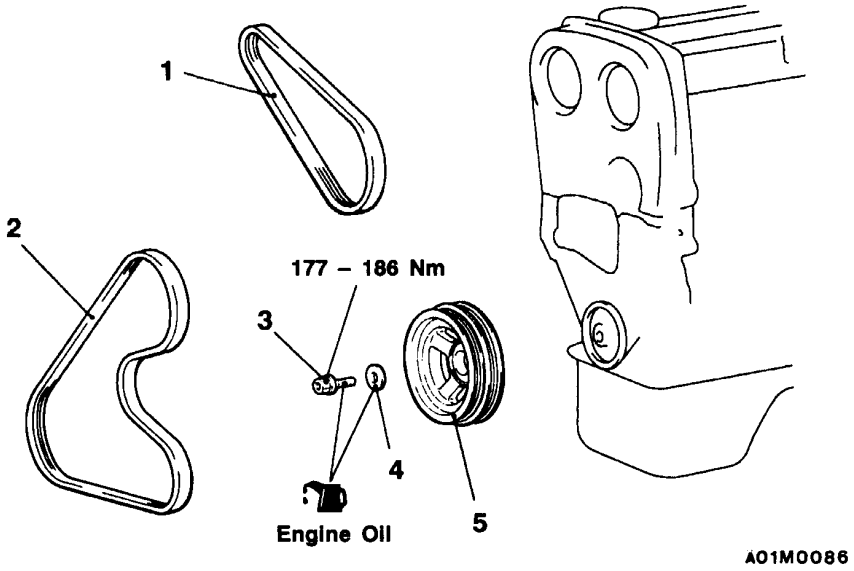


2. Run the engine at idle for 1 – 3 minutes to let it warm up.
3. With no load on the engine, repeat the drive pattern shown in the illustration at left and check if the abnormal noise disappears. (The noise should normally disappear after 10 – 30 repetitions, but if there is no change in the noise level after 30 repetitions or more, the problem is probably not due to air inside the lash adjusters.)
4. After the noise has disappeared, repeat the drive pattern shown in the illustration at left a further 5 times.
5. Run the engine at idle for 1 – 3 minutes and check that the noise has disappeared.

CRANKSHAFT PULLEY

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Under Cover (R.H.) Removal and Installation



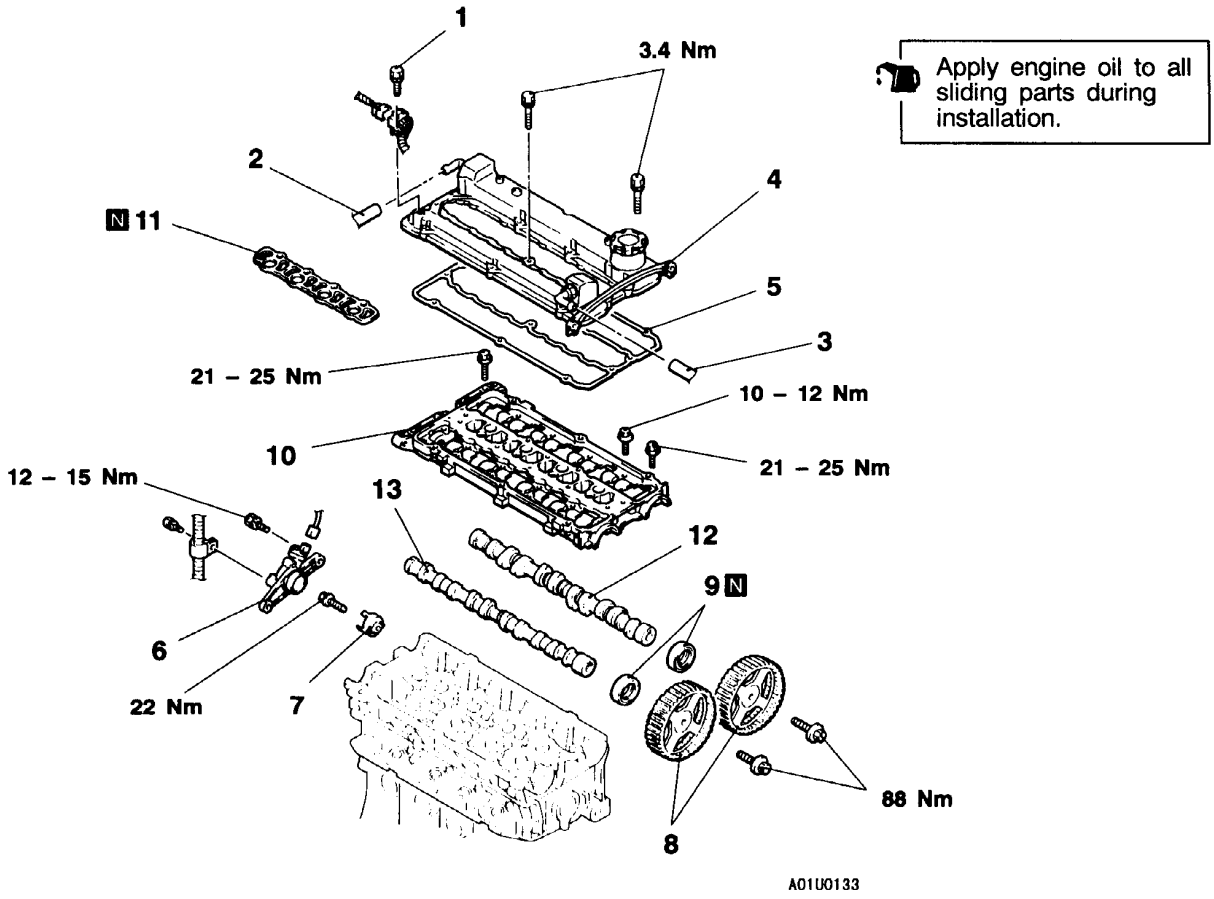
Removal steps
- Drive belt tension adjustment
1. Drive belt (Power steering and A/C)
2. Drive belt (Alternator)
◀A▶ ▶A◀ 3. Crankshaft pulley bolt
4. Crankshaft pulley washer
5. Crankshaft pulley

NOTE
Removal and installation service points are the same as before.

CAMSHAFT AND CAMSHAFT OIL SEAL

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Air Intake Hose Removal and Installation
- Timing Belt Removal and Installation
- Engine Coolant Draining and Supplying
- Intake Manifold Removal and Installation (Refer to GROUP 15.)
- Fuel Pump Removal and Installation
- Drive Belt Tension Adjustment



Removal steps

1. Connector bracket mounting bolt (Injector harness)
2. Breather hose connection
3. PCV hose connection
4. Rocker cover
5. Rocker cover gasket
6. Cam position sensor support
7. Cam position sensing cylinder

◀A▶ ▶D◀ 8. Camshaft sprocket

▶C◀ 9. Camshaft oil seal

▶B◀ 10. Beam camshaft cap

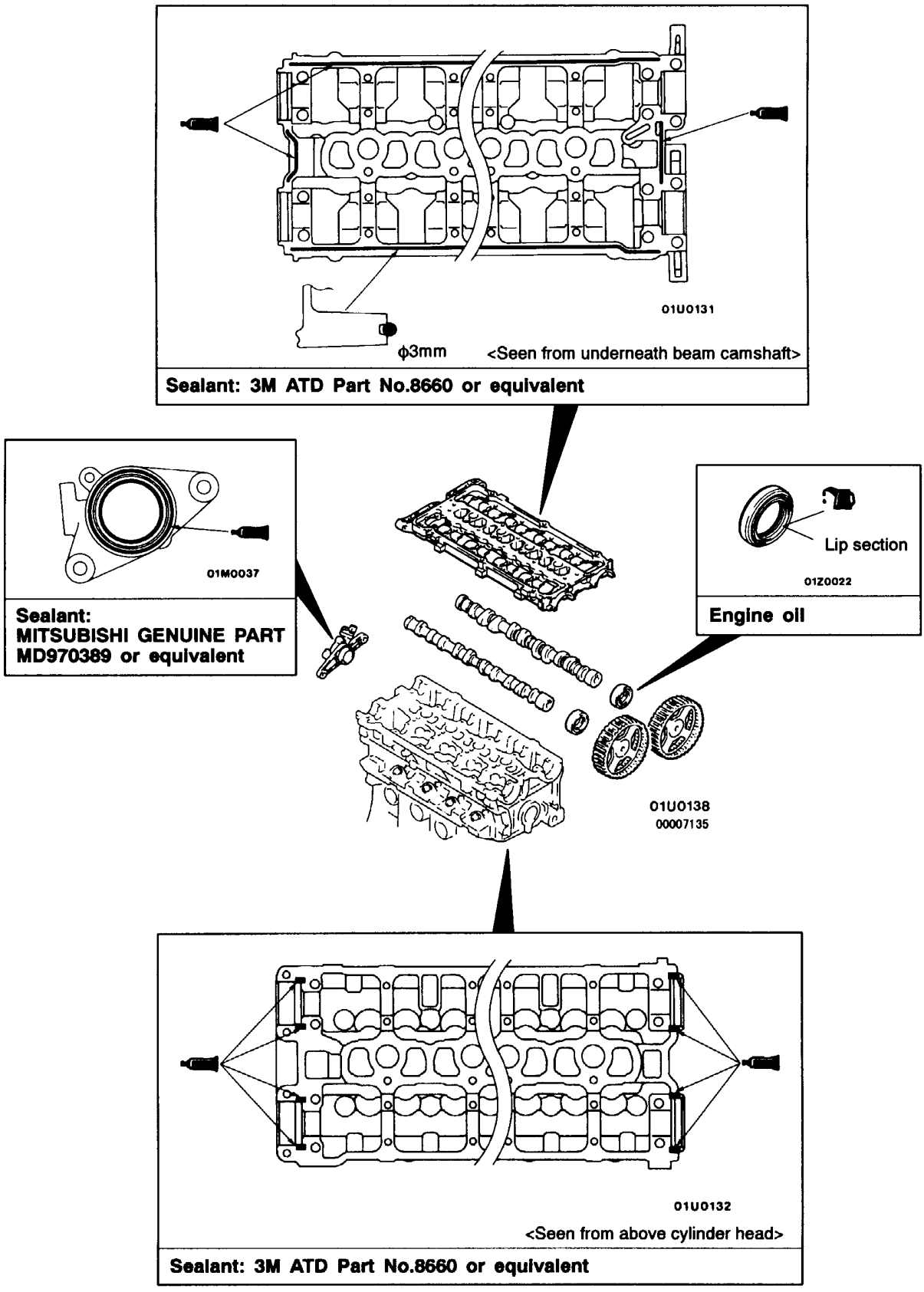
11. Beam camshaft cap gasket

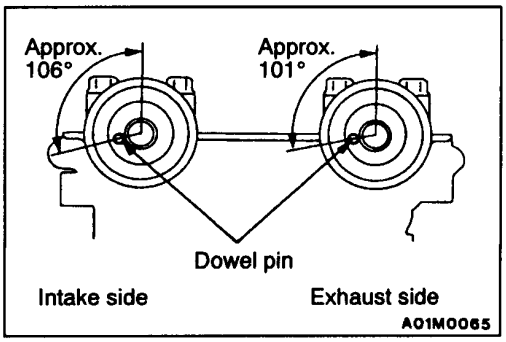
▶A◀ 12. Camshaft (exhaust side)

▶A◀ 13. Camshaft (intake side)

NOTE
Removal and installation service points which are not listed in this manual are the same as before.

Lubrication points

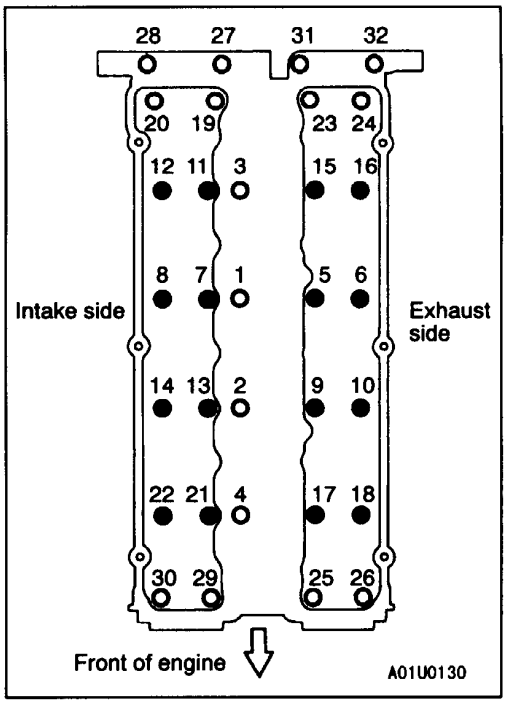




INSTALLATION SERVICE POINTS

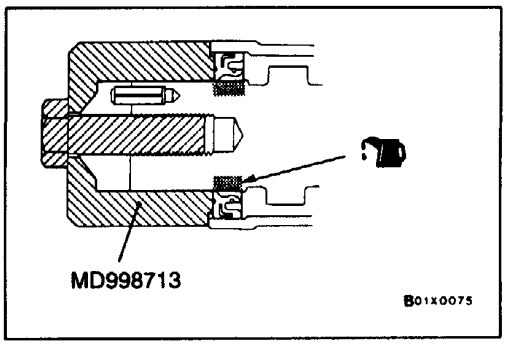
▶B◀ BEAM CAMSHAFT CAP INSTALLATION

1. Place the camshaft dowel pin as shown in the illustration.



2. Tighten the beam camshaft cap mounting bolts to the specified torque in the order shown in the illustration.

Tightening torque:
- ● : **10 – 12 Nm**
- ○ : **21 – 25 Nm**



▶C◀ CAMSHAFT OIL SEAL INSTALLATION

1. Apply engine oil to the entire circumference of the oil seal lip.
2. Press-fit the oil seal as shown in the illustration.

▶D◀ CAMSHAFT SPROCKET INSTALLATION

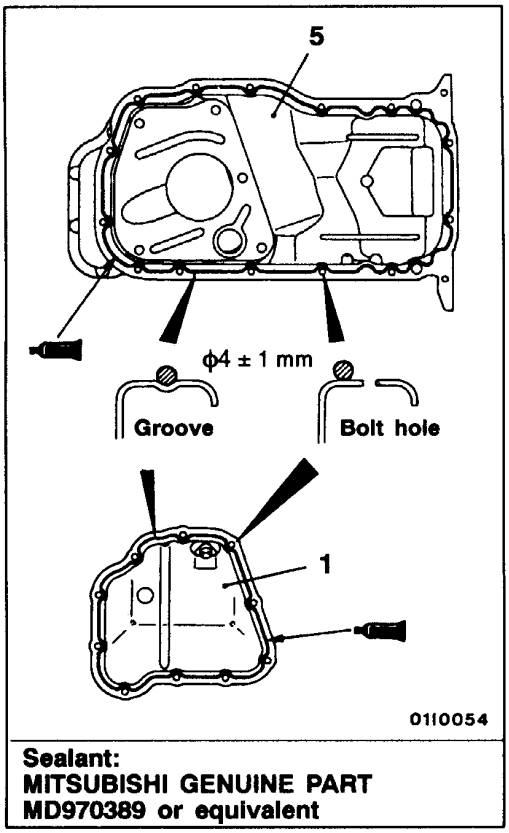
Use the special tool to secure the camshaft sprocket in the same way as during removal, and then tighten the bolt to the specified torque.

Tightening torque: 88 Nm

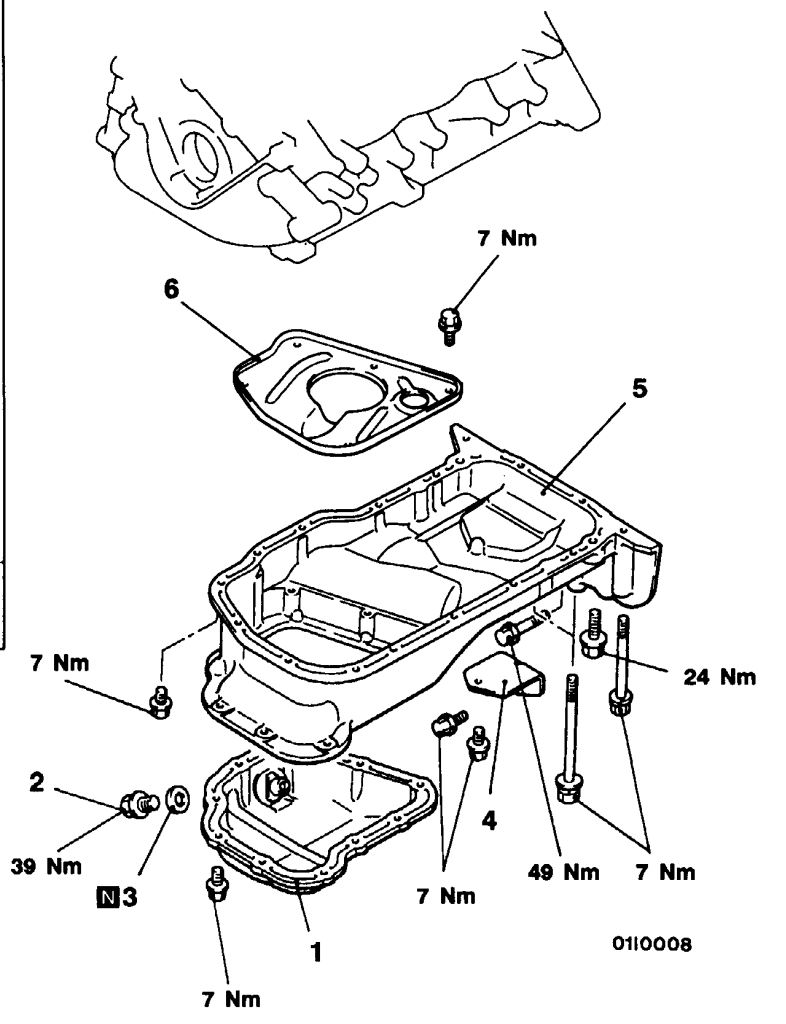
OIL PAN

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Front Exhaust Pipe Removal and Installation (Refer to GROUP 15.)
- Under Cover Removal and Installation
- Engine Oil Level Gauge Removal and Installation
- Engine Oil Draining and Supplying



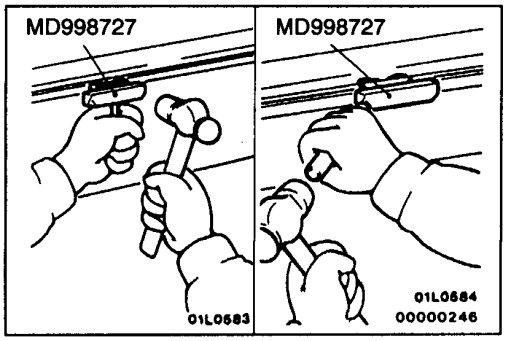
Sealant:
MITSUBISHI GENUINE PART
MD970389 or equivalent



Removal steps

◀A▶ 1. Lower oil pan
2. Drain plug
▶A◀ 3. Gasket
4. Cover
◀B▶ 5. Upper oil pan
6. Baffle plate

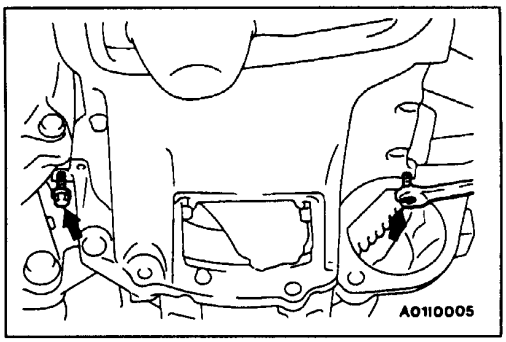
NOTE
Removal and installation service points which are not listed in this manual are the same as before.



REMOVAL SERVICE POINTS

◀A▶ LOWER OIL PAN REMOVAL

Caution
Do not bend the flange of the lower oil pan or damage the upper oil pan.



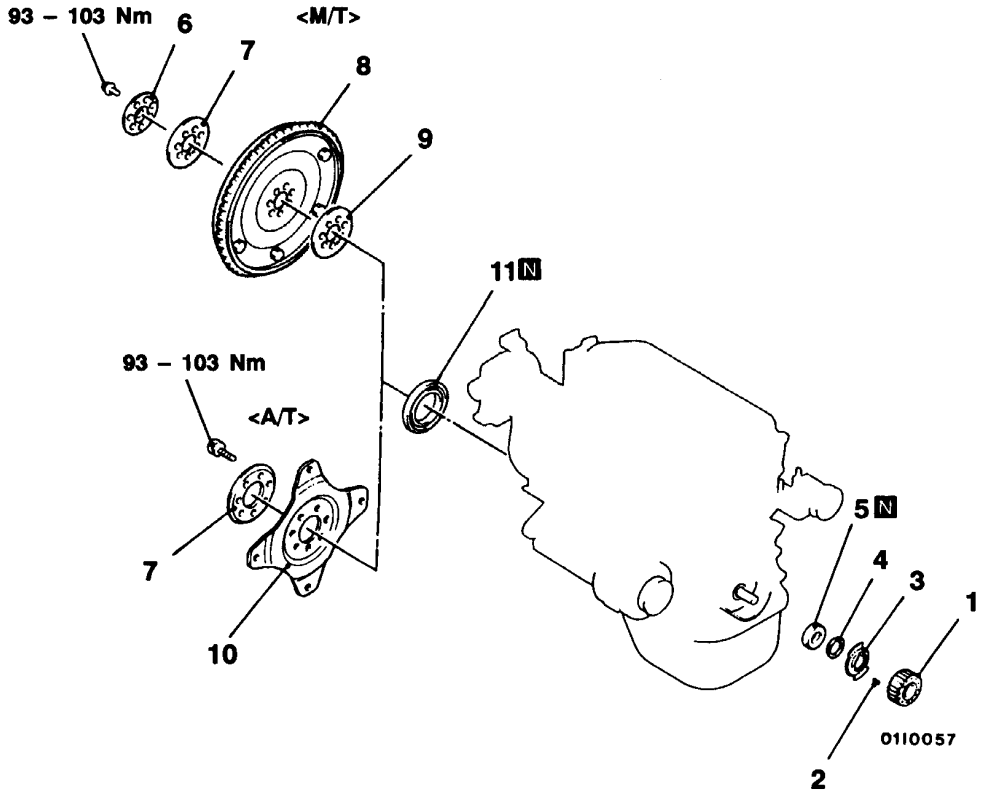
◀B▶ UPPER OIL PAN REMOVAL

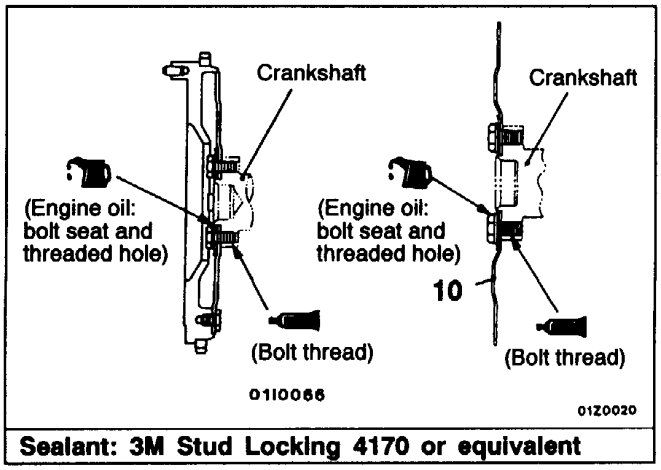
After removing all of the mounting bolts, screw the bolts into the places shown in the illustration and then remove the upper oil pan.

Caution
Because the upper oil pan used is made from aluminium, the oil pan remover (MB998727) should not be used.

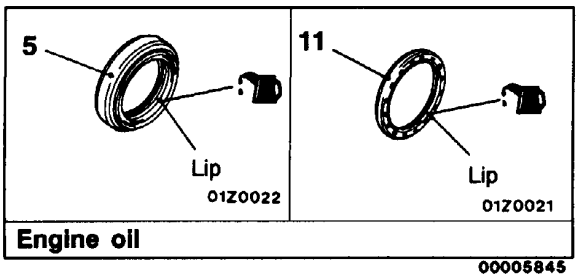
CRANKSHAFT OIL SEAL

REMOVAL AND INSTALLATION





Sealant: 3M Stud Locking 4170 or equivalent



Engine oil

00005845

Crankshaft front oil seal removal steps

- Timing belt (refer to 11A-27.)
- Crank angle sensor

1. Crankshaft sprocket
2. Key
3. Crankshaft sensing blade
4. Crankshaft spacer
5. Crankshaft front oil seal

Crankshaft rear oil seal removal steps

- Transmission assembly
- Clutch cover, disc <M/T>

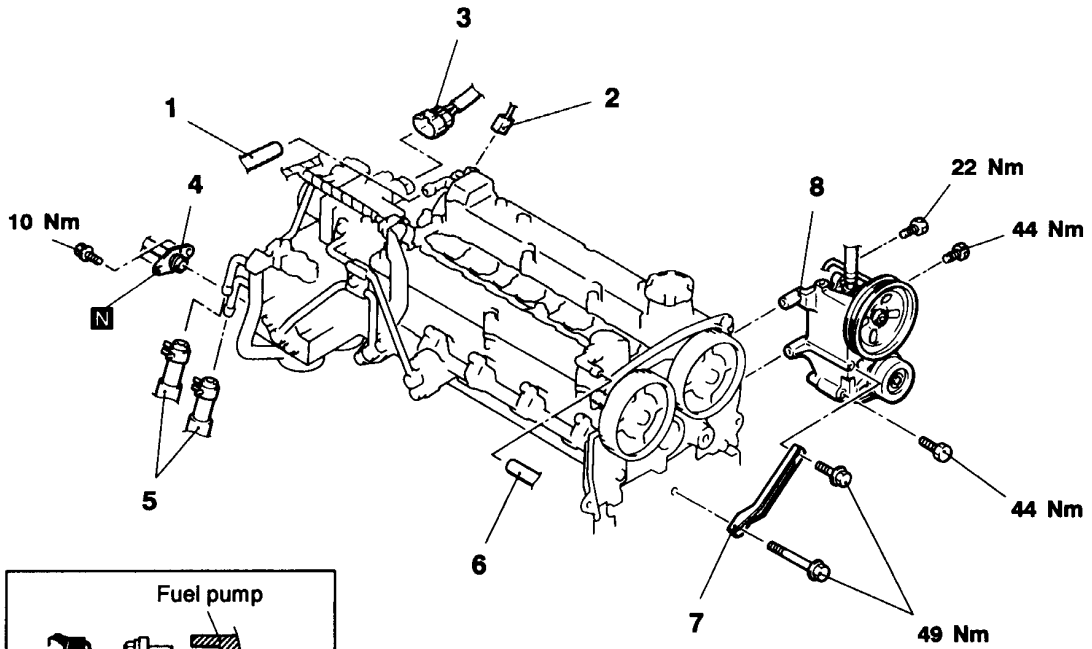
6. Plate <M/T> ◀B▶◀B▶
7. Adapter plate ◀B▶◀B▶
8. Flywheel assembly <M/T> ◀B▶◀B▶
9. Adapter plate <M/T> ◀B▶◀B▶
10. Drive plate <A/T> ◀B▶◀B▶
11. Crankshaft rear oil seal ▶A◀

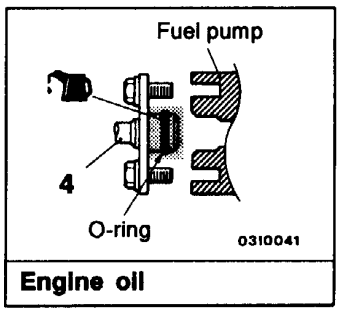
NOTE
Removal and installation service points are the same as before.

CYLINDER HEAD GASKET

REMOVAL AND INSTALLATION

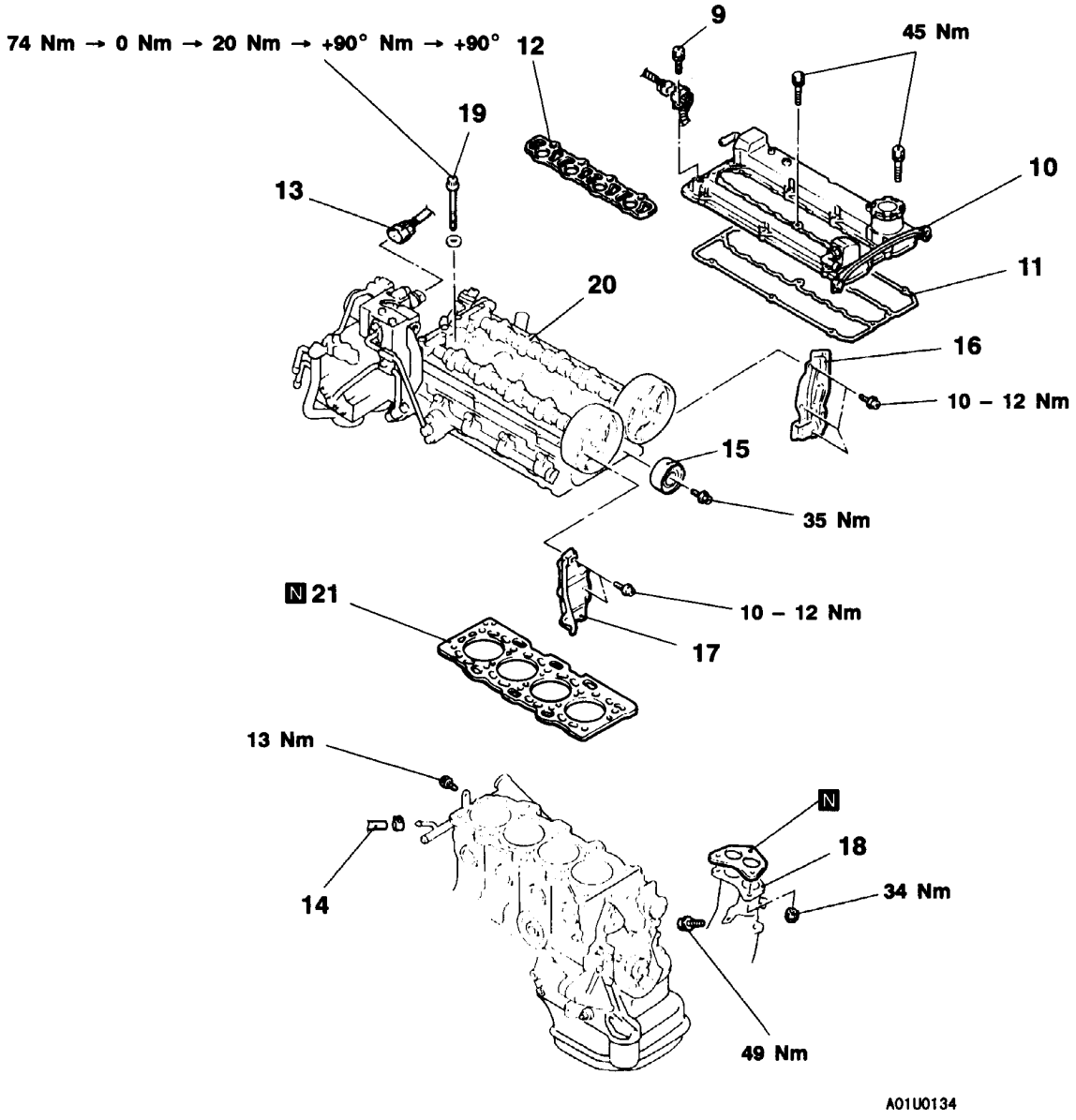
Pre-removal and Post-installation Operation
- Prevention of fuel discharge <before removal only>
- Engine Coolant Draining and Supplying
- Engine Oil Draining and Supplying
- Air Intake Hose Assembly Removal and Installation
- Engine Cover Removal and Installation
- Thermostat Case Assembly Removal and Installation
- Intake Manifold Removal and Installation (Refer to GROUP 15.)
- EGR Pipe Removal and Installation
- Timing Belt Removal and Installation
- Drive Belt Tension Adjustment





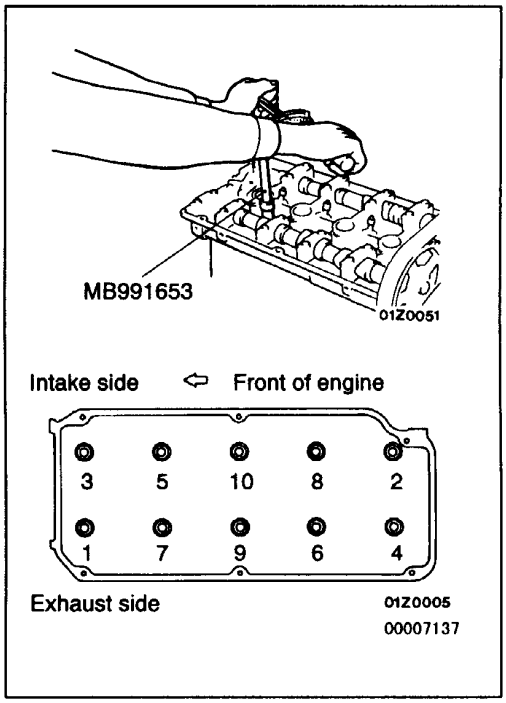
Removal steps

1. Breather hose connection
2. Cam position sensor connector
3. Fuel pump connector
▶C◀ 4. High-pressure fuel hose
5. Fuel return hose
6. PCV hose connection
7. Power steering oil pump bracket stay
◀A▶ 8. Power steering oil pump bracket assembly



9. Connector bracket mounting bolt (injector harness)
10. Rocker cover
11. Rocker cover gasket
12. Beam camshaft cap gasket
13. Engine coolant temperature sensor connector
14. Water hose connection
15. Idler pulley
16. Timing belt rear left cover
17. Timing belt rear right cover
18. Front exhaust pipe connection
◀B▶ ▶B◀ 19. Cylinder head bolt
20. Cylinder head assembly
▶A◀ 21. Cylinder head gasket

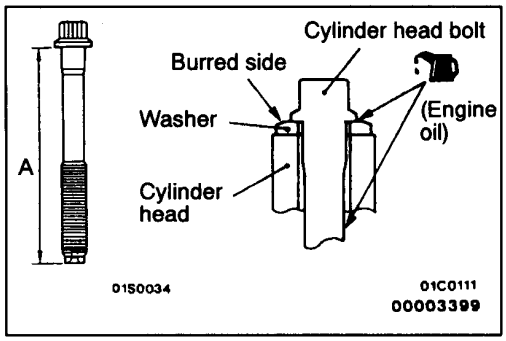
NOTE
Removal and installation service points which are not listed in this manual are the same as before.



REMOVAL SERVICE POINT

◀B▶ CYLINDER HEAD BOLT REMOVAL

Use the special tool to loosen the bolts in two or three stages in the order of the numbers shown in the illustration, and then remove the bolts.



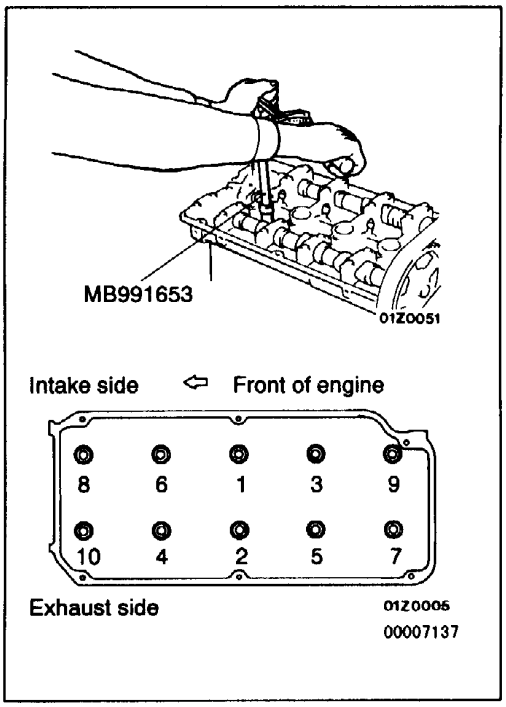
INSTALLATION SERVICE POINT

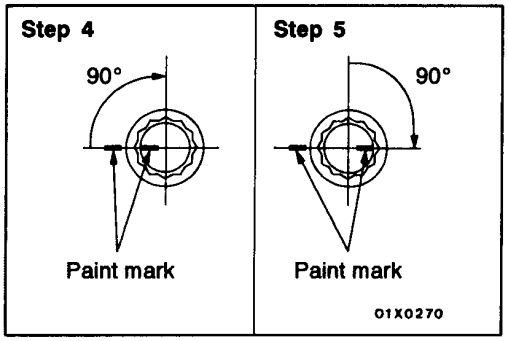
▶B◀ CYLINDER HEAD BOLT INSTALLATION

1. Check that the shank length of the cylinder head bolts are at or below the limit value. If the lengths are above the limit value, replace the bolts with new ones.

   Limit (A): 96.4 mm

2. Install the cylinder head bolt washers so that the burrs caused by tapping the washers are facing upwards.
3. Apply a small amount of engine oil to the threads of the cylinder head bolts and to the washers.
4. Use the special tool to tighten the bolts by the following procedure (over the plastic region).
   (1) Tighten the bolts to 74 Nm in the order shown in the illustration.
   (2) Fully loosen the bolts in the reverse order to the order shown in the illustration.
   (3) Tighten the bolts to 20 Nm in the order shown in the illustration.





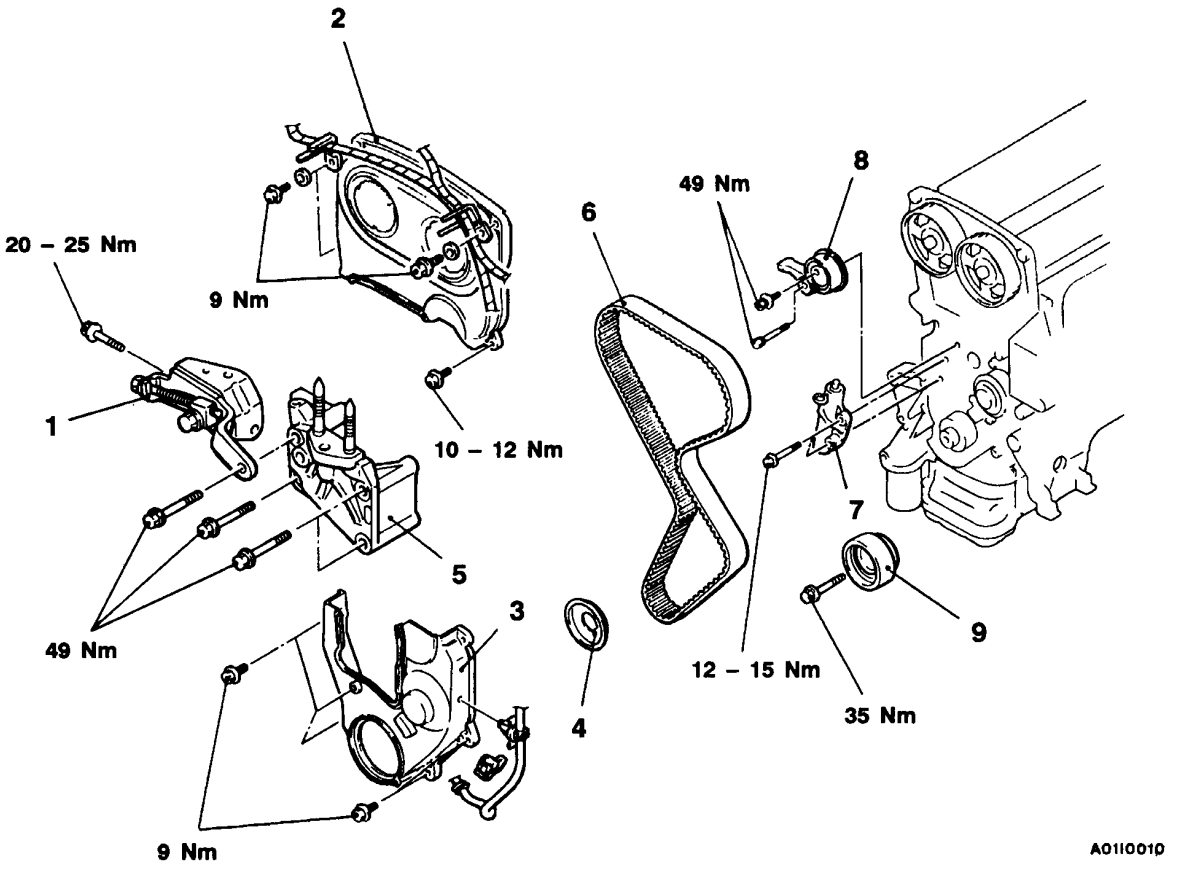
(4) Make paint marks on the heads of the cylinder head bolts and on the cylinder head, and then tighten the bolts a further 90° in the order shown in the illustration.
(5) Tighten the bolts 90° in the order shown in the illustration and check that the paint marks on the bolt heads are in a straight line with the paint marks on the cylinder head.

Caution
(1) If the tightening angle for any bolt is less than 90°, that bolt will not be sufficiently tight.
(2) If it is more than 90°, remove all of the bolts and repeat the procedure from step (1).

TIMING BELT

REMOVAL AND INSTALLATION

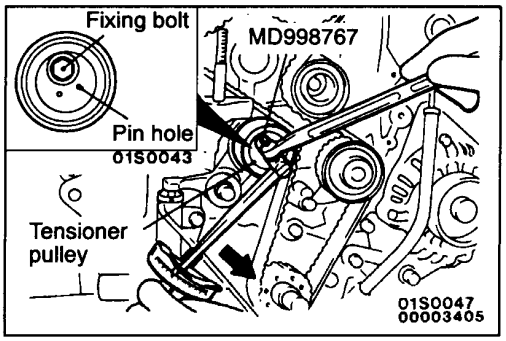
Pre-removal and Post-installation Operation
- Under Cover Removal and Installation
- Crankshaft Pulley Removal and Installation
- Drive Belt Tension Adjustment

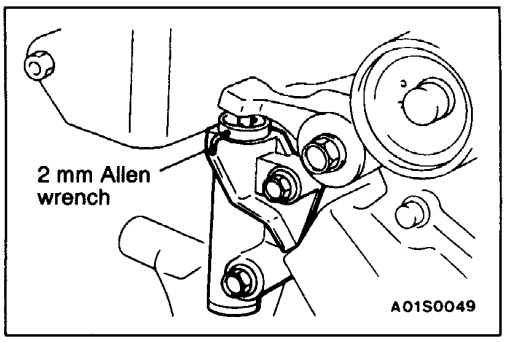


Removal steps

1. Alternator brace
2. Timing belt front upper cover
3. Timing belt front lower cover
4. Front flange
5. Engine support bracket
- ▶C◀ ◀A▶ ▶B◀ Timing belt tension adjustment
6. Timing belt
- ▶A◀ 7. Auto tensioner
8. Tensioner pulley and arm assembly
9. Idler pulley

NOTE
Removal and installation service points are the same as before.





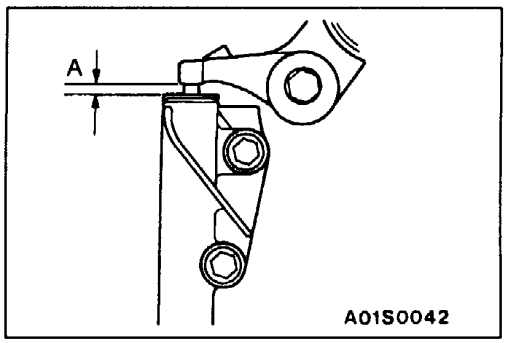
INSTALLATION SERVICE POINT

▶C◀ TIMING BELT TENSION ADJUSTMENT

1. After turning the crankshaft a 1/4 turn anti-clockwise, turn it clockwise to the position where the timing marks are aligned.
2. Loosen the fixing bolt of the tensioner pulley and using the special tool and a torque wrench, apply tension to the timing belt; then tighten the fixing bolt at the specified torque.

   Standard Value:
   2.5 Nm {timing belt tension torque (reference value)}

   Caution
   When tightening the fixing bolt, ensure that the tensioner pulley shaft doesn't rotate with the bolt.
3. Take out the 2 mm Allen wrench from the auto tensioner. At this time, check to be sure that 2 mm Allen wrench can be pulled out easily.
   Turn the crankshaft clockwise 2 turns, and after leaving it in this position for 5 minutes or more, clock again to be sure that the auto tensioner 2 mm Allen wrench can be pulled out or inserted easily.



NOTE
Even if the 2 mm Allen wrench cannot be easily inserted, then it is satisfactory if the amount of protrusion of the auto tensioner rod is within the standard value.

Standard value (A): 3.8 – 4.5 mm

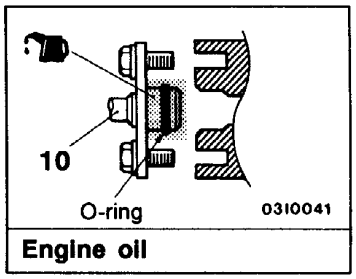
If it is outside the standard value, repeat the operations in step 1 to 4.

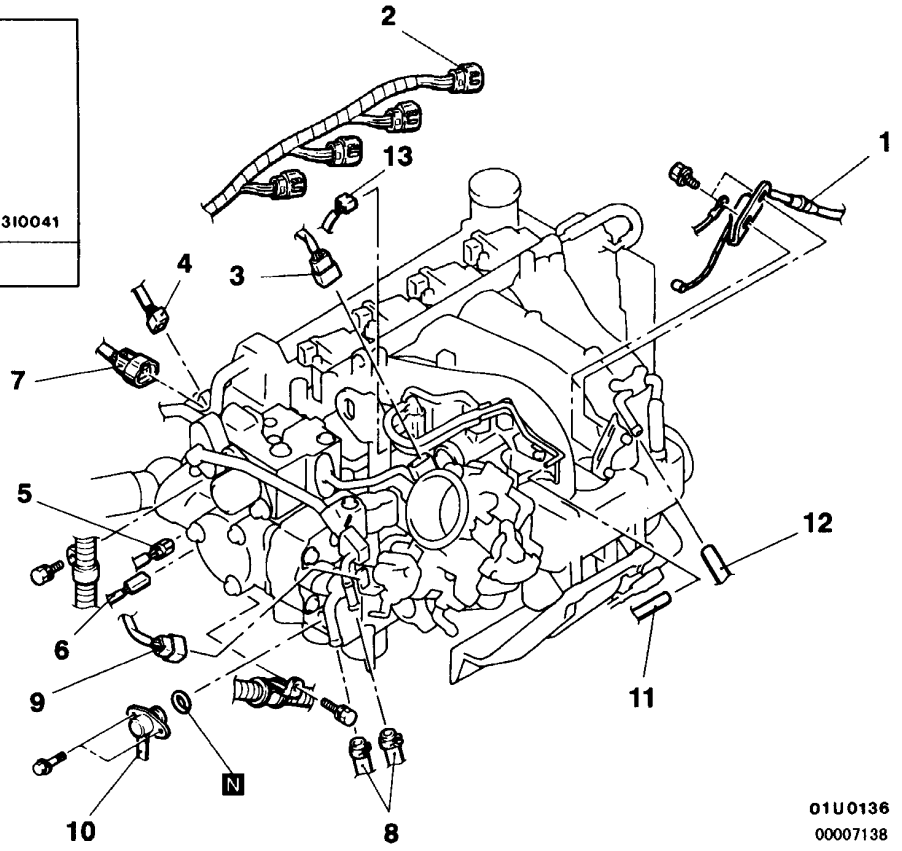
4. Check to be sure that the timing marks on all sprockets are aligned.

ENGINE ASSEMBLY

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Prevention of fuel discharge <before removal only>
- Engine Coolant Draining and Supplying
- Hood Removal and Installation
- Air Intake Hose Assembly Removal and Installation
- Radiator Assembly Removal and Installation
- Engine Cover Removal and Installation
- Under Cover Removal and Installation
- Front Exhaust Pipe Removal and Installation (Refer to GROUP 15.)
- Accelerator Cable Adjustment <after installation only>

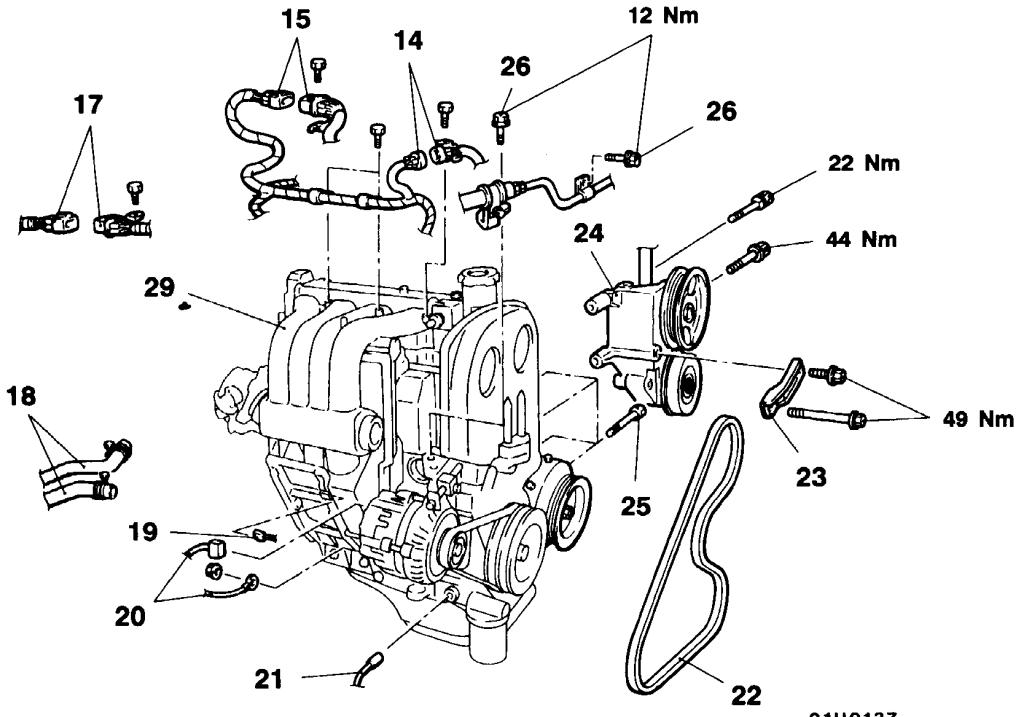


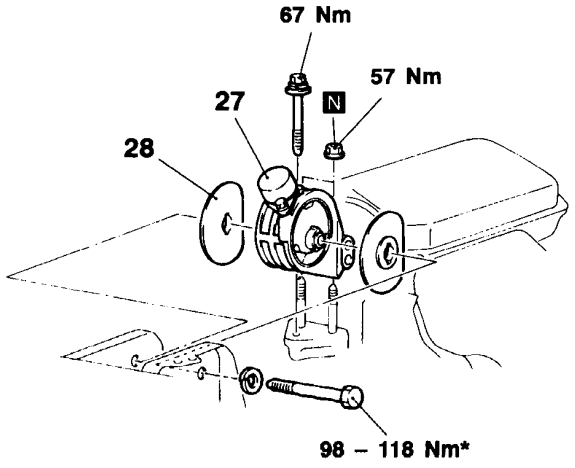


Removal steps
1. Accelerator cable
2. Ignition coil connector
3. Throttle position sensor connector
4. Cam position sensor connector
5. Engine coolant temperature sensor connector
6. Engine coolant temperature gauge unit connector
7. Fuel pump connector
8. Fuel return hose connection
9. ISC connector

▶D◀ 10. High-pressure fuel hose connection

11. Vacuum hose connection
12. Brake booster vacuum hose connection
13. Purge solenoid valve connector





14. Crank angle sensor connector
15. Injector harness connector
16. Purge solenoid valve connector
17. Air by-pass valve harness connector
18. Heater hose connection
19. Oxygen sensor connector
20. Alternator connector
21. Engine oil pressure switch connector
    • Drive belt tension adjustment
22. Drive belt (for power steering oil pump, A/C compressor)
23. Power steering oil pump bracket stay
◀A▶ 24. Power steering oil pump bracket assembly
◀B▶ 25. A/C compressor mounting bolt
26. Oil pressure hose and pipe clamp mounting bolt

◀C▶ • Transmission assembly
◀D▶ ▶C◀ 27. Engine mount bracket
▶B◀ 28. Engine mount stopper
◀E▶ ▶A◀ 29. Engine assembly

Caution
Mounting locations marked by * should be provisionally tightened, and then fully tightened when the vehicle body is supporting the full weight of the engine.

NOTE
Removal and installation service points are the same as before.

FUEL

CONTENTS

NOTE
THE GROUPS MARKED BY ARE NOT IN THIS MANUAL

GROUP 13F
FUEL SUPPLY

GENERAL

OUTLINE OF CHANGES

- Maintenance service procedures have been established for items which are different from before to correspond to the following changes.

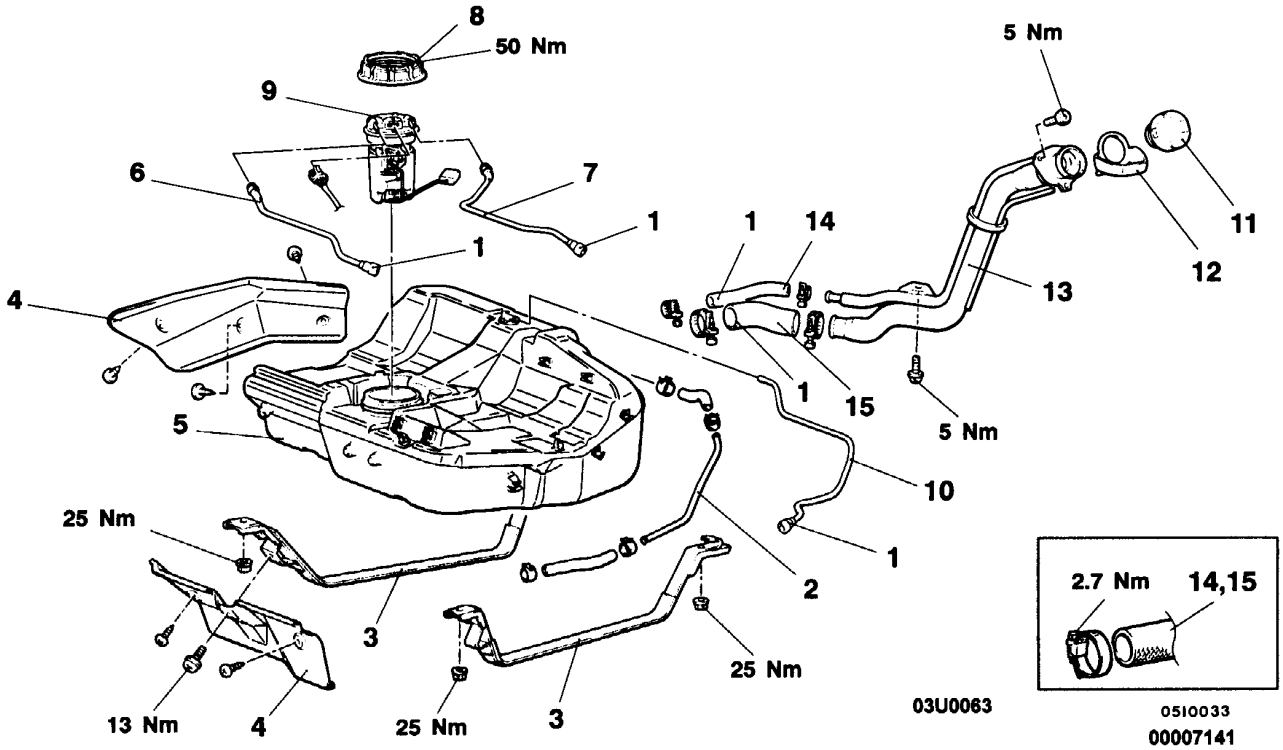
1. Removal and installation of the fuel tank
2. Removal and installation of the fuel filter

FUEL TANK

REMOVAL AND INSTALLATION

Pre-removal Operation
- Fuel Draining
- Reducing the Inner Pressure of Fuel Line and Hose
- Center Exhaust Pipe Removal (Refer to GROUP 15.)

Post-installation Operation
- Center Exhaust Pipe Installation (Refer to GROUP 15.)
- Fuel Refilling
- Fuel Leak Check



Removal steps

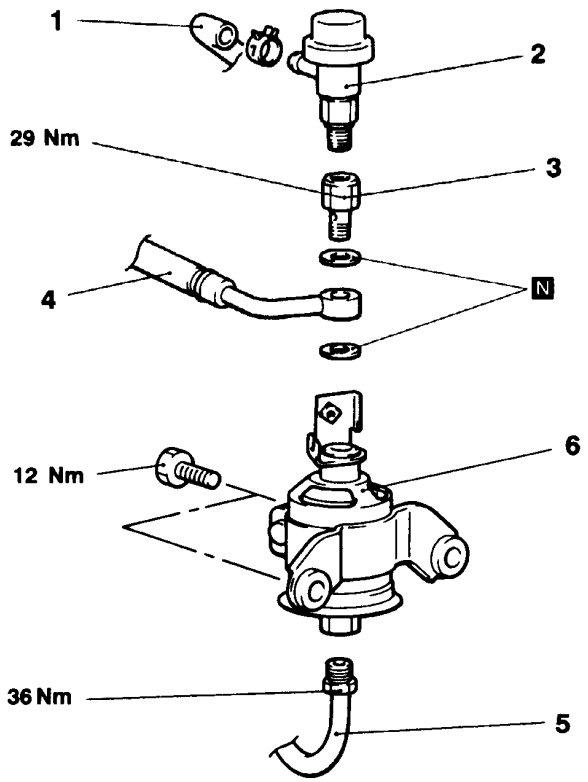
1. Hose connection
2. Fuel return pipe
3. Band
4. Protector
5. Fuel tank assembly
6. Fuel main hose
7. Fuel return hose
▶A◀ 8. Cap
9. Fuel pump module
10. Fuel vapour hose
11. Fuel filler cap
12. Fuel rubber drain
13. fuel neck assembly
14. Leveling hose
15. Filler hose

NOTE
Removal and installation service points are the same as before.

FUEL FILTER

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
Air Cleaner Assembly Removal and Installation



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Removal steps

1. Fuel return hose
2. Fuel pressure regulator
3. Fuel connector
4. Fuel high pressure regulator
5. Fuel main pipe
6. Fuel high pressure filter

GASOLINE DIRECT INJECTION (GDI)

CONTENTS

GENERAL INFORMATION

The Gasoline Direct Injection System consists of sensors which detect the engine conditions, the engine-ECU which controls the system based on signals from these sensors, and actuators which operate under the control of the engine-ECU. The engine-ECU carries out activities such as fuel injection control, idle speed control and ignition timing control. In addition, the engine-ECU is equipped with several diagnosis modes which simplify troubleshooting when a problem develops.

FUEL INJECTION CONTROL

The injector drive times and injector timing are controlled so that the optimum air/fuel mixture is supplied to the engine to correspond to the continually-changing engine operation conditions.

A single injector for each cylinder is mounted at the cylinder head. The fuel is sent under pressure from the fuel tank to the fuel pressure regulator (low pressure) by the fuel pump (low pressure). The pressure is regulated by the fuel pressure regulator (low pressure) and the fuel regulated is then sent to the fuel pump (high pressure). The fuel under increased pressure generated by the fuel pump (high pressure) is then regulated by the fuel pressure regulator (high pressure) and is then distributed to each of the injectors via the delivery pipes.

Fuel injection is normally carried out once for each cylinder for every two rotations of the crankshaft. The firing order is 1-3-4-2. This is called sequential fuel injection.

When the engine is cold or under a severe load, the "open-loop" control keeps the air/fuel ratio at a richer than usual level to maintain driveability. When the engine is under low or medium loads, the air/fuel ratio becomes leaner to reduce fuel consumption. When the engine is running at medium or high loads after having warmed up, the "closed-loop" control uses the signal from the oxygen sensor to keep the air/fuel ratio at the optimum theoretical level.

IDLE AIR CONTROL

The idle speed is kept at the optimum speed by controlling the amount of air that bypasses the throttle valve in accordance with changes in idling conditions and engine load during idling. The engine-ECU drives the idle speed control (ISC) motor to keep the engine running at the pre-set idle target speed in accordance with the engine coolant temperature and air conditioner load. In addition, when the air conditioner switch is turned off and on while the engine is idling, the ISC motor operates to adjust the throttle valve bypass air amount in accordance with the engine load conditions in order to avoid fluctuations in the engine speed.

IGNITION TIMING CONTROL

The power transistor located in the ignition primary circuit turns ON and OFF to control the primary current flow to the ignition coil. This controls the ignition timing in order to provide the optimum ignition timing with respect to the engine operating conditions. The ignition timing is determined by the engine-ECU from the engine speed, intake air volume, engine coolant temperature, atmospheric pressure and injection timing (intake stroke or compression stroke).

SELF-DIAGNOSIS FUNCTION

- When an abnormality is detected in one of the sensors or actuators related to emission control, the engine warning lamp (check engine lamp) illuminates as a warning to the driver.
- When an abnormality is detected in one of the sensors or actuators, a diagnosis code corresponding to the abnormality is output.
- The RAM data inside the engine-ECU that is related to the sensors and actuators can be read by means of the MUT-II. In addition, the actuators can be force-driven under certain circumstances.

OTHER CONTROL FUNCTIONS

1. Fuel Pump Control
   Turns the fuel pump relay ON so that current is supplied to the fuel pump while the engine is cranking or running.
2. A/C Relay Control
   Turns the compressor clutch of the A/C ON and OFF.
3. Fan Relay Control
   The revolutions of the radiator fan and condenser fan are controlled in response to the engine coolant temperature and vehicle speed.
4. Purge Control Solenoid Valve Control
   Refer to GROUP 17.
5. EGR Control Servo Control
   Refer to GROUP 17.

GENERAL SPECIFICATIONS

Items		Specifications
Throttle body	Throttle bore mm	54
	Throttle position sensor	Variable resistor type
	Idle speed control servo	Stepper motor type (Stepper motor type by-pass air control system)
	Idle position switch	Rotary contact type, within throttle position sensor
Engine-ECU	Identification model No.	E2T68374
Sensors	Air flow sensor	Karman vortex type
	Barometric pressure sensor	Semiconductor type
	Intake air temperature sensor	Thermistor type
	Engine coolant temperature sensor	Thermistor type
	Oxygen sensor	Zirconia type
	Vehicle speed sensor	Magnetic resistive element type
	Inhibitor switch	Contact switch type
	Camshaft position sensor	Hall element type
	Crank angle sensor	Hall element type
	Detonation sensor	Piezoelectric type
	Fuel pressure sensor	Metallic membrane type
	Power steering fluid pressure switch	Contact switch type

Items		Specifications
Actuators	Control relay type	Contact switch type
	Fuel pump relay type	Contact switch type
	Injector driver control relay	Contact switch type
	Injector type and number	Electromagnetic type, 4
	Injector identification mark	DIM 1000G
	Air by-pass control solenoid valve (ON/OFF)	ON/OFF type solenoid valve
	Air by-pass control solenoid valve (DUTY)	Duty cycle type solenoid valve
	EGR control servo	Stepper motor type
	Purge control solenoid valve	Duty cycle type solenoid valve
Fuel pressure regulator (low pressure)	Regulator pressure kPa	329
Fuel pressure regulator (high pressure)	Regulator pressure MPa	5

GASOLINE DIRECT INJECTION SYSTEM DIAGRAM

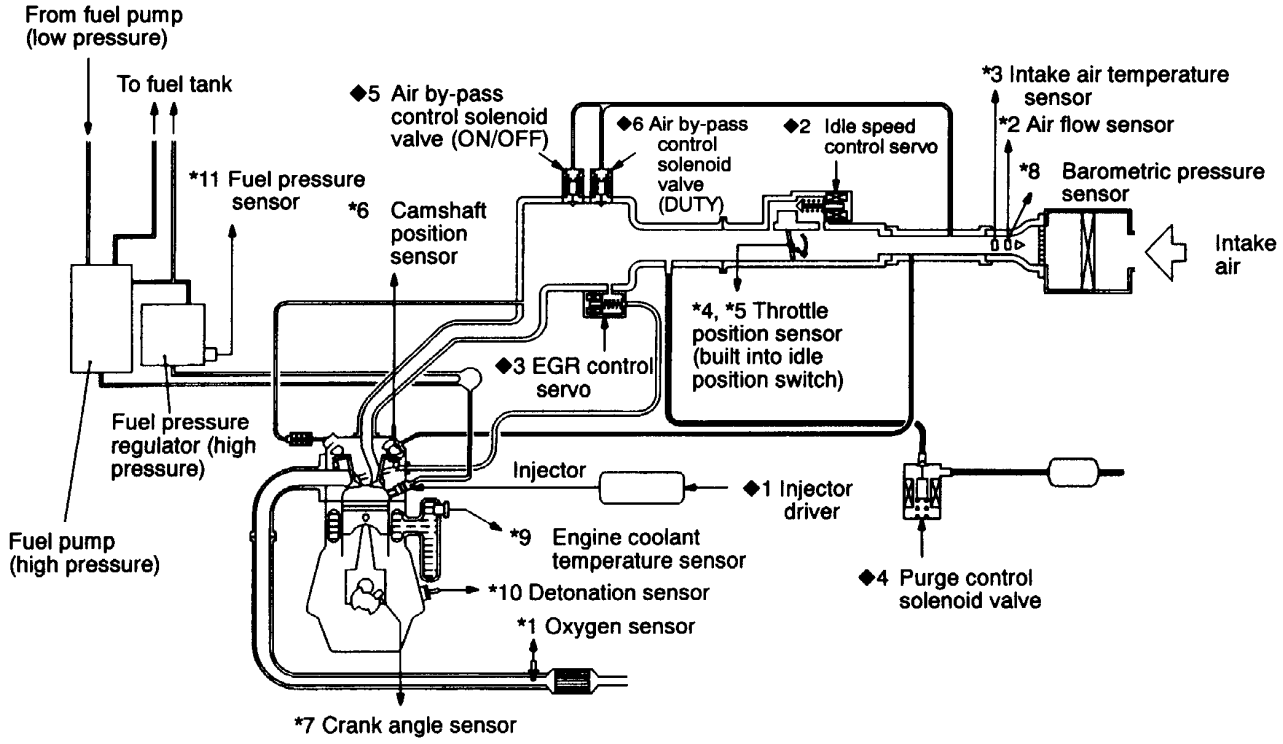
*1 Oxygen sensor
*2 Air flow sensor
*3 Intake air temperature sensor
*4 Throttle position sensor
*5 Idle position switch
*6 Camshaft position sensor
*7 Crank angle sensor
*8 Barometric pressure sensor
*9 Engine coolant temperature sensor
*10 Detonation sensor
*11 Fuel pressure sensor

- Power supply voltage
- Ignition switch – ST
- Ignition switch – IG
- Vehicle speed sensor
- A/C switch
- Inhibitor switch
- Power steering fluid pressure switch
- Alternator FR terminal
- M/T oil temperature sensor
- Electrical load switch
- Brake vacuum sensor
- Stop lamp switch
- Injector open circuit check signal
- A/T-ECU

⇨ Engine-ECU ⇨

◆1 Injector driver (injector)
◆2 Idle speed control servo
◆3 EGR control servo (stepper motor)
◆4 Purge control solenoid valve
◆5 Air by-pass control solenoid valve (ON/OFF)
◆6 Air by-pass control solenoid valve (DUTY)

- Fuel pump relay
- Control relay
- Injector driver control relay
- A/C power relay
- Engine warning lamp
- Diagnosis signal output
- Ignition coil
- Alternator G terminal
- A/T-ECU



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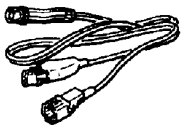
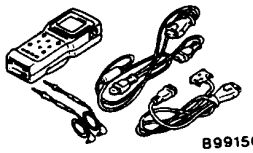
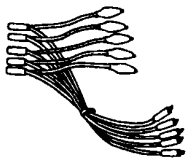
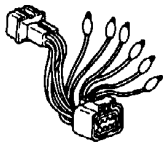
SERVICE SPECIFICATIONS

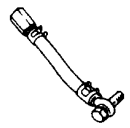
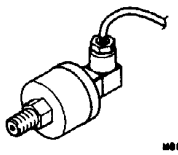
Items		Specifications
Basic idle speed r/min		750±50
Throttle position sensor adjusting voltage mV		400 – 1,000
Throttle position sensor resistance kΩ		3.5 – 6.5
Idle speed control servo coil resistance Ω		28 – 33 (at 20°C)
Intake air temperature sensor resistance kΩ	20°C	2.3 – 3.0
	80°C	0.30 – 0.42
Engine coolant temperature sensor resistance kΩ	20°C	2.1 – 2.7
	80°C	0.26 – 0.36
Oxygen sensor output voltage V		0.6 – 1.0
Fuel pressure	High pressure MPa	4 – 7
	Low pressure kPa	324 – 343
Injector coil resistance Ω		0.9 – 1.1 (at 20°C)
Air by-pass control solenoid valve coil resistance Ω	ON/OFF	7.7 – 9.3 (at 20°C)
	DUTY	7.7 – 9.3 (at 20°C)

SEALANT

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

SPECIAL TOOLS

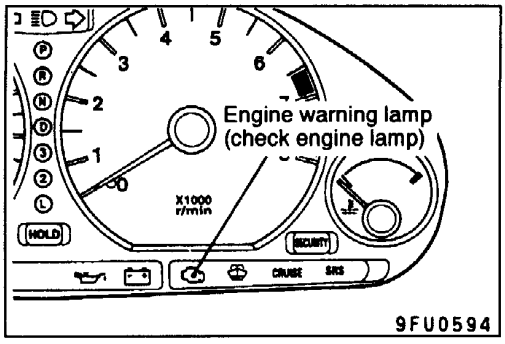
Tool	Number	Name	Use
A  B  C  D  C991223	MB991223 A: MB991219 B: MB991220 C: MB991221 D: MB991222	Harness set A: Test harness B: LED harness C: LED harness adapter D: Probe	• Fuel gauge simple inspection A: Connector pin contact pressure inspection B: Power circuit inspection C: Power circuit inspection D: Commercial tester connection
 B991502	MB991502	MUT-II sub assembly	• Reading diagnosis code • GDI system inspection
	MB991348, MB991658	Test harness set	• Measurement of voltage during trouble-shooting • Inspection using an analyzer
	MB991709	Test harness	
	MB991519	Alternator harness connector	Measurement of voltage during troubleshooting
	MD998463	Test harness (6-pin, square)	• Inspection of idle speed control servo • Inspection using an analyzer
	MD998478	Test harness (3-pin, triangle)	• Measurement of voltage during trouble-shooting • Inspection using an analyzer

Tool	Number	Name	Use
	MD998709	Adaptor hose	Measurement of fuel pressure
	MD998742	Hose adaptor	
	MB991637	Fuel pressure gauge set	

TROUBLESHOOTING

DIAGNOSIS TROUBLESHOOTING FLOW

Refer to GROUP 00 – How to Use Troubleshooting/Inspection Service Points.



DIAGNOSIS FUNCTION

ENGINE WARNING LAMP (CHECK ENGINE LAMP)

If an abnormality occurs in any of the following items related to the Gasoline Direct Injection (GDI) system, the engine warning lamp will illuminate.
If the lamp remains illuminated or if the lamp illuminates while the engine is running, check the diagnosis code output.

Engine warning lamp inspection items

Engine-ECU
Oxygen sensor
Air flow sensor
Intake air temperature sensor
Throttle position sensor
Engine coolant temperature sensor
Crank angle sensor
Camshaft position sensor
Barometric pressure sensor
Detonation sensor
Injector
Abnormal combustion
Immobilizer system
Fuel pressure sensor
Excessive intake air amount
Brake vacuum sensor

METHOD OF READING AND ERASING DIAGNOSIS CODES

Refer to GROUP 00 – How to Use Troubleshooting/Inspection Service Points.

INSPECTION USING MUT-II DATA LIST AND ACTUATOR TESTING

1. Carry out inspection by means of the data list and the actuator test function.
   If there is an abnormality, check and repair the chassis harnesses and components.
2. After repairing, re-check using the MUT-II and check that the abnormal input and output have returned to normal as a result of the repairs.
3. Erase the diagnosis code memory.
4. Remove the MUT-II.
5. Start the engine again and carry out a road test to confirm that the problem has disappeared.

FAIL-SAFE FUNCTION REFERENCE TABLE

When the main sensor malfunctions are detected by the diagnosis function, the vehicle is controlled by means of the pre-set control logic to maintain safe conditions for driving.

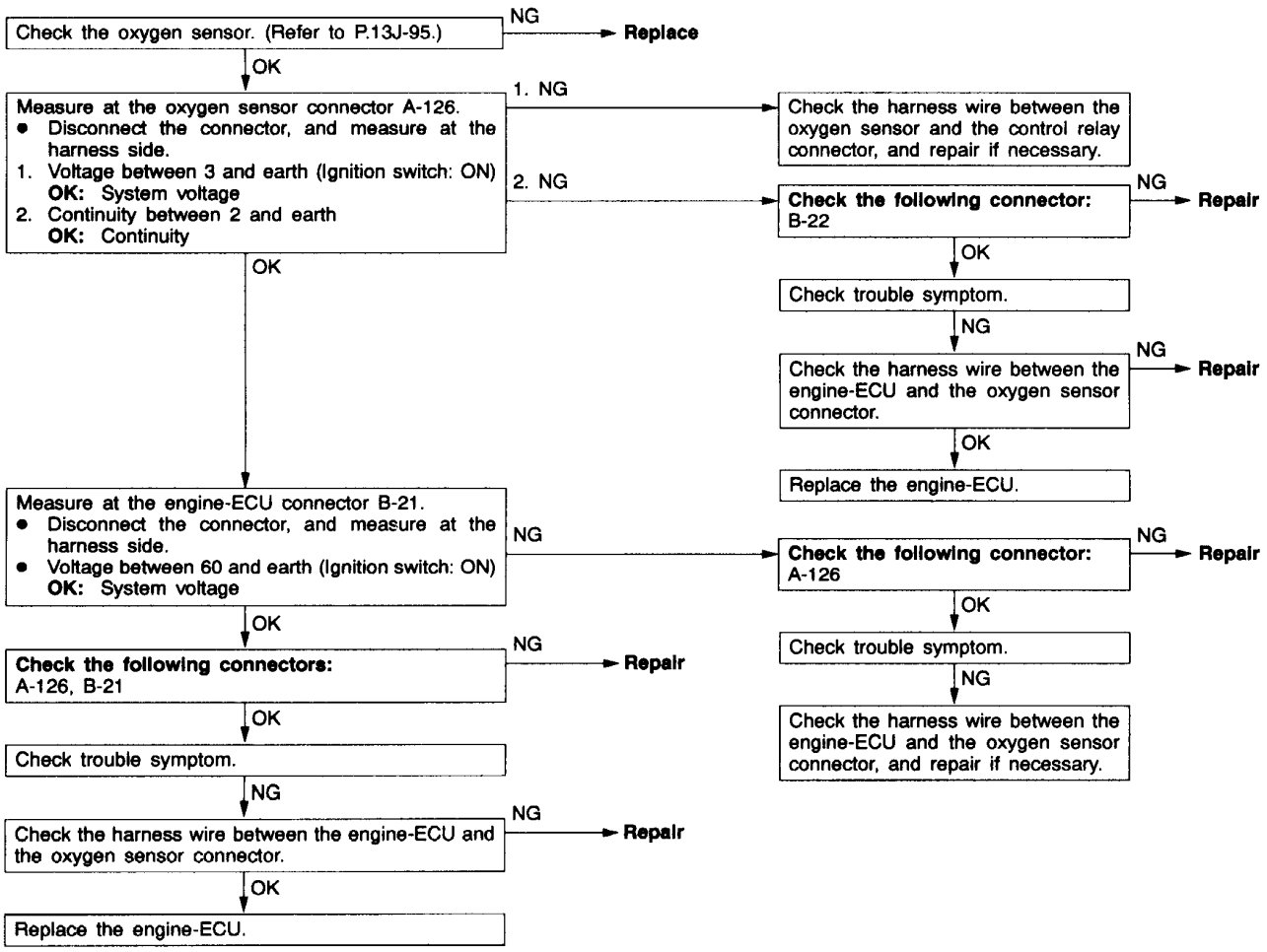
Malfunctioning item	Control contents during malfunction
Air flow sensor	(1) Lean fuel combustion driving and feedback control driving are prevented. (2) Basic injection drive timing and basic ignition timing are set by means of the mapping values from the throttle position sensor signal and the crank angle sensor signal.
Intake air temperature sensor	Control is carried out as if the intake air temperature is 25°C.
Throttle position sensor	(1) Lean fuel combustion driving is prevented. (2) Dashpot compensation for the idle speed control is prevented.
Engine coolant temperature sensor	Control is carried out as if the engine coolant temperature is 80°C. Furthermore, this control will continue until the ignition switch is turned to OFF, even if the sensor signal returns to normal.
Camshaft position sensor	Control is carried out as if the conditions before the failure judgement occurred are continuing.
Vehicle speed sensor	(1) Lean fuel combustion driving is prevented. However, this condition is cleared if the engine speed is continuously at 1,500 r/min or more for a certain length of time. (2) Lean fuel combustion during idling is prevented.
Barometric pressure sensor	Control is carried out as if the barometric pressure is 101 kPa (760 mmHg).
Detonation sensor	Ignition timing is fixed to the timing for standard petrol.
Injector	(1) Lean fuel combustion driving is prevented. (2) EGR operation is cut.
Abnormal combustion	Lean fuel combustion driving is prevented.
Excessive intake air amount	When the air flow sensor output is compared with the throttle position sensor output and the air amount is judged to be excessive, compression stroke fuel injection and lean fuel combustion driving are set.
Communication line with A/T-ECU	Ignition timing retarding control (engine and transmission total control) during transmission gear shifting is prevented.
Alternator FR terminal	Alternator output suppression control under high electrical loads is prevented. (Alternator works as a normal alternator.)
Fuel pressure sensor	Control is carried out as if the fuel pressure is 5 MPa.

INSPECTION CHART FOR DIAGNOSIS CODES

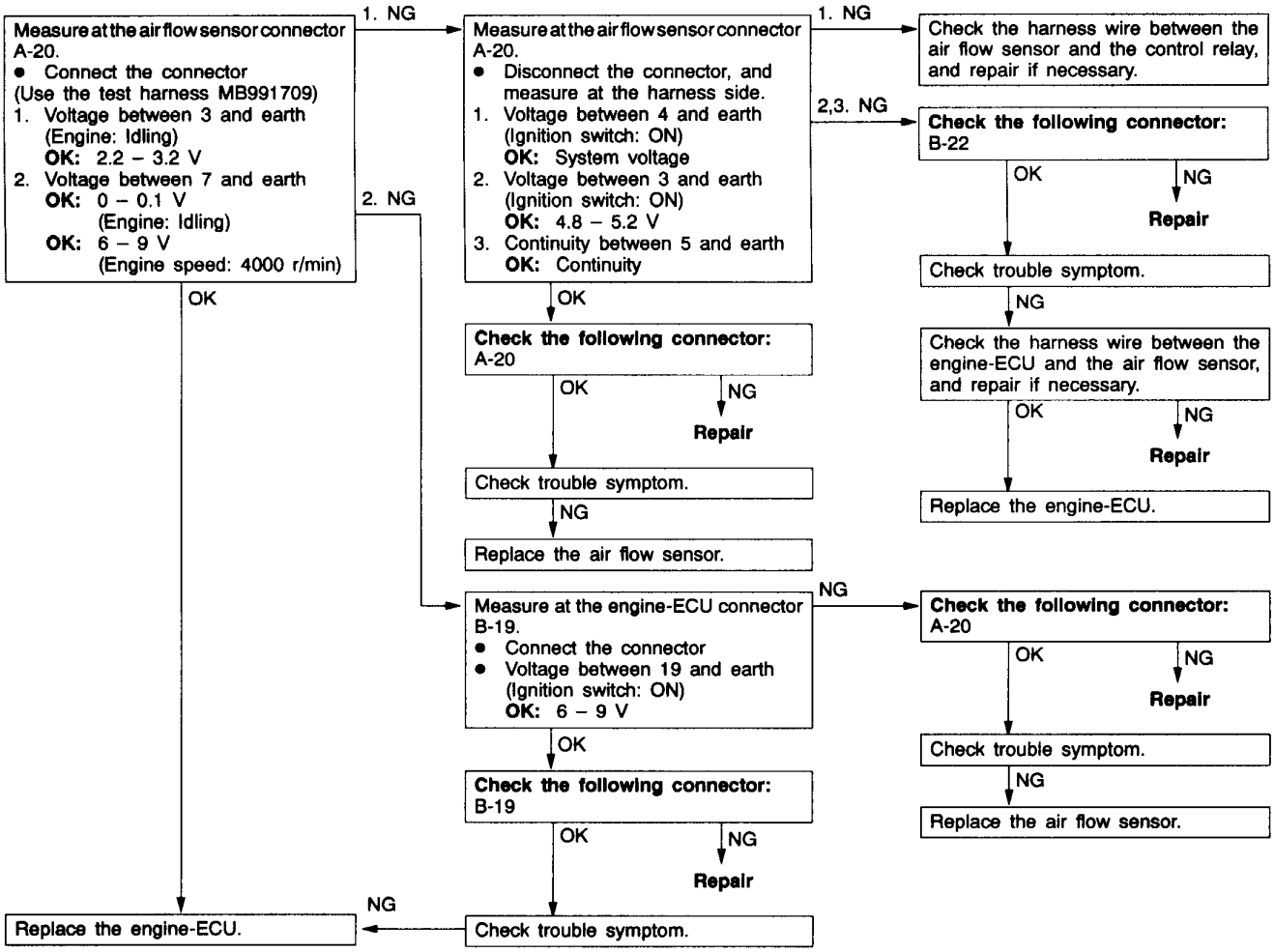
Code No.	Diagnosis item	Reference page
11	Oxygen sensor system	13J-12
12	Air flow sensor system	13J-13
13	Intake air temperature sensor system	13J-14
14	Throttle position sensor system	13J-15
21	Engine coolant temperature sensor system	13J-16
22	Crank angle sensor system	13J-17
23	Camshaft position sensor system	13J-18
24	Vehicle speed sensor system	13J-19
25	Barometric pressure sensor system	13J-20
31	Detonation sensor system	13J-21
41	Injector system	13J-22
44	Abnormal combustion	13J-23
54	Immobilizer system	13J-24
56	Fuel pressure sensor system	13J-25
58	Excessive intake air amount	13J-26
61	Communication wire with A/T-ECU system	13J-26
64	Alternator FR terminal system	13J-27
66	Brake vacuum sensor system	13J-28

INSPECTION PROCEDURE FOR DIAGNOSIS CODES

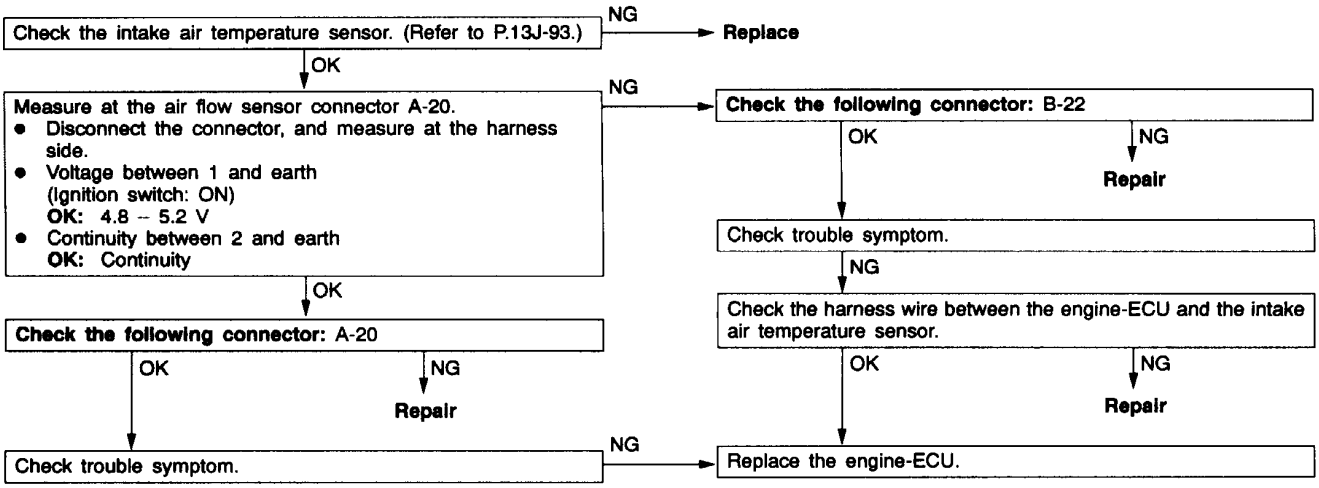
Code No. 11 Oxygen sensor system	Probable cause
Range of check • 3 minutes have passed after engine was started. • Engine coolant temperature is approx. 80°C or more. • Intake air temperature is 20–50°C. • Engine speed is approx. 2,000–3,000 r/min • Vehicle is moving at constant speed on a flat, level road surface Set conditions • The oxygen sensor output voltage is around 0.6 V for 30 seconds (does not cross 0.6 V for 30 seconds). • When the range of check operations given above which accompany starting of the engine are carried out four time in succession, a problem is detected after each operation.	• Malfunction of the oxygen sensor • Improper connector contact, open circuit or short-circuited harness wire • Malfunction of the engine-ECU



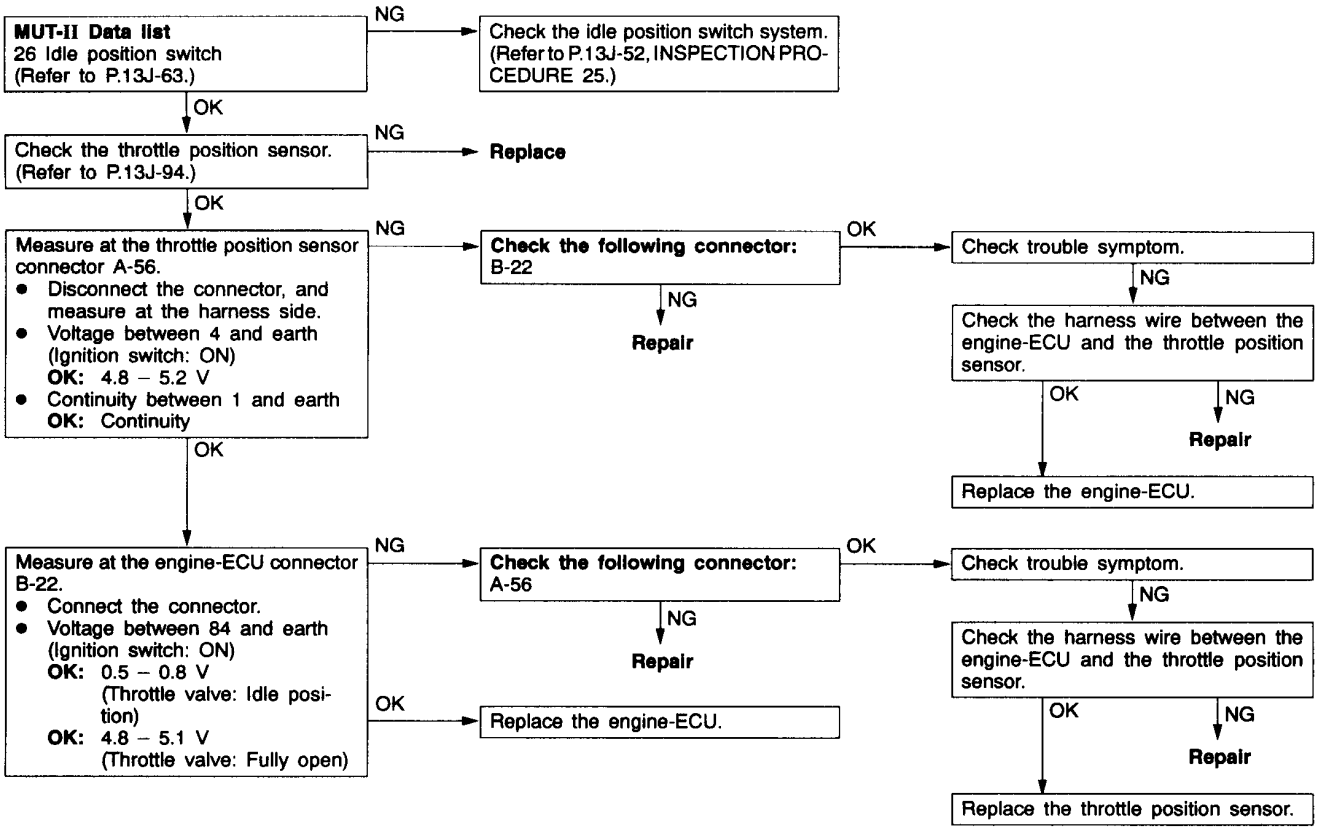
Code No.12 Air flow sensor system	Probable cause
Range of check • Engine speed is 500 r/min or more. Set conditions • Sensor output frequency is 3.3 Hz or less for 4 seconds.	• Malfunction of the air flow sensor • Open circuit or short-circuited harness wire of air flow sensor circuit • Malfunction of the engine-ECU



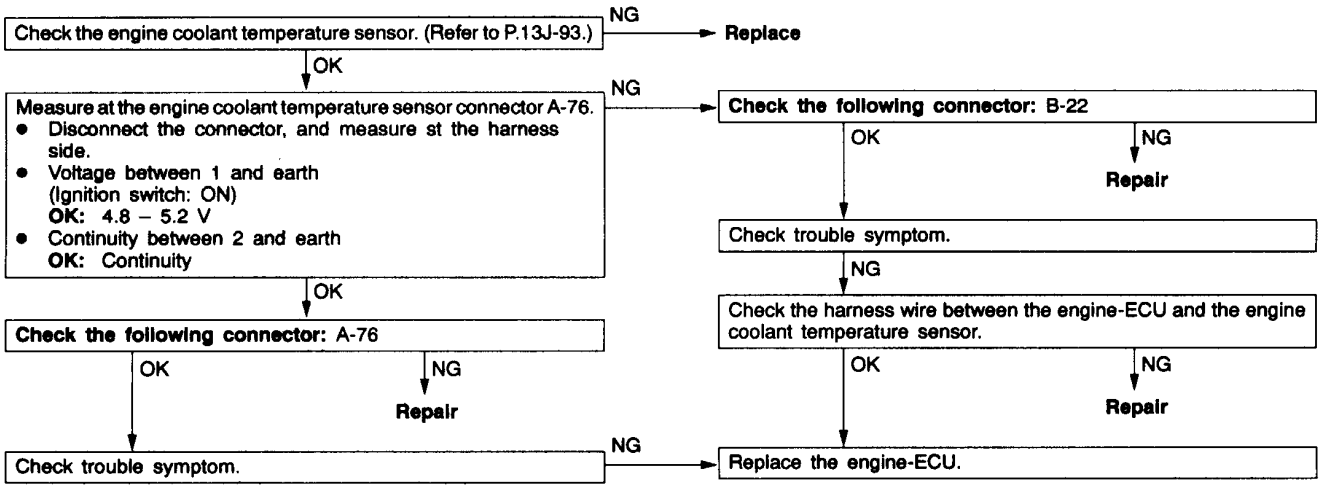
Code No.13 Intake air temperature sensor system	Probable cause
Range of check • After 60 seconds have passed since the engine have started Set conditions • Sensor resistance is 0.14 kΩ or less for 4 seconds. or • Sensor resistance is 50 kΩ or more for 4 seconds.	• Malfunction of the intake air temperature sensor • Open circuit or short-circuited harness wire of the intake air temperature sensor circuit • Malfunction of the engine-ECU



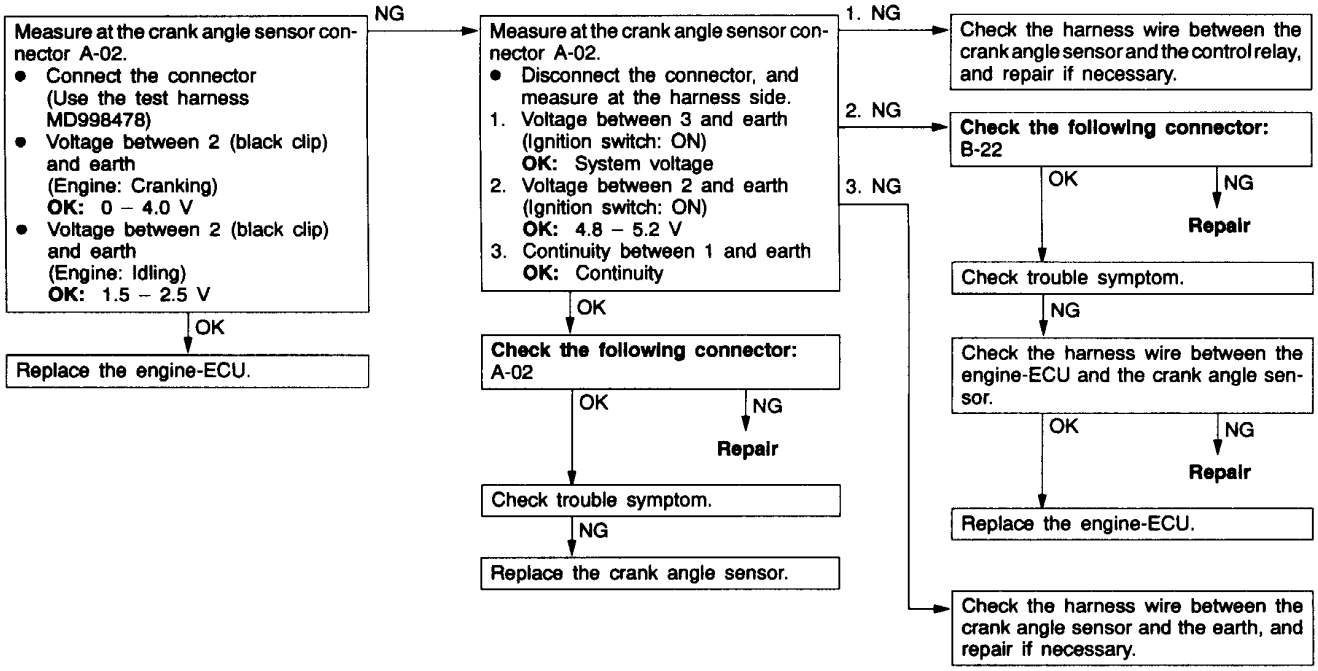
Code No.14 Throttle position sensor system	Probable cause
Range of check • After 60 seconds have passed since the engine have started Set conditions • Sensor output voltage is 0.2 V or less for 4 seconds. or • Idle position switch is ON and sensor output voltage is 2.0 V or more for 4 seconds.	• Malfunction of the throttle position sensor • Open circuit or short-circuited harness wire of the throttle position sensor circuit • Idle position switch ON malfunction • Short-circuit in idle position switch signal line • Malfunction of the engine-ECU



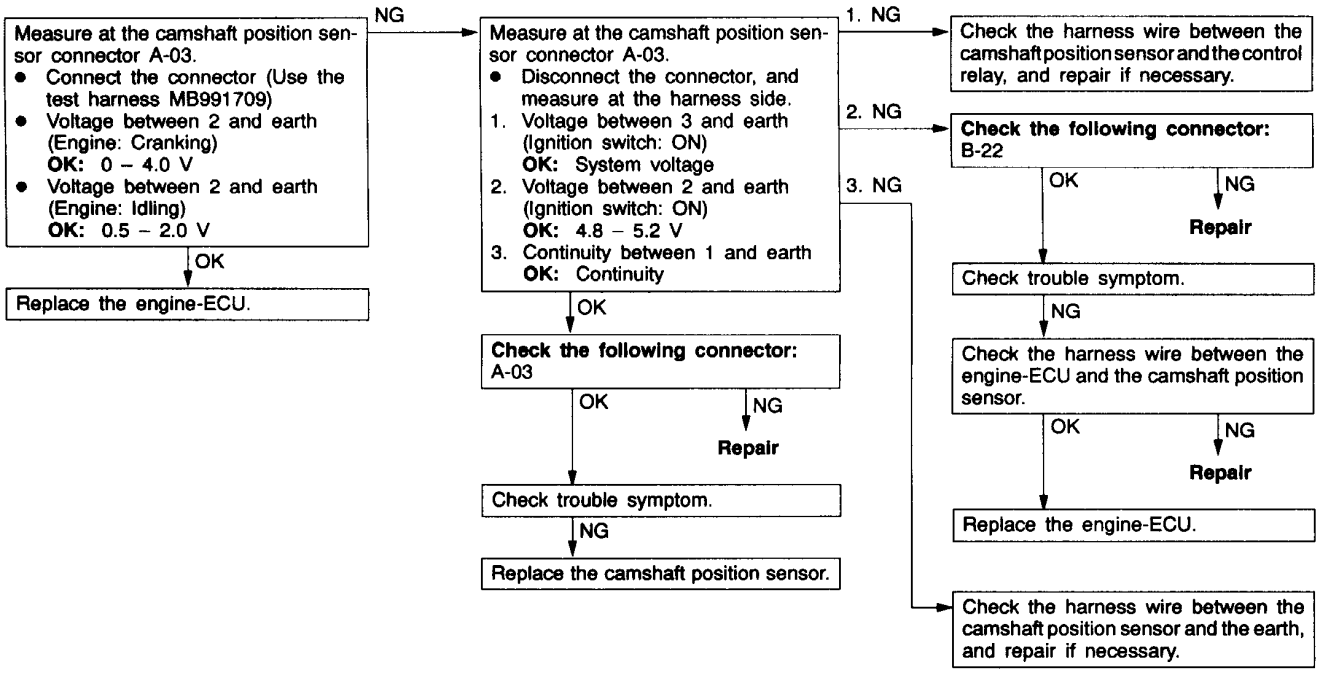
Code No.21 Engine coolant temperature sensor system	Probable cause
Range of check • After 60 seconds have passed since the engine have started Set conditions • Sensor resistance is 50 Ω or less for 4 seconds. or • Sensor resistance is 72 kΩ or more for 4 seconds.	• Malfunction of the engine coolant temperature sensor • Open circuit or short-circuited harness wire of the engine coolant temperature sensor circuit • Malfunction of the engine-ECU
Range of check • After engine starts Set conditions • After 5 minutes or more have passed since the engine coolant temperature after filtering has dropped from 40°C or more to less than this temperature	



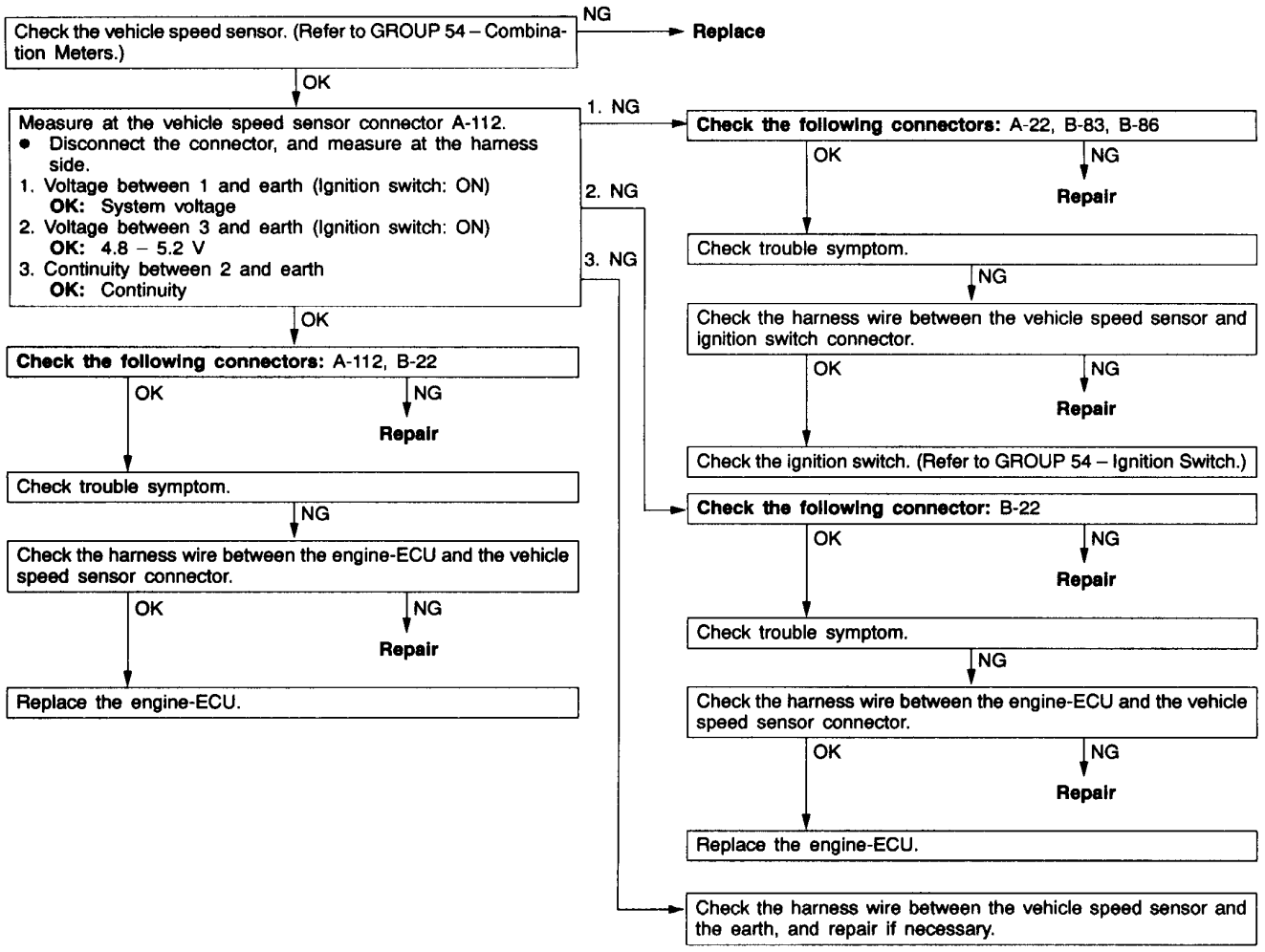
Code No.22 Crank angle sensor system	Probable cause
Range of check • Engine: During cranking Set conditions • Sensor output voltage does not change for 4 seconds (no pulse signal is being input).	• Malfunction of the crank angle sensor • Open circuit or short-circuited harness wire of the crank angle sensor circuit • Malfunction of the engine-ECU



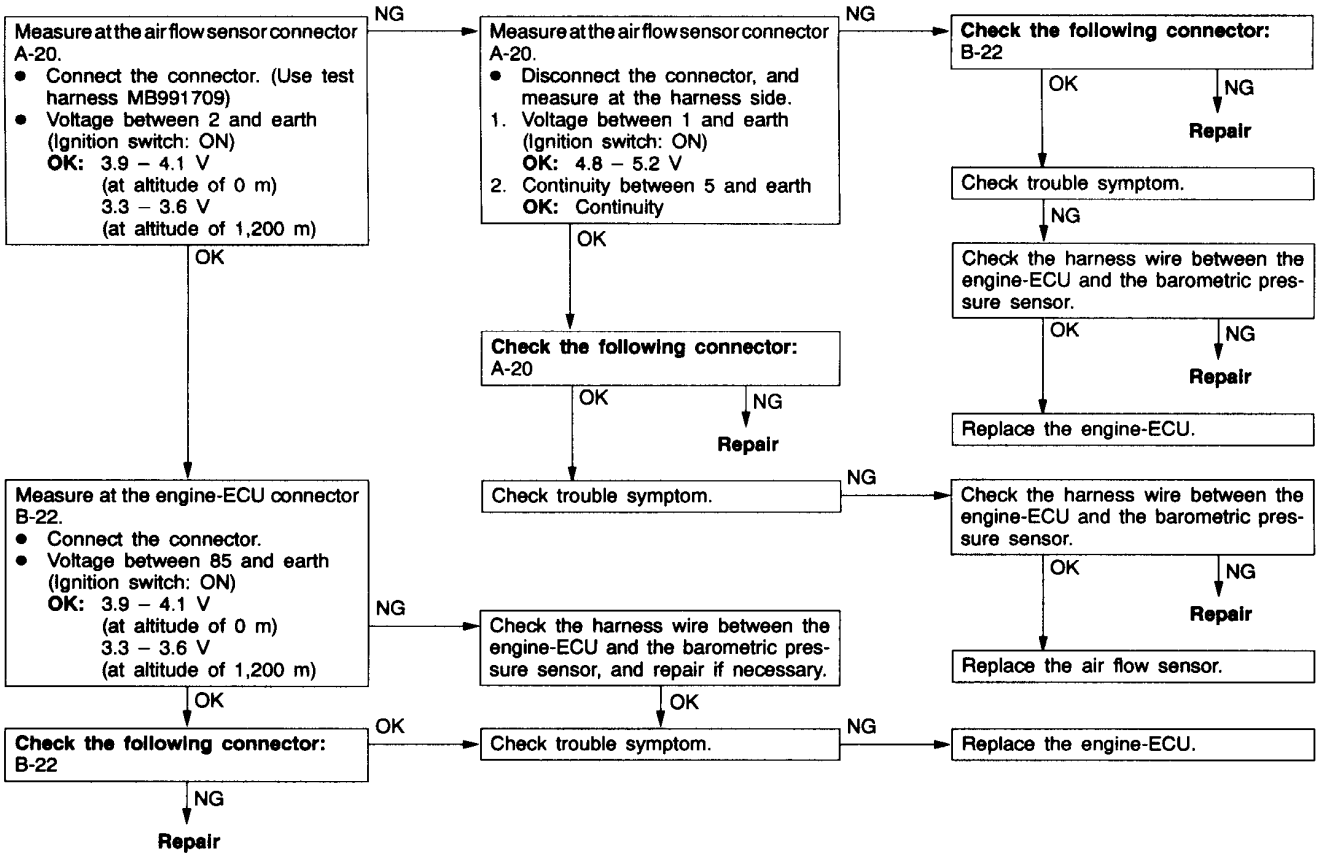
Code No.23 Camshaft position sensor system	Probable cause
Range of check • While engine is cranking or running Set conditions • Sensor output voltage does not change for 4 seconds (no pulse signal is being input). or • Abnormal pulse signal pattern is output.	• Malfunction of the camshaft position sensor • Open circuit or short-circuited harness wire of the camshaft position sensor • Malfunction of the engine-ECU



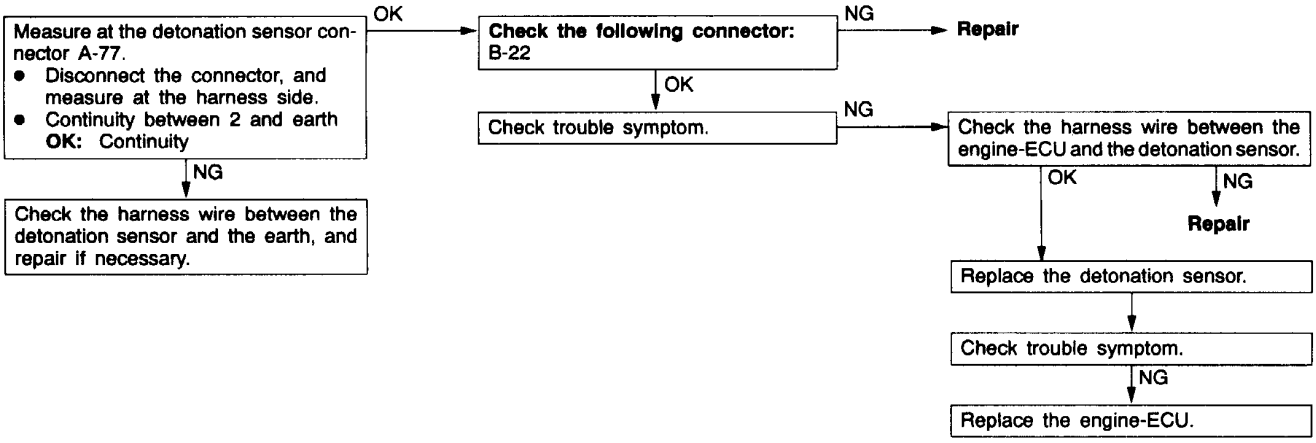
Code No. 24 Vehicles speed sensor system	Probable cause
Range of check • Ignition switch: ON • Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts. • Idle position switch: OFF • Engine speed is 3,000 r/min or more. • Driving under high engine load conditions. Set conditions • Sensor output voltage does not change for 4 seconds (no pulse signal input).	• Malfunction of the vehicle speed sensor • Improper connector contact, open circuit or short-circuited harness wire of the vehicle speed sensor circuit • Malfunction of the engine-ECU



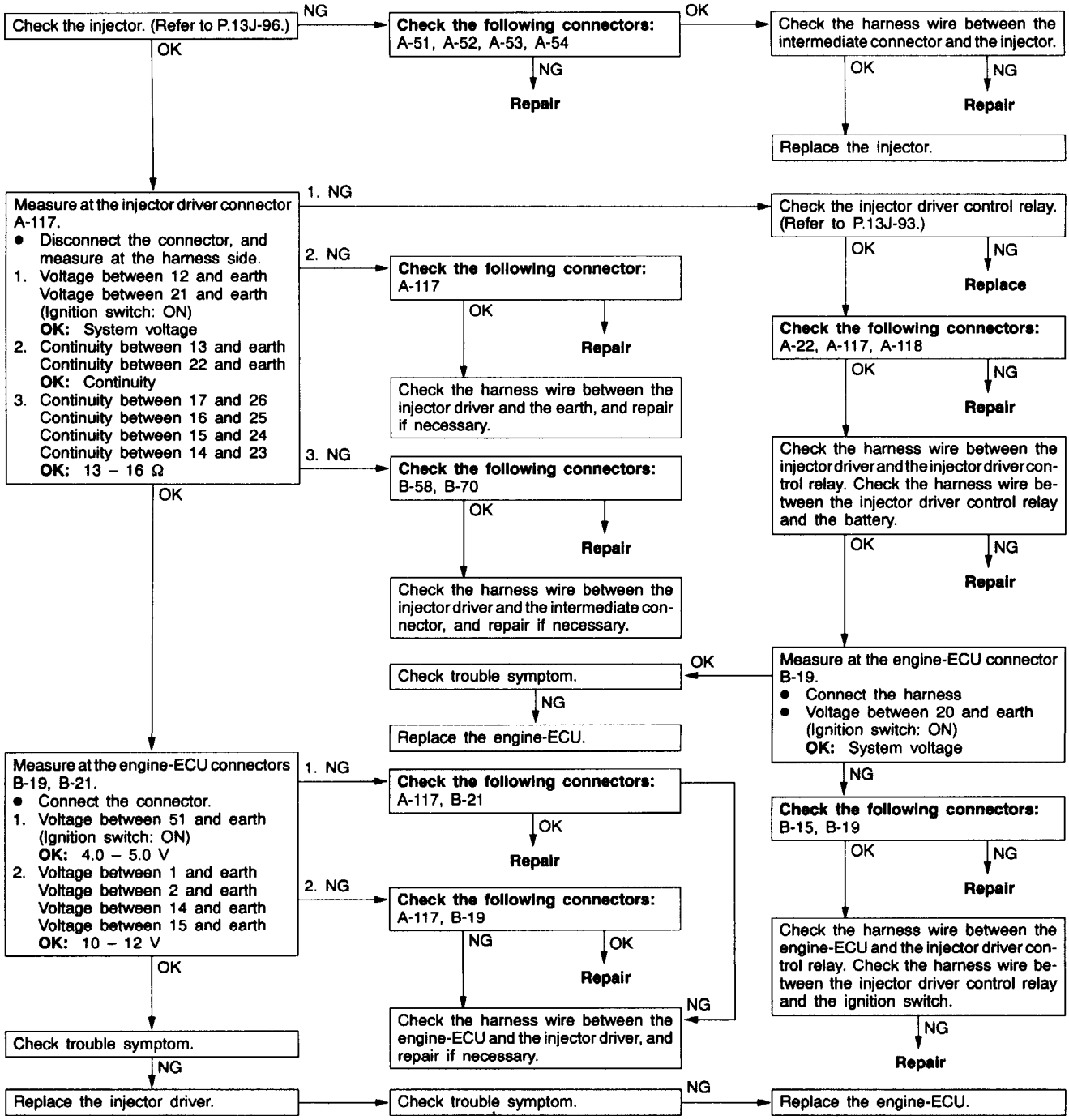
Code No.25 Barometric pressure sensor system	Probable cause
Range of check • After 60 seconds have passed since the engine have started • Battery voltage is 8 V or more. Set conditions • Sensor output voltage is 0.2 V or less for 4 seconds. or • Sensor output voltage is 4.5 V or more for 4 seconds.	• Malfunction of the barometric pressure sensor • Open circuit or short-circuited harness wire of the barometric pressure sensor • Malfunction of the engine-ECU



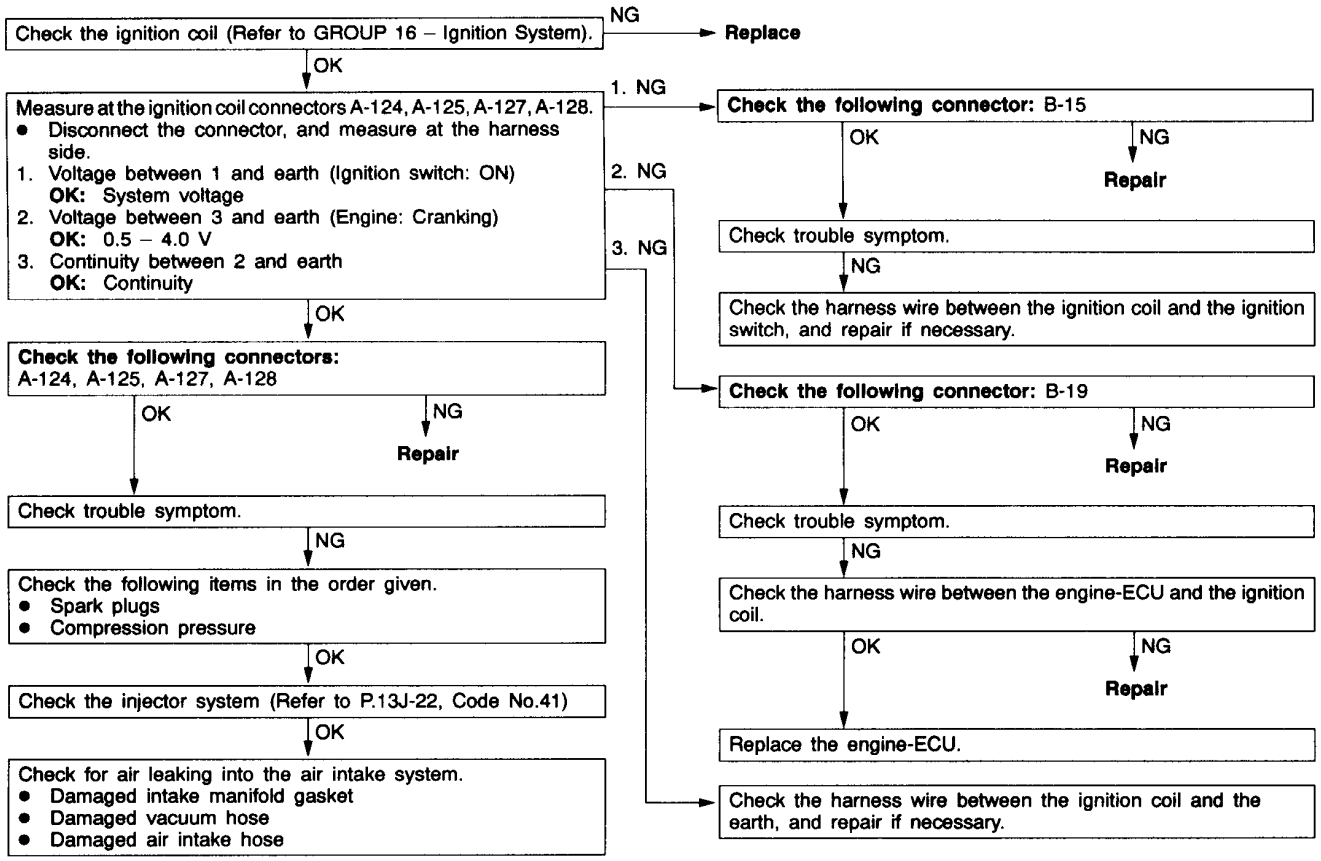
Code No.31 Detonation sensor system	Probable cause
Range of check • After 60 seconds have passed since the engine have started Set conditions • Amount of change in the sensor output voltage (detonation sensor peak voltage for each half rotation of the crankshaft) is 0.06 V or less for 200 continuous times.	• Malfunction of the detonation sensor • Open circuit or short-circuited harness wire of the detonation sensor • Malfunction of the engine-ECU



Code No.41 Injector system	Probable cause
Range of check • While engine is cranking or running • Engine speed is 4,000 r/min or less. • System voltage is 10 V or more. • While fuel cut and injector forced drive (actuator test) are not being carried out Set conditions • Injector open circuit check signal is not output by the injector driver for a set number of times.	• Malfunction of the injector • Malfunction of the injector driver control relay • Malfunction of the injector driver • Open circuit or short-circuited harness wire of the injector drive circuit • Malfunction of the engine-ECU

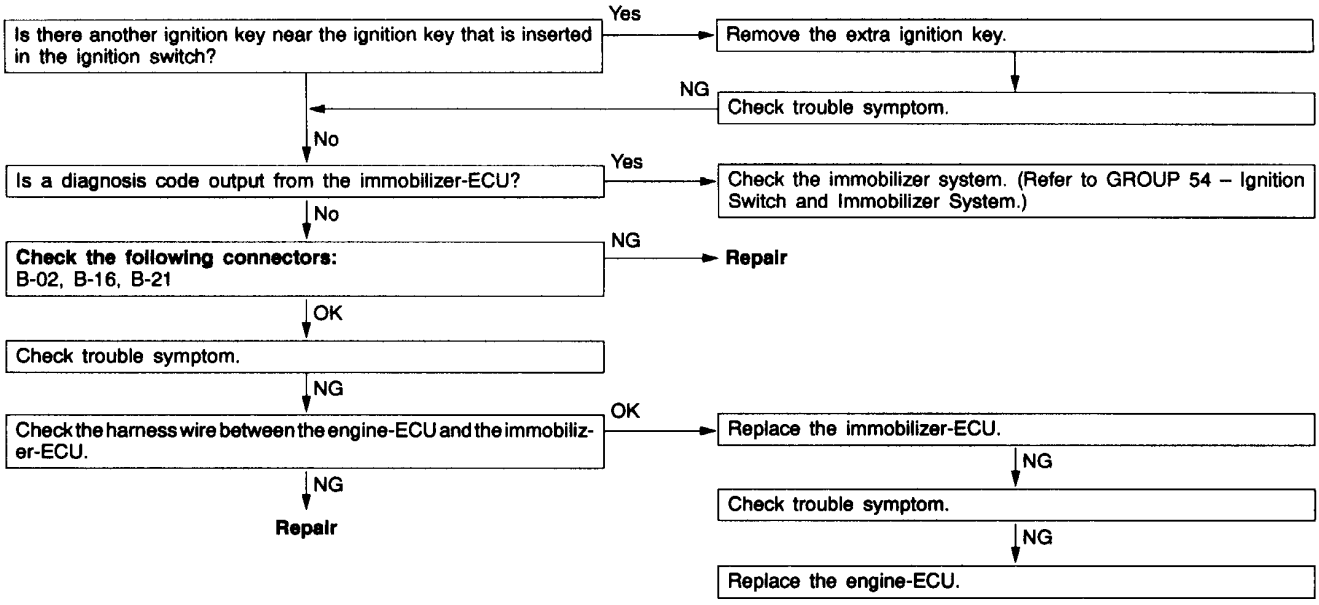


Code No.44 Abnormal combustion	Probable cause
Range of check • While engine is running during lean fuel combustion Set conditions • Abnormal engine speed due to mis-firing is detected by the crank angle sensor	• Malfunction of the ignition coil • Malfunction of the spark plug • Open circuit or short-circuit in ignition primary circuit • Malfunction of the injector system • Malfunction of the engine-ECU

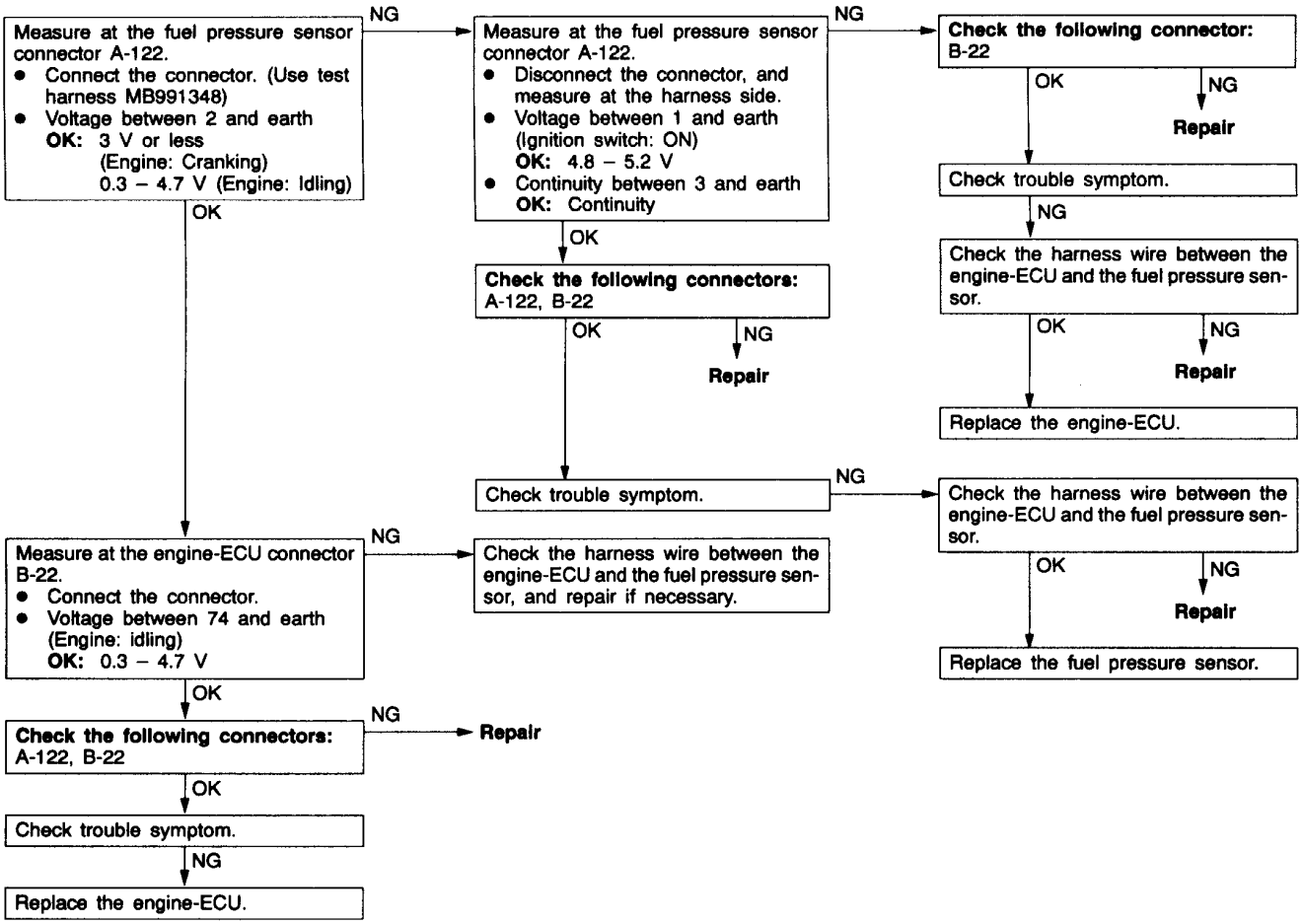


Code No.54 Immobilizer system	Probable cause
Range of Check • Ignition switch: ON Set Conditions • Improper communication between the engine-ECU and immobilizer-ECU	• Radio interference of ID codes • Incorrect ID code • Malfunction of harness or connector • Malfunction of immobilizer-ECU • Malfunction of engine-ECU

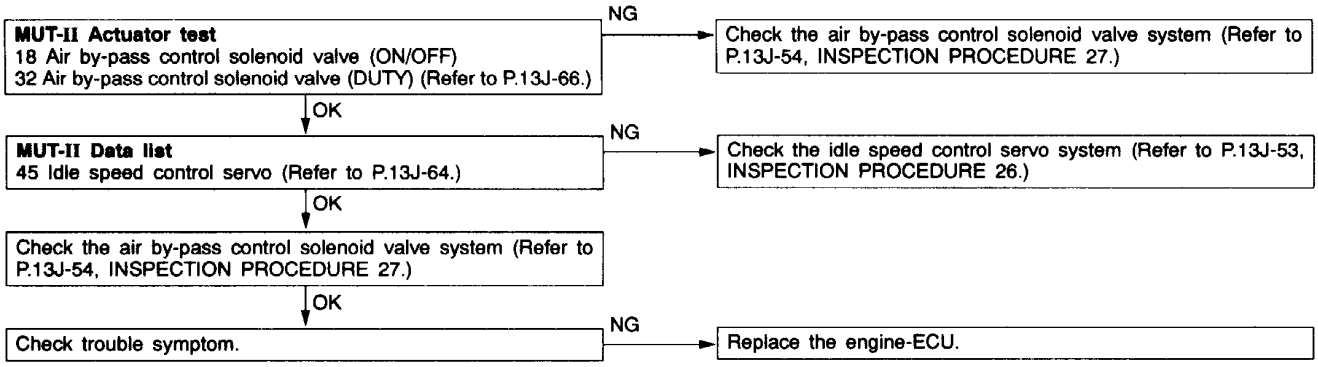
NOTE
(1) If the ignition switches are close each other when starting the engine, radio interference may cause this code to be displayed.
(2) This code may be displayed when registering the key ID code.



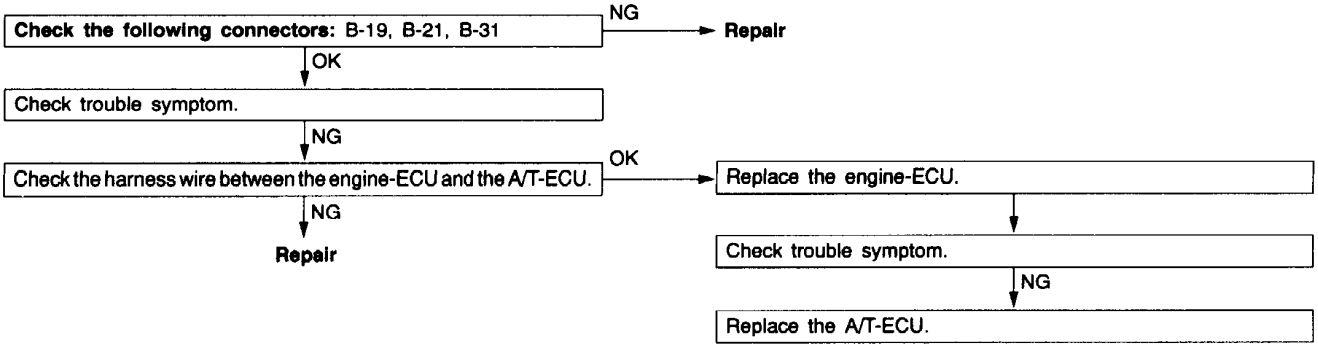
Code No.56 Fuel pressure sensor system	Probable cause
Range of check • Ignition switch: ON Set conditions • Sensor output voltage is 4.7 V or more. or • Sensor output voltage is 0.3 V or less.	• Malfunction of the fuel pressure sensor • Open circuit or short-circuited harness wire of the fuel pressure sensor • Malfunction of the engine-ECU



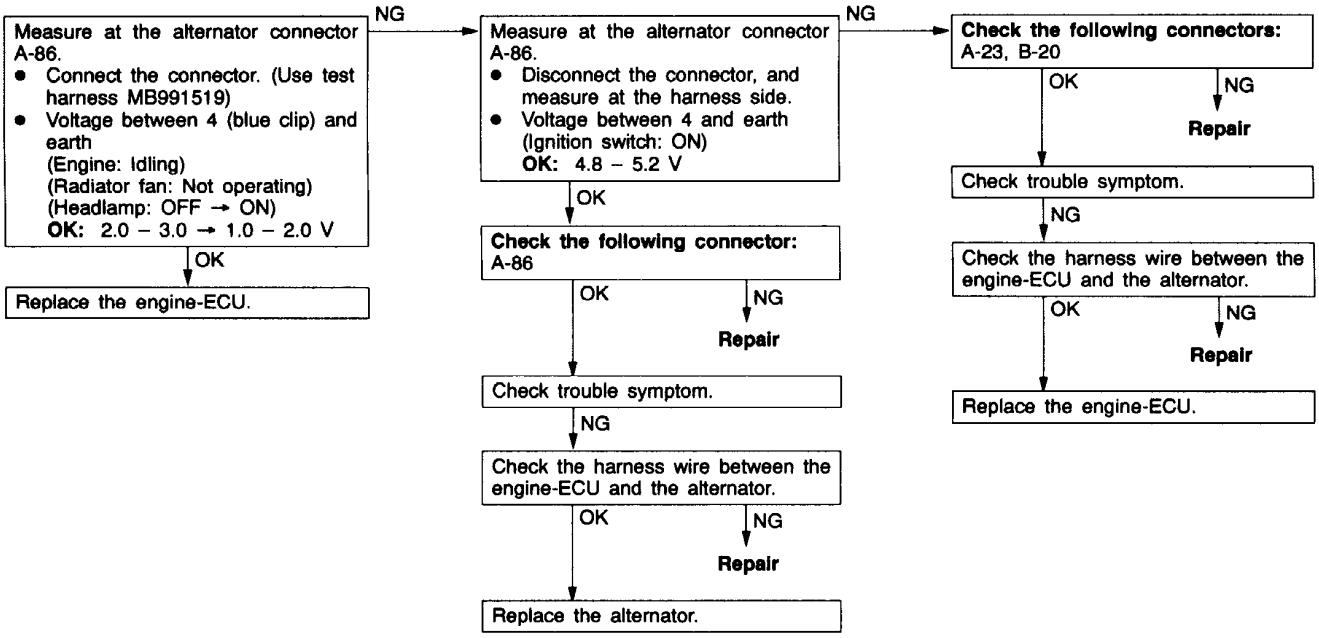
Code No.58 Excessive intake air amount	Probable cause
Range of check • While engine is running in lean compression mode • Engine speed is 3,000 r/min or less. • Throttle position sensor output voltage is 1 V or less. Set conditions • Air flow sensor output frequency is 100 Hz or more for 1 second.	• Malfunction of the idle speed control servo • Open circuit or short-circuited harness wire of the idle speed control servo • Malfunction of the air by-pass control solenoid valve (ON/OFF, DUTY) • Short-circuited harness wire of the air by-pass control solenoid valve (ON/OFF, DUTY) • Malfunction of the engine-ECU
Range of check • While engine is not running in lean compression mode Set conditions • Air flow sensor output frequency is higher than the map value specified by the engine speed for 1 second.	



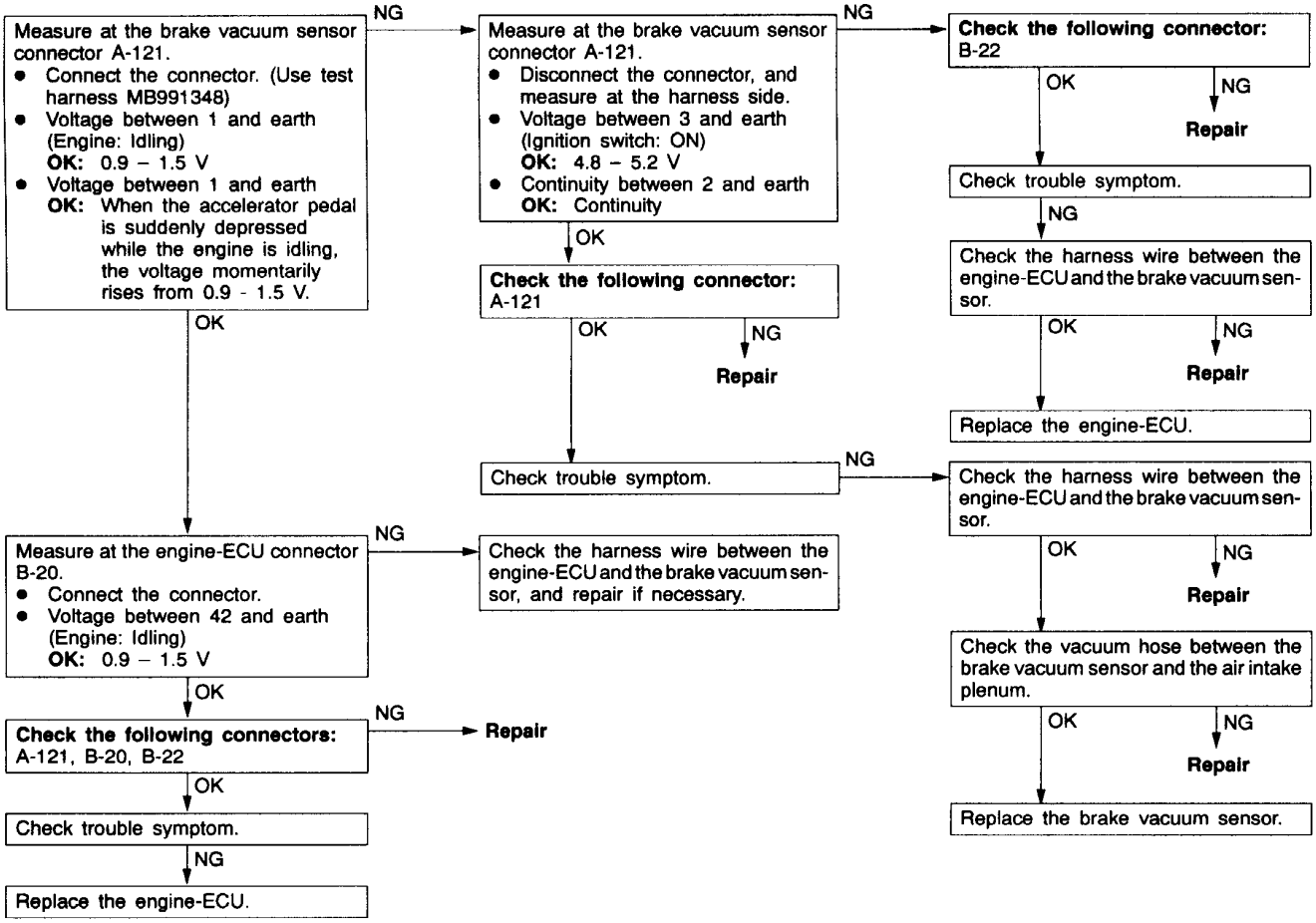
Code No.61 Communication wire with A/T-ECU system	Probable cause
Range of check • After 60 seconds have passed since the engine have started Set conditions • Torque reduction request signal from A/T-ECU is input continuously for 1.5 seconds or more.	• Short circuit in ECU communication circuit • Malfunction of the engine-ECU • Malfunction of the A/T-ECU



Code No.64 Alternator FR terminal system	Probable cause
Range of check • Engine speed is 50 r/min or more. Set conditions • Input voltage from alternator FR terminal is 4.5 V or more for 20 seconds.	• Open circuit in alternator FR terminal circuit • Malfunction of the engine-ECU



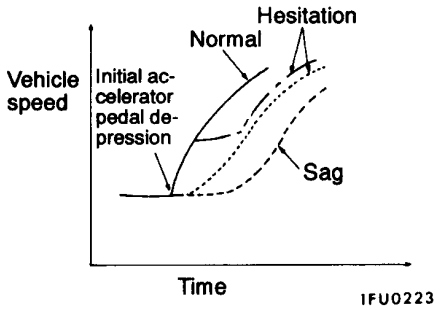
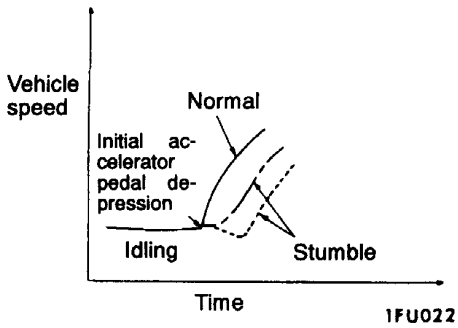
Code No.66 Brake vacuum sensor system	Probable cause
Range of check • Ignition switch: ON Set conditions • Sensor output voltage is 4.8 V or more. or • Sensor output voltage is 0.2 V or less.	• Malfunction of the brake vacuum sensor • Improper connector contact, open circuit or short-circuited harness wire of the brake vacuum sensor • Malfunction of the engine-ECU



INSPECTION CHART FOR TROUBLE SYMPTOMS

Trouble symptom		Inspection procedure No.	Reference page
Communication with MUT-II is impossible.	Communication with all systems is not possible.	1	13J-31
	Communication with engine-ECU only is not possible.	2	13J-32
Engine warning lamp and related parts	The engine warning lamp does not illuminate right after the ignition switch is turned to the ON position.	3	13J-33
	The engine warning lamp remains illuminating and never goes out.	4	13J-33
Starting	No initial combustion (starting impossible)	5	13J-34
	Initial combustion but no complete combustion (starting impossible)	6	13J-35
	Long time to start (improper starting)		
Idling stability (Improper idling)	Unstable idling (Rough idling, hunting)	7	13J-36
	Idling speed is high. (Improper idling speed)	8	13J-38
	Idling speed is low. (Improper idling speed)		
Idling stability (Engine stalls)	When the engine is cold, it stalls at idling. (Die out)	9	13J-39
	When the engine is hot, it stalls at idling. (Die out)	10	13J-40
	The engine stalls when starting the car. (Pass out)	11	13J-42
	The engine stalls when decelerating.	12	13J-43
Driving	Hesitation, sag or stumble	13	13J-43
	Poor acceleration		
	Surge		
	The feeling of impact or vibration when accelerating	14	13J-45
	The feeling of impact or vibration when decelerating	15	13J-45
	Knocking	16	13J-45
Dieseling		17	13J-46
Too high CO and HC concentration when idling		18	13J-46
Low alternator output voltage (approx. 12.3 V)		19	13J-47
Fans (radiator fan, A/C condensor fan) are inoperative		20	13J-48

PROBLEM SYMPTOMS TABLE (FOR YOUR INFORMATION)

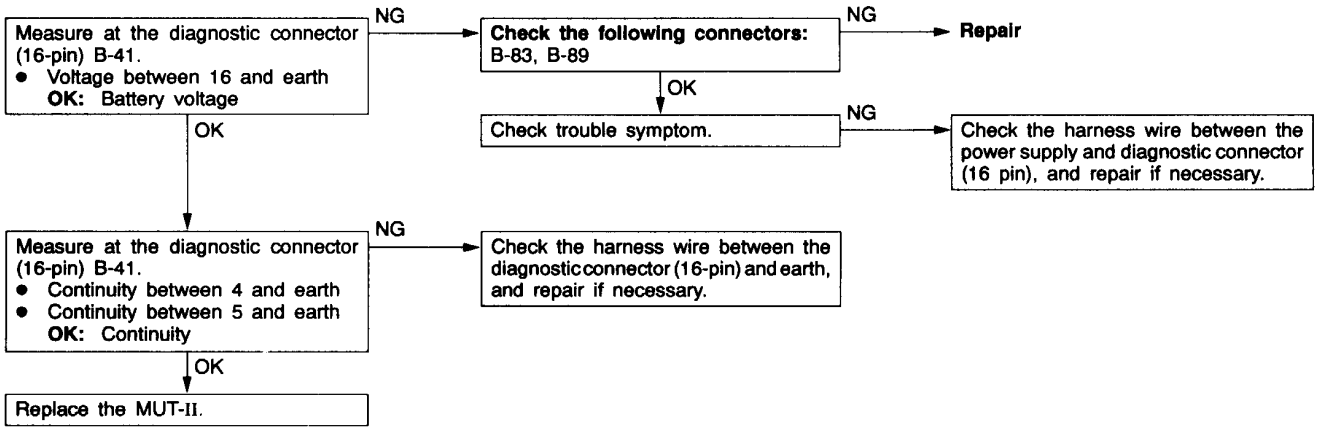
Items		Symptom
Starting	Won't start	The starter is used to crank the engine, but there is no combustion within the cylinders, and the engine won't start.
	Fires up and dies	There is combustion within the cylinders, but then the engine soon stalls.
	Hard starting	Engine starts after cranking a while.
Idling stability	Hunting	Engine speed doesn't remain constant; changes at idle.
	Rough idle	Usually, a judgement can be based upon the movement of the tachometer pointer, and the vibration transmitted to the steering wheel, shift lever, body, etc. This is called rough idle.
	Incorrect idle speed	The engine doesn't idle at the usual correct speed.
	Engine stall (Die out)	The engine stalls when the foot is taken from the accelerator pedal, regardless of whether the vehicles is moving or not.
	Engine stall (Pass out)	The engine stalls when the accelerator pedal is depressed or while it is being used.
Driving	Hesitation, Sag	"Hesitation" is the delay in response of the vehicle speed (engine speed) that occurs when the accelerator is depressed in order to accelerate from the speed at which the vehicle is now traveling, or a temporary drop in vehicle speed (engine speed) during such acceleration. Serious hesitation is called "sag". 
	Poor acceleration	Poor acceleration is inability to obtain an acceleration corresponding to the degree of throttle opening, even though acceleration is smooth, or the inability to reach maximum speed.
	Stumble	Engine speed increase is delayed when the accelerator pedal is initially depressed for acceleration. 

Items		Symptom
Driving	Shock	The feeling of a comparatively large impact or vibration when the engine is accelerated or decelerated.
	Surge	This is repeated surging ahead during constant speed travel or during variable speed travel.
	Knocking	A sharp sound like a hammer striking the cylinder walls during driving and which adversely affects driving.
Stopping	Run on ("Dieseling")	The condition in which the engine continues to run after the ignition switch is turned to OFF. Also called "Dieseling".

INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

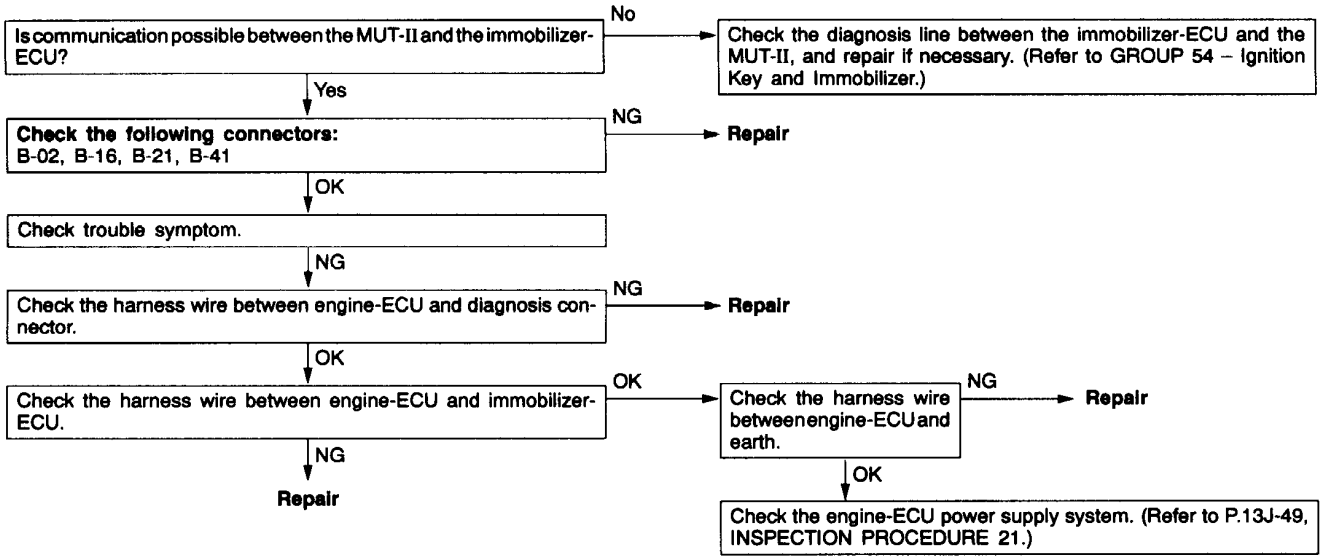
INSPECTION PROCEDURE 1

Communication with MUT-II is not possible. (Communication with all systems is not possible.)	**Probable cause**
The cause is probably a defect in the power supply system (including earth) for the diagnosis line.	• Malfunction of the connector • Malfunction of the harness wire



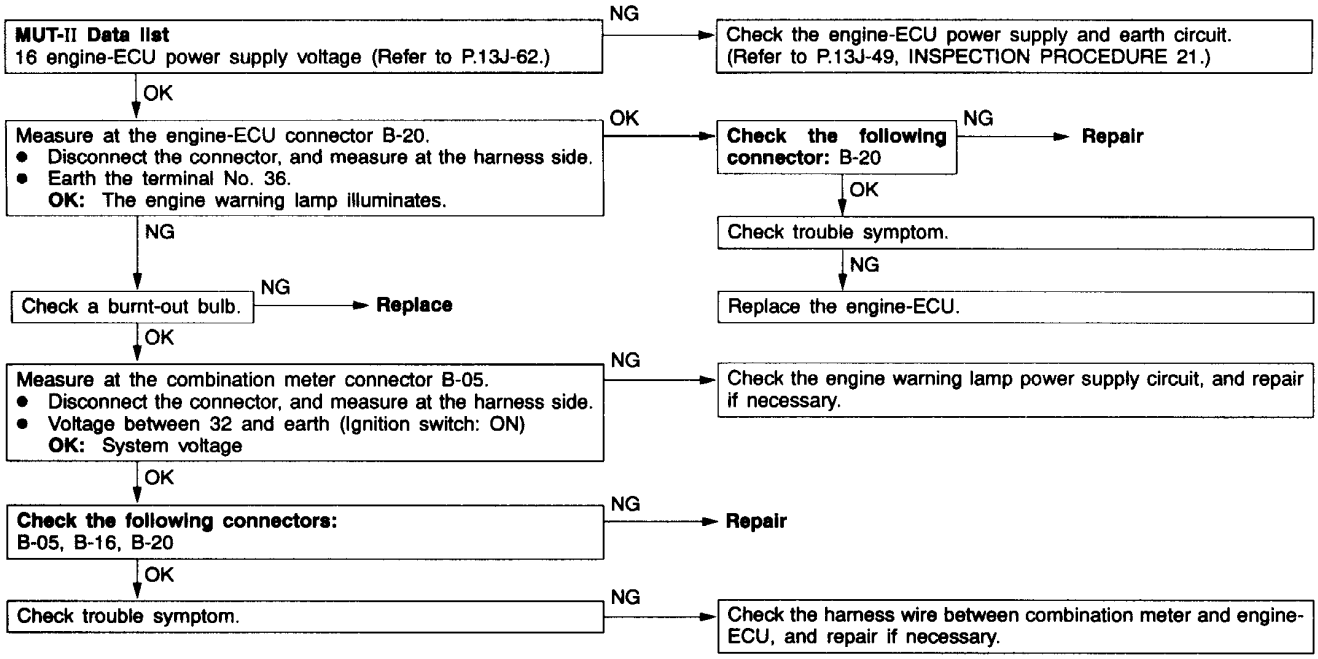
INSPECTION PROCEDURE 2

MUT-II communication with engine-ECU is impossible.	Probable cause
One of the following causes may be suspected. • No power supply to engine-ECU. • Defective earth circuit of engine-ECU. • Defective engine-ECU. • Improper communication line between engine-ECU and MUT-II	• Malfunction of engine-ECU power supply circuit • Malfunction of engine-ECU • Malfunction of immobilizer-ECU • Open circuit between immobilizer-ECU and diagnosis connector • Open circuit between engine-ECU and immobilizer-ECU



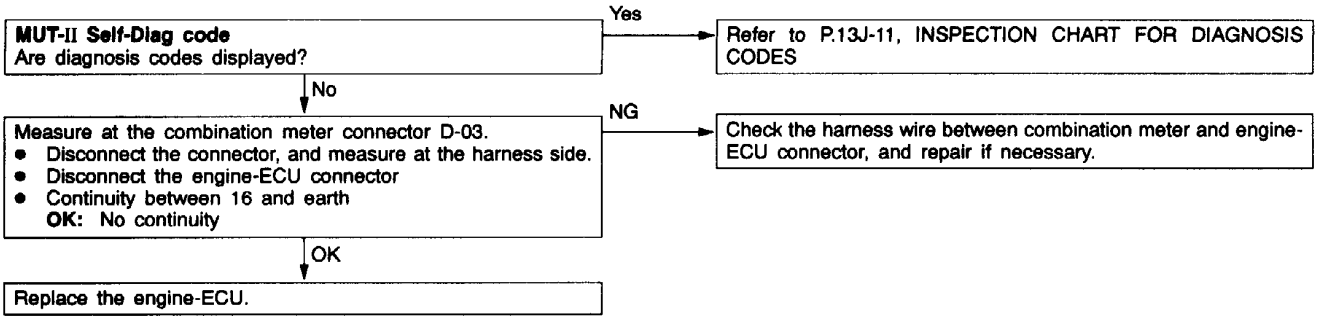
INSPECTION PROCEDURE 3

The engine warning lamp does not illuminate right after the ignition switch is turned to the ON position.	Probable cause
Because there is a burnt-out bulb, the engine-ECU causes the engine warning lamp to illuminate for five seconds immediately after the ignition switch is turned to ON. If the engine warning lamp does not illuminate immediately after the ignition switch is turned to ON, one of the malfunctions listed at right has probably occurred.	• Burnt-out bulb • Defective warning lamp circuit • Malfunction of the engine-ECU



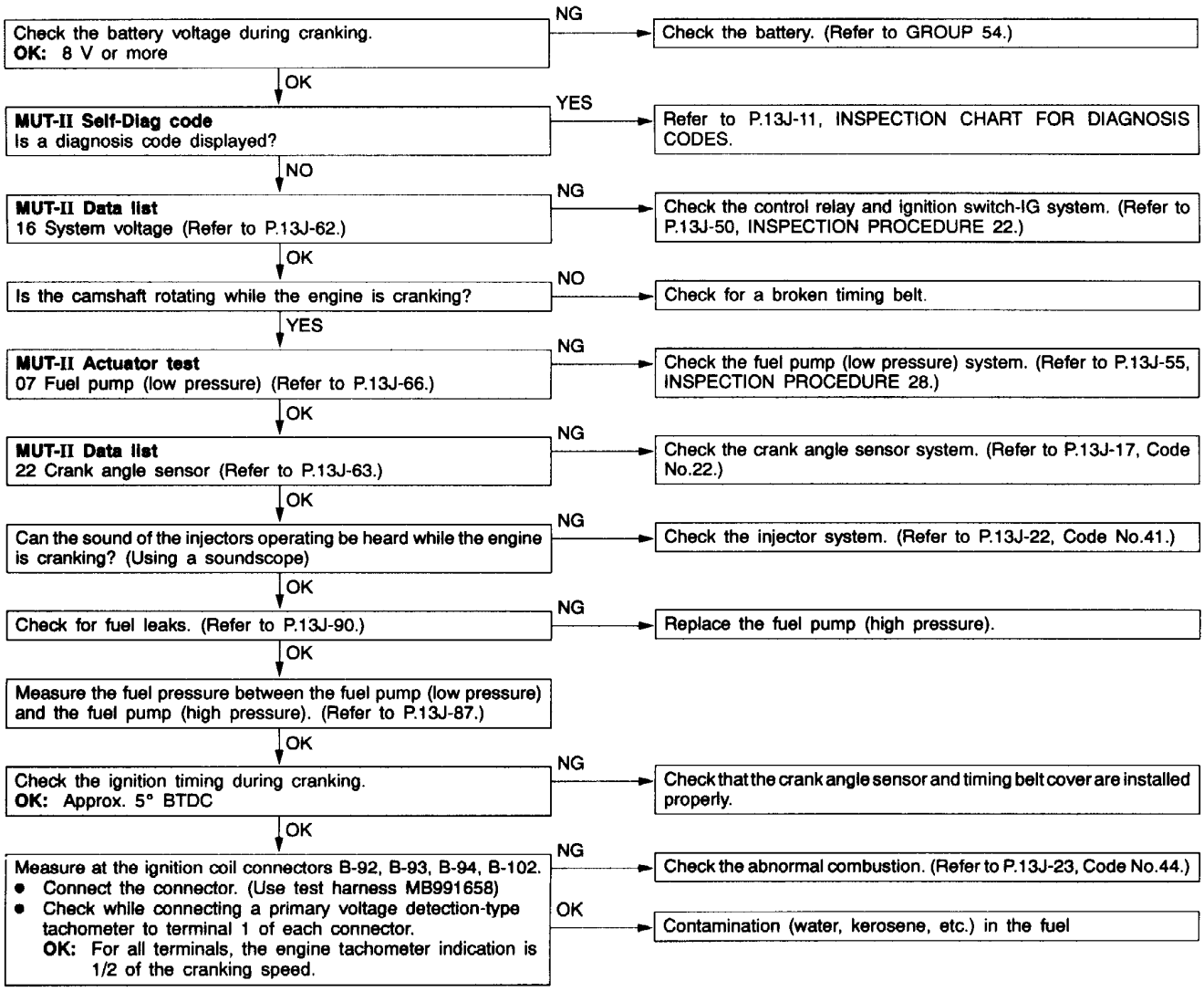
INSPECTION PROCEDURE 4

The engine warning lamp remains illuminating and never goes out.	Probable cause
In cases such as the above, the cause is probably that the engine-ECU is detecting a problem in a sensor or actuator, or that one of the malfunctions listed at right has occurred.	• Short-circuit between the engine warning lamp and engine-ECU • Malfunction of the engine-ECU



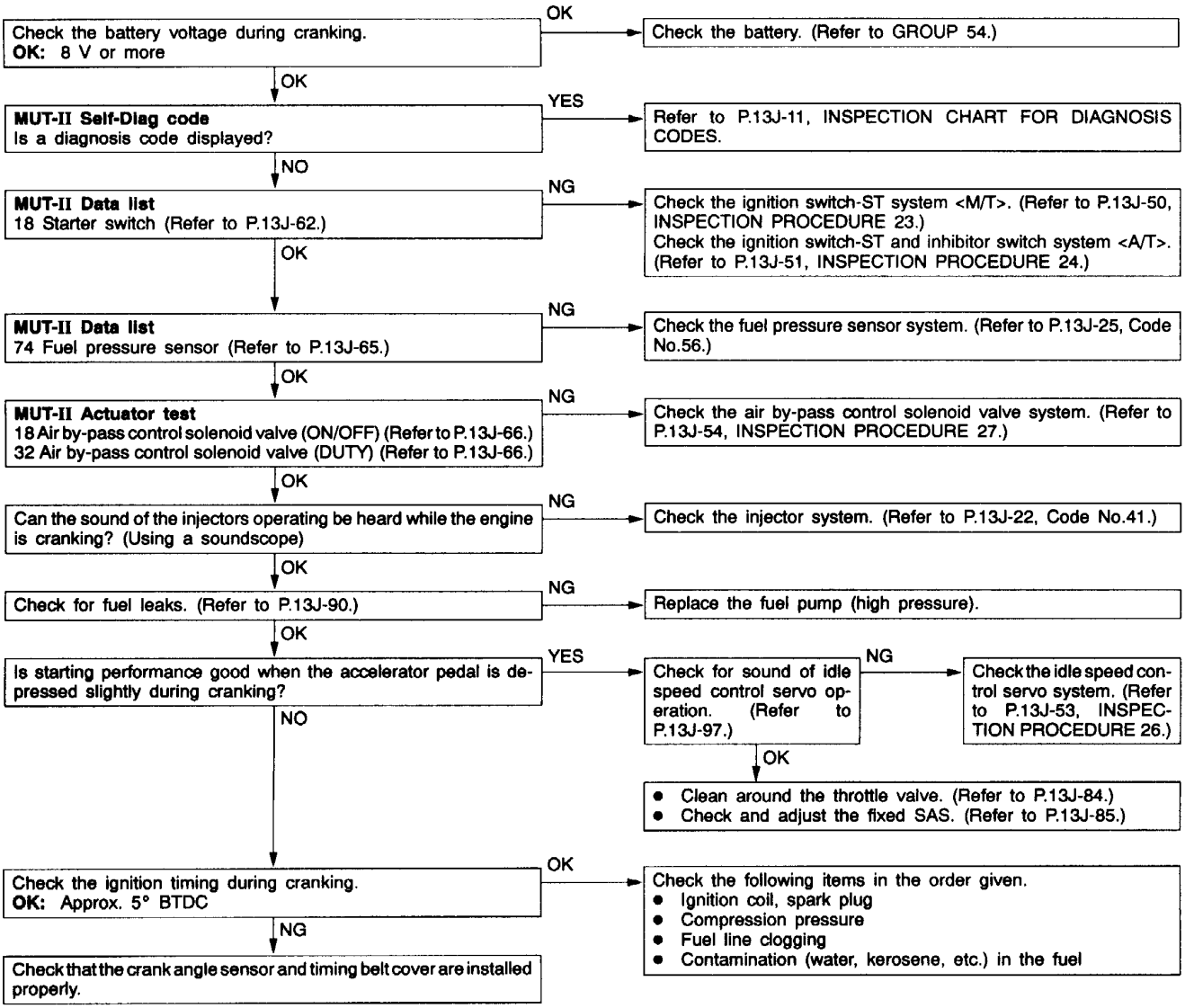
INSPECTION PROCEDURE 5

No initial combustion (starting impossible)	Probable cause
The cause is probably a problem with the supply of fuel to the combustion chambers or a malfunction of the ignition circuit. Furthermore, there is a slight possibility that the fuel is contaminated.	• Malfunction of the fuel supply system • Malfunction of the ignition system • Malfunction of the engine-ECU • Malfunction of the immobilizer-ECU



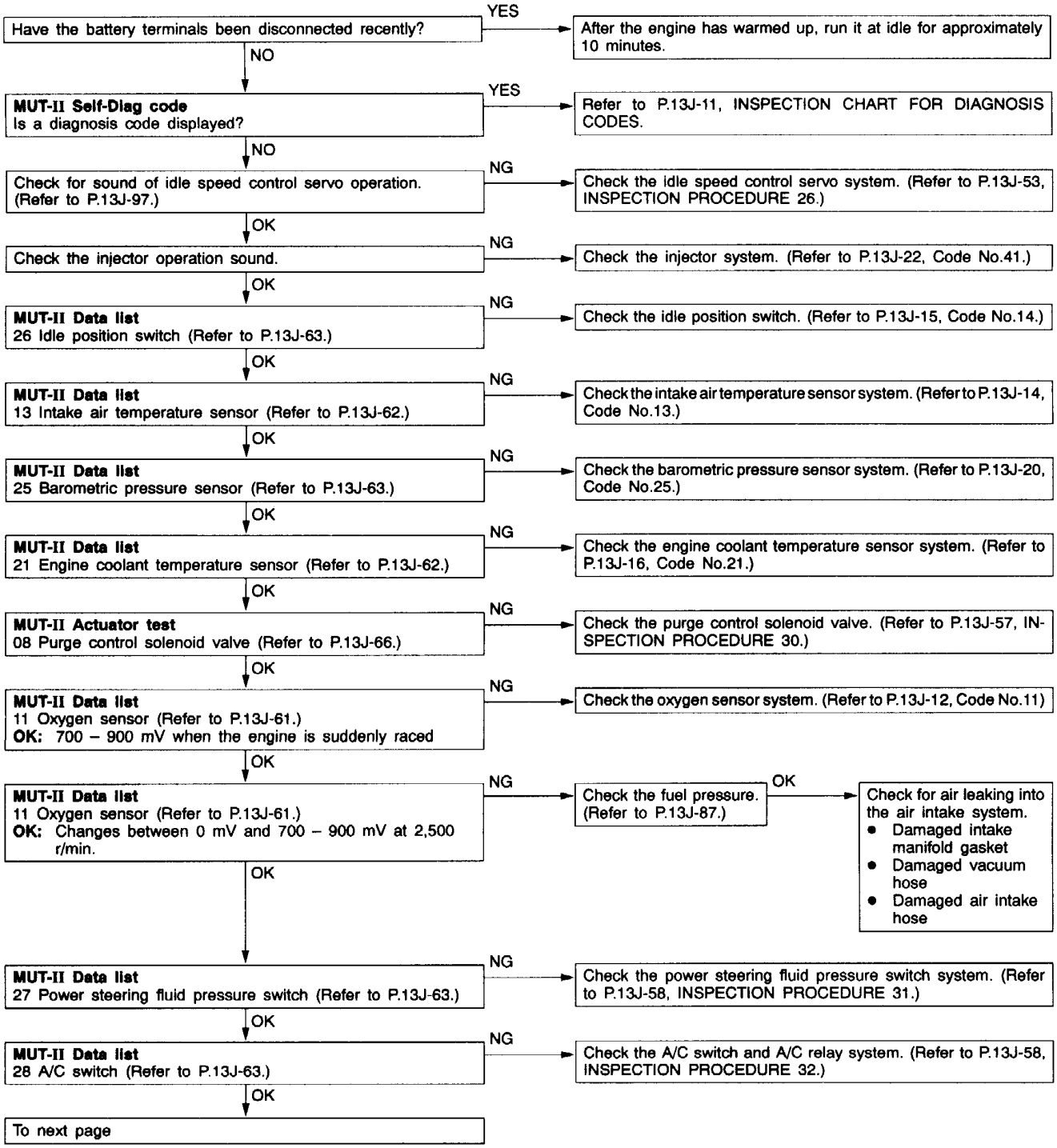
INSPECTION PROCEDURE 6

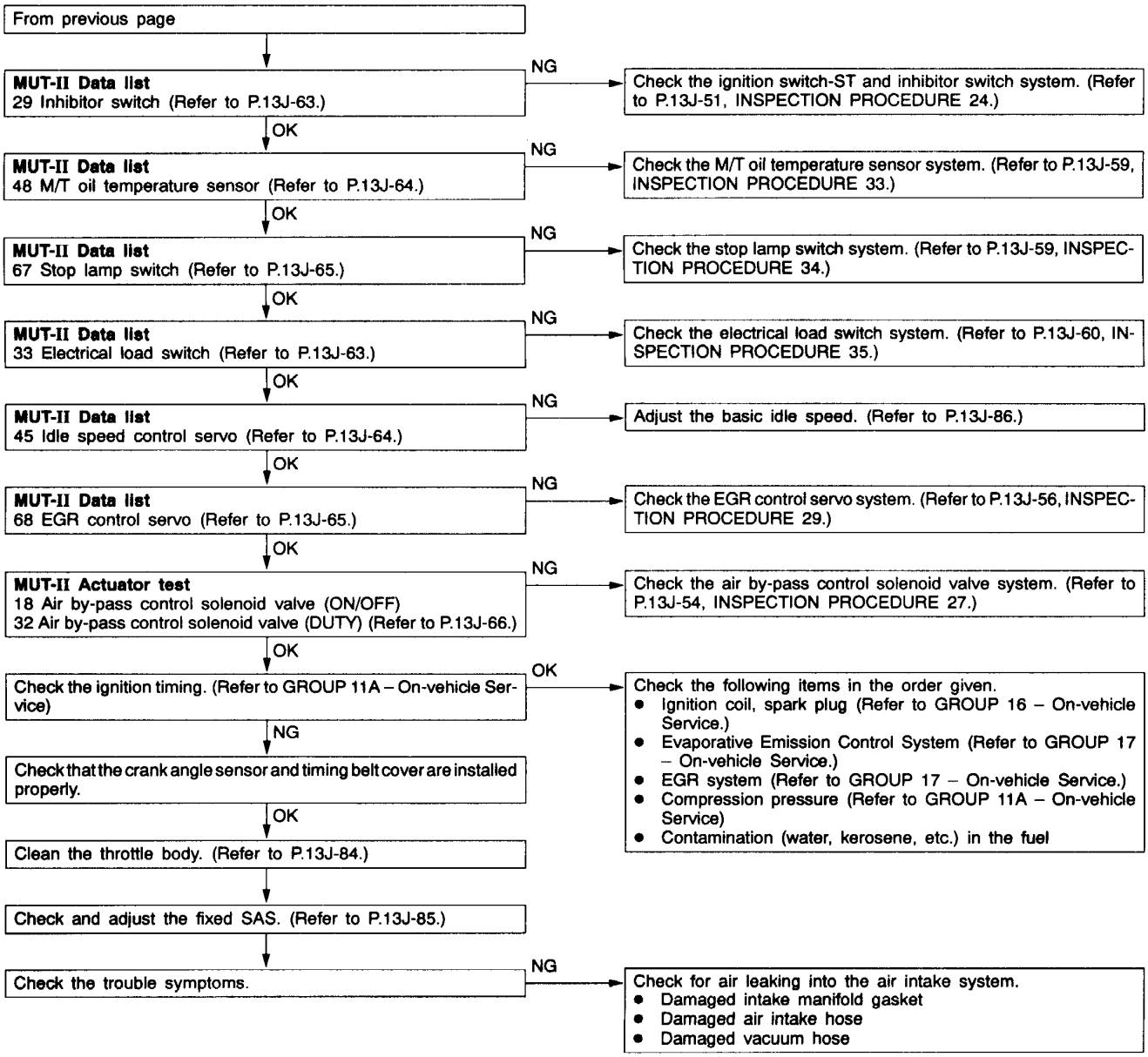
Initial combustion but no complete combustion (starting impossible) Long time to start (improper starting)	Probable cause
The cause is probably poor ignition due to a malfunctioning spark plug (weak spark), an incorrect air/fuel ratio when starting or incorrect fuel pressure switching.	• Malfunction of the fuel supply system • Malfunction of the fuel pressure sensor • Malfunction of the ignition system • Malfunction of the idle speed control system • Malfunction of the air by-pass control system • Malfunction of the engine-ECU



INSPECTION PROCEDURE 7

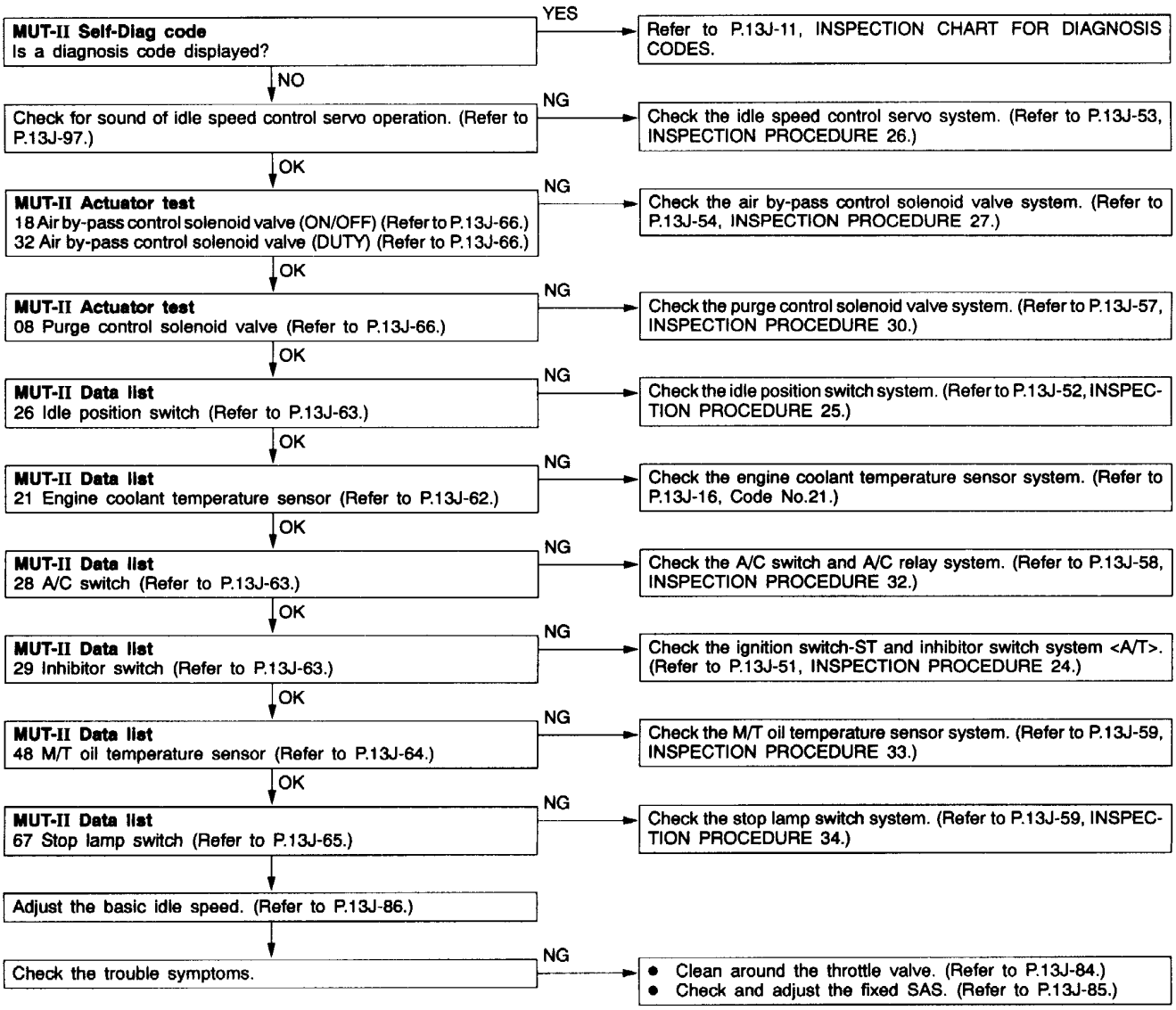
Unstable idling (Rough idling, hunting)	Probable cause
The cause is probably a malfunction of the ignition system, or incorrect air/fuel ratio, idle speed control, air by-pass control or compression pressure. Because the probable range of causes is so wide, checking starts from those items which are most likely to be the cause.	• Malfunction of the ignition system • Malfunction of air/fuel ratio control system • Malfunction of the idle speed control system • Malfunction of the air by-pass control system • Incorrect compression pressure • Air leaking into air intake system




From previous page
MUT-II Data list
29 Inhibitor switch (Refer to P.13J-63.)
NG
Check the ignition switch-ST and inhibitor switch system. (Refer to P.13J-51, INSPECTION PROCEDURE 24.)
OK
MUT-II Data list
48 M/T oil temperature sensor (Refer to P.13J-64.)
NG
Check the M/T oil temperature sensor system. (Refer to P.13J-59, INSPECTION PROCEDURE 33.)
OK
MUT-II Data list
67 Stop lamp switch (Refer to P.13J-65.)
NG
Check the stop lamp switch system. (Refer to P.13J-59, INSPECTION PROCEDURE 34.)
OK
MUT-II Data list
33 Electrical load switch (Refer to P.13J-63.)
NG
Check the electrical load switch system. (Refer to P.13J-60, INSPECTION PROCEDURE 35.)
OK
MUT-II Data list
45 Idle speed control servo (Refer to P.13J-64.)
NG
Adjust the basic idle speed. (Refer to P.13J-86.)
OK
MUT-II Data list
68 EGR control servo (Refer to P.13J-65.)
NG
Check the EGR control servo system. (Refer to P.13J-56, INSPECTION PROCEDURE 29.)
OK
MUT-II Actuator test
18 Air by-pass control solenoid valve (ON/OFF)
32 Air by-pass control solenoid valve (DUTY) (Refer to P.13J-66.)
NG
Check the air by-pass control solenoid valve system. (Refer to P.13J-54, INSPECTION PROCEDURE 27.)
OK
Check the ignition timing. (Refer to GROUP 11A – On-vehicle Service)
OK
Check the following items in the order given.
• Ignition coil, spark plug (Refer to GROUP 16 – On-vehicle Service.)
• Evaporative Emission Control System (Refer to GROUP 17 – On-vehicle Service.)
• EGR system (Refer to GROUP 17 – On-vehicle Service.)
• Compression pressure (Refer to GROUP 11A – On-vehicle Service)
• Contamination (water, kerosene, etc.) in the fuel
NG
Check that the crank angle sensor and timing belt cover are installed properly.
OK
Clean the throttle body. (Refer to P.13J-84.)
Check and adjust the fixed SAS. (Refer to P.13J-85.)
Check the trouble symptoms.
NG
Check for air leaking into the air intake system.
• Damaged intake manifold gasket
• Damaged air intake hose
• Damaged vacuum hose

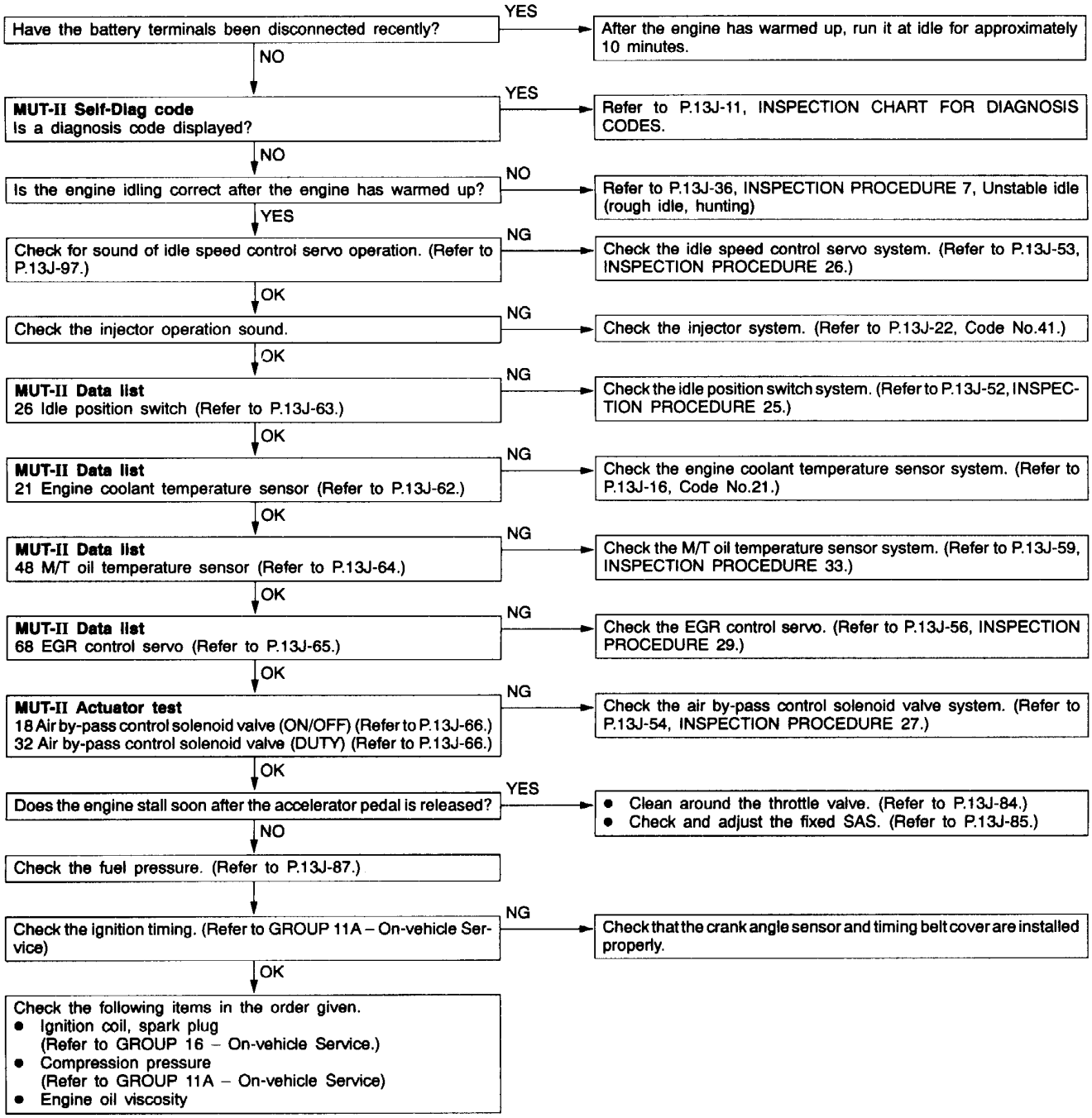
INSPECTION PROCEDURE 8

Idling speed is high, Idling speed is low (Improper idling speed)	Probable cause
The cause is probably that the intake air amount during idling is too great or too small.	• Malfunction of the idle speed control system • Malfunction of the air by-pass control system • Malfunction of the throttle body



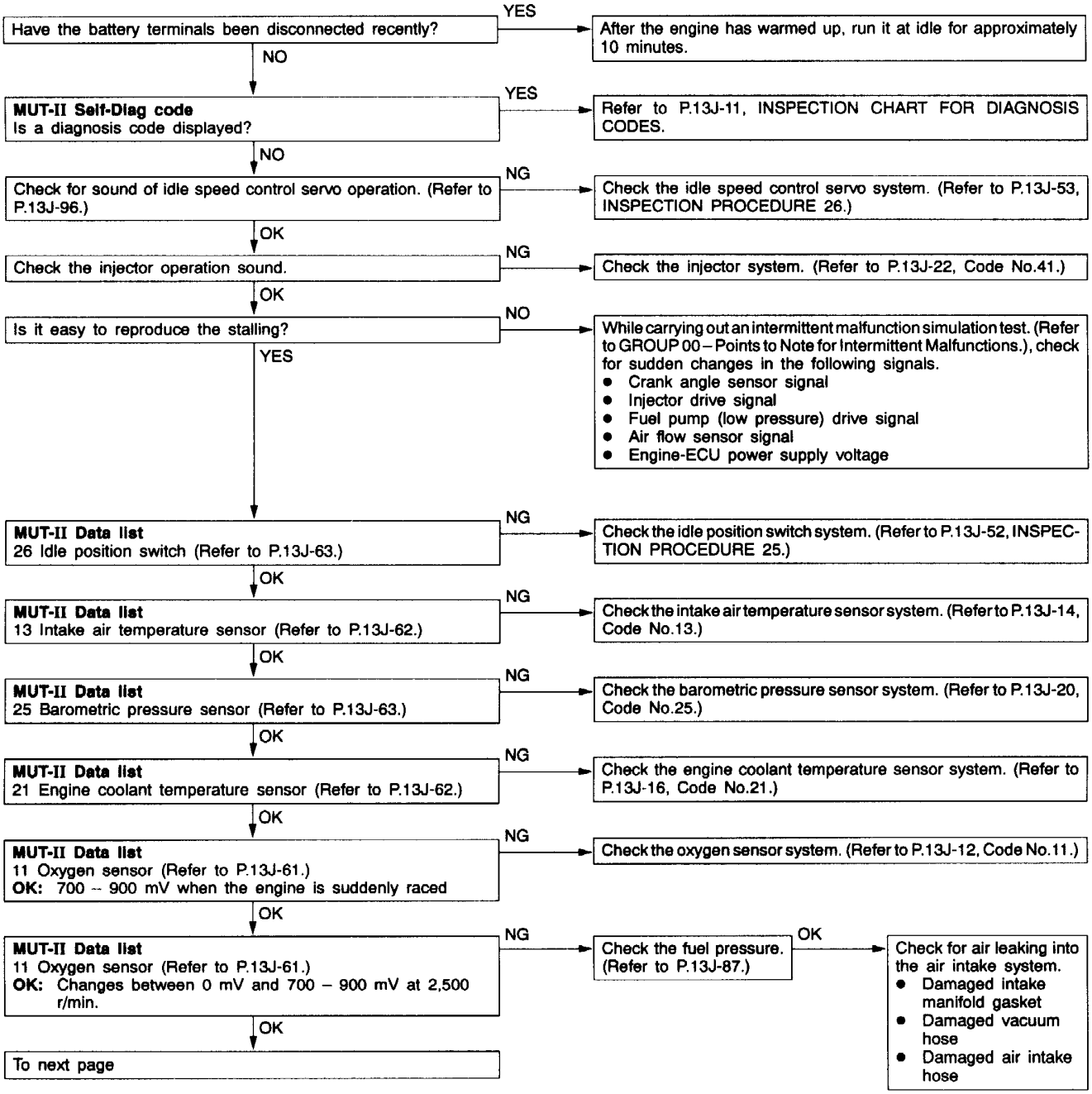
INSPECTION PROCEDURE 9

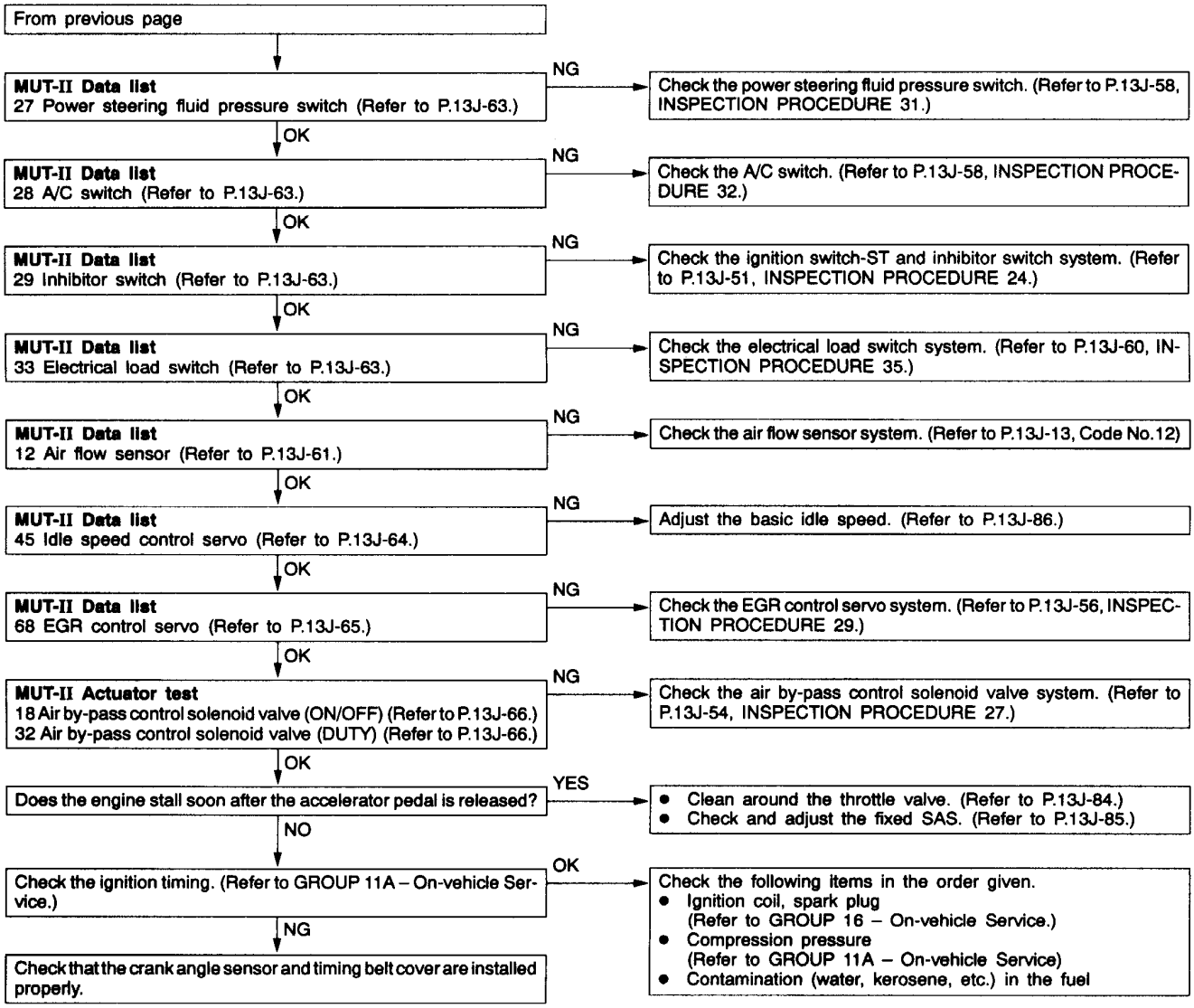
When the engine is cold, it stalls at idling. (Die out)	Probable cause
The cause is probably an incorrect air/fuel ratio when the engine is cold, or insufficient intake air.	• Malfunction of the idle speed control system • Malfunction of the air by-pass control system • Malfunction of the throttle body



INSPECTION PROCEDURE 10

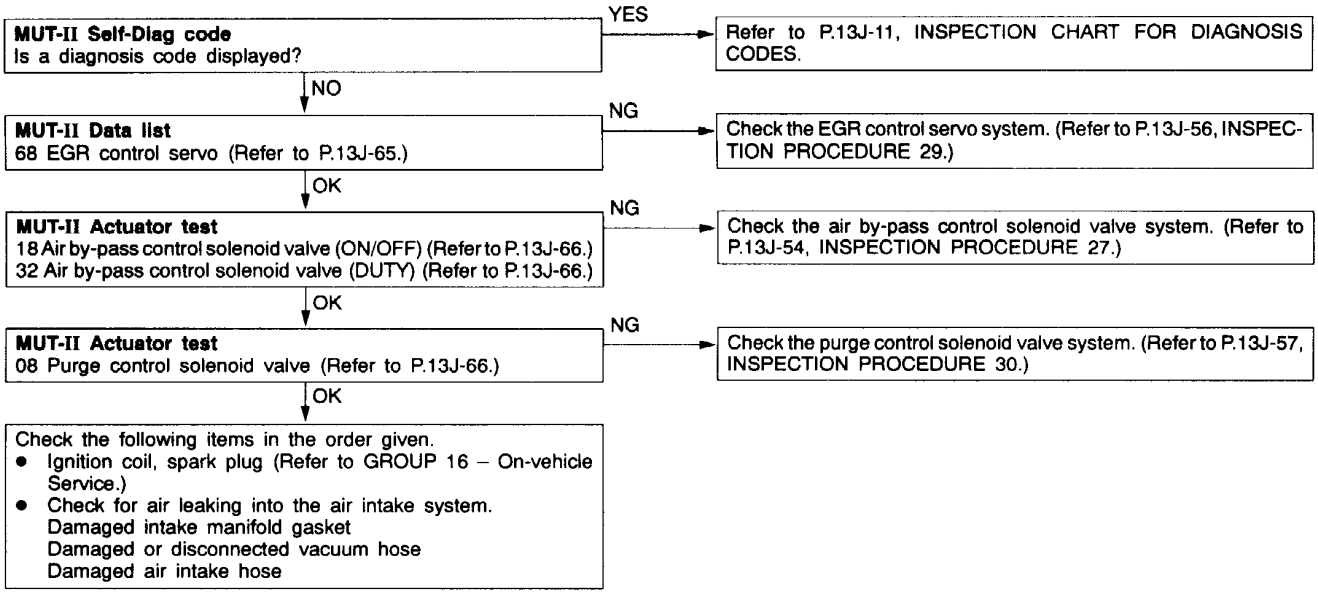
When the engine is hot, it stalls at idling. (Die out)	Probable cause
The cause is probably a malfunction of the ignition system, or incorrect air/fuel ratio, idle speed control, air by-pass control or compression pressure. In addition, if the engine suddenly stalls, another possible cause might be a poor connector contact.	• Malfunction of the ignition system • Malfunction of the air/fuel ratio control system • Malfunction of the idle speed control system • Malfunction of the air by-pass control system • Malfunction of the throttle body • Poor connector contact • Air leaking into air intake system




From previous page
MUT-II Data list
27 Power steering fluid pressure switch (Refer to P.13J-63.)
NG
Check the power steering fluid pressure switch. (Refer to P.13J-58, INSPECTION PROCEDURE 31.)
OK
MUT-II Data list
28 A/C switch (Refer to P.13J-63.)
NG
Check the A/C switch. (Refer to P.13J-58, INSPECTION PROCEDURE 32.)
OK
MUT-II Data list
29 Inhibitor switch (Refer to P.13J-63.)
NG
Check the ignition switch-ST and inhibitor switch system. (Refer to P.13J-51, INSPECTION PROCEDURE 24.)
OK
MUT-II Data list
33 Electrical load switch (Refer to P.13J-63.)
NG
Check the electrical load switch system. (Refer to P.13J-60, INSPECTION PROCEDURE 35.)
OK
MUT-II Data list
12 Air flow sensor (Refer to P.13J-61.)
NG
Check the air flow sensor system. (Refer to P.13J-13, Code No.12)
OK
MUT-II Data list
45 Idle speed control servo (Refer to P.13J-64.)
NG
Adjust the basic idle speed. (Refer to P.13J-86.)
OK
MUT-II Data list
68 EGR control servo (Refer to P.13J-65.)
NG
Check the EGR control servo system. (Refer to P.13J-56, INSPECTION PROCEDURE 29.)
OK
MUT-II Actuator test
18 Air by-pass control solenoid valve (ON/OFF) (Refer to P.13J-66.)
32 Air by-pass control solenoid valve (DUTY) (Refer to P.13J-66.)
NG
Check the air by-pass control solenoid valve system. (Refer to P.13J-54, INSPECTION PROCEDURE 27.)
OK
Does the engine stall soon after the accelerator pedal is released?
YES
• Clean around the throttle valve. (Refer to P.13J-84.)
• Check and adjust the fixed SAS. (Refer to P.13J-85.)
NO
Check the ignition timing. (Refer to GROUP 11A – On-vehicle Service.)
OK
Check the following items in the order given.
• Ignition coil, spark plug (Refer to GROUP 16 – On-vehicle Service.)
• Compression pressure (Refer to GROUP 11A – On-vehicle Service)
• Contamination (water, kerosene, etc.) in the fuel
NG
Check that the crank angle sensor and timing belt cover are installed properly.

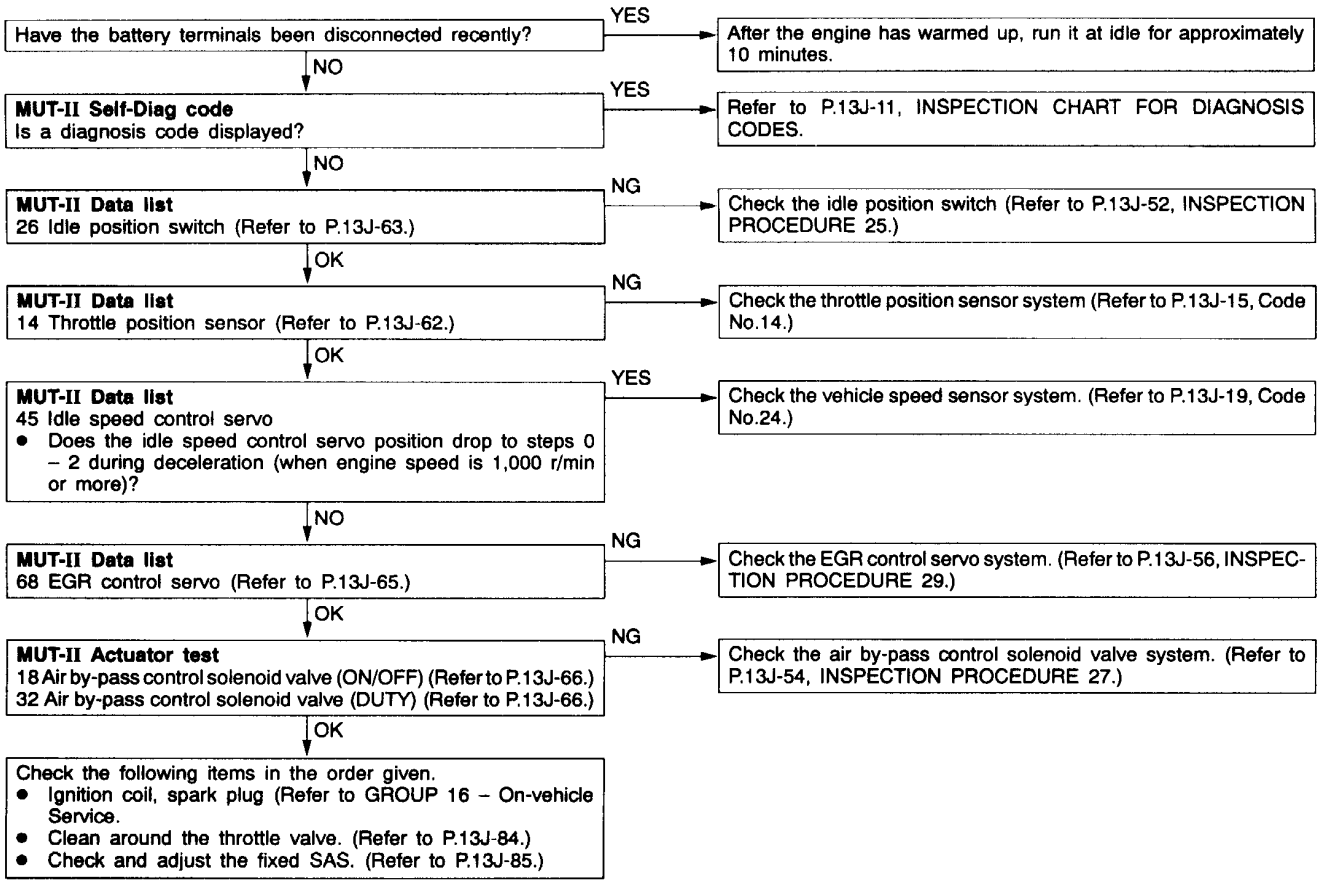
INSPECTION PROCEDURE 11

The engine stalls when starting the car. (Pass out)	Probable cause
The cause is probably poor ignition due to a malfunctioning spark plug (weak spark), or an incorrect air/fuel ratio when the accelerator is depressed.	• Malfunction of the ignition system • Malfunction of the air by-pass control system • Malfunction of the EGR control servo • Air leaking into air intake system



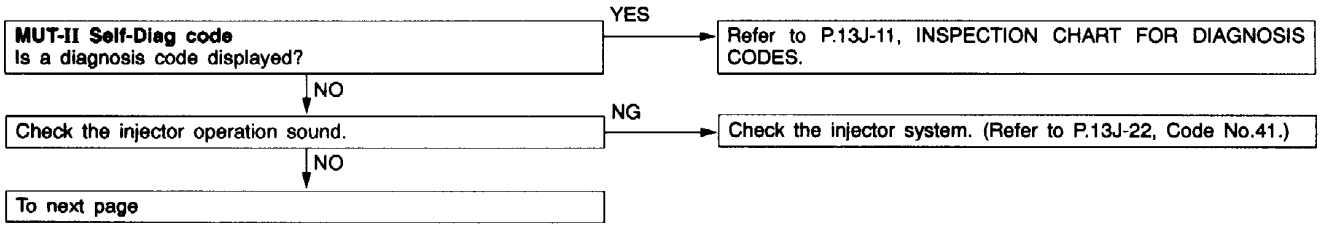
INSPECTION PROCEDURE 12

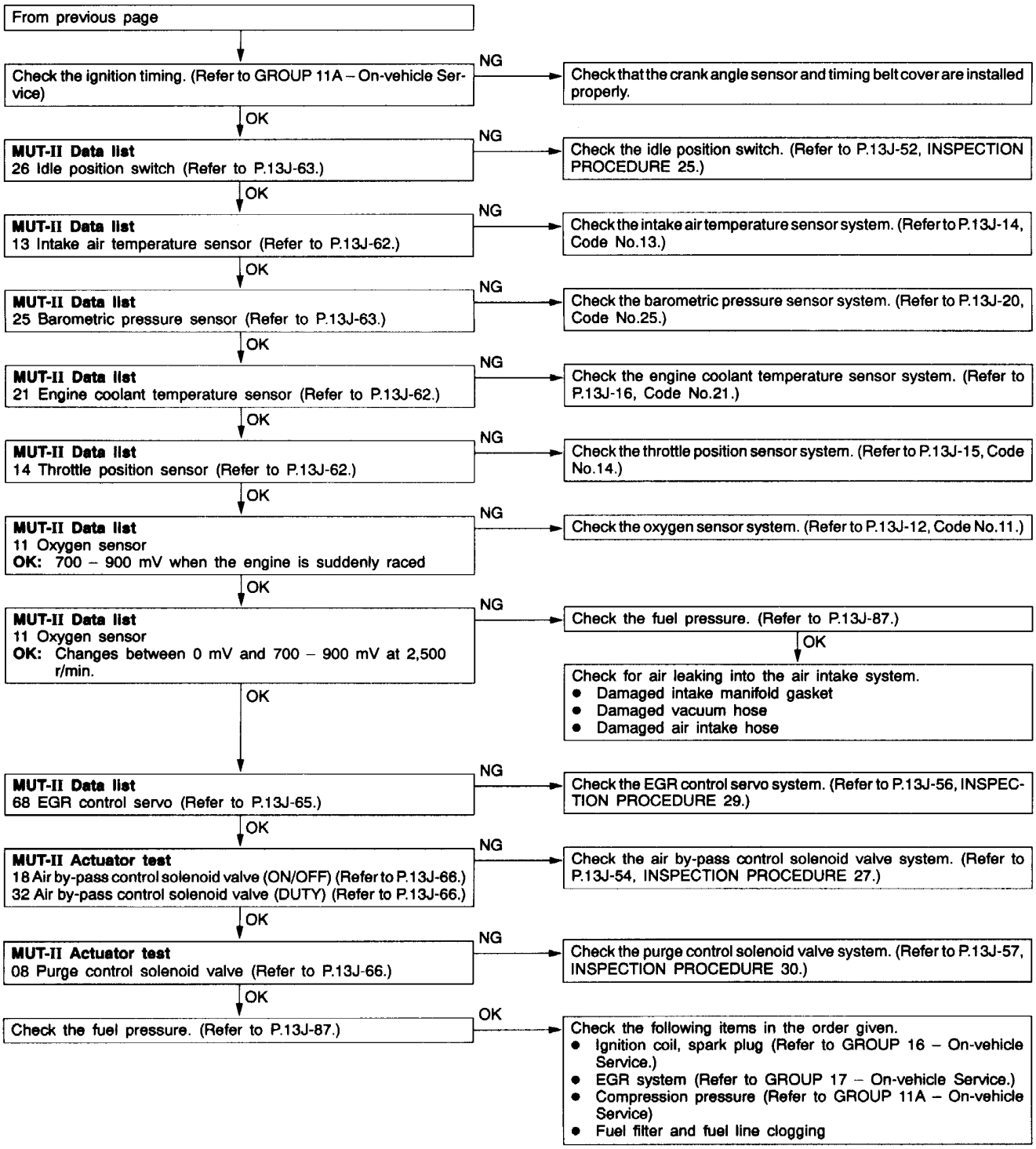
The engine stalls when decelerating	Probable cause
The cause is probably insufficient intake air due to an idle speed control malfunction, or incorrect air/fuel ratio due to an air by-pass control or EGR malfunction.	• Malfunction of the idle speed control system • Malfunction of the air by-pass control system • Malfunction of the EGR control servo



INSPECTION PROCEDURE 13

Hesitation, sag, stumble, poor acceleration or surge	Probable cause
The cause is probably a malfunction of the ignition system, or incorrect air/fuel ratio, air by-pass control or compression pressure.	• Malfunction of the ignition system • Malfunction of the air/fuel ratio control system • Malfunction of the air by-pass control system • Poor compression pressure • Air leaking into air intake system




From previous page
Check the ignition timing. (Refer to GROUP 11A – On-vehicle Service)
NG
Check that the crank angle sensor and timing belt cover are installed properly.
OK
MUT-II Data list
26 Idle position switch (Refer to P.13J-63.)
NG
Check the idle position switch. (Refer to P.13J-52, INSPECTION PROCEDURE 25.)
OK
MUT-II Data list
13 Intake air temperature sensor (Refer to P.13J-62.)
NG
Check the intake air temperature sensor system. (Refer to P.13J-14, Code No.13.)
OK
MUT-II Data list
25 Barometric pressure sensor (Refer to P.13J-63.)
NG
Check the barometric pressure sensor system. (Refer to P.13J-20, Code No.25.)
OK
MUT-II Data list
21 Engine coolant temperature sensor (Refer to P.13J-62.)
NG
Check the engine coolant temperature sensor system. (Refer to P.13J-16, Code No.21.)
OK
MUT-II Data list
14 Throttle position sensor (Refer to P.13J-62.)
NG
Check the throttle position sensor system. (Refer to P.13J-15, Code No.14.)
OK
MUT-II Data list
11 Oxygen sensor
OK: 700 – 900 mV when the engine is suddenly raced
NG
Check the oxygen sensor system. (Refer to P.13J-12, Code No.11.)
OK
MUT-II Data list
11 Oxygen sensor
OK: Changes between 0 mV and 700 – 900 mV at 2,500 r/min.
NG
Check the fuel pressure. (Refer to P.13J-87.)
OK
Check for air leaking into the air intake system.
• Damaged intake manifold gasket
• Damaged vacuum hose
• Damaged air intake hose
OK
MUT-II Data list
68 EGR control servo (Refer to P.13J-65.)
NG
Check the EGR control servo system. (Refer to P.13J-56, INSPECTION PROCEDURE 29.)
OK
MUT-II Actuator test
18 Air by-pass control solenoid valve (ON/OFF) (Refer to P.13J-66.)
32 Air by-pass control solenoid valve (DUTY) (Refer to P.13J-66.)
NG
Check the air by-pass control solenoid valve system. (Refer to P.13J-54, INSPECTION PROCEDURE 27.)
OK
MUT-II Actuator test
08 Purge control solenoid valve (Refer to P.13J-66.)
NG
Check the purge control solenoid valve system. (Refer to P.13J-57, INSPECTION PROCEDURE 30.)
OK
Check the fuel pressure. (Refer to P.13J-87.)
OK
Check the following items in the order given.
• Ignition coil, spark plug (Refer to GROUP 16 – On-vehicle Service.)
• EGR system (Refer to GROUP 17 – On-vehicle Service.)
• Compression pressure (Refer to GROUP 11A – On-vehicle Service)
• Fuel filter and fuel line clogging

INSPECTION PROCEDURE 14

The feeling of impact when accelerating	Probable cause
The cause is probably an ignition leak being generated in line with an increase in the spark plug demand voltage during acceleration.	• Malfunction of the ignition system

MUT-II Self-Diag code
Is a diagnosis code displayed?
YES → Refer to P.13J-11, INSPECTION CHART FOR DIAGNOSIS CODES.
NO ↓
Check the following items in the order given.
- Ignition coil, spark plug
- Ignition leak.

INSPECTION PROCEDURE 15

The feeling of impact when decelerating	Probable cause
The cause is probably insufficient intake air due to an idle speed control malfunction.	• Malfunction of the idle speed control system

MUT-II Self-Diag code
Is a diagnosis code displayed?
YES → Refer to P.13J-11, INSPECTION CHART FOR DIAGNOSIS CODES.
NO ↓
Check for sound of idle speed control servo operation. (Refer to P.13J-97.)
NG → Check the idle speed control servo system. (Refer to P.13J-53, INSPECTION PROCEDURE 26.)
OK ↓
MUT-II Data list
14 Throttle position sensor (Refer to P.13J-62.)
NG → Check the throttle position sensor system. (Refer to P.13J-15, Code No.14.)
OK ↓
MUT-II Data list
26 Idle position switch (Refer to P.13J-63.)
NG → Check the idle position switch system. (Refer to P.13J-52, INSPECTION PROCEDURE 25.)
OK ↓
Clean around the throttle valve. (Refer to P.13J-84.)

INSPECTION PROCEDURE 16

Knocking	Probable cause
The cause is probably incorrect detonation control or an incorrect heating value for the spark plugs.	• Malfunction of the detonation sensor • Incorrect heat value of the spark plug

MUT-II Self-Diag code
Is a diagnosis code displayed?
YES → Refer to P.13J-11, INSPECTION CHART FOR DIAGNOSIS CODES.
NO ↓
Does knocking occur when driving while the detonation sensor connector is disconnected? (At this time, use the MUT-II to check whether the ignition timing is retarded from when the detonation sensor connector is connected.)
NO → Check the idle speed control servo system. (Refer to P.13J-53, INSPECTION PROCEDURE 26.)
YES ↓
Check the following items in the order given.
- Spark plug
- Contamination (water, kerosene, etc.) in the fuel

INSPECTION PROCEDURE 17

Run-on (Dieseling)	Probable cause
The cause is probably a leaking injector.	• Malfunction of the injector

Replace the injector.

INSPECTION PROCEDURE 18

Too high CO and HC concentration when idling	Probable cause
The cause is probably an incorrect air/fuel ratio.	• Malfunction of the air/fuel ration control system • Deterioration of the catalyst

MUT-II Self-Diag code
Is a diagnosis code displayed?
YES → Refer to P.13J-11, INSPECTION CHART FOR DIAGNOSIS CODES.
NO ↓

Check the ignition timing. (Refer to GROUP 11A – On-vehicle Service.)
NG → Check that the crank angle sensor and timing belt cover are installed properly.
OK ↓

MUT-II Data list
21 Engine coolant temperature sensor (Refer to P.13J-62.)
NG → Check the engine coolant temperature sensor system. (Refer to P.13J-16, Code No.21.)
OK ↓

MUT-II Data list
13 Intake air temperature sensor (Refer to P.13J-62.)
NG → Check the intake air temperature sensor system. (Refer to P.13J-14, Code No.13.)
OK ↓

MUT-II Data list
25 Barometric pressure sensor (Refer to P.13J-63.)
NG → Check the barometric pressure sensor system. (Refer to P.13J-20, Code No.25.)
OK ↓

MUT-II Data list
11 Oxygen sensor
OK: 700 – 900 mV when the engine is suddenly raced
NG → Check the oxygen sensor system. (Refer to P.13J-11, Code No.11.)
OK ↓

MUT-II Data list
11 Oxygen sensor
OK: Changes between 0 mV and 700 – 900 mV at 2,500 r/min.
OK → Replace the oxygen sensor.
Check the trouble symptoms.
NG ↓
NG → Check the fuel pressure. (Refer to P.13J-87.)
OK ↓

Check the following items in the order given.
- Ignition coil, spark plug (Refer to GROUP 16 – On-vehicle Service.)
- Compression pressure (Refer to GROUP 11A – On-vehicle Service.)
- Positive crankcase ventilation system (Refer to GROUP 17 – On-vehicle Service.)

OK ↓

MUT-II Data list
68 EGR control servo (Refer to P.13J-65.)
NG → Check the EGR control servo system. (Refer to P.13J-56, INSPECTION PROCEDURE 29.)
OK ↓

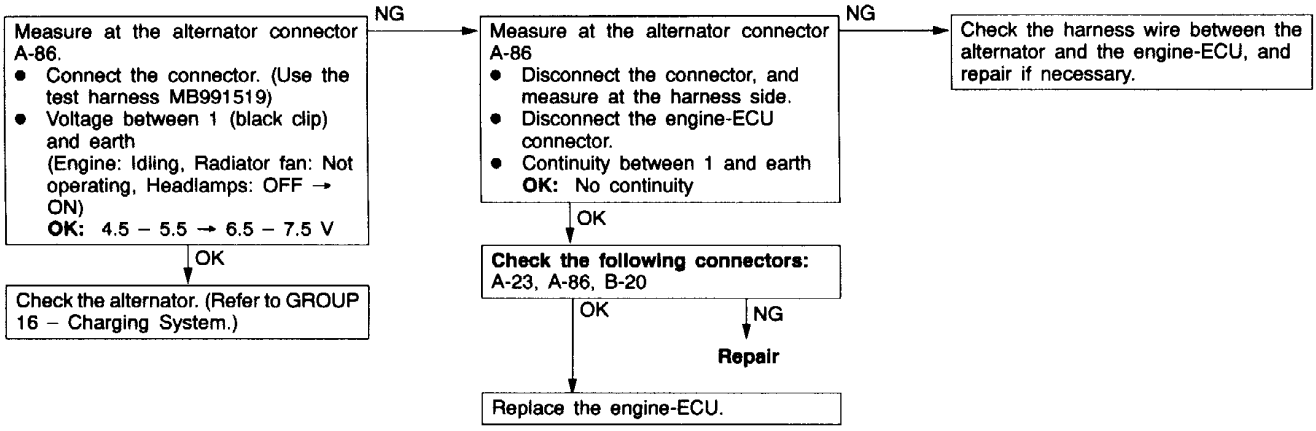
MUT-II Actuator test
08 Purge control solenoid valve (Refer to P.13J-66.)
NG → Check the purge control solenoid valve system. (Refer to P.13J-57, INSPECTION PROCEDURE 30.)
OK ↓

Check the trouble symptoms.
NG ↓

Replace the three-way catalytic converter.

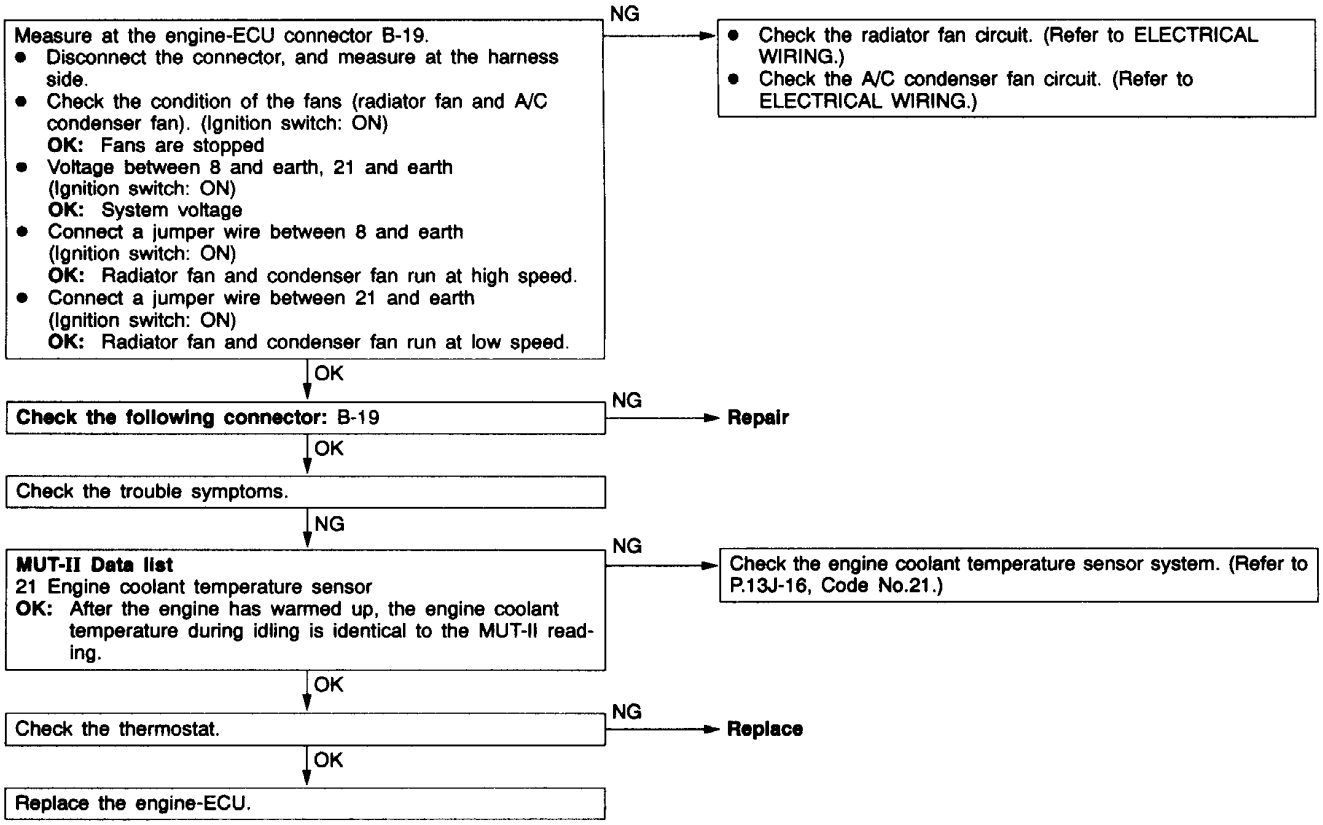
INSPECTION PROCEDURE 19

Low alternator output voltage (approx. 12.3 V)	Probable cause
The cause is probably a malfunction of the alternator or one of the problems listed at right.	• Malfunction of the charging system • Open circuit between the alternator G terminal and the engine-ECU • Malfunction of the engine-ECU



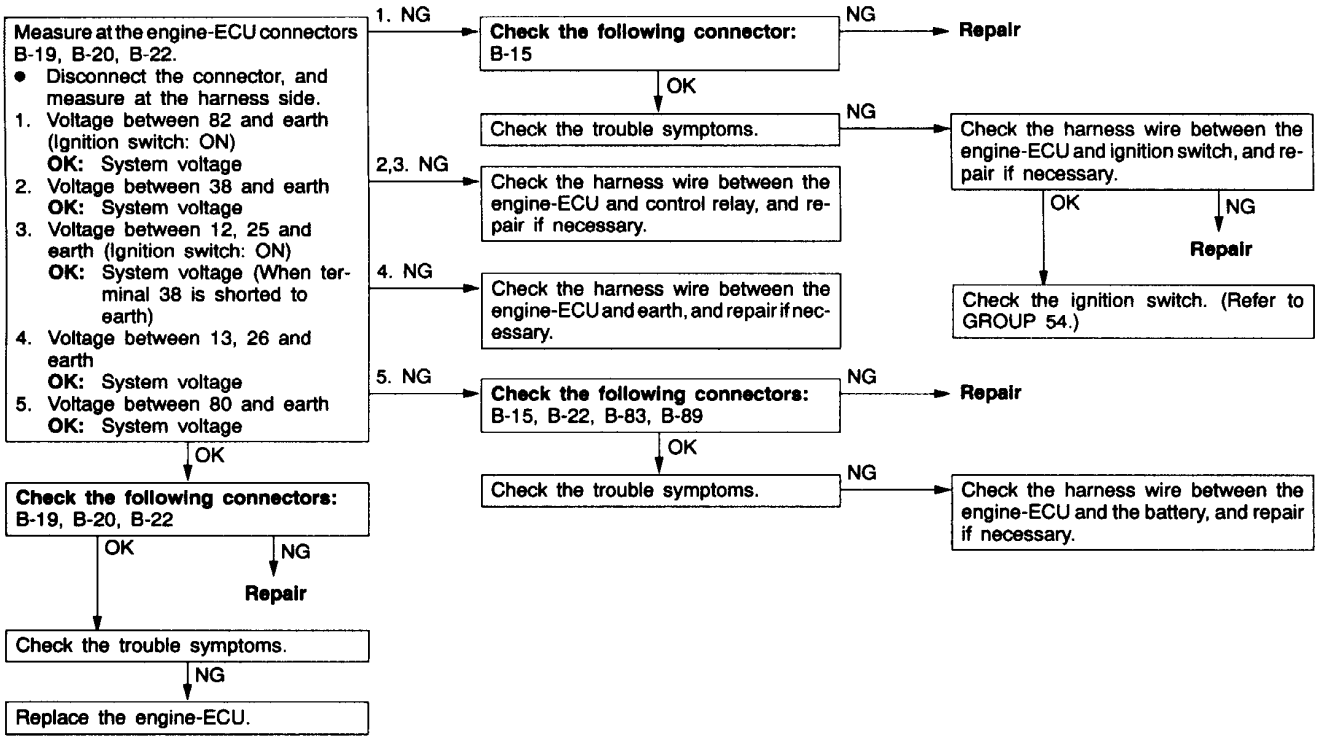
INSPECTION PROCEDURE 20

Fans (radiator fan, A/C condenser fan) are inoperative.	Probable cause
The fan motor relay is controlled by the power transistor inside the engine-ECU turning ON and OFF.	• Malfunction of the fan motor relay • Malfunction of the fan motor • Malfunction of the thermostat • Improper connector contact, open circuit or short-circuited harness wire • Malfunction of the engine-ECU



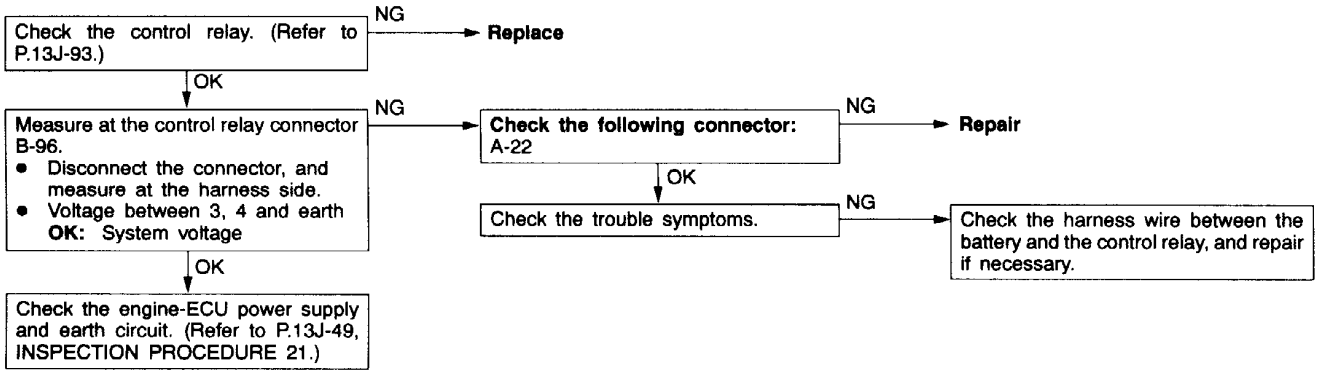
INSPECTION PROCEDURE 21

Engine-ECU power supply	Probable cause
The cause is probably a malfunction of the engine-ECU or one of the problems listed at right.	• Open circuit or short-circuited harness wire in the engine-ECU power supply circuit • Open circuit or short-circuited harness wire in the engine-ECU earth circuit • Malfunction of the engine-ECU



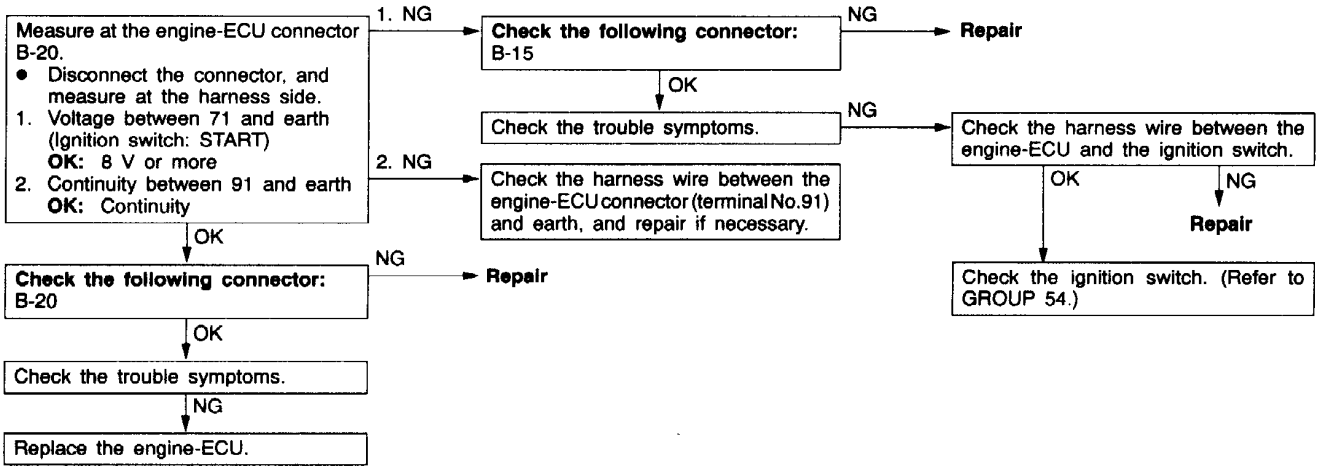
INSPECTION PROCEDURE 22

Control relay and ignition switch-IG system	Probable cause
When the ignition switch ON signal is input to the engine-ECU, the engine-ECU turns on the control relay. This causes system voltage to be supplied to the engine-ECU and to the sensors and actuators.	• Malfunction of the ignition switch • Malfunction of the control relay • Open circuit or short-circuited harness wire of the control relay circuit • Malfunction of the engine-ECU



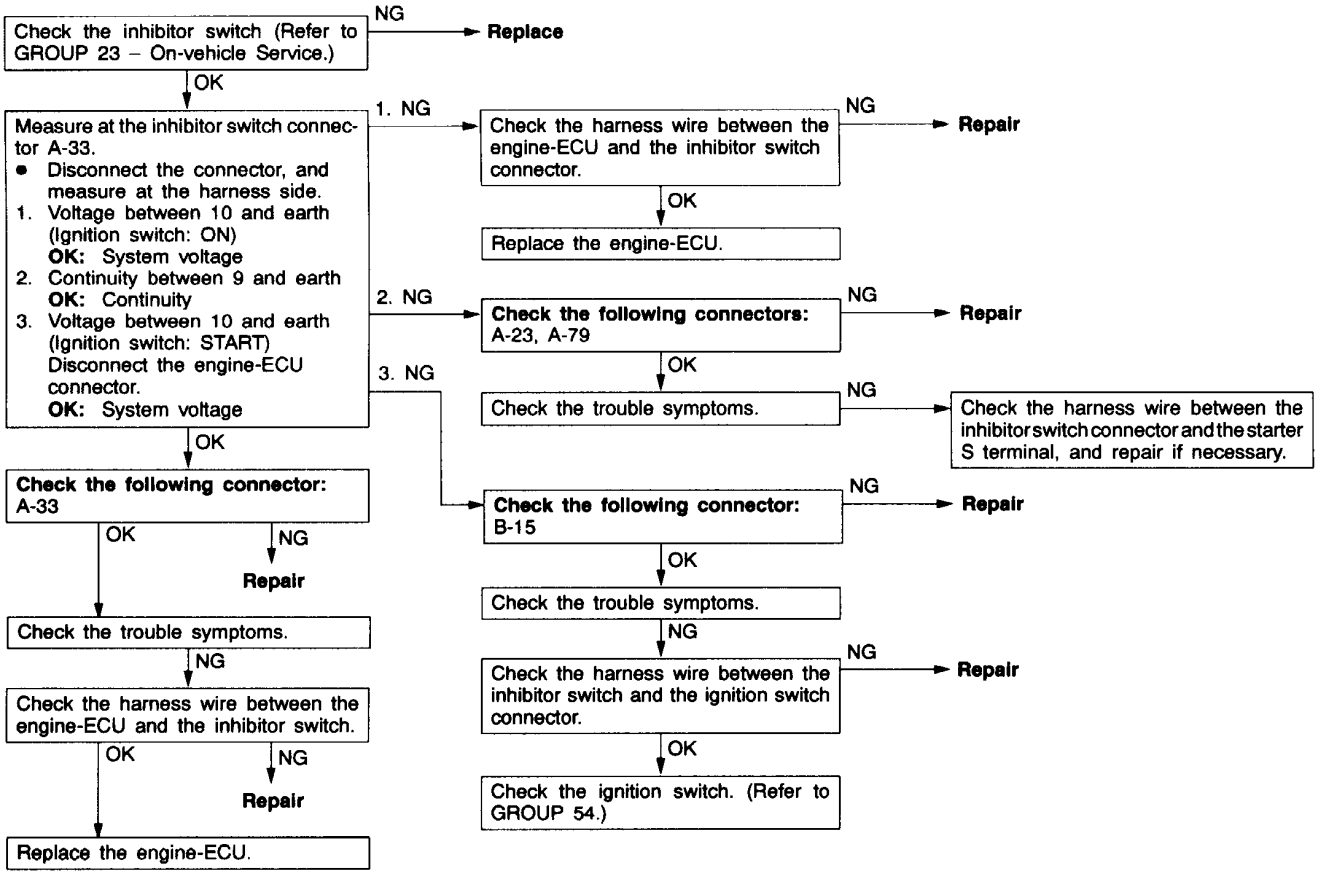
INSPECTION PROCEDURE 23

Ignition switch-ST system <M/T>	Probable cause
The ignition switch-ST outputs a HIGH signal to the engine-ECU while the engine is cranking. The engine-ECU uses this signal to carry out functions such as fuel injection control during starting.	• Malfunction of the ignition switch • Open circuit or short-circuited harness wire of the ignition switch circuit • Malfunction of the engine-ECU



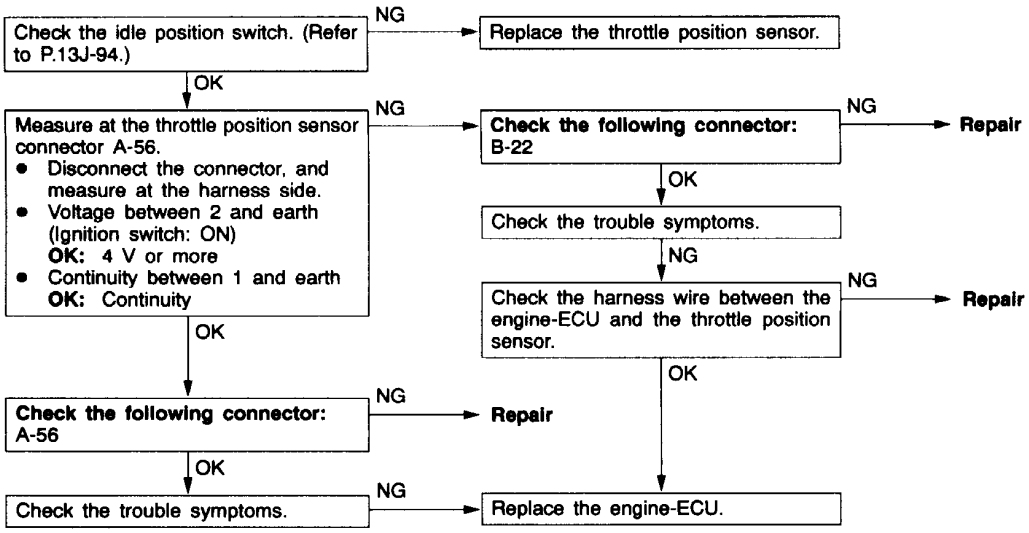
INSPECTION PROCEDURE 24

Ignition switch-ST and inhibitor switch system <A/T>	Probable cause
The ignition switch-ST outputs a HIGH signal to the engine-ECU while the engine is cranking, and the engine-ECU uses this signal to carry out functions such as fuel injection control during starting. The inhibitor switch inputs the position of the selector lever to the engine-ECU. The engine-ECU uses this signal to carry out idle speed control.	• Malfunction of the ignition switch • Malfunction of the inhibitor switch • Open circuit or short-circuited harness wire between ignition switch and inhibitor switch • Malfunction of the engine-ECU



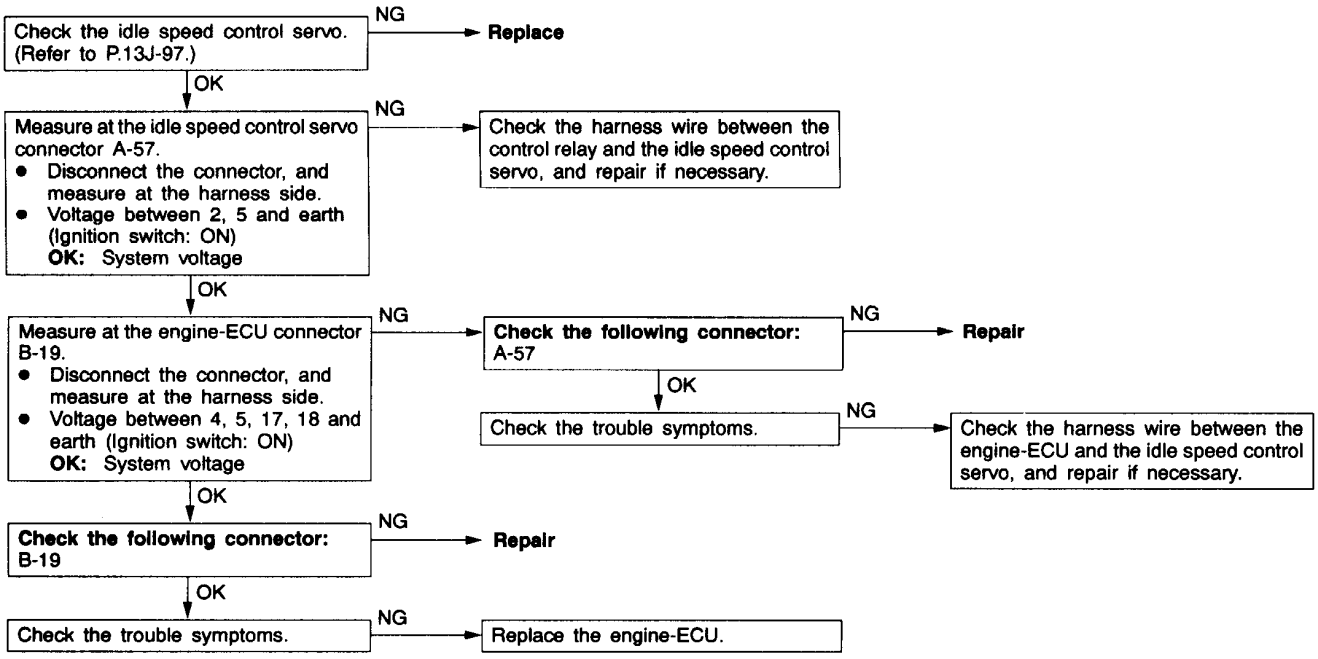
INSPECTION PROCEDURE 25

Idle position switch system	Probable cause
The idle position switch inputs a signal to the engine-ECU when the throttle lever is fully closed. The engine-ECU uses this signal to carry out idle speed control.	• Malfunction of the accelerator cable • Maladjustment of the fixed SAS • Maladjustment of the idle position switch and throttle position sensor • Open circuit or short-circuited harness wire in the idle position switch circuit • Malfunction of the engine-ECU



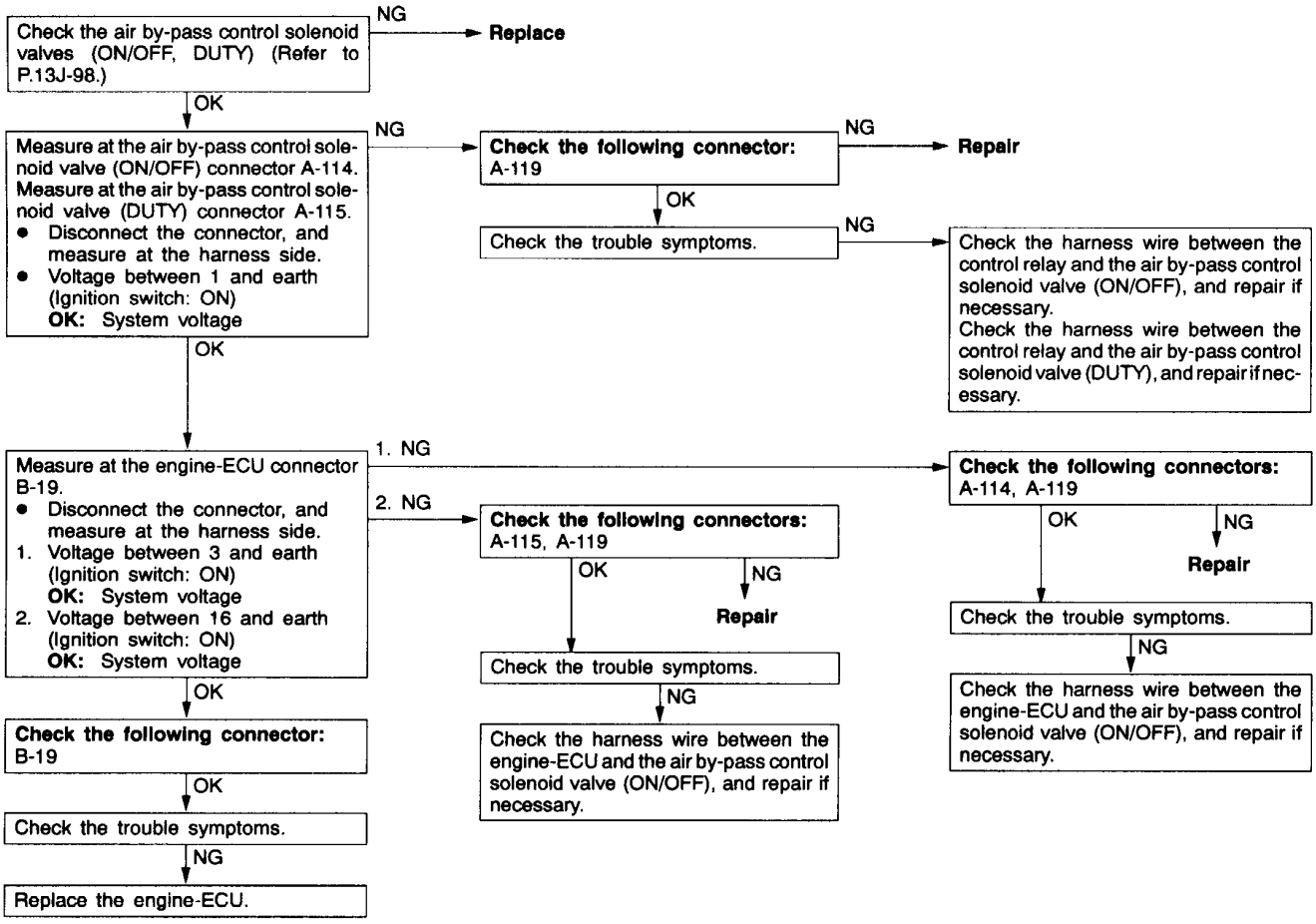
INSPECTION PROCEDURE 26

Idle speed control servo (ISC) system	Probable cause
The engine-ECU controls the amount of intake air during idling by opening and closing the servo valve which is located in the air by-pass passage.	• Malfunction of the idle speed control servo • Open circuit or short-circuited harness wire in the idle speed control servo circuit • Malfunction of the engine-ECU



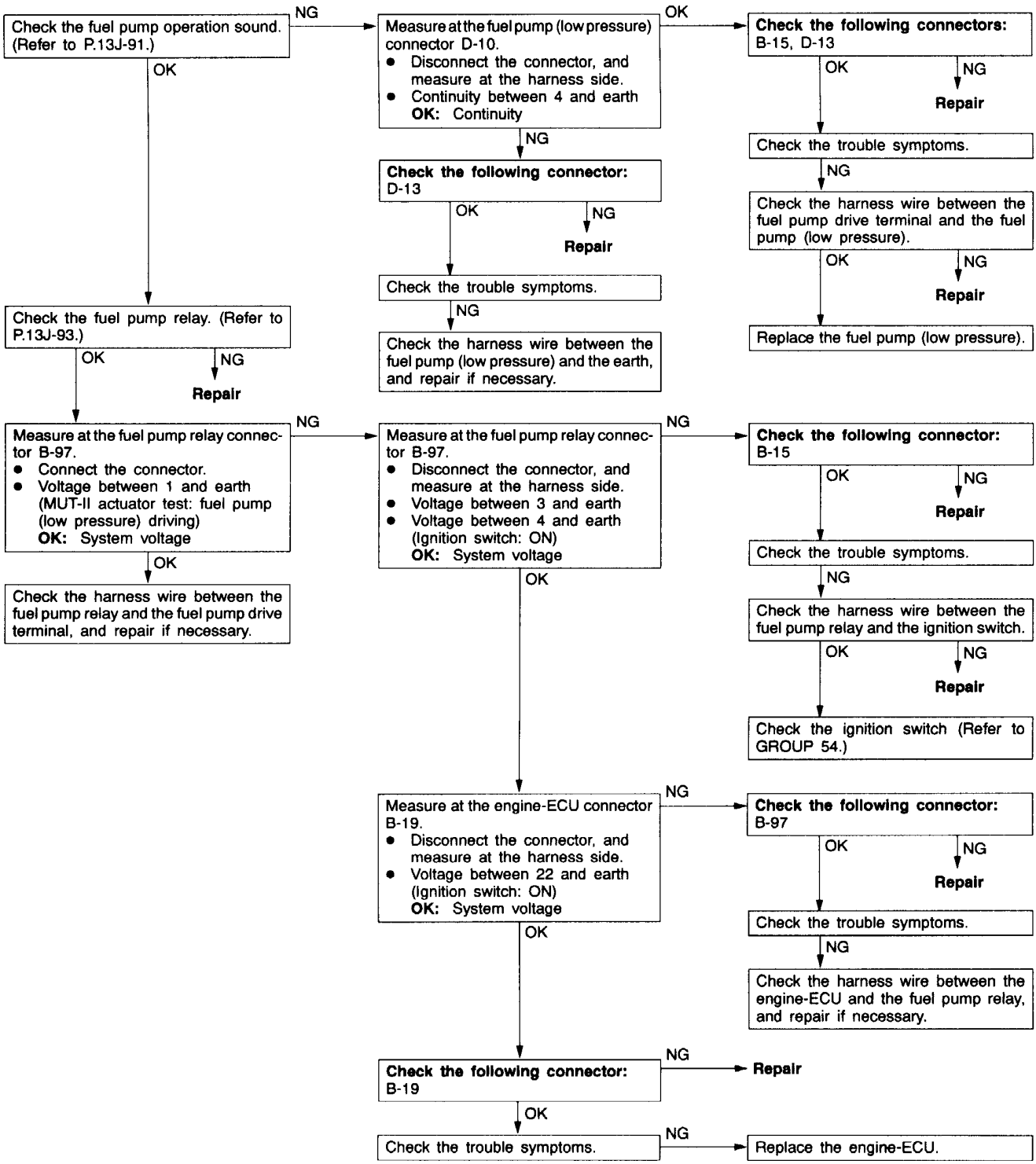
INSPECTION PROCEDURE 27

Air by-pass control solenoid valve system	Probable cause
The engine-ECU controls the two ON/OFF and DUTY solenoid valves in order to adjust the by-pass air amount.	• Malfunction of the air by-pass control solenoid valves (ON/OFF, DUTY) • Open circuit or short-circuited harness wire in the air by-pass control solenoid valves (ON/OFF, DUTY) • Malfunction of the engine-ECU



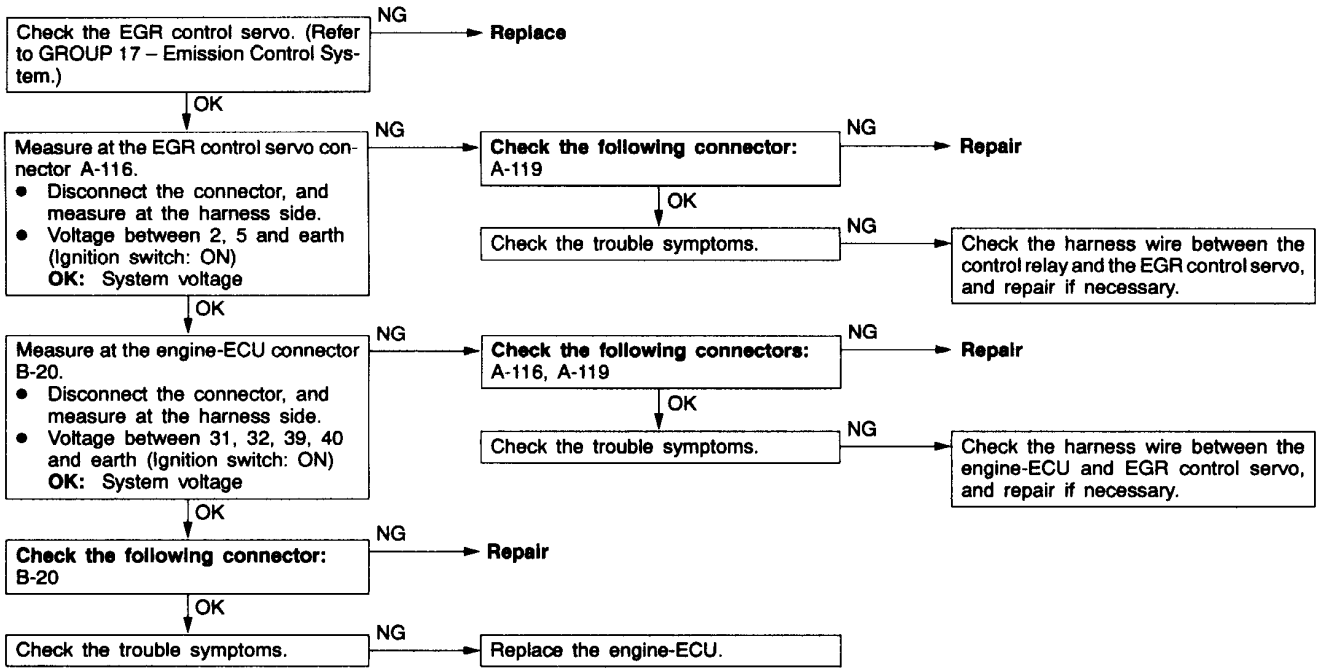
INSPECTION PROCEDURE 28

Fuel pump (low pressure) system	Probable cause
The engine-ECU turns on the fuel pump relay when the engine is cranking and when it is running, so that drive power is supplied to the fuel pump (low pressure).	• Malfunction of the fuel pump relay • Malfunction of the fuel pump (low pressure) system • Open circuit or short-circuited harness wire in the fuel pump (low pressure) drive circuit • Malfunction of the engine-ECU



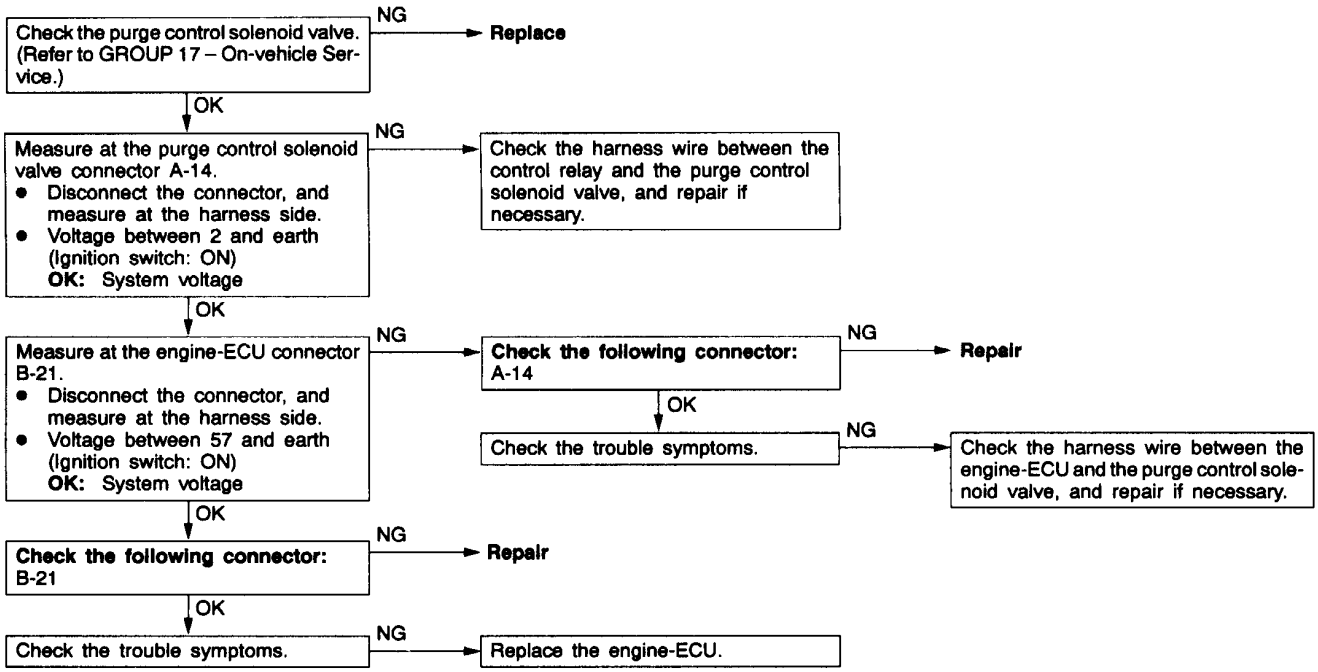
INSPECTION PROCEDURE 29

EGR control servo system	Probable cause
The engine-ECU controls the EGR control servo in order to control the amount of exhaust gas mixed in the intake air.	• Malfunction of the EGR control servo • Open circuit or short-circuited harness wire in the EGR control servo circuit • Malfunction of the engine-ECU



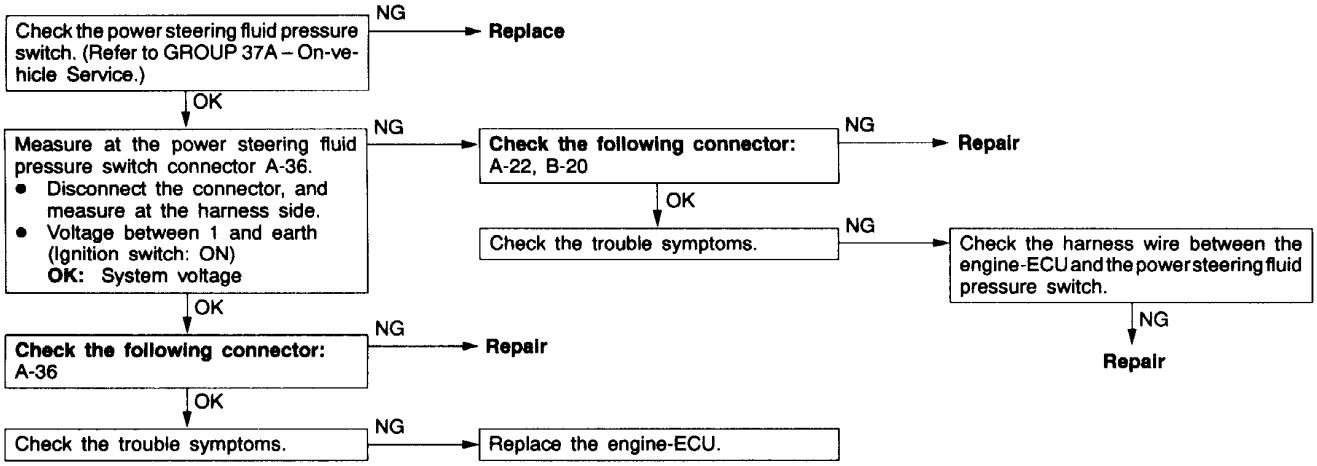
INSPECTION PROCEDURE 30

Purge control solenoid valve system	Probable cause
The engine-ECU controls the purge control solenoid valve in order to control the purge air coming from the canister.	• Malfunction of the purge control solenoid valve • Open circuit or short-circuited harness wire in the purge control solenoid valve circuit • Malfunction of the engine-ECU



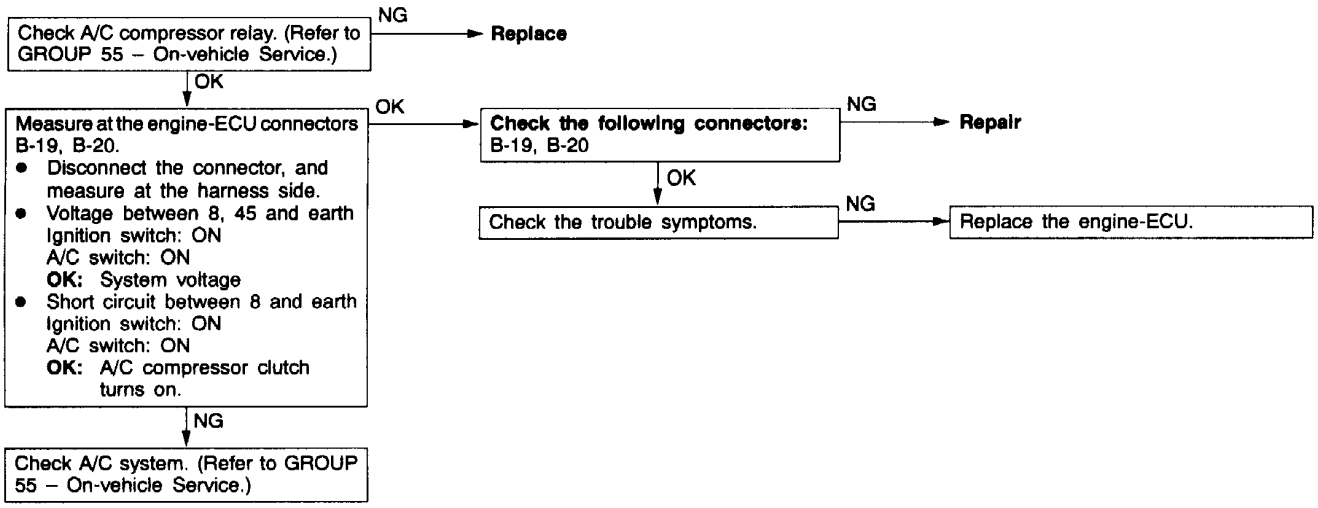
INSPECTION PROCEDURE 31

Power steering fluid pressure switch system	Probable cause
This switch inputs the amount of power steering load to the engine-ECU. The engine-ECU uses this input to control the idle speed control servo so that the idle speed is increased when the power steering is operating.	• Malfunction of the power steering fluid pressure switch • Open circuit or short-circuited harness wire in the power steering fluid pressure switch circuit • Malfunction of the engine-ECU



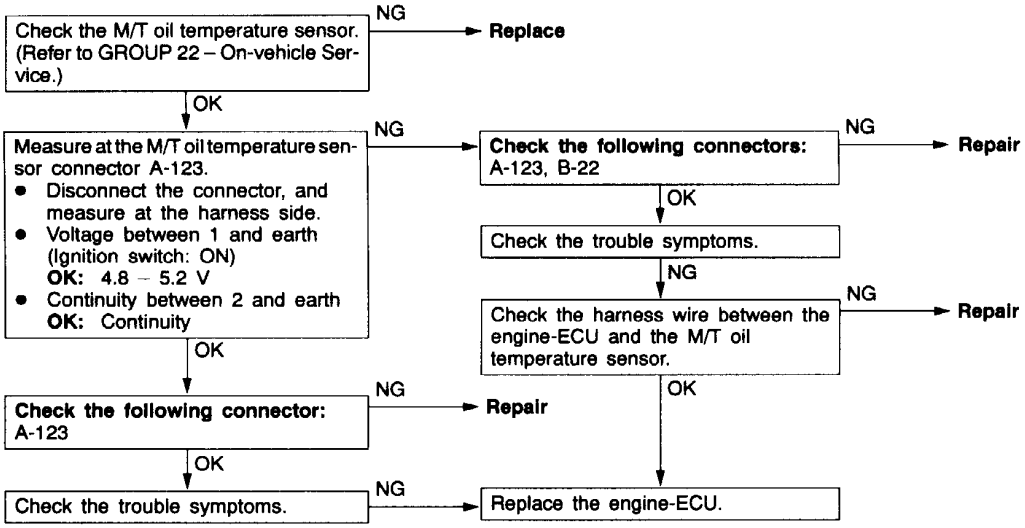
INSPECTION PROCEDURE 32

A/C switch and A/C relay system	Probable cause
When an A/C ON signal is input to the engine-ECU, the engine-ECU controls the idle speed control servo to increase the idle speed, and also operates the A/C compressor magnetic clutch.	• Malfunction of the A/C control system • Malfunction of the A/C switch • Open circuit or short-circuited harness wire in the A/C switch circuit • Malfunction of the engine-ECU



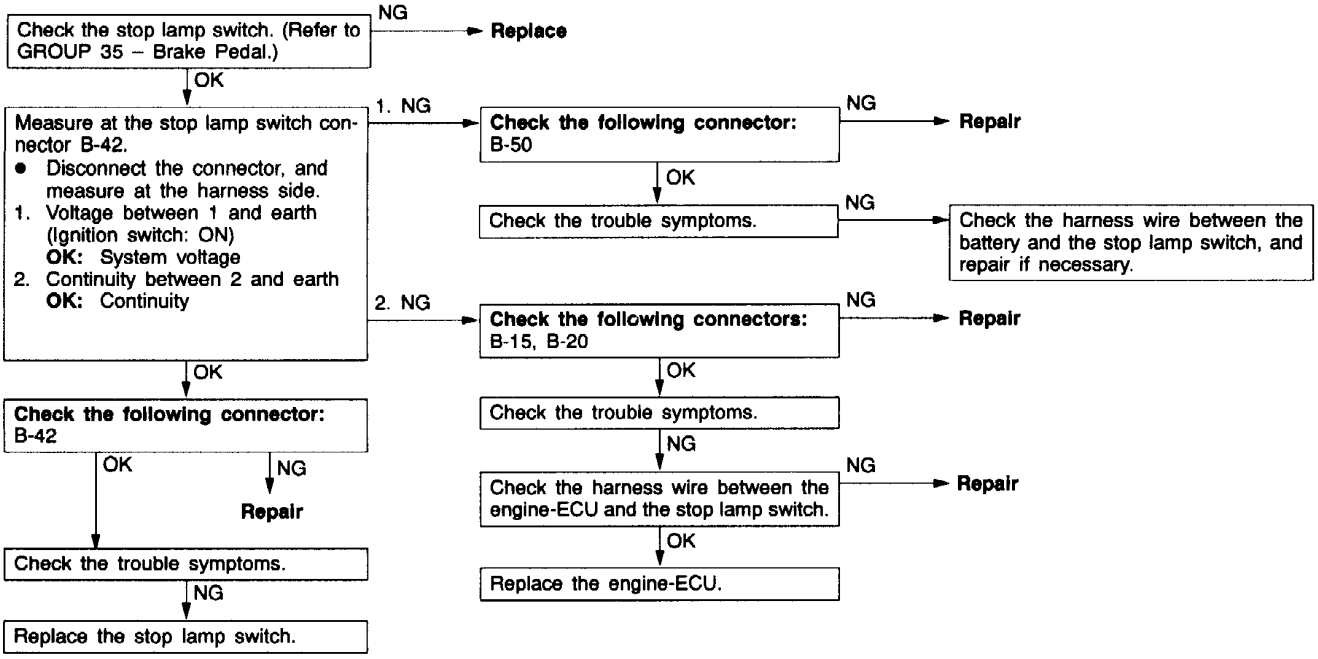
INSPECTION PROCEDURE 33

M/T oil temperature sensor system	Probable cause
This sensor inputs the manual transmission oil temperature to the engine-ECU. The engine-ECU uses this input to control the idle speed control servo so that the idle speed is increased when the manual transmission oil temperature becomes low.	• Malfunction of the M/T oil temperature sensor • Open circuit or short-circuited harness wire in the M/T oil temperature sensor circuit • Malfunction of the engine-ECU



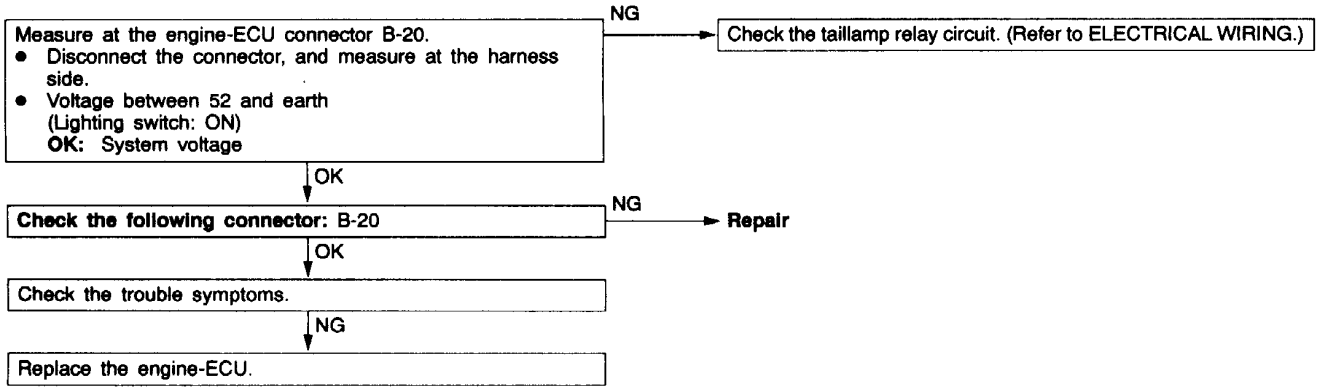
INSPECTION PROCEDURE 34

Stop lamp switch system	Probable cause
This switch inputs the brake pedal depression amount to the engine-ECU. The engine-ECU uses this input to detect brake operation in order to switch the fuel injection mode.	• Malfunction of the stop lamp switch • Open circuit or short-circuited harness wire in the stop lamp switch circuit • Malfunction of the engine-ECU



INSPECTION PROCEDURE 35

Electrical load switch	Probable cause
During idling, the ON/OFF condition of switches in equipment which have a large electrical load is input to the engine-ECU. The engine-ECU controls the idle speed control servo based on this input.	• Improper connector contact, open circuit or short-circuited harness wire in the taillamp relay circuit • Malfunction of the engine-ECU



DATA LIST REFERENCE TABLE

Caution
When shifting the select lever to D range, the brakes should be applied so that the vehicle does not move forward.

NOTE
*1. In a new vehicle [driven approximately 500 km or less], the air flow sensor output frequency is sometimes 10% higher than the standard frequency.
*2. The idle position switch normally turns off when the voltage of the throttle position sensor is 50 – 100 mV higher than the voltage at the idle position. If the throttle position switch turns back on after the throttle position sensor voltage has risen by 100 mV and the throttle valve has opened, the idle position switch and the throttle position sensor need to be adjusted.
*3. In a new vehicle [driven approximately 500 km or less], the injector drive time is sometimes 10% longer than the standard time.
*4. In a new vehicle [driven approximately 500 km or less], the step of the stepper motor is sometimes 30 steps greater than the standard value.

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
11	Oxygen sensor	Engine:After having warmed up Air/fuel mixture is made leaner when decelerating, and is made richer when racing.	When at 4,000 r/min, engine is suddenly decelerated	200 mV or less	Code No. 11	13J-12
			When engine is suddenly raced	600 – 1,000 mV		
		Engine:After having warmed up The oxygen sensor signal is used to check the air/fuel mixture ratio, and control condition is also checked by the ECU.	Engine is idling	400 mV or less (Changes)		
			2,500 r/min	600 – 1,000 mV		
12	Air flow sensor*1	• Engine coolant temperature: 80 – 95°C • Lamps, electric cooling fan and all accessories: OFF • Transmission: Neutral (A/T: P range)	Engine is idling	20 – 55 Hz	–	–
			2,500 r/min	65 – 85 Hz		
			Engine is raced	Frequency increases in response to racing		

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
13	Intake air temperature sensor	Ignition switch: ON or with engine running	When intake air temperature is –20°C	–20°C	Code No. 13	13J-14
			When intake air temperature is 0°C	0°C		
			When intake air temperature is 20°C	20°C		
			When intake air temperature is 40°C	40°C		
			When intake air temperature is 80°C	80°C		
14	Throttle position sensor	Ignition switch: ON	Set to idle position	300 – 1,000 mV	Code No. 14	13J-15
			Gradually open	Increases in proportion to throttle opening angle		
			Open fully	4,500 – 5,500 mV		
16	Power supply voltage	Ignition switch: ON		System voltage	Procedure No. 21	13J-49
18	Cranking signal (ignition switch-ST)	Ignition switch: ON	Engine: Stopped	OFF	Procedure No. 23 <M/T> Procedure No. 24 <A/T>	13J-50 <M/T> 13J-51 <A/T>
			Engine: Cranking	ON		
21	Engine coolant temperature sensor	Ignition switch: ON or with engine running	When engine coolant temperature is –20°C	–20°C	Code No. 21	13J-16
			When engine coolant temperature is 0°C	0°C		
			When engine coolant temperature is 20°C	20°C		
			When engine coolant temperature is 40°C	40°C		
			When engine coolant temperature is 80°C	80°C		

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
22	Crank angle sensor	• Engine: Cranking • Tachometer: Connected	Compare the engine speed readings on the tachometer and the MUT-II.	Accord	Code No. 22	13J-17
		• Engine: Idling • Idle position switch: ON	When engine coolant temperature is –20°C	1,300 – 1,500 rpm		
			When engine coolant temperature is 0°C	1,150 – 1,250 rpm		
			When engine coolant temperature is 20°C	1,000 – 1,200 rpm		
			When engine coolant temperature is 40°C	750 – 950 rpm		
			When engine coolant temperature is 80°C	550 – 850 rpm		
25	Barometric pressure sensor	Ignition switch: ON	At altitude of 0 m	101 kPa	Code No. 25	13J-20
			At altitude of 600 m	95 kPa		
			At altitude of 1,200 m	88 kPa		
			At altitude of 1,800 m	81 kPa		
26	Idle position switch	Ignition switch: ON Check by operating accelerator pedal repeatedly	Throttle valve: Set to idle position	ON	Procedure No. 25	13J-52
			Throttle valve: Slightly open	OFF*2		
27	Power steering fluid pressure switch	Engine: Idling	Steering wheel stationary	OFF	Procedure No. 31	13J-58
			Steering wheel turning	ON		
28	A/C switch	Engine: Idling (when A/C switch is ON, A/C compressor should be operating.)	A/C switch: OFF	OFF	Procedure No. 32	13J-58
			A/C switch: ON	ON		
29	Inhibitor switch <A/T>	Ignition switch: ON	P or N	P or N	Procedure No. 24	13J-51
			D, 2, L or R	D, 2, L or R		
33	Electrical load switch	All accessories: OFF	Lighting switch only: OFF → ON	OFF → ON	Procedure No. 35	13J-60

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
41	Injectors	• Engine: Idling • Transmission: Neutral (A/T: P range)	When engine coolant temperature is 0°C	0.9 – 1.1 ms	–	–
			When engine coolant temperature is 20°C	0.8 – 1.0 ms		
			When engine coolant temperature is 50°C	0.7 – 0.9 ms		
			When engine coolant temperature is 80°C	0.5 – 0.7 ms		
	Injectors*3	• Engine coolant temperature: 80–95°C • Lamps, electric cooling fan and all accessories: OFF • Transmission: Neutral (A/T : P range)	Engine is idling	0.5 – 0.7 ms	–	–
			2,500 r/min	0.6 – 0.7 ms		
			When engine is suddenly raced	Increases		
44	Ignition coils and power transistors	• Engine: After having warmed up • Timing lamp is set. (The timing lamp is set in order to check actual ignition timing.)	Engine is idling	12 – 20°BTDC	–	–
			2,500 r/min	30 – 40°BTDC		
45	ISC (stepper) motor position *4	• Engine coolant temperature: 80 – 95°C • Lamps, electric cooling fan and all accessories: OFF • Transmission: Neutral (A/T : P range) • Idle position switch: ON • Engine: Idling • When A/C switch is ON, A/C compressor should be operating	A/C switch: OFF	10 – 55 STEP	–	–
			A/C switch: OFF → ON	Increases by 15 – 55 steps		
			• A/C switch: OFF • Select lever: N range → D range	Increases by 10 – 40 steps		
48	M/T oil temperature sensor	Drive after the engine has warmed up.	Drive for 15 minutes or more.	Gradually increases to 50° – 90°C.	Procedure No. 33	13J-59

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
49	A/C relay	Engine: After having warmed up/Engine is idling	A/C switch: OFF	OFF (Compressor clutch is not operating)	Procedure No. 32	13J-58
			A/C switch: ON	ON (Compressor clutch is operating)		
66	Brake vacuum sensor	• Engine coolant temperature: 80 – 95°C • Lamps, electric cooling fan and all accessories: OFF • Transmission: Neutral (A/T: P range)	When the engine is running at idle, stop the engine, and then turn the ignition switch to ON and depress the brake pedal several times.	Negative pressure drops	Code No. 66	13J-28
67	Stop lamp switch	Ignition switch: ON	Brake pedal: Depressed	ON	Procedure No. 34	13J-59
			Brake pedal: Released	OFF		
68	EGR control servo	• Engine coolant temperature: 80 – 95°C • Lamps, electric cooling fan and all accessories: OFF • Transmission: Neutral (A/T: P range)	Engine is idling	5 – 15 STEP	Procedure No. 29	13J-56
			2,500 r/min	0 – 5 STEP		
			When engine is suddenly raced	0 – 5 STEP		
74	Fuel pressure sensor	• Engine coolant temperature: 80 – 95°C • Lamps, electric cooling fan and all accessories: OFF • Transmission: Neutral (A/T: P range)	Engine; Idling	4 – 7 MPa	Code No. 56	13J-25
99	Fuel injection mode	Engine: After warmed-up	Engine: Idling (several minutes after engine starts)	Lean compression	–	–
			2,500 r/min	Stoichiometric feedback		
			When engine is idling and then suddenly raced	Open-loop		

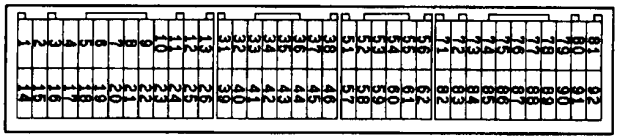
ACTUATOR TEST REFERENCE TABLE

Item No.	Inspection item	Drive contents	Inspection contents	Normal condition	Inspection procedure No.	Reference page
01	Injectors	Cut fuel to No. 1 injector	Engine: After having warmed up/Engine is idling (Cut the fuel supply to each injector in turn and check cylinders which don't affect idling.)	Idling condition becomes different (becomes unstable).	Code No. 41	13J-22
02		Cut fuel to No. 2 injector				
03		Cut fuel to No. 3 injector				
04		Cut fuel to No. 4 injector				
07	Fuel pump (low pressure)	Fuel pump operates and fuel is recirculated.	Ignition switch: ON	Sound of operation is heard.	Procedure No. 28	13J-55
08	Purge control solenoid valve	Solenoid valve turns from OFF to ON.	Ignition switch: ON	Sound of operation can be heard when solenoid valve is driven.	Procedure No. 30	13J-57
17	Basic ignition timing	Set to ignition timing adjustment mode	Engine: Idling Timing light is set	5°BTDC	–	–
18	Air by-pass control solenoid valve (ON/OFF)	Solenoid valve turns from OFF to ON.	Ignition switch: ON	Sound of operation can be heard when solenoid valve is driven.	Procedure No. 27	13J-54
20	Fan motor relay	Drive the fan motor	Ignition switch: ON	Condenser fan motor operates	Procedure No. 20	13J-48
21	Fan motor relay	Drive the fan motor	Ignition switch: ON	Condenser fan motor and radiator fan motor operate	Procedure No. 20	13J-48
30	SAS adjustment mode	Set to SAS adjustment mode	Ignition switch: ON	Idle speed control (ISC) servo is fixed at step 6.	–	–
32	Air by-pass control solenoid valve (DUTY)	Solenoid valve turns from OFF to ON.	Ignition switch: ON	Sound of operation can be heard when solenoid valve is driven.	Procedure No. 27	13J-54

CHECK AT THE ENGINE-ECU TERMINALS

TERMINAL VOLTAGE CHECK CHART

Engine-ECU Connector Terminal Arrangement



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Terminal No.	Check item	Check condition (Engine condition)		Normal condition
1	No.1 injector	Engine: Idling after having warmed up		10 – 12 V
14	No.2 injector			
2	No.3 injector			
15	No.4 injector			
3	Air by-pass control solenoid valve (ON/OFF)	Engine: Idling after having warmed up		System voltage
		Engine: 2,500 r/min		System voltage
16	Air by-pass control solenoid valve (DUTY)	Engine: Idling after having warmed up		System voltage
		Engine: 2,500 r/min		System voltage
4	Idle speed control servo (A)	Engine: Immediately after the warm engine has been started		System voltage ↔ 0 – 0.5 V (changes repeatedly)
17	Idle speed control servo (B)			
5	Idle speed control servo (C)			
18	Idle speed control servo (D)			
7	A/T-ECU communication output	Engine: Idling Selector lever position: D range		Other than 0 V
59	A/T-ECU communication input			
8	A/C relay	Engine: Idling	A/C switch: OFF	0 – 0.1 V
			A/C switch: ON	Momentarily system voltage or momentarily 6 V or more
10	No.1 ignition coil	Engine: 2,500 r/min		0.1 – 0.3 V
11	No.2 ignition coil			
23	No.3 ignition coil			
24	No.4 ignition coil			

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
12	Power supply	Ignition switch: ON		System voltage
25	Power supply			
13	Earth	At all times		0 V
26	Earth			
19	Air flow sensor reset signal	Engine: Idling		0 – 0.1 V
		Engine: 4,000 r/min		6 – 9 V
90	Air flow sensor	Engine: Idling		2.2 – 3.2 V
		Engine: 2,500 r/min		
20	Injector driver control relay	Ignition switch: OFF		0 – 0.1 V
		Ignition switch: ON		0.5 – 1 V
21	Fan motor relay (LO)	Radiator fan and condenser fan are not operating (Engine coolant temperature is 90°C or less)		System voltage
		Radiator fan and condenser fan are operating (Engine coolant temperature is 90 – 105°C)		0 – 3 V
22	Fuel pump relay	Ignition switch: ON	Engine: Stopped	System voltage
			Engine: Idling	0 – 1 V
39	EGR control servo (A)	Engine: Immediately after the warm engine has been started		System voltage ↔ 0 – 0.5 V (changes repeatedly)
40	EGR control servo (B)			
31	EGR control servo (C)			
32	EGR control servo (D)			
33	Alternator G terminal	Engine: Idling after having warmed up Radiator fan: Not operating Headlamp: OFF → ON Stop lamp: OFF → ON Rear defogger switch: OFF → ON		4.5 – 5.5 V → 6.5 – 7.5 V
41	Alternator FR terminal	Engine: Idling after having warmed up Radiator fan: Not operating Headlamp: OFF → ON Stop lamp: OFF → ON Rear defogger switch: OFF → ON		2.0 – 3.0 V → 1.0 – 2.0 V
35	Stop lamp switch	Brake pedal: Depressed		System voltage
		Brake pedal: Released		0 – 0.1 V

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
36	Engine warning lamp	Ignition switch: OFF → ON		0 – 0.1 V → System voltage (after several seconds have passed)
37	Power steering fluid pressure switch	Steering wheel: Neutral position		System voltage
		Steering wheel: Turned		0 – 0.1 V
38	Control relay	Ignition switch: ON		0 – 1 V
		Ignition switch: OFF		System voltage
42	Brake vacuum sensor	Engine: Accelerator pedal is suddenly depressed while the engine is idling after having warmed up		Voltage drops slightly
45	A/C switch	Engine: Idling	A/C switch: OFF	0 – 0.1 V
			A/C switch: ON	System voltage
51	Injector open circuit check signal	Engine: Idling		0 ↔ 5 V (changes repeatedly)
52	Electrical load switch	Engine: Idling	Turn off the lighting switch	0 – 3 V
			Turn on the lighting switch	System voltage
54	Fan motor relay (HI)	Radiator fan is not operating (Engine coolant temperature is 90°C or less)		System voltage
		Radiator fan is operating (Engine coolant temperature is 105°C or more)		0 – 3 V
56	Diagnosis control terminal	–		–
62	Diagnosis output terminal	Ignition switch: ON At normal condition (no diagnosis output)		4 – 5 V
57	Purge control solenoid valve	Ignition switch: ON	Engine: Stopped	System voltage
			Engine: Running at 2,500 r/min after having warmed up	0 – 3 V
58	Tachometer	Engine: Cranking		0 ↔ 5 V (changes repeatedly)
60	Oxygen sensor heater control	Ignition switch: ON	Engine: Stopped	System voltage
			Engine: After starting	0 – 0.5 V
76	Oxygen sensor	Engine: Running at 2,500 r/min after having warmed up		0 ↔ 1 V (changes repeatedly)

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
71	Ignition switch-ST	Engine: Cranking		8 V or more
72	Intake air temperature sensor	Ignition switch: ON	Intake air temperature: 0°C	3.2 – 3.8 V
			Intake air temperature: 20°C	2.3 – 2.9 V
			Intake air temperature: 40°C	1.5 – 2.0 V
74	Fuel pressure sensor	Engine: Idling		0.3 – 4.7 V
75	M/T oil temperature sensor	M/T oil temperature: 25°C		2.4 – 2.7 V
		M/T oil temperature: 80°C		0.5 – 0.8 V
77	Sensor power supply (5 V)	Ignition switch: ON		4.8 – 5.2 V
81				
78	Detonation sensor	Engine: Idling after having warmed up		Other than 0 V
80	Back-up power supply	Ignition switch: OFF		System voltage
82	Ignition switch	Ignition switch: OFF		0 – 0.1 V
		Ignition switch: ON		System voltage
83	Engine coolant temperature sensor	Ignition switch: ON	Engine coolant temperature: 0°C	3.2 – 3.8 V
			Engine coolant temperature: 20°C	2.3 – 2.9 V
			Engine coolant temperature: 50°C	1.0 – 1.6 V
			Engine coolant temperature: 80°C	0.3 – 0.9 V
84	Throttle position sensor	Ignition switch: ON	Throttle valve: Idle position	0.5 – 0.8 V
			Throttle valve: Fully open	4.8 – 5.1 V
85	Barometric pressure sensor	Ignition switch: ON	Altitude: 0 m	3.9 – 4.1 V
			Altitude: 1,200 m	3.3 – 3.6 V
86	Vehicle speed sensor	Ignition switch: ON Move the vehicle slowly forward		0 ↔ 5 V (changes repeatedly)
87	Idle position switch	Ignition switch: ON	Throttle valve: Idle position	0 – 0.1 V
			Throttle valve: Slightly open	4.5 – 5 V

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
88	Camshaft position sensor	Engine: Cranking		0 ↔ 4 V (changes repeatedly)
		Engine: Idling		
89	Crank angle sensor	Engine: Cranking		0 ↔ 4 V (changes repeatedly)
		Engine: Idling		
91	Inhibitor switch	Ignition switch: ON	Selector lever position: N or P	0 – 0.1 V
			Selector lever position: D, 2, L or R	System voltage
92	Sensor earth	At all times		0 V

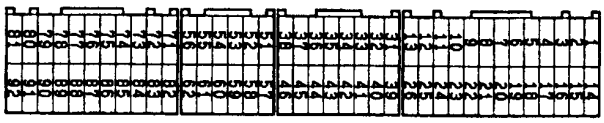
CHECK CHART FOR RESISTANCE AND CONTINUITY BETWEEN TERMINALS

1. Turn the ignition switch to OFF.
2. Disconnect the engine-ECU connector.
3. Measure the resistance and check for continuity between the terminals of the engine-ECU harness-side connector while referring to the check chart.

   NOTE
   (1) When measuring resistance and checking continuity, a harness for checking contact pin pressure should be used instead of inserting a test probe.
   (2) Checking need not be carried out in the order given in the chart.

   Caution
   If the terminals that should be checked are mistaken, or if connector terminals are not correctly shorted to earth, damage may be caused to the vehicle wiring, sensors, engine-ECU and/or ohmmeter.
   Be careful to prevent this!
4. If the ohmmeter shows any deviation from the standard value, check the corresponding sensor, actuator and related electrical wiring, and then repair or replace.
5. After repair or replacement, recheck with the ohmmeter to confirm that the repair or replacement has corrected the problem.

Engine-ECU Harness Side Connector Terminal Arrangement



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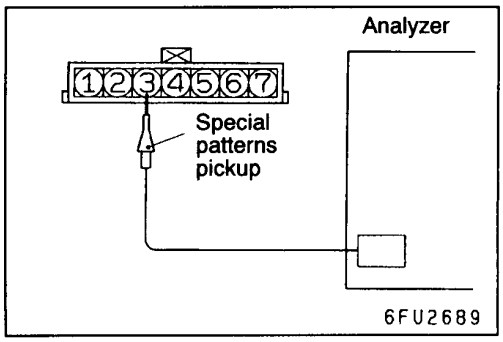
Terminal No.	Check item	Check condition	Standard value, normal value
3 – 12	Air by-pass control solenoid valve (ON/OFF)	20°C	8 – 11 Ω
16 – 12	Air by-pass control solenoid valve (DUTY)	20°C	8 – 11 Ω
4 – 12	Idle speed control servo (A)	20°C	31 – 38 Ω
17 – 12	Idle speed control servo (B)		
5 – 12	Idle speed control servo (C)		
18 – 12	Idle speed control servo (D)		
13 – Body earth	Earth	At all times	Continuity (0 Ω)
26 – Body earth	Earth		
92 – Body earth	Sensor earth		
39 – 12	EGR control servo (A)	20°C	15 – 20 Ω
40 – 12	EGR control servo (B)		
31 – 12	EGR control servo (C)		
32 – 12	EGR control servo (D)		
57 – 12	Purge control solenoid valve	20°C	35 – 40 Ω
60 – 12	Oxygen sensor heater control	20°C	13 – 17 Ω
72 – 92	Intake air temperature sensor	Intake air temperature: 0°C	5.1 – 6.5 Ω
		Intake air temperature: 20°C	2.3 – 3.0 Ω
		Intake air temperature: 40°C	0.9 – 1.3 Ω

Terminal No.	Check item	Check condition	Standard value, normal value
75 – 92	M/T oil temperature sensor	M/T oil temperature: 25°C	1.95 – 2.05 kΩ
		M/T oil temperature: 80°C	0.3 – 0.4 kΩ
83 – 92	Engine coolant temperature sensor	Engine coolant temperature: 0°C	5.75 – 5.85 kΩ
		Engine coolant temperature: 20°C	2.4 – 2.5 kΩ
		Engine coolant temperature: 50°C	0.75 – 0.85 kΩ
		Engine coolant temperature: 80°C	0.3 – 0.4 kΩ
84 – 92	Throttle position sensor	Throttle valve: Idle position	0.5 – 0.7 kΩ
		Throttle valve: Fully open	0.3 – 0.5 kΩ
85 – 92	Barometric pressure sensor	20°C	3.1 – 3.4 kΩ
87 – 92	Idle position switch	Throttle valve: Idle position	Continuity (0 Ω)
		Throttle valve: Slightly open	No continuity
91 – Body earth	Inhibitor switch	Selector lever position: N or P	Continuity (0 Ω)
		Selector lever position: D, 2, L or R	No continuity



INSPECTION PROCEDURE USING AN ANALYZER

AIR FLOW SENSOR (AFS)

Measurement Method

1. Disconnect the air flow sensor connector, and connect the special tool (test harness: MB991709) in between. (All terminals should be connected.)
2. Connect the analyzer special patterns pickup to air flow sensor connector terminal 3.

Alternate Method (Test harness not available)

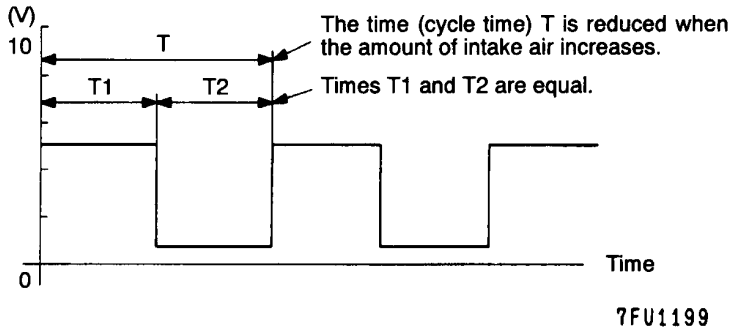
1. Connect the analyzer special patterns pickup to engine-ECU terminal 90.

Standard Wave Pattern

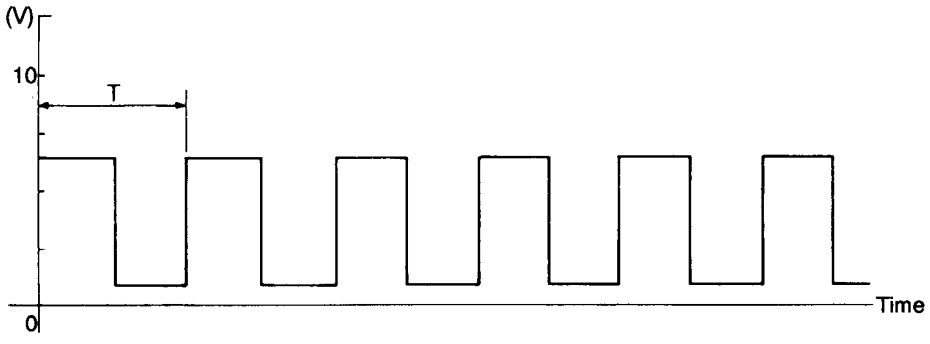
Observation conditions

Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine r/min	Idle speed

Standard wave pattern

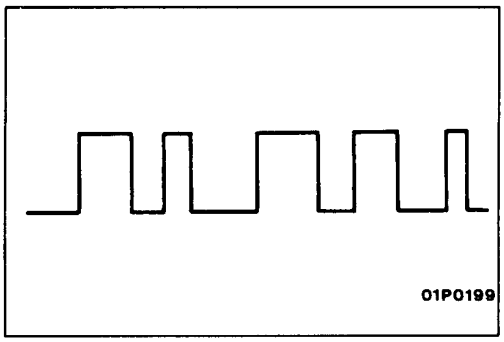


Observation conditions (from conditions above engine speed is increased by racing.)



Wave Pattern Observation Points

Check that cycle time T becomes shorter and the frequency increases when the engine speed is increased.



Examples of Abnormal Wave Patterns

- Example 1

  Cause of problem

  Sensor interface malfunction

  Wave pattern characteristics

  Rectangular wave pattern is output even when the engine is not started.

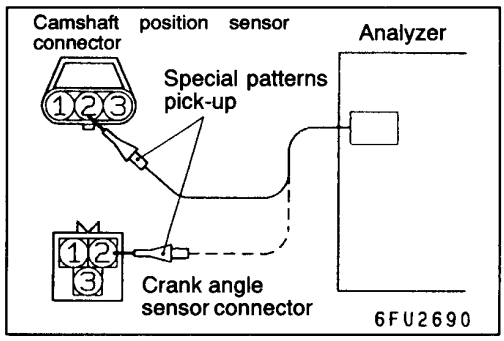
- Example 2

  Cause of problem

  Damaged rectifier or vortex generation column

  Wave pattern characteristics

  Unstable wave pattern with non-uniform frequency. However, when an ignition leak occurs during acceleration, the wave pattern will be distorted temporarily, even if the air flow sensor is normal.



CAMSHAFT POSITION SENSOR AND CRANK ANGLE SENSOR

Measurement Method

1. Disconnect the camshaft position sensor connector and connect the special tool (test harness: MB991709) in between. (All terminals should be connected.)
2. Connect the analyzer special patterns pickup to camshaft position sensor terminal 2.
3. Disconnect the crank angle sensor connector and connect the special tool (test harness: MD998478) in between.
4. Connect the analyzer special patterns pickup to crank angle sensor terminal 2.

Alternate Method (Test harness not available)

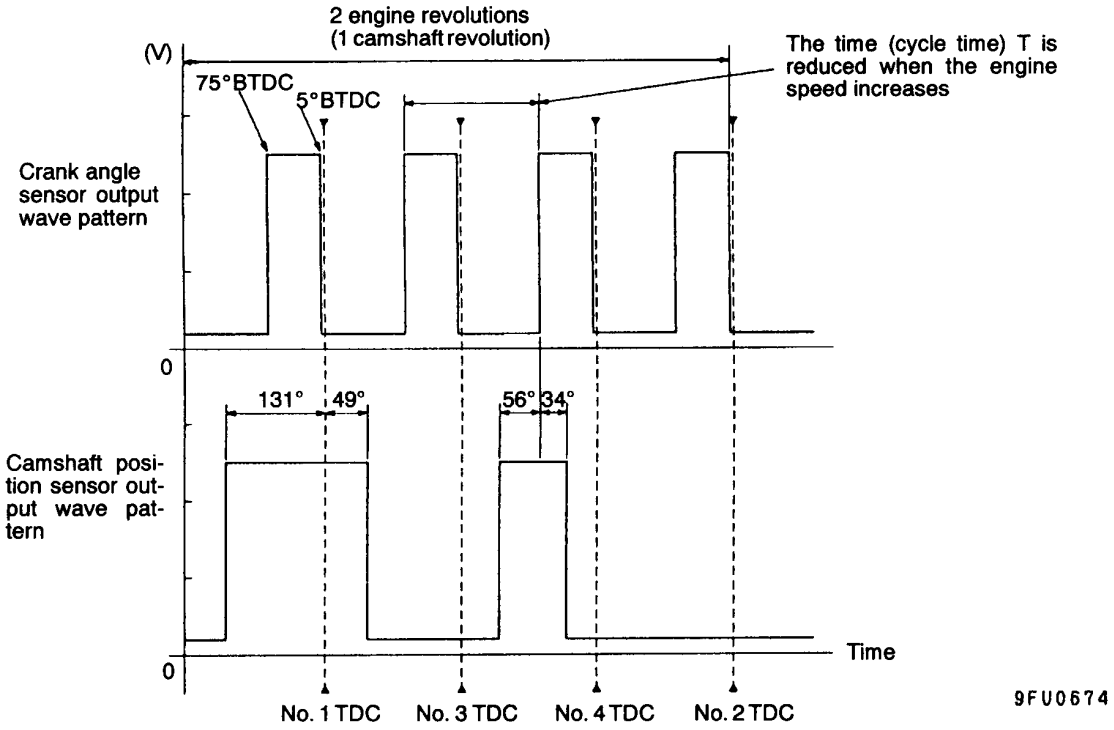
1. Connect the analyzer special patterns pickup to engine-ECU terminal 88. (When checking the camshaft position sensor signal wave pattern.)
2. Connect the analyzer special patterns pickup to engine-ECU terminal 89. (When checking the crank angle sensor signal wave pattern.)

Standard Wave Pattern

Observation conditions

Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine r/min	Idle speed

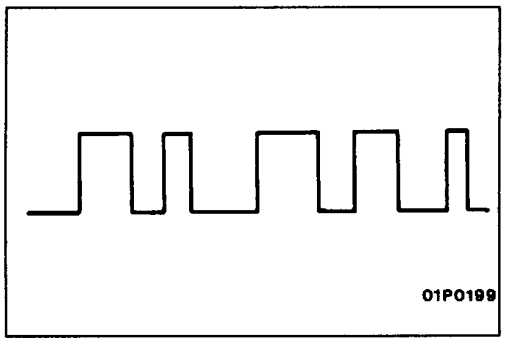
Standard wave pattern



TDC: Top dead centre

Wave Pattern Observation Points

Check that cycle time T becomes shorter when the engine speed increases.



Examples of Abnormal Wave Patterns

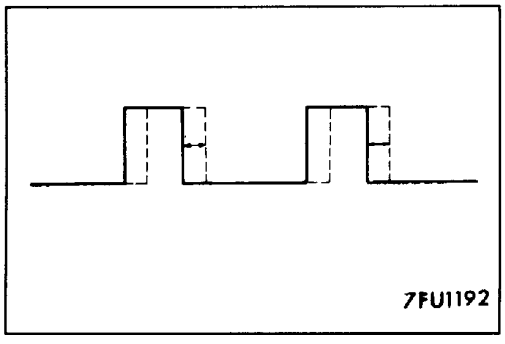
- Example 1

  Cause of problem

  Sensor interface malfunction

  Wave pattern characteristics

  Rectangular wave pattern is output even when the engine is not started.



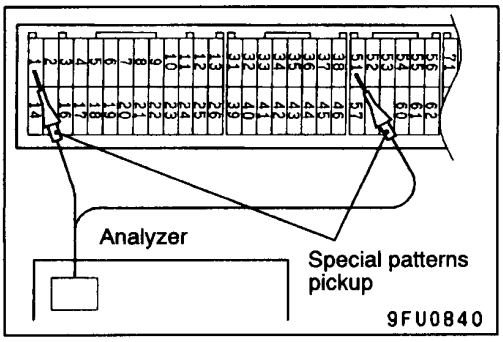
- Example 2

  Cause of problem

  Loose timing belt
  Abnormality in sensor disk

  Wave pattern characteristics

  Wave pattern is displaced to the left or right.



INJECTORS AND INJECTOR OPEN CIRCUIT CHECK SIGNAL

Measurement Method

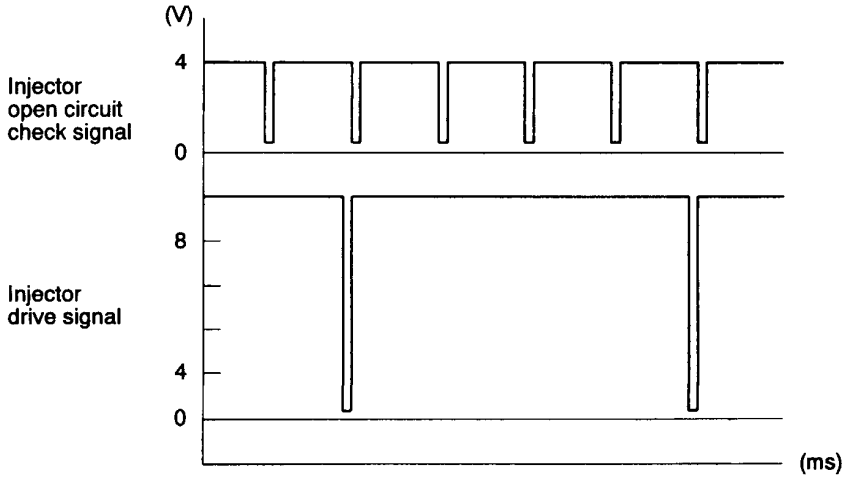
1. Connect the analyzer special patterns pickup to terminal 1 (No.1 injector) of the engine-ECU connector.
2. Connect the analyzer special patterns pickup to terminal 51 (injector open circuit check signal) of the engine-ECU connector.
3. After checking terminal 1, check terminal 14 (No.2 injector), terminal 2 (No.3 injector) and terminal 15 (No.4 injector).

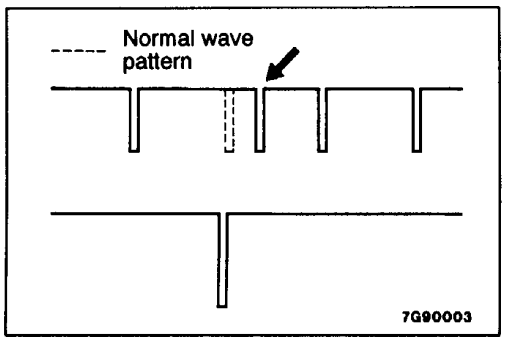
Standard Wave Pattern

Observation conditions

Function	Special pattern
Pattern height	Low
Pattern selector	Display
Engine r/min	Idle speed

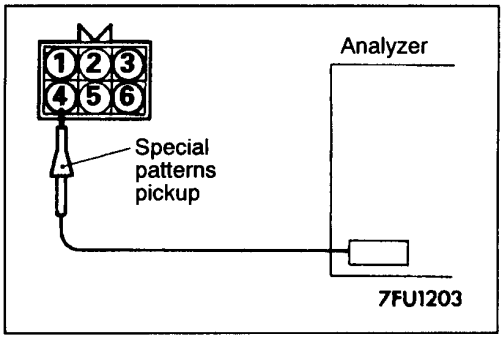
Standard wave pattern





Wave Pattern Observation Points

- Check that the injector drive time is identical to the time displayed on the MUT-II.
- Check that the injector signals become greatly extended but soon return to their normal wave length when the engine is suddenly raced.
- Check that the injector open circuit check signal is synchronized with each rising portion of the injector drive signal.



IDLE SPEED CONTROL (ISC) SERVO (STEPPER MOTOR)

Measurement Method

1. Disconnect the ISC servo connector and connect the special tool (test harness: MD998463) in between.
2. Connect the analyzer special patterns pickup to the ISC servo-side connector terminal 1 (red clip of the special tool), terminal 3 (blue clip), terminal 4 (black clip) and terminal 6 (yellow clip) respectively.

Alternate Method (Test harness not available)

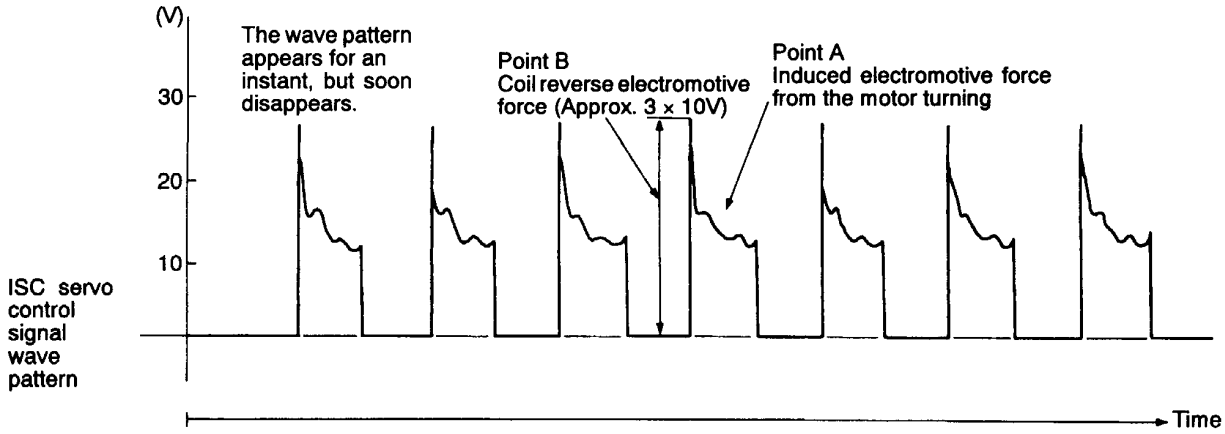
1. Connect the analyzer special patterns pickup to engine-ECU terminal 4, connection terminal 5, connection terminal 17, and connection terminal 18 respectively.

Standard Wave Pattern

Observation conditions

Function	Special patterns
Pattern height	High
Pattern selector	Display
Engine condition	When the engine coolant temperature is 20°C or below, turn the ignition switch from OFF to ON (without starting the engine).
	While the engine is idling, turn the A/C switch to ON.
	Immediately after starting the warm engine

Standard wave pattern



7FU1204

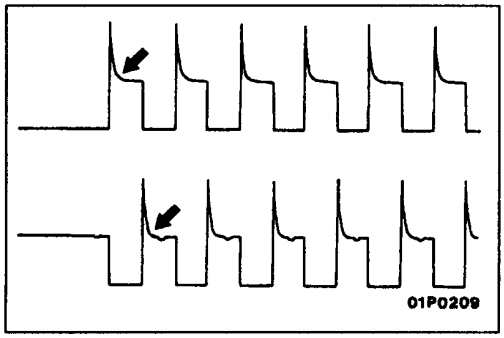
Wave Pattern Observation Points

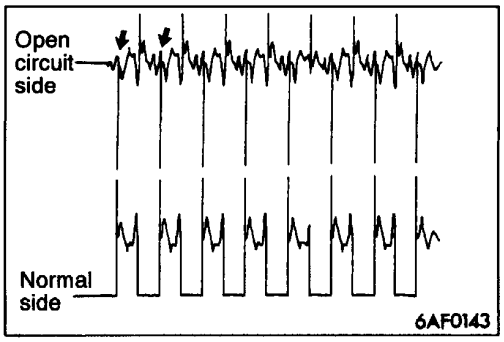
Check that the standard wave pattern appears when the ISC servo is operating.
Point A: Presence or absence of induced electromotive force from the motor turning. (Refer to the abnormal wave pattern.)

Contrast with standard wave pattern	Probable cause
Induced electromotive force does not appear or is extremely small.	Motor is malfunctioning

Point B: Height of coil reverse electromotive force

Contrast with standard wave pattern	Probable cause
Coil reverse electromotive force does not appear or is extremely small.	Short in the coil





Examples of Abnormal Wave Pattern

- Example 1

  Cause of problem

  Motor is malfunctioning. (Motor is not operating.)

  Wave pattern characteristics

  Induced electromotive force from the motor turning does not appear.

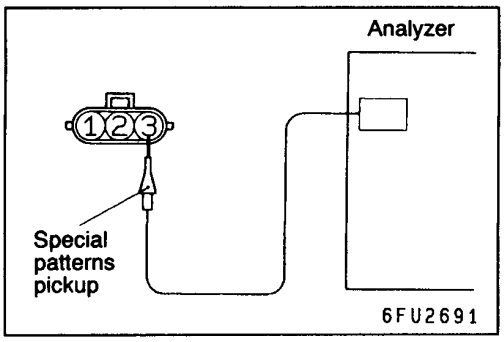
- Example 2

  Cause of problem

  Open circuit in the line between the ISC servo and the engine-ECU

  Wave pattern characteristics

  Current is not supplied to the motor coil on the open circuit side. (Voltage does not drop to 0 V.)
  Furthermore, the induced electromotive force waveform at the normal side is slightly different from the normal waveform.



IGNITION COIL AND POWER TRANSISTOR

Power transistor control signal

Measurement Method

1. Disconnect the ignition coil connector, and connect the special tool (test harness: MB991658) in between. (All terminals should be connected.)
2. Connect the analyzer special patterns pickup to terminal 3 of each ignition coil connector in turn.

Alternate Method (Test harness not available)

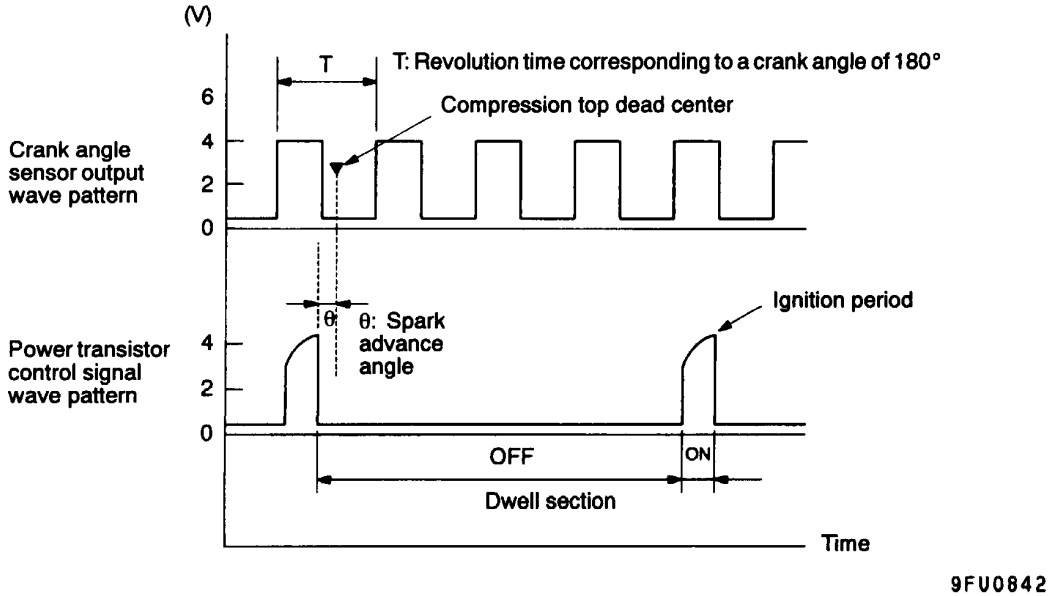
1. Connect the analyzer special patterns pickup to engine-ECU terminal 10 (No. 1 – No. 4), terminal 23 (No. 2 – No. 3) respectively.

Standard Wave Pattern

Observation condition

Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine r/min	Approx. 1,200 r/min

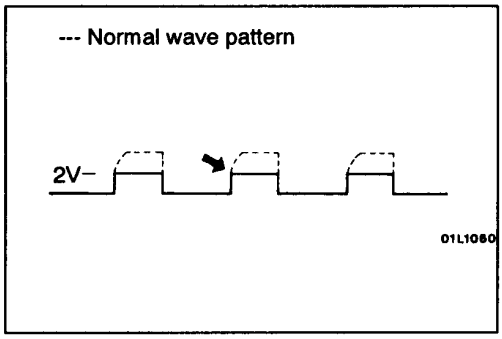
Standard wave pattern

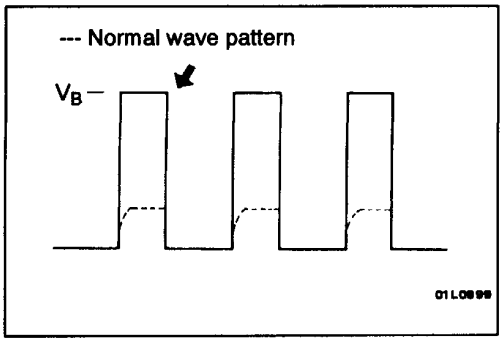


Wave Pattern Observation Points

Point: Condition of wave pattern build-up section and maximum voltage (Refer to abnormal wave pattern examples 1 and 2.)

Condition of wave pattern build-up section and maximum voltage	Probable cause
Rises from approx. 2V to approx. 4.5V at the top-right	Normal
2V rectangular wave	Open-circuit in ignition primary circuit
Rectangular wave at power voltage	Power transistor malfunction





Examples of Abnormal Wave Patterns

- Example 1

  Wave pattern during engine cranking

  Cause of problem

  Open-circuit in ignition primary circuit

  Wave pattern characteristics

  Top-right part of the build-up section cannot be seen, and voltage value is approximately 2V too low.

- Example 2

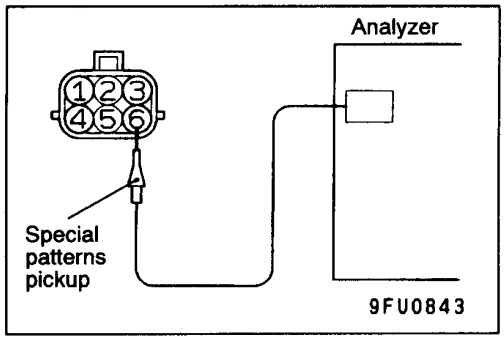
  Wave pattern during engine cranking

  Cause of problem

  Malfunction in power transistor

  Wave pattern characteristics

  Power voltage results when the power transistor is ON.



EGR CONTROL SERVO (STEPPER MOTOR)

Measurement Method

1. Disconnect the EGR control servo connector, and connect the special tool (test harness: MB991658) in between.
2. Connect the analyzer special patterns pickup to the EGR control servo-side connector terminal 1, terminal 3, terminal 4 and terminal 6 respectively.

Alternate Method (Test harness not available)

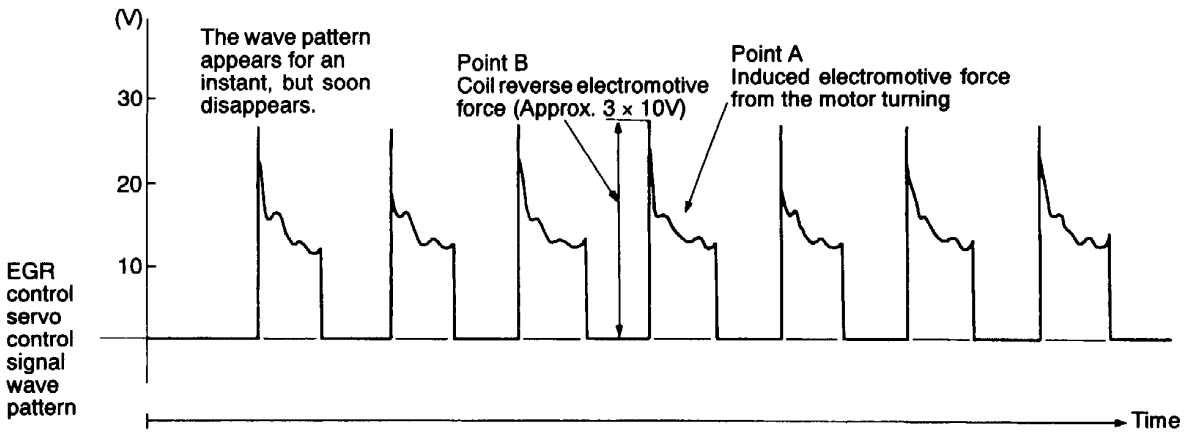
1. Connect the analyzer special patterns pickup to engine-ECU terminal 39, connection terminal 40, connection terminal 31, and connection terminal 32 respectively.

Standard Wave Pattern

Observation conditions

Function	Special patterns
Pattern height	High
Pattern selector	Display
Engine condition	When the engine coolant temperature is 20°C or below, turn the ignition switch from OFF to ON (without starting the engine).
	While the engine is idling, turn the A/C switch to ON.
	Immediately after starting the warm engine

Standard wave pattern



7FU1204

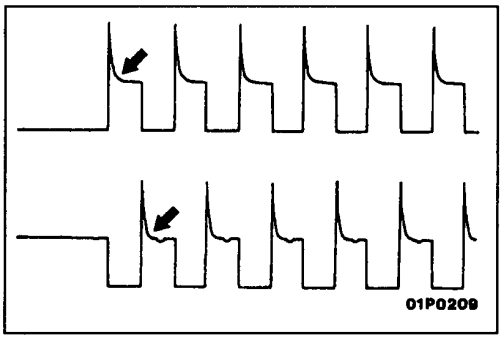
Wave Pattern Observation Points

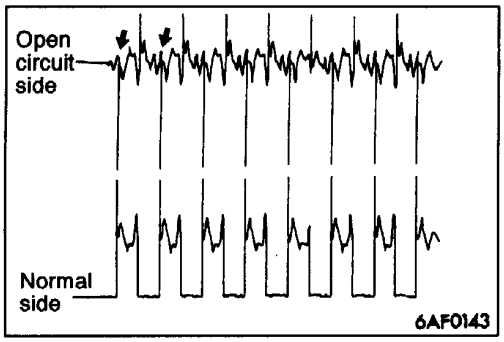
Check that the standard wave pattern appears when the EGR control servo is operating.
Point A: Presence or absence of induced electromotive force from the motor turning. (Refer to the abnormal wave pattern.)

Contrast with standard wave pattern	Probable cause
Induced electromotive force does not appear or is extremely small.	Motor is malfunctioning

Point B: Height of coil reverse electromotive force

Contrast with standard wave pattern	Probable cause
Coil reverse electromotive force does not appear or is extremely small.	Short in the coil





Examples of Abnormal Wave Pattern

- Example 1

  Cause of problem

  Motor is malfunctioning. (Motor is not operating.)

  Wave pattern characteristics

  Induced electromotive force from the motor turning does not appear.

- Example 2

  Cause of problem

  Open circuit in the line between the EGR control servo and the engine-ECU

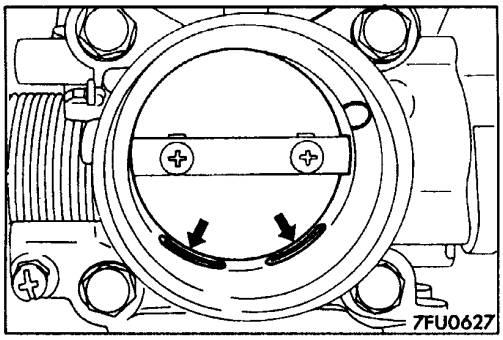
  Wave pattern characteristics

  Current is not supplied to the motor coil on the open circuit side. (Voltage does not drop to 0 V.)
  Furthermore, the induced electromotive force waveform at the normal side is slightly different from the normal waveform.

ON-VEHICLE SERVICE

THROTTLE BODY (THROTTLE VALVE AREA) CLEANING

1. Start the engine and warm it up until the coolant is heated to 80°C or higher and then stop the engine.
2. Remove the air intake hose from the throttle body.

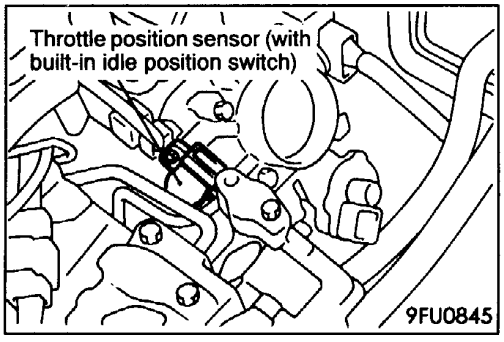


3. Plug the bypass passage inlet of the throttle body.

   Caution
   Do not allow cleaning solvent to enter the bypass passage.

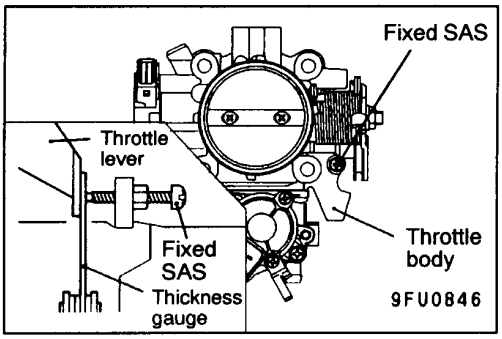
4. Spray cleaning solvent into the valve through the throttle body intake port and leave it for about 5 minutes.
5. Start the engine, race it several times and idle it for about 1 minute. If the idling speed becomes unstable (or if the engine stalls) due to the bypass passage being plugged, slightly open the throttle valve to keep the engine running.
6. If the throttle valve deposits are not removed, repeat steps 4 and 5.
7. Unplug the bypass passage inlet.
8. Attach the air intake hose.
9. Use the MUT-II to erase the self-diagnosis code.
10. Adjust the basic idle speed. (Refer to P.13J-83.)

    NOTE
    If the engine hunts while idling after adjustment of the basic idle speed, disconnect the (–) cable from the battery for 10 seconds or more, and then reconnect it and run the engine at idle for about 10 minutes.

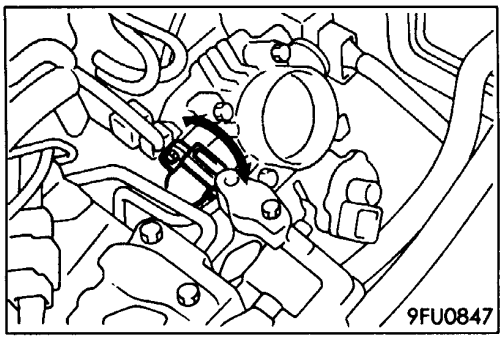


IDLE POSITION SWITCH AND THROTTLE POSITION SENSOR ADJUSTMENT

1. Connect the MUT-II to the diagnosis connector.

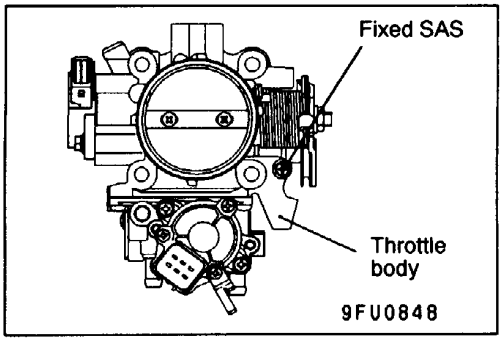


2. Insert a thickness gauge with a thickness of 0.45 mm between the fixed SAS and the throttle lever.
3. Turn the ignition switch to ON (but do not start the engine).



4. Loosen the throttle position sensor mounting bolt, and then turn the throttle position sensor anti-clockwise as far as it will go.
5. Check that the idle position switch is ON at this position.
6. Slowly turn the throttle position sensor clockwise and find the point where the idle position switch turns off. Securely tighten the throttle position sensor mounting bolt at this point.
7. Check the throttle position sensor output voltage.

   Standard value: 400 – 1,000 mV
8. If there is a deviation from the standard value, check the throttle position sensor and the related harness.
9. Remove the thickness gauge.
10. Turn the ignition switch to OFF.
11. Disconnect the MUT-II.



FIXED SAS ADJUSTMENT

NOTE
(1) The fixed SAS should not be moved unnecessarily; it has been precisely adjusted by the manufacturer.
(2) If the adjustment is disturbed for any reason, readjust as follows.

1. Loosen the tension of the accelerator cable sufficiently.
2. Back out the fixed SAS lock nut.
3. Turn the fixed SAS counterclockwise until it is sufficiently backed out, and fully close the throttle valve.
4. Tighten the fixed SAS until the point where the throttle lever is touched (i.e., the point at which the throttle valve begins to open) is found.
   From that point, tighten the fixed SAS 1-1/4 turn.
5. While holding the fixed SAS so that it doesn't move, tighten the lock nut securely.
6. Adjust the tension of the accelerator cable.
7. Adjust the basic idling speed.
8. Adjust the idle position switch and the throttle position sensor (P.13J-84).

BASIC IDLE SPEED ADJUSTMENT

NOTE
(1) The standard idling speed has been adjusted by the speed adjusting screw (SAS) by the manufacturer, and there should usually be no need for readjustment.
(2) If the adjustment has been changed by mistake, the idle speed may become too high or the idle speed may drop too low when loads from components such as the A/C are placed on the engine. If this occurs, adjust by the following procedure.
(3) The adjustment, if made, should be made after first confirming that the spark plugs, the injectors, the idle speed control servo, the compression pressure, etc., are all normal.

1. Before inspection and adjustment, set the vehicle to the pre-inspection condition.
2. Connect the MUT-II to the diagnosis connector (16-pin).

   NOTE
   When the MUT-II is connected, the diagnosis control terminal should be earthed.

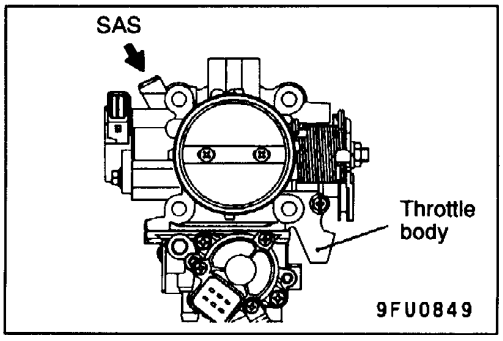
3. Start the engine and run at idle.
4. Select the item No.30 of the MUT-II Actuator test.

   NOTE
   This holds the ISC servo at the basic step to adjust the basic idle speed.

5. Check the idle speed.

   Standard value:
   750 ± 50 r/min

   NOTE
   (1) The engine speed may be 20 to 100 r/min lower than indicated above for a new vehicle [driven approximately 500 km or less], but no adjustment is necessary.
   (2) If the engine stalls or the engine speed is low even though the vehicle has been driven approximately 500 km or more, it is probable that deposits are adhered to the throttle valve, so clean it. (Refer to P.13J-84.)



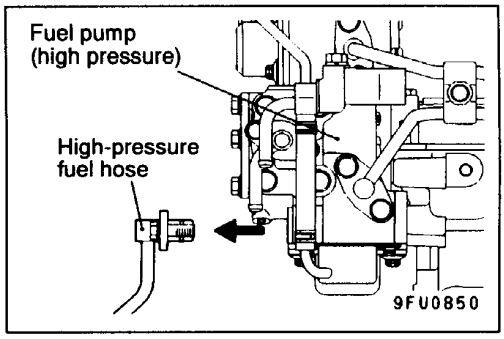
6. If not within the standard value range, turn the speed adjusting screw (SAS) to make the necessary adjustment.

   NOTE
   If the idling speed is higher than the standard value range even when the SAS is fully closed, check whether or not there is any indication that the fixed SAS has been moved. If there is an indication that it has been moved, adjust the fixed SAS.

7. Press the MUT-II clear key, and release the ISC servo from the Actuator test mode.

   NOTE
   Unless the ISC servo is released, the Actuator test mode will continue 27 minutes.

8. Switch OFF the ignition switch.
9. Disconnect the MUT-II.
10. Start the engine again and let it run at idle speed for about 10 minutes; check that the idling condition is normal.

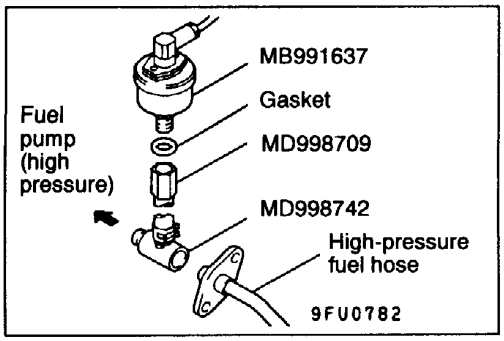


FUEL PRESSURE TEST

MEASUREMENT OF FUEL LOW PRESSURE BETWEEN FUEL PUMP (LOW PRESSURE) AND FUEL PUMP (HIGH PRESSURE)

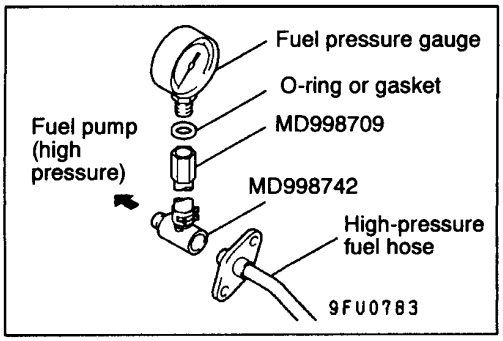
1. Release residual pressure from the fuel pipe line to prevent fuel gush out. (Refer to P.13J-91.)
2. Disconnect the high-pressure fuel hose at the fuel pump (high pressure) side.

   Caution
   Cover the hose connection with rags to prevent splash of fuel that could be caused by some residual pressure in the fuel pipe line.



3. Remove the union joint and bolt from the special tool (adapter hose) and instead attach the special tool (hose adapter) to the adapter hose.
4. Install the special tool (for measuring the fuel pressure) that was set up in step 3.

   <When using the fuel pressure gauge set (special tool)>
   (1) Install the special tool (for measuring the fuel pressure) between the high-pressure fuel hose and the fuel pump (high pressure).
   (2) Install the fuel pressure gauge set (special tool) on the special tool (for measuring the fuel pressure) putting the gasket between them.
   (3) Connect the lead wire of the fuel pressure gauge set (special tool) to the power supply (cigarette lighter socket) and to the MUT-II.



<When using the fuel pressure gauge>
(1) Install the fuel pressure gauge on the special tool (for measuring the fuel pressure) putting a suitable O-ring or gasket between them.
(2) Install the special tool which was set up in step (1) between the high-pressure fuel hose and the fuel pump (high pressure).

5. Connect the MUT-II to the diagnosis connector.
6. Turn the ignition switch to ON. (But do not start the engine.)
7. Select "Item No.07" from the MUT-II Actuator test to drive the fuel pump (low pressure) at the fuel tank side. Check that there are no fuel leaks from any parts.
8. Finish the actuator test or turn the ignition switch to OFF.
9. Start the engine and run at idle.
10. Measure fuel pressure while the engine is running at idle.

Standard value:
324 – 343 kPa at kerb idle

11. Check to see that fuel pressure at idle does not drop even after the engine has been raced several times.
12. If fuel pressure is out of the standard value, troubleshoot and repair according to the table below.

Symptom	Probable cause	Remedy
• Fuel pressure too low • Fuel pressure drops after racing	Clogged fuel filter	Replace fuel filter
	Fuel leaking to return side due to poor fuel pressure regulator (low pressure) valve seating or settled spring	Replace fuel pressure regulator (low pressure)
	Low fuel pump (low pressure) delivery pressure	Replace the fuel pump (low pressure)
Fuel pressure too high	Binding valve in fuel pressure regulator (low pressure)	Replace fuel pressure regulator (low pressure)
	Clogged fuel return hose or pipe	Clean or replace hose or pipe

13. Stop the engine and check change of fuel pressure gauge reading. Normal if the reading does not drop within 2 minutes. If it does, observe the rate of drop and troubleshoot and repair according to the table below.

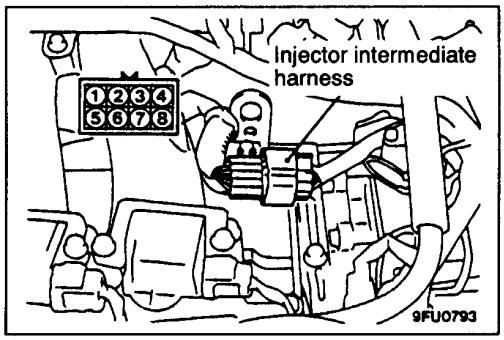
Symptom	Probable cause	Remedy
Fuel pressure drops gradually after engine is stopped	Leaky fuel pressure regulator (low pressure) valve seat	Replace fuel pressure regulator (low pressure)
Fuel pressure drops sharply immediately after engine is stopped	Check valve in fuel pump (low pressure) is held open	Replace the fuel pump (low pressure)

14. Release residual pressure from the fuel pipe line. (Refer to P.13J-91.)

15. Remove the fuel pressure gauge and special tools from the fuel pump (high pressure).

    Caution
    Cover the hose connection with rags to prevent splash of fuel that could be caused by some residual pressure in the fuel pipe line.

16. Replace the O-ring at the end of the high-pressure fuel hose with a new one. Furthermore, apply engine oil to the new O-ring before replacement.
17. Fit the high-pressure fuel hose to the fuel pump (high pressure) and tighten the mounting bolt to specified torque.
18. Check for any fuel leaks by following the procedure in step 7.
19. Disconnect the MUT-II.



MEASUREMENT OF FUEL HIGH PRESSURE BETWEEN FUEL PUMP (HIGH PRESSURE) AND INJECTORS

NOTE
Measurement of the fuel pressure between the fuel pump (high pressure) and the injectors should be carried out after checking that the fuel pressure between the fuel pump (low pressure) and the fuel pump (high pressure) is normal.

1. Connect the MUT-II to the diagnosis connector.
2. Disconnect the injector intermediate harness connector.
3. Turn the ignition switch to ON.
4. Select "Item No.74" from the MUT-II Data list.
5. Crank the engine continuously for 2 seconds or more, and visually check that there are no fuel leaks from any parts.

   Caution
   If any fuel leaks appear, stop cranking immediately and repair the source of the leak.

6. Immediately after cranking is finished, the fuel pressure should drop to about 4 MPa. Check this value.
7. Wait for 3 minutes or more after cranking stops, and then check that the fuel pressure has dropped by less than 1 MPa from the value observed in step 6.

   Caution
   If the fuel pressure drops by more than 1 MPa, it means that there is likely to be a leak in the high-pressure fuel system, so this system should be checked.

8. Turn the ignition switch to OFF.
9. Connect the injector intermediate harness connector.
10. Start the engine and run at idle.

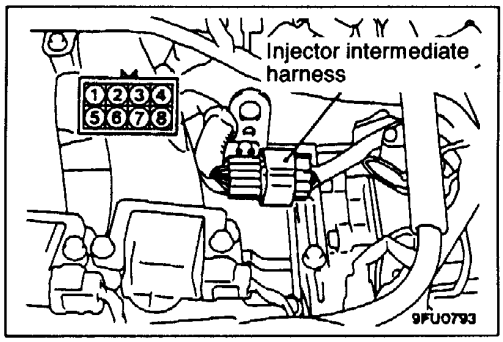
11. Measure fuel pressure while the engine is running at idle.

    Standard value: 4 – 7 MPa

12. Check to see that fuel pressure at idle does not drop even after the engine has been raced several times.
13. If fuel pressure is out of the standard value, troubleshoot and repair according to the table below.

Symptom	Probable cause	Remedy
• Fuel pressure too low • Fuel pressure drops after racing	Fuel leaking to return side due to poor fuel pressure regulator (high pressure) valve seating or settled spring	Replace fuel pressure regulator (high pressure)
	Low fuel pump (high pressure) delivery pressure	Replace the fuel pump (high pressure)
Fuel pressure too high	Binding valve in fuel pressure regulator (high pressure)	Replace fuel pressure regulator (high pressure)
	Clogged fuel return hose or pipe	Clean or replace hose or pipe

14. Stop the engine and turn the ignition switch to OFF.
15. Disconnect the MUT-II.



FUEL LEAK CHECK

1. Connect the MUT-II to the diagnosis connector.
2. Disconnect the injector intermediate harness connector.
3. Turn the ignition switch to ON.
4. Select "Item No.74" from the MUT-II Data list.
5. Crank the engine continuously for 2 seconds or more, and visually check that there are no fuel leaks from any parts.

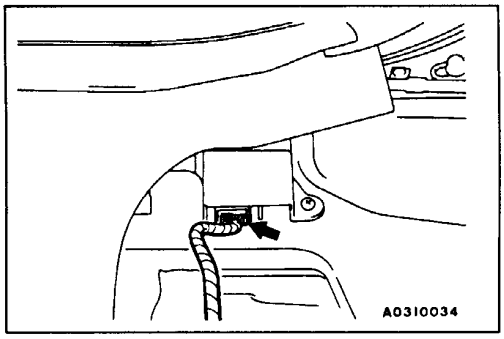
   Caution
   If any fuel leaks appear, stop cranking immediately and repair the source of the leak.

6. Immediately after cranking is finished, the fuel pressure should drop to about 4 MPa. Check this value.

7. Wait for 3 minutes or more after cranking stops, and then check that the fuel pressure has dropped by less than 1 MPa from the value observed in step 6.

   Caution
   If the fuel pressure drops by more than 1 MPa, it means that there is likely to be a leak in the high-pressure fuel system, so this system should be checked.

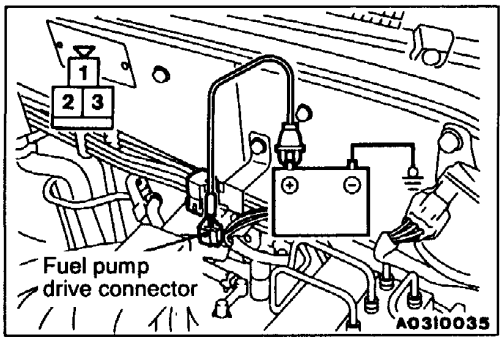
8. Turn the ignition switch to OFF.
9. Connect the injector intermediate harness connector.
10. Disconnect the MUT-II.



FUEL PUMP CONNECTOR DISCONNECTION (HOW TO REDUCE THE FUEL PRESSURE)

When removing the fuel pipe, hose, etc., since fuel pressure in the fuel pipe line is high, do the following operation so as to release fuel pressure in the line and prevent fuel from running out.

1. Raise the rear seat cushion.
2. Disconnect the floor wiring harness and fuel wiring harness under the floor carpet.
3. After starting the engine and letting it run until it stops naturally, turn the ignition switch to OFF.
4. Connect the fuel wiring harness and floor wiring harness.
5. Install the rear seat cushion.



FUEL PUMP OPERATION CHECK

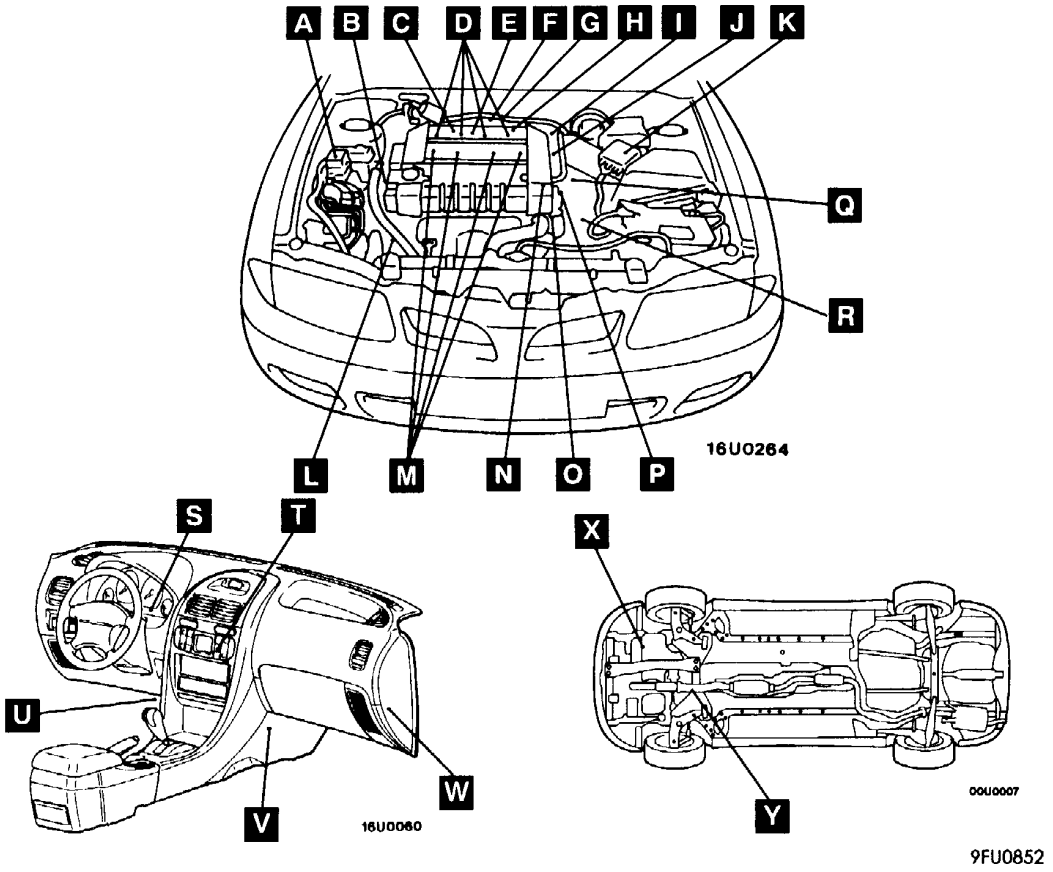
1. Check the operation of the fuel pump by using the MUT-II to force-drive the fuel pump.
2. If the fuel pump will not operate, check by using the following procedure, and if it is normal, check the drive circuit.
   (1) Turn the ignition switch to OFF.
   (2) When the fuel pump drive connector (black) is attached directly to the battery, check if the sound of the fuel pump operation can be heard.

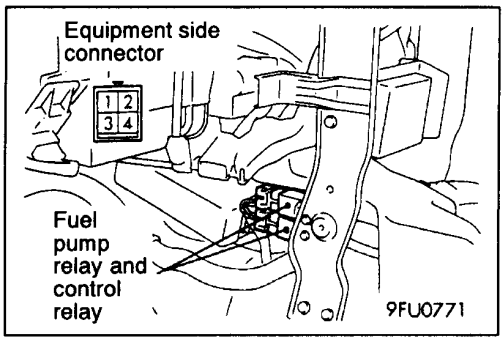
   NOTE
   As the fuel pump is an in-tank type, the fuel pump sound is hard to hear, so remove the fuel filler cap and check from the tank inlet.

   (3) Check the fuel pressure by pinching the fuel hose with the fingertips.

COMPONENT LOCATION

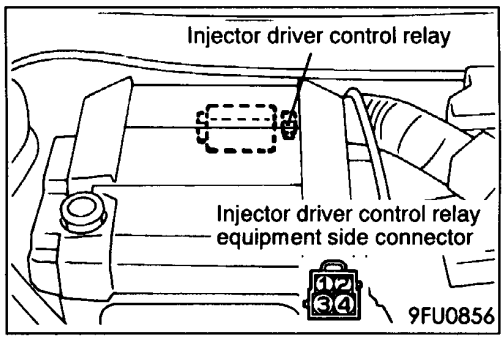
Name	Symbol	Name	Symbol
A/C relay	A	Engine warning lamp (check engine lamp)	S
A/C switch	T	Fuel pressure sensor	P
Air by-pass control solenoid valve (DUTY)	C	Idle speed control (ISC) servo	J
Air by-pass control solenoid valve (ON/OFF)	C	Ignition coil	M
Air flow sensor (with intake air temperature sensor and barometric pressure sensor)	K	Inhibitor switch <A/T>	R
		Injectors	D
Camshaft position sensor	N	Injector driver	F
Control relay and fuel pump relay	U	Injector driver control relay	G
Crank angle sensor	B	M/T oil temperature sensor	X
Detonation sensor	E	Oxygen sensor	Y
Diagnosis connector	U	Power steering fluid pressure switch	L
EGR control servo	H	Purge control solenoid valve	H
Engine coolant temperature sensor	O	Throttle position sensor (with idle position switch)	I
Engine-ECU	W	Vehicle speed sensor	Q





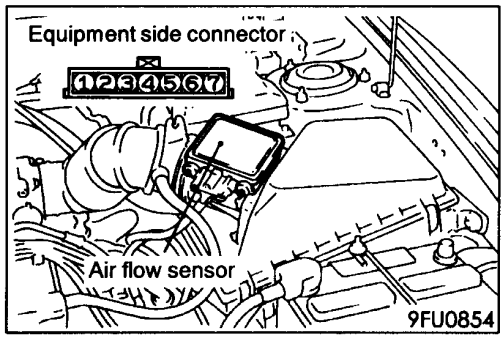
CONTROL RELAY AND FUEL PUMP RELAY CONTINUITY CHECK

Battery voltage	Terminal No.			
	1	2	3	4
Not supplied		○		○
Supplied	○	⊖	○	⊕



INJECTOR DRIVER CONTROL RELAY CONTINUITY CHECK

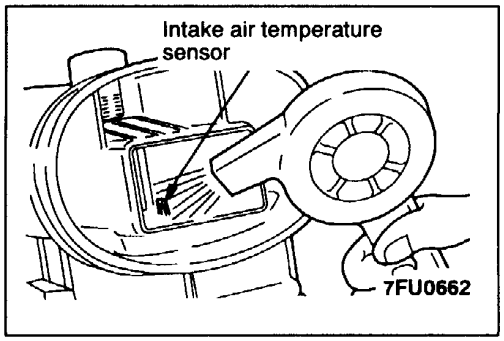
Battery voltage	Terminal No.			
	1	2	3	4
Not supplied	○	○		
Supplied	⊕	⊖	○	○



INTAKE AIR TEMPERATURE SENSOR CHECK

1. Disconnect the air flow sensor connector.
2. Measure resistance between terminals 5 and 6.

   Standard value:
   2.3 – 3.0 kΩ (at 20°C)
   0.30 – 0.42 kΩ (at 80°C)

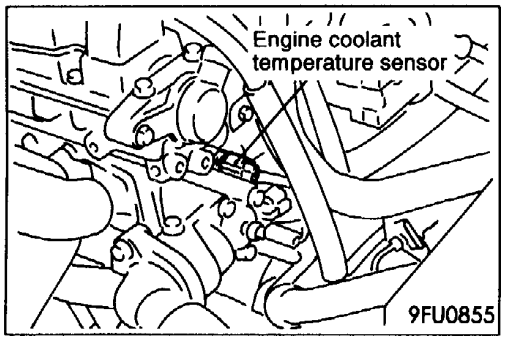


3. Measure resistance while heating the sensor using a h drier.

   Normal condition:

Temperature (°C)	Resistance (kΩ)
Higher	Smaller

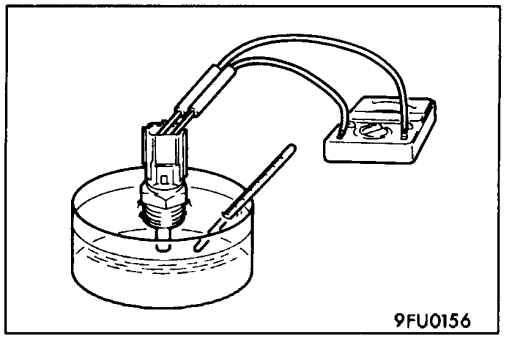
4. If the value deviates from the standard value or resistance remains unchanged, replace the air flow sen assembly.



ENGINE COOLANT TEMPERATURE SENSOR CHECK

Caution
Be careful not to touch the connector (resin section) w the tool when removing and installing.

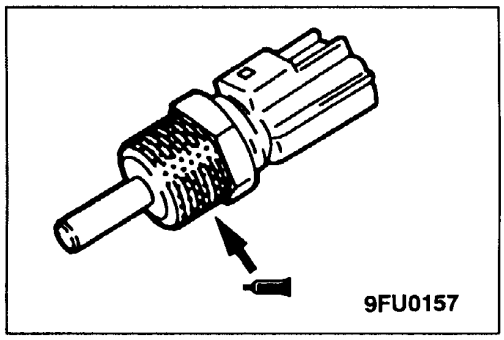
1. Remove the engine coolant temperature sensor.



2. With temperature sensing portion of engine coolant temperature sensor immersed in hot water, check resistance.

   Standard value:
   2.1 – 2.7 kΩ (at 20°C)
   0.26 – 0.36 kΩ (at 80°C)

3. If the resistance deviates from the standard value greatly, replace the sensor.

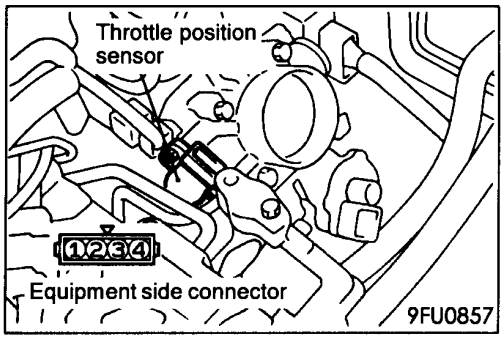


4. Apply sealant to threaded portion.

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

5. Install the engine coolant temperature sensor and tighten it to the specified torque.

   Tightening torque: 29 Nm



THROTTLE POSITION SENSOR CHECK

1. Disconnect the throttle position sensor connector.
2. Measure the resistance between the throttle position sensor side connector terminal 1 and terminal 4.

   Standard value: 3.5 – 6.5 kΩ

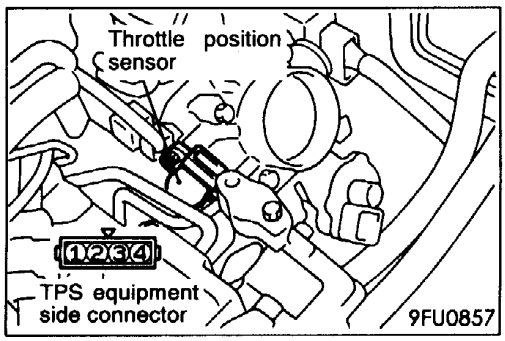
3. Measure the resistance between the throttle position sensor side connector terminal 3 and terminal 4.

   Normal condition:

Throttle valve slowly open until fully open from the idle position	Changes smoothly in proportion to the opening angle of the throttle valve

4. If the resistance is outside the standard value, or if it doesn't change smoothly, replace the throttle position sensor.

   NOTE
   For the throttle position sensor adjustment procedure, refer to P.13J-84.



IDLE POSITION SWITCH CHECK

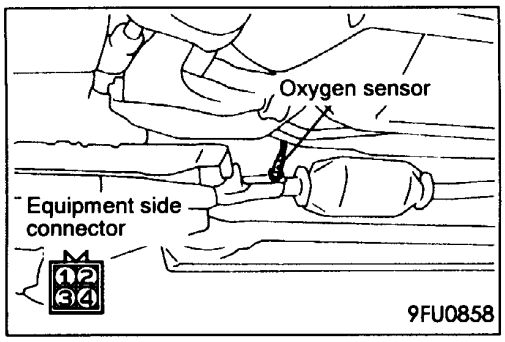
1. Disconnect the throttle position sensor connector.
2. Check the continuity between the throttle position sensor connector side terminal 2 and terminal 4.

   Normal condition:

Accelerator pedal	Continuity
Depressed	Non-conductive
Released	Conductive (0 Ω)

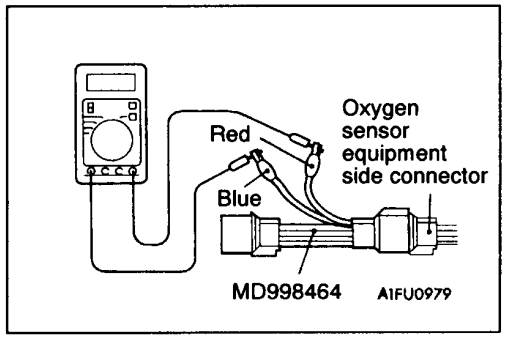
3. If out of specification, replace the throttle position sensor.

NOTE
After replacement, the idle position switch and throttle position sensor should be adjusted. (Refer to P.13J-84.)

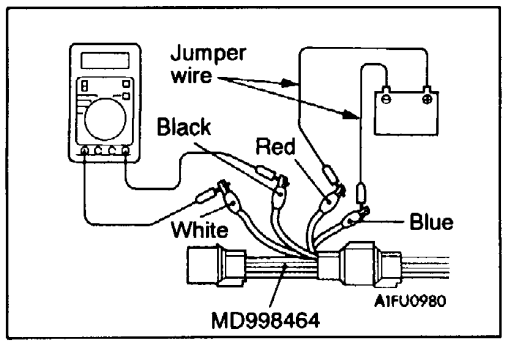


OXYGEN SENSOR CHECK

1. Disconnect the oxygen sensor connector and connect the special tool (test harness) to the connector on the oxygen sensor side.
2. Make sure that there is continuity (2.5 – 5.0 Ω at 20°C) between terminal 1 (red clip of special tool) and terminal 3 (blue clip of special tool) on the oxygen sensor connector.



3. If there is no continuity, replace the oxygen sensor.
4. Warm up the engine until engine coolant is 80°C or higher.



5. Use a jumper wire to connect terminal 1 (red clip) of the oxygen sensor connector to the battery (+) terminal and terminal 3 (blue clip) to the battery (–) terminal.

Caution
Be very careful when connecting the jumper wire; incorrect connection can damage the oxygen sensor.

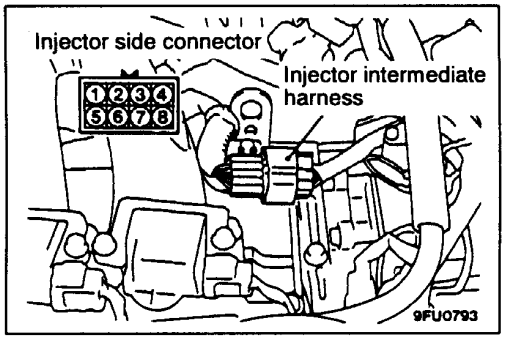
6. Connect a digital voltage meter between terminal 2 (black clip) and terminal 4 (white clip).
7. While repeatedly racing the engine, measure the oxygen sensor output voltage.

Standard value:

Engine	Oxygen sensor output voltage	Remarks
When racing the engine	0.6 – 1.0 V	If you make the air/fuel ratio rich by racing the engine repeatedly, a normal oxygen sensor will output a voltage of 0.6 – 1.0 V.

8. If the sensor is defective, replace the oxygen sensor.

NOTE
For removal and installation of the oxygen sensor, refer to GROUP 15 – Exhaust Pipe and Main Muffler.



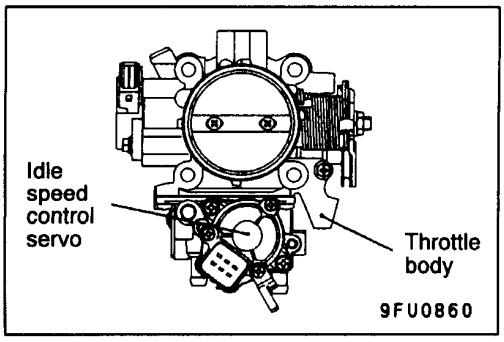
INJECTOR CHECK

1. Disconnect the injector intermediate harness connector.
2. Measure the resistance between each of the terminals.

Standard value: 0.9 – 1.1 Ω (at 20°C)

Injector	Measurement terminal
No.1 cylinder	1 – 2
No.2 cylinder	3 – 4
No.3 cylinder	5 – 6
No.4 cylinder	7 – 8

3. Connect the injector intermediate harness connector.

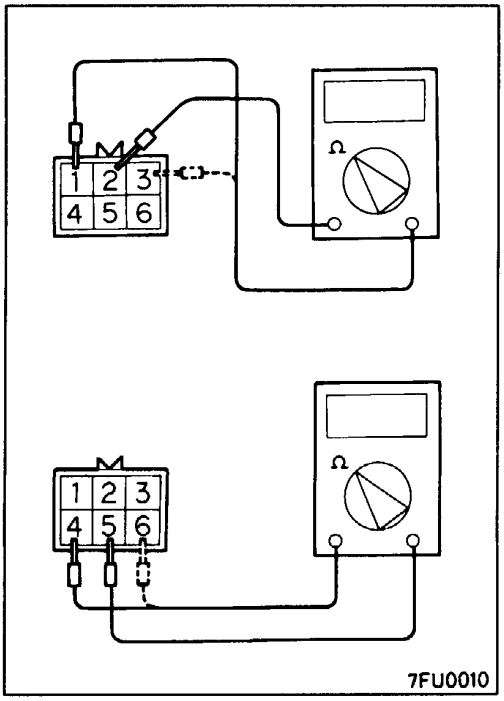


IDLE SPEED CONTROL (ISC) SERVO (STEPPER MOTOR) CHECK

Checking the Operation Sound

1. Check that the engine coolant temperature is 20°C or below.

   NOTE
   Disconnecting the engine coolant temperature sensor connector and connecting the harness-side of the connector to another engine coolant temperature sensor that is at 20°C or below is also okay.
2. Check that the operation sound of the stepper motor can be heard after the ignition is switched ON. (but without starting the motor.)
3. If the operation sound cannot be heard, check the stepper motor's activation circuit.
   If the circuit is normal, it is probable that there is a malfunction of the stepper motor or of the engine control unit.

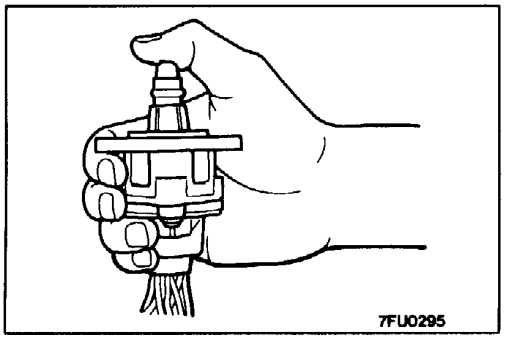


Checking the Coil Resistance

1. Disconnect the idle speed control servo connector and connect the special tool (test harness).
2. Measure the resistance between terminal 2 (white clip of the special tool) and either terminal 1 (red clip) or terminal 3 (blue clip) of the connector at the idle speed control servo side.

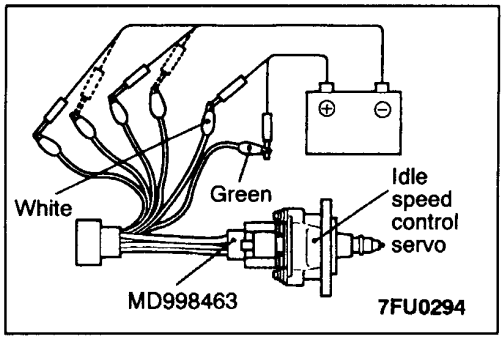
   Standard value: 28 – 33 Ω (at 20°C)
3. Measure the resistance between terminal 5 (green clip of the special tool) and either terminal 6 (yellow clip) or terminal 4 (black clip) of the connector at the idle speed control servo side.

   Standard value: 28 – 33 Ω (at 20°C)

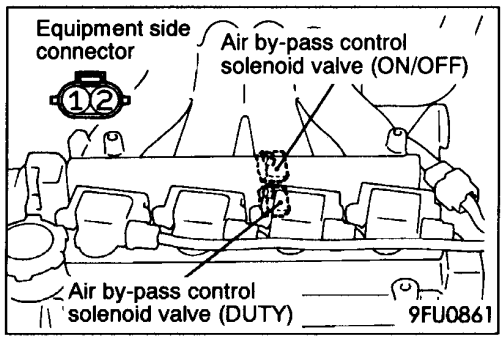


Operation Check

1. Remove the throttle body.
2. Remove the stepper motor.



3. Connect the special tool (test harness) to the idle speed control servo connector.
4. Connect the positive (+) terminal of a power supply (approx. 6 V) to the white clip and the green clip.
5. With the idle speed control servo as shown in the illustration, connect the negative (–) terminal of the power supply to each clip as described in the following steps, and check whether or not a vibrating feeling (a feeling of very slight vibration of the stepper motor) is generated as a result of the activation of the stepper motor.
   (1) Connect the negative (–) terminal of the power supply to the red and black clip.
   (2) Connect the negative (–) terminal of the power supply to the blue and black clip.
   (3) Connect the negative (–) terminal of the power supply to the blue and yellow clip.
   (4) Connect the negative (–) terminal of the power supply to the red and yellow clip.
   (5) Connect the negative (–) terminal of the power supply to the red and black clip.
   (6) Repeat the tests in sequence from (5) to (1).
6. If, as a result of these tests, vibration is detected, the stepper motor can be considered to be normal.



AIR BY-PASS CONTROL SOLENOID VALVE CHECK

1. Measure the resistance between the terminals of the air by-pass control solenoid valve (DUTY).

   Standard value: 7.7 – 9.3 Ω (at 20°C)

2. Measure the resistance between the terminals of the air by-pass control solenoid valve (ON/OFF).

   Standard value: 7.7 – 9.3 Ω (at 20°C)

PURGE CONTROL SOLENOID VALVE CHECK

Refer to GROUP 17 – Emission Control System.

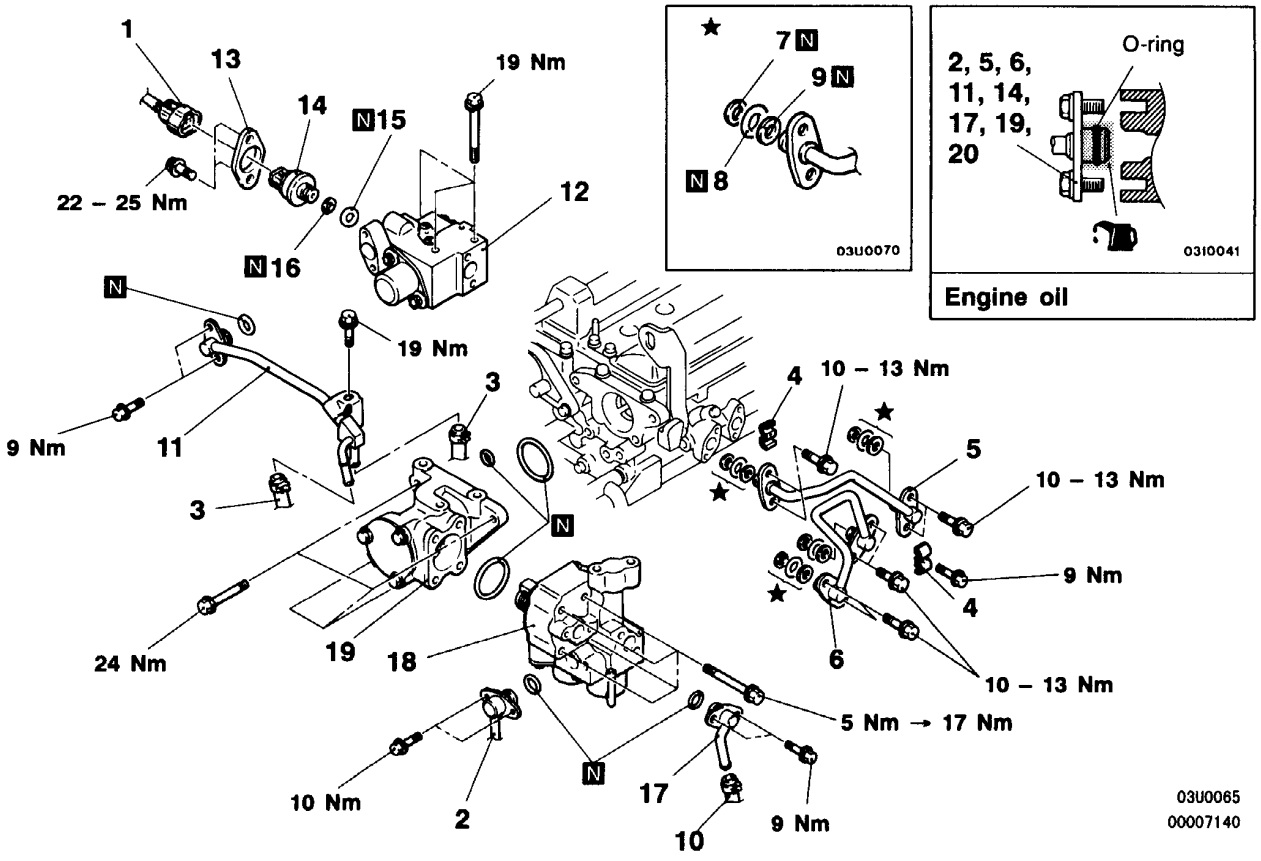
EGR CONTROL SERVO CHECK

Refer to GROUP 17 – Emission Control System.

FUEL PUMP (HIGH PRESSURE)

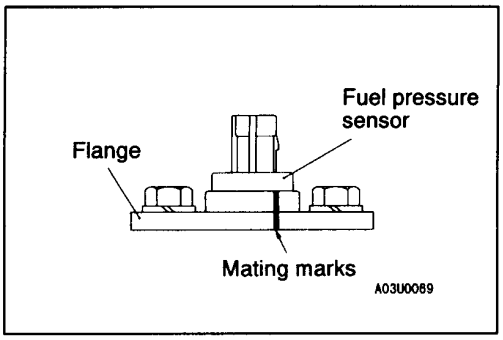
REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Engine Coolant Draining and Supplying
- Prevention of fuel discharge <before removal only>
- Air Intake Hose Assembly Removal and Installation
- Engine Cover Removal and Installation
- Ignition Coil Removal and Installation
- Throttle Body Removal and Installation (Refer to 13J-106.)
- Accelerator Cable Adjustment <after installation only>
- Fuel Leak Check <after installation only>



Removal steps

1. Fuel pressure sensor connector
▶I◀ 2. High-pressure fuel hose connection
3. Fuel return hose connection
4. Clamp
▶H◀ 5. Fuel return pipe assembly
▶H◀ 6. Fuel feed pipe assembly
▶G◀ 7. Back-up ring A
▶G◀ 8. O-ring
▶G◀ 9. Back-up ring B
10. Fuel hose connection
▶F◀ 11. Fuel return lower pipe assembly
12. Fuel pressure regulator (high pressure) assembly
◀A▶ ▶E◀ 13. Flange
▶E◀ 14. Fuel pressure sensor
▶D◀ 15. O-ring
▶D◀ 16. Back-up ring
▶C◀ 17. Fuel nipple assembly
▶B◀ 18. Fuel pump (high pressure)
▶A◀ 19. Pump camshaft case assembly

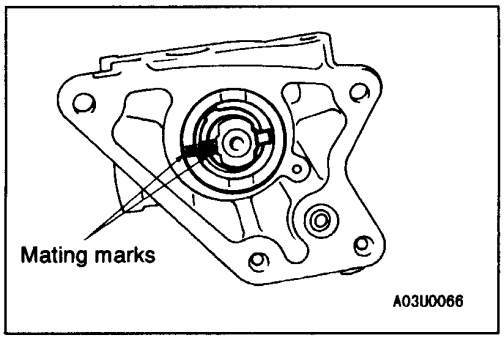


REMOVAL SERVICE POINT

◀A▶ FLANGE REMOVAL

If reusing the fuel pressure sensor, make the mating marks on the sensor and the flange before removing the flange.

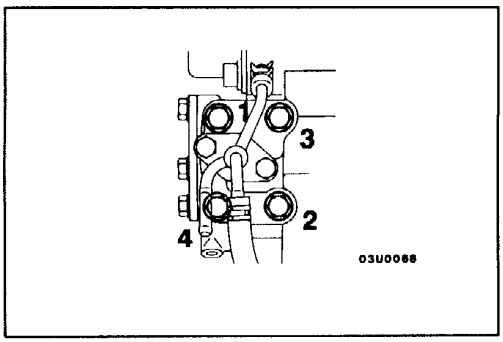
NOTE
The flange will be bent when it is installed to the engine. Because of this, the sealing condition and installation condition of the fuel pressure sensor will be maintained in good condition. Therefore, the mating marks should be made in order to install the flange in the original condition. If replacing the fuel pressure sensor with a new part, the sensor and flange should be replaced together.



INSTALLATION SERVICE POINTS

▶A◀ PUMP CAMSHAFT CASE ASSEMBLY INSTALLATION

1. Set the No.1 cylinder to the compression top dead centre position.
2. Align the mating mark on the housing of the pump camshaft case assembly with the mating mark on the coupling, and then install the pump camshaft case assembly to the engine.



▶B◀ FUEL PUMP (HIGH PRESSURE) INSTALLATION

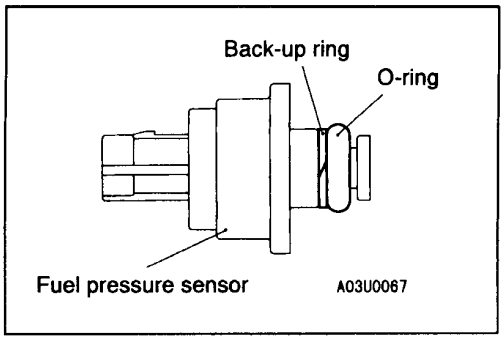
Use a torque wrench with a precision of 0.5 Nm to tighten the fuel pump mounting bolts according to the following procedure.

1. Tighten the bolts to 5 Nm in the order shown in the illustration.
2. Tighten the bolts to 17 Nm in the order shown in the illustration. The overall difference in tightening torque between the four bolts should be within 2 Nm.

▶C◀ FUEL NIPPLE ASSEMBLY INSTALLATION

Apply a small amount of fresh engine oil to the O-ring.

Caution
Take care not to let any of the engine oil get inside the fuel pump (high pressure).



▶D◀ BACK-UP RING/O-RING INSTALLATION

Install the back-up ring and the O-ring as shown in the illustration.

Caution
Take care not to install the back-up ring A for the injector, fuel feed pipe or fuel return pipe by mistake. (Outer diameter of the back-up ring for the fuel pressure sensor: 15.1 mm)

▶E◀ FUEL PRESSURE SENSOR/FLANGE INSTALLATION

1. Apply a small amount of fresh engine oil to the O-ring.

   Caution
   Take care not to let any of the engine oil get inside the fuel pressure regulator (high pressure) assembly.

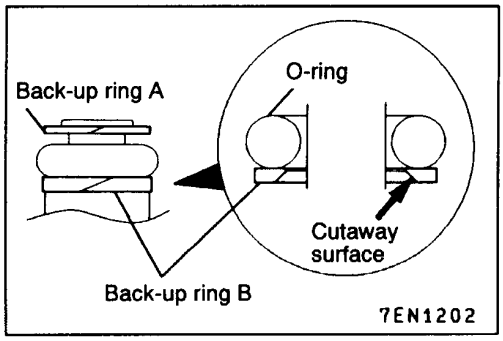
2. Align the mating marks which were made at the time of removal, and then install the fuel pressure sensor and flange to the fuel pressure regulator (high pressure) assembly.

   Caution
   If replacing the fuel pressure sensor with a new part, the sensor and flange should be replaced together.

▶F◀ FUEL RETURN LOWER PIPE ASSEMBLY INSTALLATION

Apply a small amount of fresh engine oil to the O-ring.

Caution
Take care not to let any of the engine oil get inside the fuel pressure regulator (high pressure) assembly.



▶G◀ BACK-UP RING B/O-RING/BACK-UP RING A INSTALLATION

Install the back-up rings and the O-ring as shown in the illustration.

Caution

1. **Install the back-up ring B facing its cutaway surface toward the opposite side of the O-ring as shown in the illustration.**
2. **Confirm the outer diameter of the back-up ring A. Take care not to install the back-up ring for the fuel pressure sensor by mistake. (Outer diameter of the back-up ring A: 14.8 mm)**

▶H◀ FUEL FEED PIPE ASSEMBLY/FUEL RETURN PIPE ASSEMBLY INSTALLATION

Apply a small amount of fresh engine oil to the O-ring.

Caution

Take care not to let any of the engine oil get inside the fuel pump (high pressure) or the delivery pipe assembly.

▶I◀ HIGH-PRESSURE FUEL HOSE INSTALLATION

1. Apply a small amount of fresh engine oil to the O-ring.

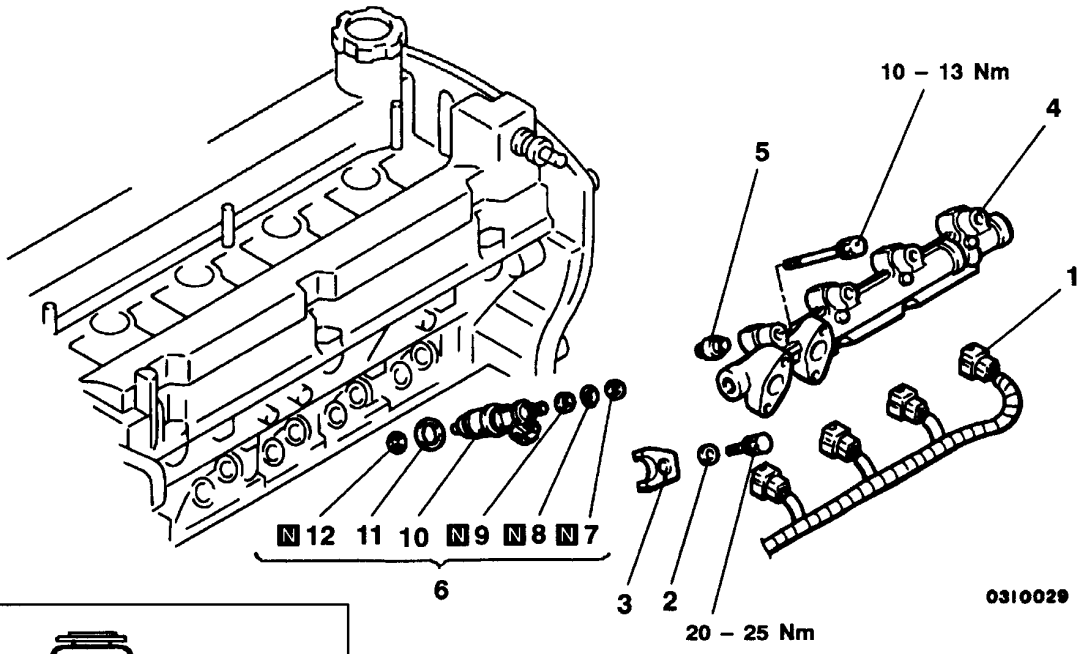
   Caution

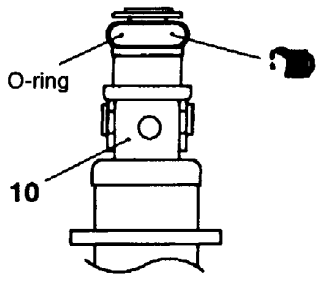
   Take care not to let any of the engine oil get inside the fuel pump (high pressure).
2. While being careful not to damage the O-ring, turn the high-pressure fuel hose to the left and right and connect it to the fuel pump (high pressure). After connecting, check that the hose turns smoothly.
3. If the hose does not turn smoothly, the cause may be that the O-ring is getting caught. Disconnect the hose, check the O-ring for damage and re-connect the hose to the fuel pump (high pressure) and then re-check.

INJECTOR

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Engine Coolant Draining and Supplying
- Prevention of fuel discharge <before removal only>
- Air Intake Hose Assembly Removal and Installation
- Engine Cover Removal and Installation
- Ignition Coil Removal and Installation
- Throttle Body Removal and Installation (Refer to 13J-106.)
- Intake Manifold Removal and Installation (Refer to GROUP 15.)
- Accelerator Cable Adjustment <after installation only>
- Fuel Leak Check <after installation only>





Engine oil

00005883

Removal steps

◀A▶ 1. Injector harness connector
2. Washer
3. Injector holder
◀B▶ ▶C◀ 4. Delivery pipe assembly
5. Insulator
◀B▶ ▶C◀ 6. Fuel injector assembly
▶B◀ 7. Back-up ring A
▶B◀ 8. O-ring
▶B◀ 9. Back-up ring B
10. Fuel injector
11. Gasket
▶A◀ 12. Corrugated washer

REMOVAL SERVICE POINTS

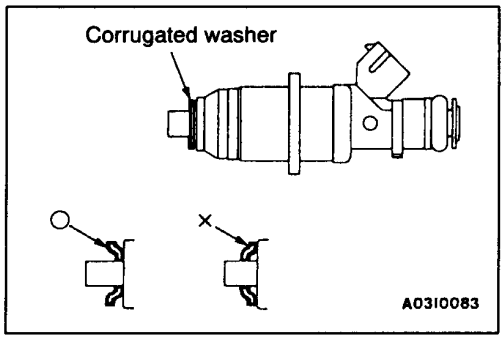
◀A▶ INJECTOR HARNESS CONNECTOR DISCONNECTION

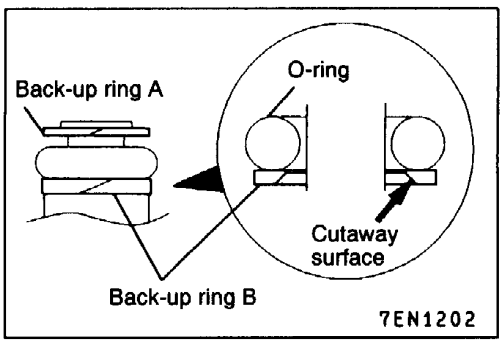
Caution
Disconnect the battery (–) cable from its terminal before carrying out this operation.

◀B▶ DELIVERY PIPE ASSEMBLY/FUEL INJECTOR ASSEMBLY REMOVAL

Remove the delivery pipe assembly with the fuel injector assembly still attached.

Caution
Be careful not to drop the fuel injector assembly when removing the delivery pipe assembly.





INSTALLATION SERVICE POINTS

▶A◀ CORRUGATED WASHER INSTALLATION

Caution
1. **The corrugated washer should always be replaced with a new part.**
2. **There should be no scratches or foreign particles on the corrugated washer mounting surface of the injector.**
3. **Be careful not to mistake the corrugated washer installation direction.**

▶B◀ BACK-UP RING B/O-RING/BACK-UP RING A INSTALLATION

Install the back-up rings and the O-ring as shown in the illustration.

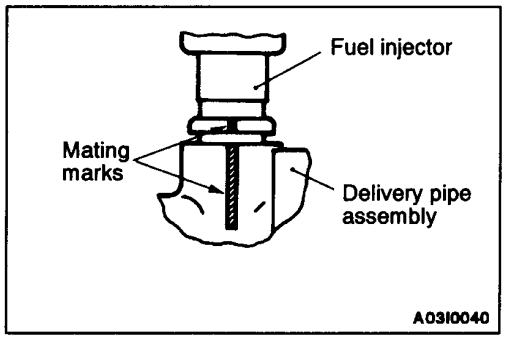
Caution
1. **Install the back-up ring B facing its cutaway surface toward the opposite side of the O-ring as shown in the illustration.**
2. **Confirm the outer diameter of the back-up ring A. Take care not to install the back-up ring for the fuel pressure sensor by mistake. (Outer diameter of the back-up ring A: 14.8 mm)**

▶C◀ FUEL INJECTOR ASSEMBLY/DELIVERY PIPE ASSEMBLY INSTALLATION

1. Apply a small amount of fresh engine oil to the O-ring.

   Caution
   Take care not to let any of the engine oil get inside the delivery pipe assembly.

2. While being careful not to damage the O-ring, turn the fuel injector assembly to the left and right and connect it to the delivery pipe assembly. After connecting, check that the fuel injector turns smoothly.
3. If the fuel injector does not turn smoothly, the cause may be that the O-ring is getting caught. Remove the fuel injector, check the O-ring for damage and re-connect the fuel injector to the delivery pipe assembly and then re-check.

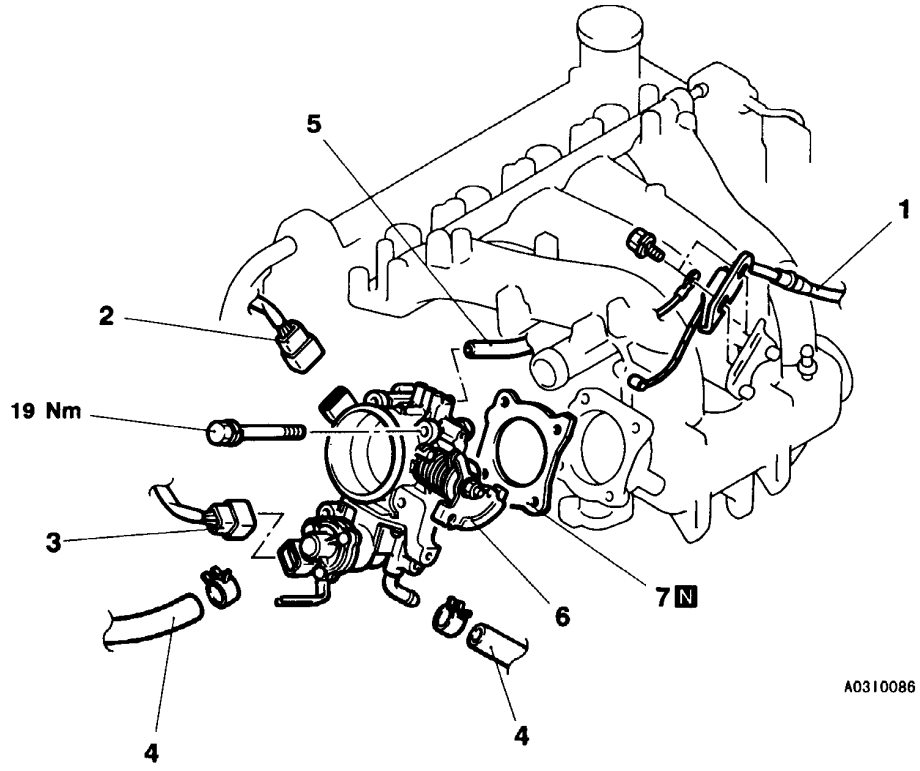


4. Align the mating marks on the delivery pipe assembly and the fuel injector, and then install the delivery pipe assembly with the injector assembly still attached.

THROTTLE BODY

REMOVAL AND INSTALLATION

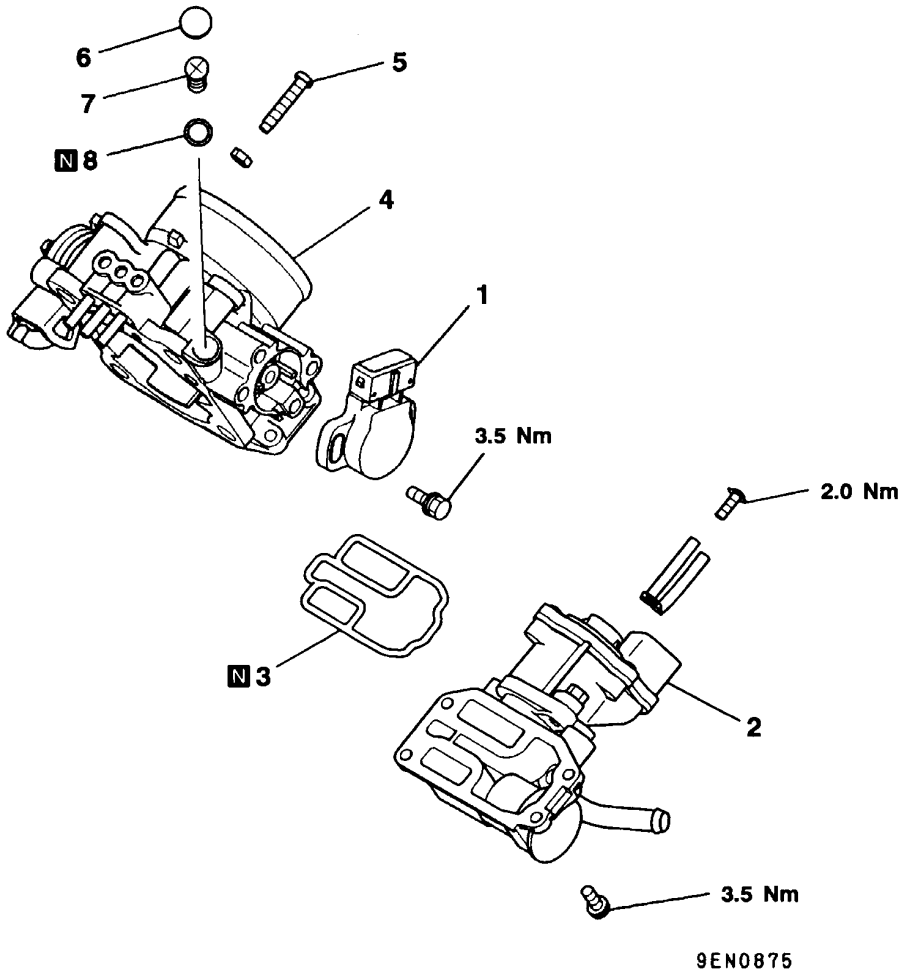
Pre-removal and Post-installation Operation
- Engine Coolant Draining and Supplying
- Air Intake Hose Removal and Installation
- Accelerator Cable Adjustment <after installation only>



Removal steps
1. Accelerator cable connection
2. Throttle position sensor connector
3. Idle speed control servo connector
4. Water hose connection
5. Vacuum hose connection
6. Throttle body
▶A◀ 7. Throttle body gasket

NOTE
Removal and installation service points are the same as before.

DISASSEMBLY AND REASSEMBLY



Disassembly steps

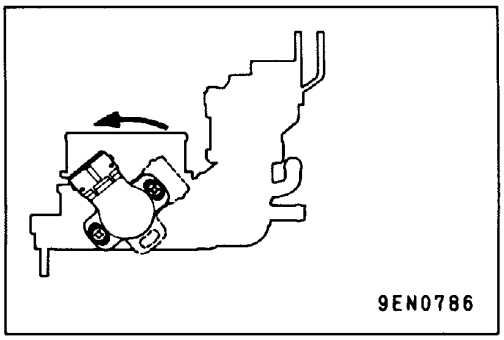
▶A◀ 1. Throttle position sensor
2. Idle speed control body assembly
3. O-ring
4. Throttle body
5. Fixed SAS
6. Cap
7. Speed adjusting screw
8. O-ring

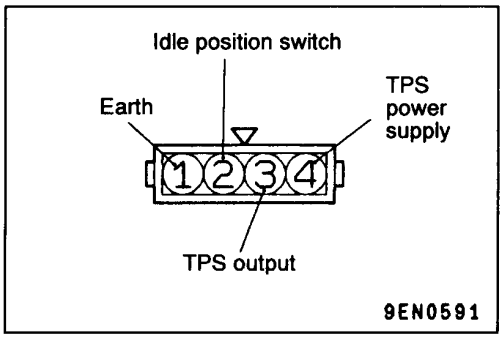
NOTE
1. The fixed SAS and the speed adjusting screw are correctly adjusted at the factory and should not be removed.
2. If the fixed SAS should happen to have been removed, carry out fixed SAS adjustment.
3. If the speed adjusting screw should happen to have been removed, carry out speed adjusting screw adjustment.

CLEANING THROTTLE BODY PARTS

1. Clean all throttle body parts.
   Do not use solvent to clean the following parts:
   - Throttle position sensor
   - Accelerator pedal position sensor
   - Idle speed control body assembly

   If these parts are immersed in solvent, their insulation will deteriorate.
   Wipe them with cloth only.
2. Check if the vacuum port or passage is clogged. Use compressed air to clean the vacuum passage.





REASSEMBLY SERVICE POINT

▶A◀ THROTTLE POSITION SENSOR (TPS) INSTALLATION

1. Install the TPS so that it faces as shown in the illustration, and then tighten it with the screw.
2. Connect a multimeter between terminal (4) (TPS power supply) and terminal (3) (TPS output) of the TPS connector, and check that the resistance increases gradually as the throttle valve is opened slowly to the fully-open position.
3. Check the continuity between terminal (2) (idle position switch) and terminal (1) (earth) of the TPS connector when the throttle valve is fully closed and fully open.

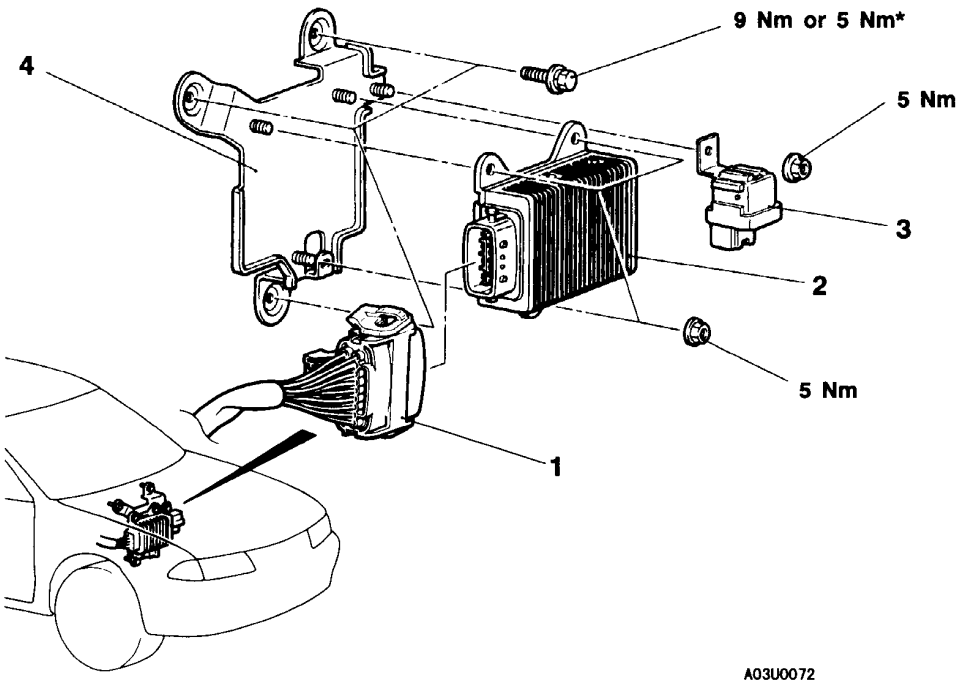
   Normal condition:

Throttle valve condition	Continuity
Fully closed	Continuity
Fully open	No continuity

   If there is no continuity when the throttle valve is fully closed, turn the TPS body anti-clockwise and then check again.
4. If there is an abnormality, replace the TPS.

INJECTOR DRIVER

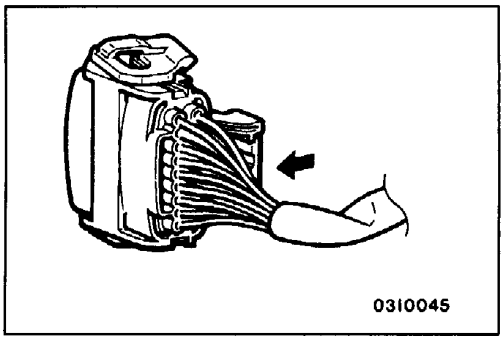
REMOVAL AND INSTALLATION



Removal steps

◀A▶ 1. Injector driver connector
◀B▶ 2. Injector driver
3. Injector driver control relay
4. Bracket

NOTE
Tightening torque marked with * is for earth bolts (head marking: E).



REMOVAL SERVICE POINTS

◀A▶ INJECTOR DRIVER CONNECTOR DISCONNECTION

Press the injector driver connector in the place shown in the illustration to disconnect the injector driver connector.

Caution
Disconnect the battery (–) cable from its terminal before carrying out this operation.

◀B▶ INJECTOR DRIVER REMOVAL

Caution
The injector driver will become hot after the vehicle has been driven, so take care when handling it.

GROUP 14
ENGINE COOLING

GENERAL

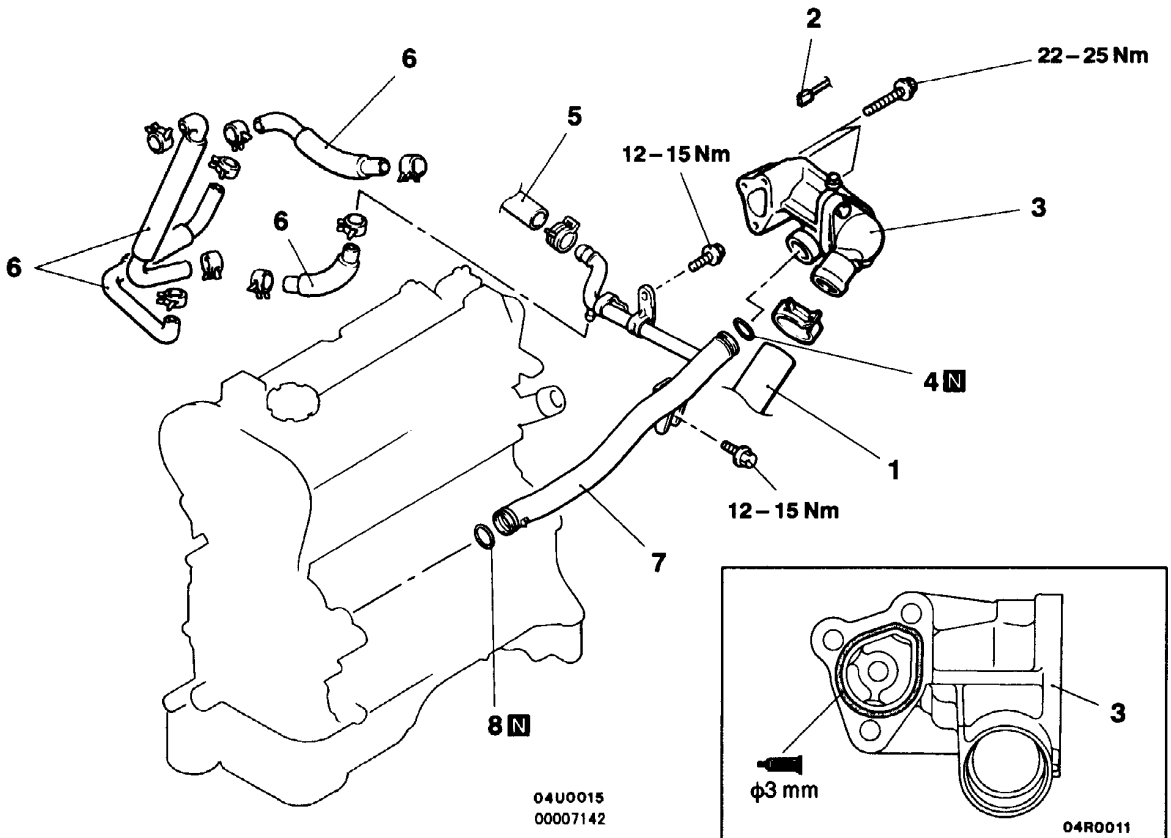
OUTLINE OF CHANGES

The following maintenance service procedures have been established to correspond to the addition of vehicles with 4G9-GDI engine. Maintenance service procedures not listed below are the same as before.

WATER HOSE AND WATER PIPE

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Engine Coolant Draining and Suppling
- Air Cleaner and Air Intake Hose Assembly Removal and Installation



Sealant
Mitsubishi Genuine Part No.
MD970389 or equivalent

Removal steps

◀A▶ ▶C◀ 1. Radiator lower hose connection
2. Engine coolant temperature gauge unit connector
▶B◀ 3. Thermostat case assembly
▶A◀ 4. O-ring
5. Heater hose connection
- Intake manifold (Refer to GROUP 15.)

6. Water hose
7. Water inlet pipe assembly
▶A◀ 8. O-ring

NOTE
Removal and installation service points are the same as before.

GROUP 15
INTAKE AND EXHAUST

GENERAL

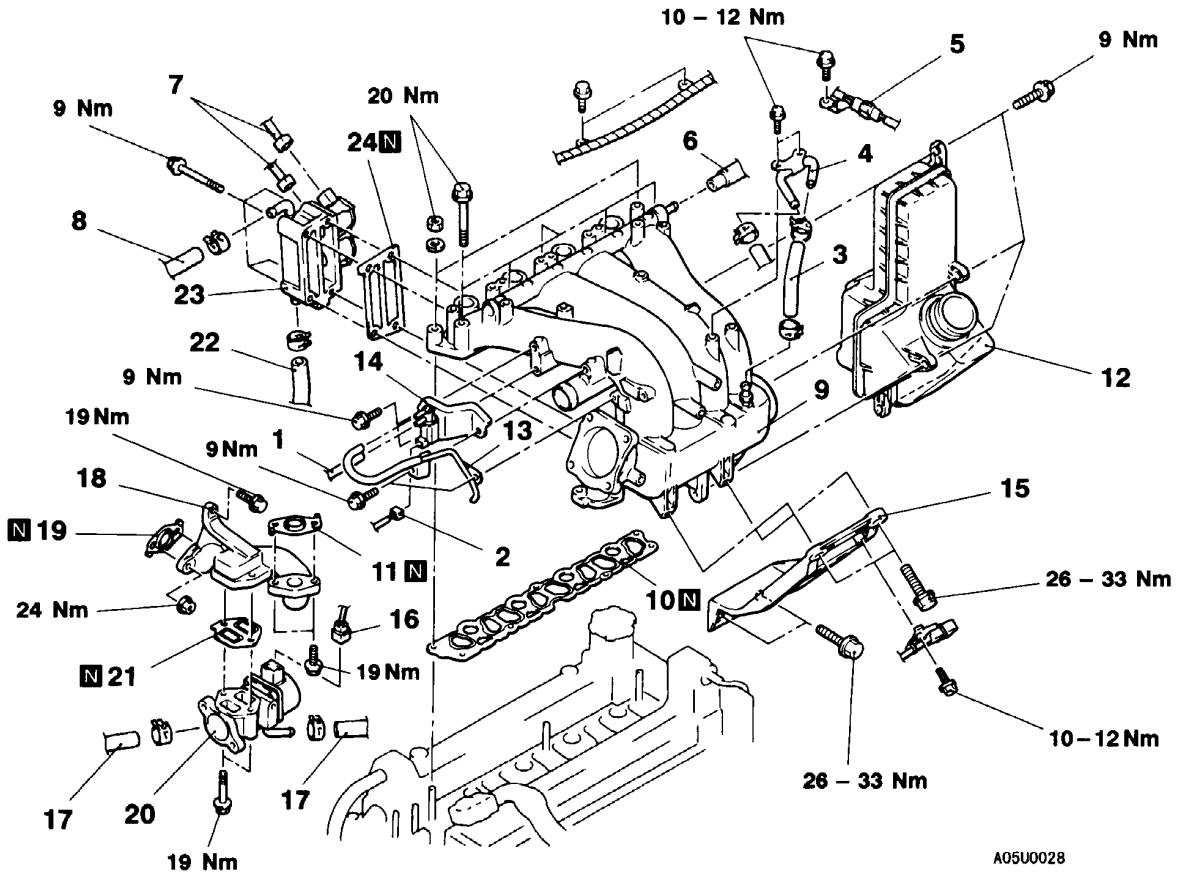
OUTLINE OF CHANGES

The following maintenance service procedures have been established to correspond to the addition of vehicles with 4G9-GDI engine. Maintenance service procedures not listed below are the same as before.

INTAKE MANIFOLD

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Engine Coolant Draining and Supplying
- Air Intake Hose Assembly Removal and Installation
- Engine Cover Removal and Installation
- Ignition Coil Removal and Installation
- Throttle Body Removal and Installation (Refer to GROUP 13J.)



Intake manifold removal steps
1. Vacuum hose connection
2. Purge control solenoid valve connector
3. Brake booster vacuum hose connection
4. Brake booster vacuum pipe
5. Connector bracket (for crank angle sensor)
6. PCV hose connection
7. Air by-pass solenoid valve connector
8. Water hose connection
9. Intake manifold assembly
10. Intake manifold gasket
11. EGR pipe gasket
12. Surging resonator
13. Vacuum pipe and hose assembly
14. Purge control solenoid valve
15. Intake manifold stay

EGR valve assembly removal steps
9. Intake manifold assembly
16. EGR servo connector
17. Water hose connection
18. EGR valve support
19. EGR pipe gasket
20. EGR valve assembly
21. EGR valve gasket

Air by-pass valve removal steps
9. Intake manifold assembly
22. Water hose connection
23. Air by-pass valve
24. Air by-pass valve gasket

INSPECTION

Check the following points; replace the part if a problem is found.

INTAKE MANIFOLD CHECK

1. Check for damage or cracking of any part.
2. Check for obstruction of the negative pressure (vacuum) outlet port, and for obstruction of the water passage or gas passage.
3. Using a straight edge and thickness gauge, check for distortion of the cylinder head installation surface.

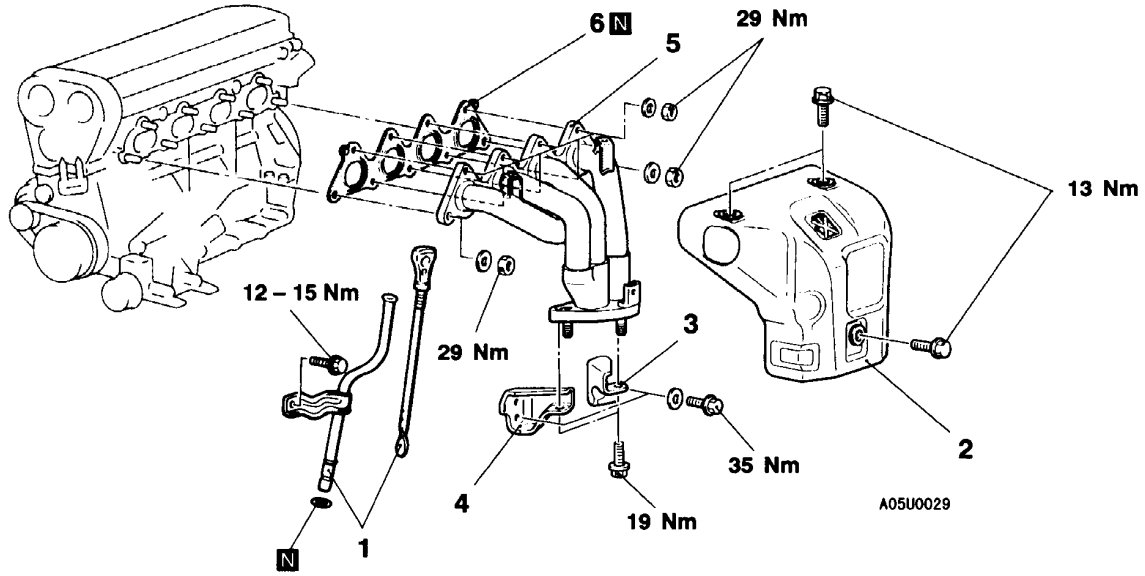
   Standard value: 0.15 mm or less

   Limit: 0.20 mm

EXHAUST MANIFOLD

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
Front Exhaust Pipe Removal and installation
(Refer to P.15-5.)



Removal steps

1. Oil level gauge guide assembly
2. Heat protector
3. Exhaust manifold bracket (A)
4. Exhaust manifold bracket (B)
5. Exhaust manifold
6. Exhaust manifold gasket

INSPECTION

EXHAUST MANIFOLD CHECK

1. Check for damage or cracking of any part.
2. Using a straight edge and thickness gauge, check for distortion of the cylinder head installation surface.

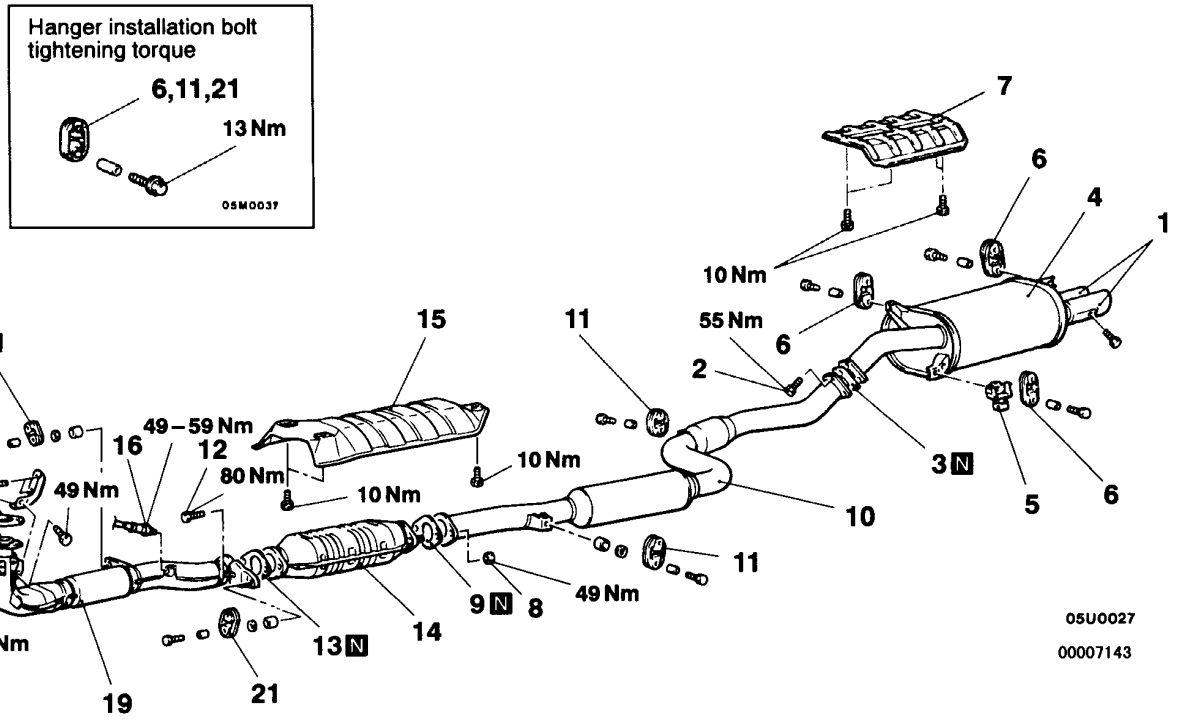
   Standard value: 0.15 mm or less

   Limit: 0.20 mm

EXHAUST PIPE AND MAIN MUFFLER

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
Under Cover Removal and Installation



Main muffler removal steps
1. Mouldings
2. Bolt
3. Gasket
4. Main muffler
5. Dynamic damper
6. Hanger
7. Rear floor heat protector panel

Center exhaust pipe removal steps
2. Bolt
3. Gasket
8. Self locking nuts
9. Gasket
10. Center exhaust pipe
11. Hanger
12. Bolt
13. Gasket
14. Catalytic converter
15. Front floor heat protector panel

Front exhaust pipe removal steps
12. Bolt
13. Gasket
◀A▶ ▶A◀ 16. Oxygen sensor
17. Self locking nuts
18. Gasket
19. Front exhaust pipe
20. Front exhaust pipe bracket
21. Hanger

NOTE
Removal and installation service points are the same as before.

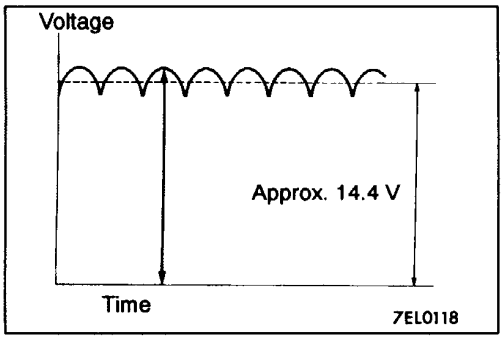
ENGINE ELECTRICAL

CONTENTS

CHARGING SYSTEM

GENERAL INFORMATION

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

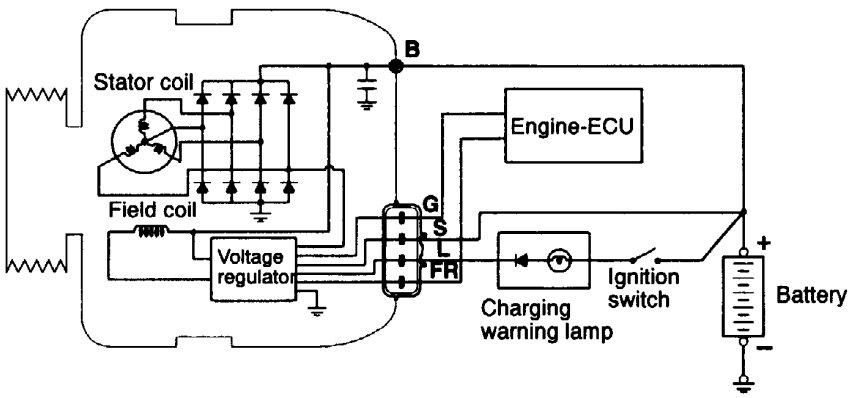


OPERATION

Rotation of the excited field coil generates AC voltage in the stator.
This alternating current is rectified through diodes to DC voltage having a waveform 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.

SYSTEM DIAGRAM



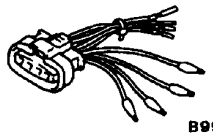
ALTERNATOR SPECIFICATIONS

Items	4G9
Type	Battery voltage sensing
Rated output V/A	12/100
Voltage regulator	Electronic built-in type

SERVICE SPECIFICATIONS

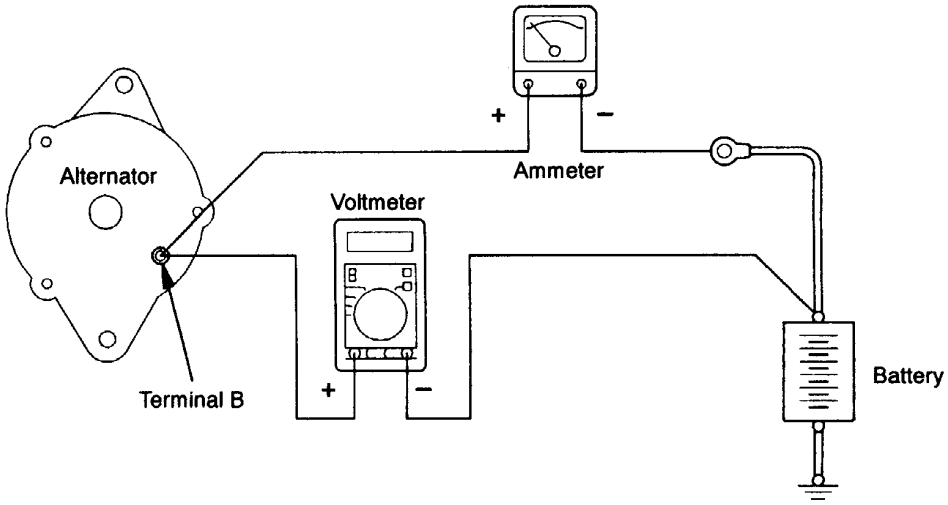
Items		Standard value	Limit
Alternator output line voltage drop (at 30A) V		–	max. 0.3
Regulated voltage ambient temp. at voltage regulator V	–20°C	14.2–15.4	–
	20°C	13.9–14.9	–
	60°C	13.4–14.6	–
	80°C	13.1–14.5	–
Output current		–	70% of normal output current
Rotor coil resistance Ω		Approx. 2 – 5	–

SPECIAL TOOL

Tool	Number	Name	Use
 B991519	MB991519	Alternator test harness	Checking the alternator (S terminal voltage)

ON-VEHICLE SERVICE

ALTERNATOR OUTPUT LINE VOLTAGE DROP TEST



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 11A – 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.)

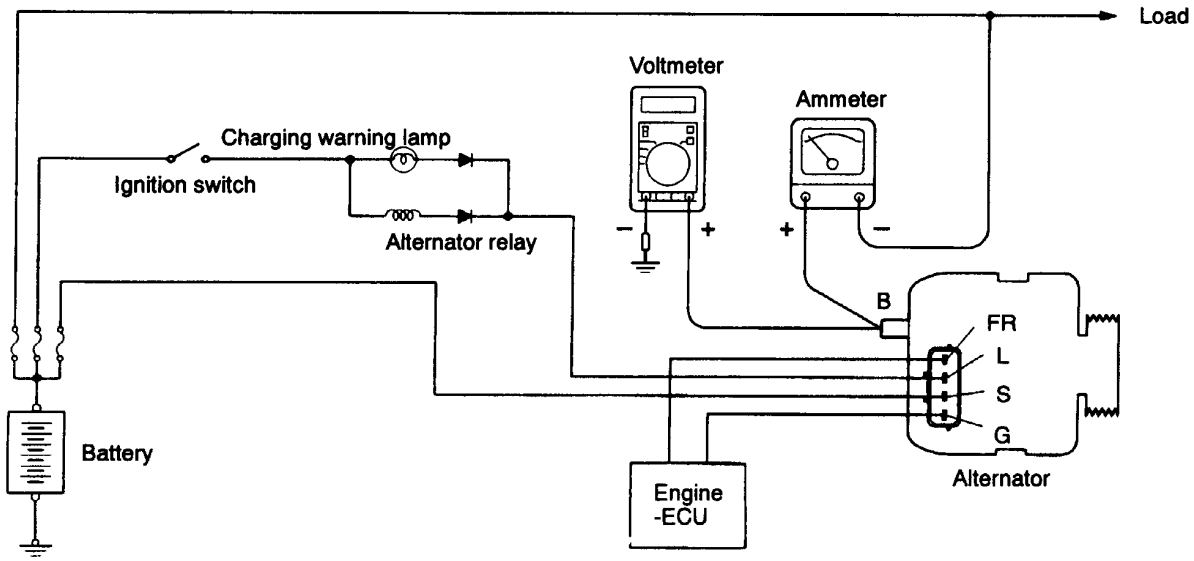
(6) Reconnect the negative battery cable.
(7) Connect a tachometer or the MUT-II. (Refer to GROUP 11A – On-vehicle Service.)
(8) Leave the hood open.
(9) Start the engine.
(10) With the engine running at 2,500 r/min, turn the headlamps and other lamps on and off to adjust the alternator load so that 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. When the value range is 40 A, the limit is max. 0.4 V.

(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 off all lamps and the ignition switch.
(14) Remove the tachometer or the MUT-II.
(15) Disconnect the negative battery cable.
(16) Disconnect the ammeter and voltmeter.
(17) Connect the alternator output wire to the alternator "B" terminal.
(18) Connect the negative battery cable.

OUTPUT CURRENT TEST



This test determines whether the alternator output current is normal.

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

NOTE
The 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 11A – 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 the negative battery cable.
(7) Connect a tachometer or the MUT-II. (Refer to GROUP 11A – On-vehicle Service.)
(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.

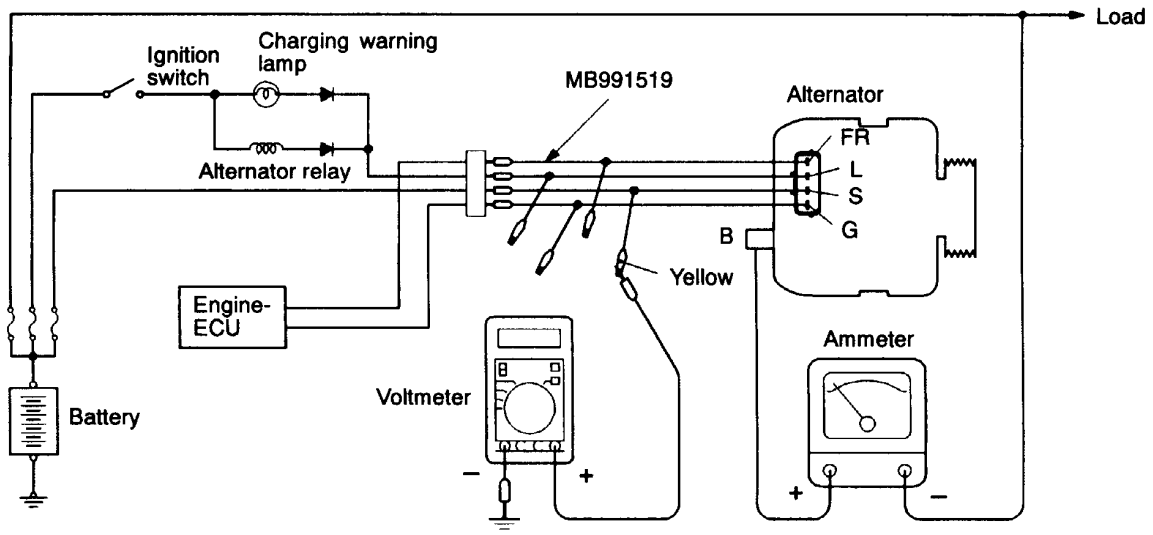
(10) Turn the light switch on to turn on headlamps and then start the engine.
(11) Immediately after setting the headlamps to high beam and turning the heater blower switch to the high revolution position, increase the engine speed to 2,500 r/min and read the maximum current output value displayed on 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) Remove the tachometer or the MUT-II.
(16) Disconnect the negative battery cable.
(17) Disconnect the ammeter and voltmeter.
(18) Connect the alternator output wire to the alternator "B" terminal.
(19) Connect the negative battery cable.

REGULATED VOLTAGE TEST



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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.
- Alternator drive belt tension (Refer to GROUP 11A – 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) Use the special tool (Alternator test harness: MB991519) to connect a digital voltmeter between the alternator S terminal and earth. (Connect the (+) lead of 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) Reconnect the negative battery cable.
(8) Connect a tachometer or the MUT-II. (Refer to GROUP 11A – On-vehicle Service.)
(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.

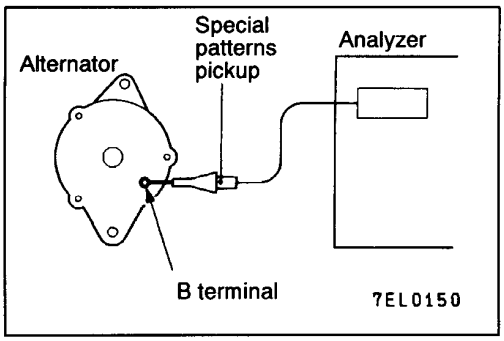
(10) Turn all lamps and accessories off.
(11) Start the engine.
(12) Increase the engine speed to 2,500 r/min.
(13) Read the value displayed on the voltmeter when the alternator output current alternator becomes 10 A or less.

(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)Remove the tachometer or the MUT-II.
(18)Disconnect the negative battery cable.
(19)Disconnect the ammeter and voltmeter.
(20)Connect the alternator output wire to the alternator "B" terminal.
(21)Remove the special tool, and return the connector to the original condition.
(22)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



WAVEFORM CHECK USING AN ANALYZER

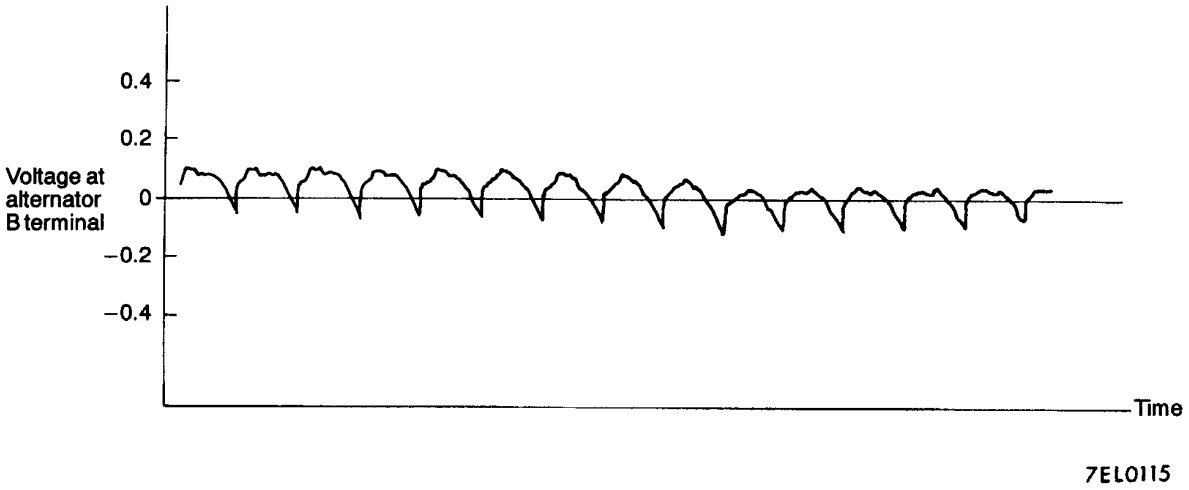
MEASUREMENT METHOD

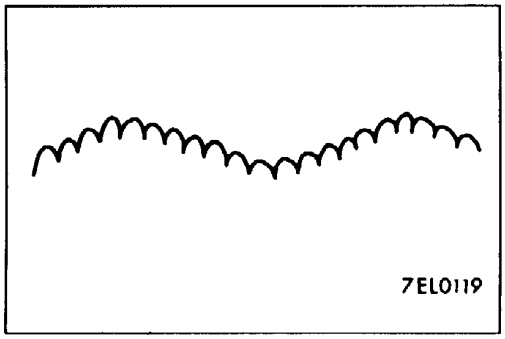
Connect the analyzer special patterns pick-up to the alternator B terminal.

STANDARD WAVEFORM

Observation Conditions

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





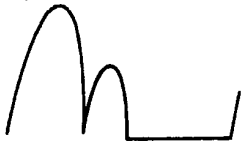
NOTE

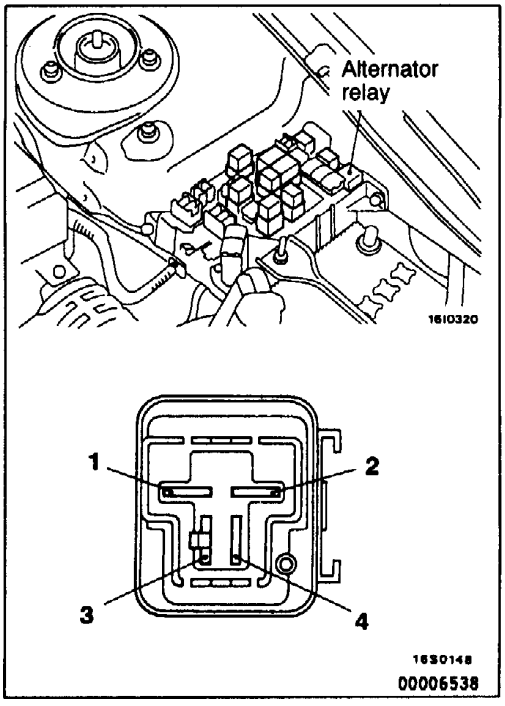
The voltage waveform of the alternator B terminal can undulate as shown at left. This waveform is produced when the regulator operates according to fluctuations in the alternator load (current), and is normal for the alternator.

In addition, when the voltage waveform reaches an excessively high value (approx. 2 V or higher at idle), it often indicates an open circuit due to a brown fuse between alternator B terminal and battery, but not a defective alternator.

EXAMPLES OF ABNORMAL WAVEFORMS

NOTE
1. The size of the waveform patterns differs largely, depending on the adjustment of the variable knob on the analyzer.
2. Identification of abnormal waveforms is easier when there is a large output current (regulator is not operating). (Waveforms 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 waveforms	Problem cause	Abnormal waveforms	Problem cause
Example 1  A7EL0120	• Open diode	Example 4  A7EL0123	• Short in stator coil
Example 2  A7EL0121	• Short in diode	Example 5  A7EL0124	• Open supplementary diode
Example 3  A7EL0122	• Broken wire in stator coil	At this time, the charging warning lamp is illuminated.	



ALTERNATOR RELAY CONTINUITY CHECK

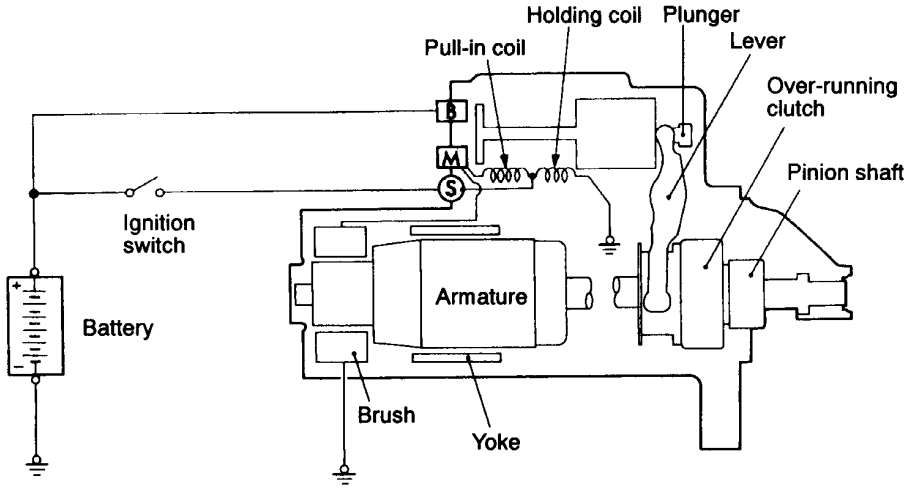
1. Remove the alternator relay from the relay box inside the engine compartment.
2. Set the analogue-type circuit tester to the Ω range and check that there is continuity when the (+) terminal of the tester is connected to terminal 2 of the alternator relay and the (–) terminal is connected to terminal 4.
3. Next, check that there is no continuity when the (+) terminal is connected to terminal 4 and the (–) terminal is connected to terminal 2.
4. If the continuity checks in steps 2 and 3 show a defect, replace the alternator relay.

STARTING SYSTEM

GENERAL INFORMATION

If the ignition switch is turned to the "START" position, current flows in the pull-in and holding coils provided inside magnetic switch, attracting the plunger. When the plunger is attracted, the lever connected to the plunger is actuated to engage 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 overrunning clutch is provided between the pinion and the armature shaft, to prevent damage to the starter.

SYSTEM DIAGRAM



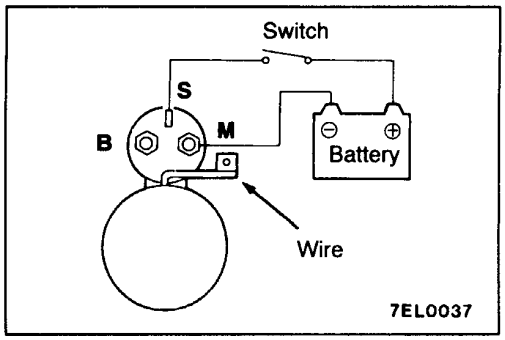
6EN0939

STARTER MOTOR SPECIFICATIONS

Items	4G9
Type	Reduction drive with planetary gear
Rated output kW/V	1.0/12
No. of pinion teeth	8

SERVICE SPECIFICATIONS

Items	Standard value	Limit
Pinion gap mm	0.5–2.0	–
Commutator outer diameter mm	29.4	28.8
Commutator runout mm	–	0.05
Commutator undercut mm	0.5	0.2



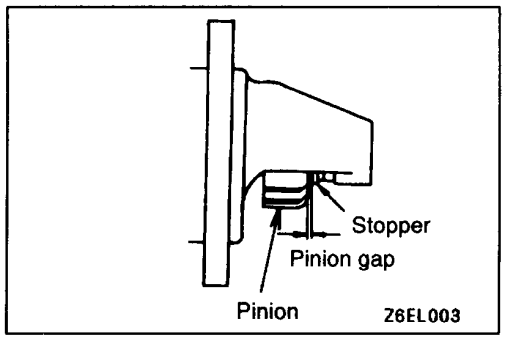
STARTER MOTOR

INSPECTION

PINION GAP ADJUSTMENT

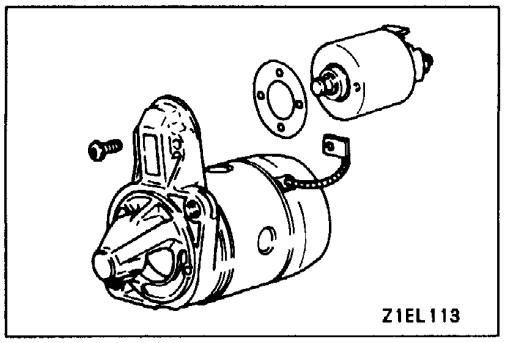
1. Disconnect field coil wire from M-terminal of magnetic switch.
2. Connect a 12V battery between S-terminal and M-terminal.
3. Set switch to "ON", and pinion will move out.

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

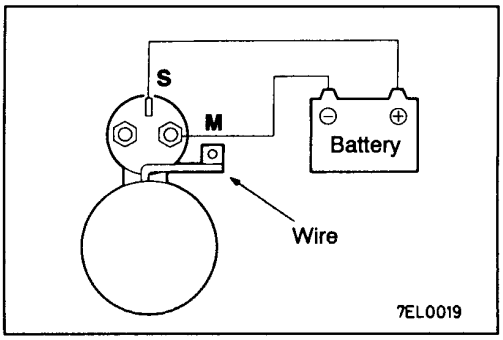


4. Check pinion to stopper clearance (pinion gap) with a thickness gauge.

   Pinion gap: 0.5–2.0 mm



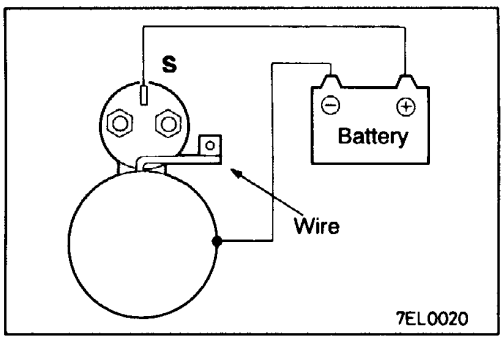
5. If pinion gap is out of specification, adjust by adding or removing gaskets between magnetic switch and front bracket.



MAGNETIC SWITCH PULL-IN TEST

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

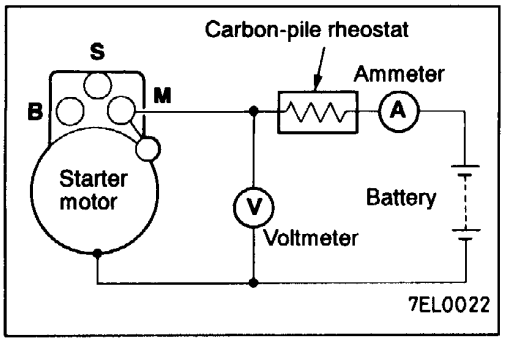
   Caution
   This test must be performed quickly (in less than 10 seconds) to prevent coil from burning.
3. If pinion moves out, then pull-in coil is good. If it doesn't, replace magnetic switch.



MAGNETIC SWITCH HOLD-IN TEST

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

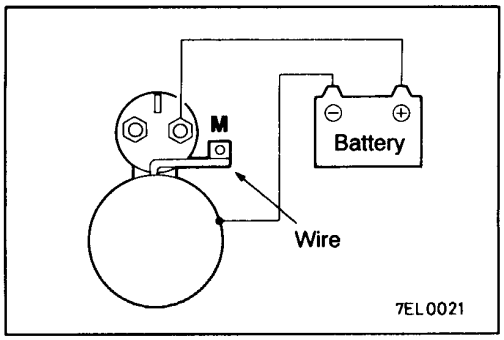
   Caution
   This test must be performed quickly (in less than 10 seconds) to prevent coil from burning.
3. Manually pull out the pinion as far as the pinion stopper position.
4. If pinion remains out, everything is in order. If pinion moves in, hold-in circuit is open. Replace magnetic switch.



FREE RUNNING TEST

1. Place starter motor in a vise equipped with soft jaws and connect a fully-charged 12-volt battery to starter motor as follows:
2. Connect a test ammeter (100-ampere scale) and carbon pile rheostat in series with battery positive post and starter motor terminal.
3. Connect a voltmeter (15-volt scale) across starter motor.
4. Rotate carbon pile to full-resistance position.
5. Connect battery cable from battery negative post to starter motor body.
6. Adjust the rheostat until the battery voltage shown by the voltmeter is 11 V.
7. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely.

   Current: max. 90 Amps



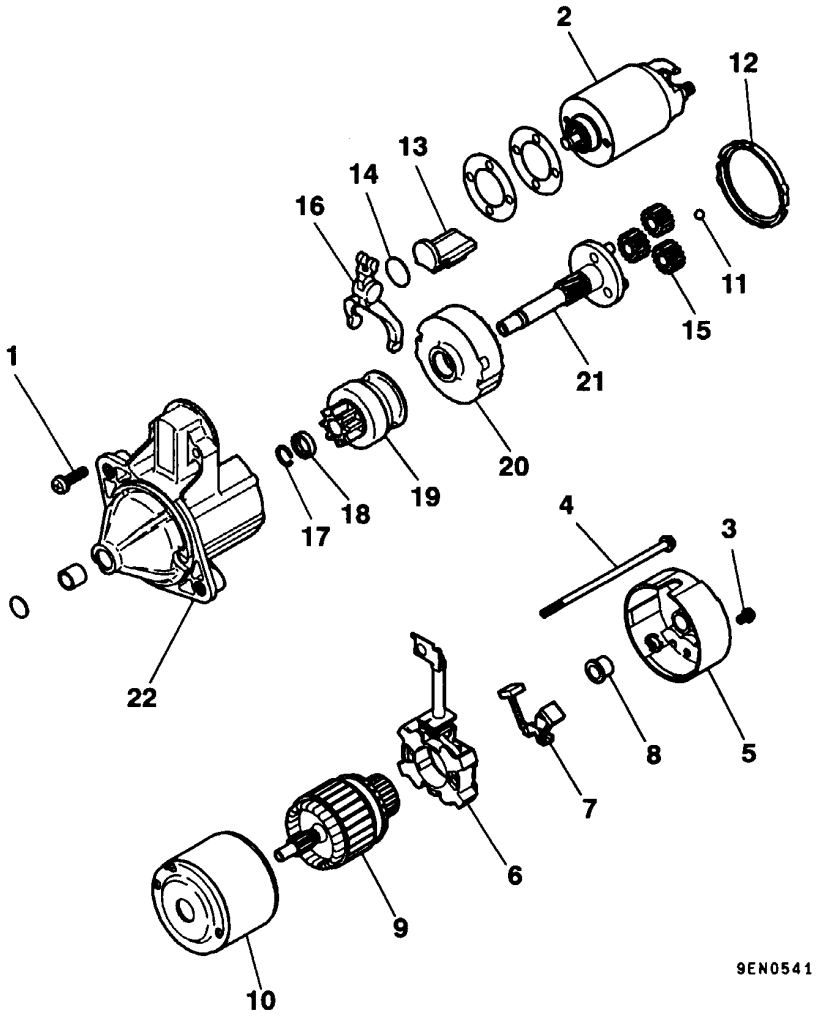
MAGNETIC SWITCH RETURN TEST

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

   Caution
   This test must be performed quickly (In less than 10 seconds) to prevent coil from burning.
3. Pull pinion out and release. If pinion quickly returns to its original position, everything is in order. If it doesn't, replace magnetic switch.

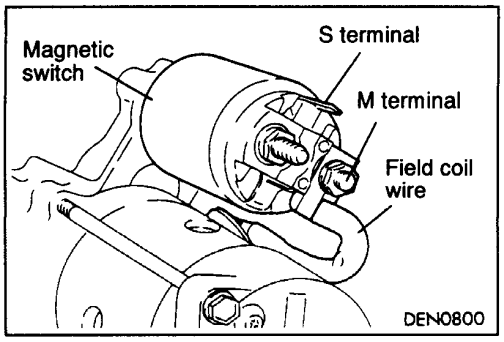
   Caution
   Be careful not to get your fingers caught when pulling out the pinion.

DISASSEMBLY AND REASSEMBLY



Disassembly steps

1. Screw
◀A▶ 2. Magnetic switch
3. Screw
4. Screw
5. Rear bracket
6. Brush holder
7. Brush
8. Rear bearing
◀B▶ 9. Armature
10. Yoke assembly
◀B▶ 11. Ball
12. Packing A
13. Packing B
14. Plate
15. Planetary gear
16. Lever
◀C▶ ▶A◀ 17. Snap ring
◀C▶ ▶A◀ 18. Stop ring
19. Overrunning clutch
20. Internal gear
21. Planetary gear holder
22. Front bracket



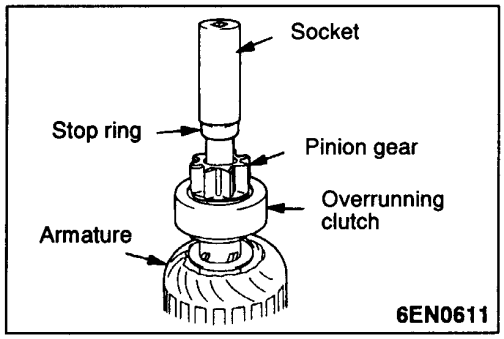
DISASSEMBLY SERVICE POINTS

◀A▶ MAGNETIC SWITCH REMOVAL

Disconnect the field coil wire from terminal M of the magnetic switch.

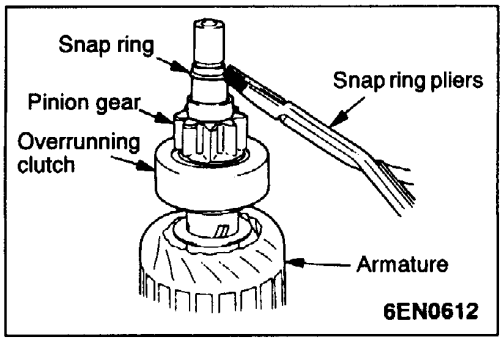
◀B▶ ARMATURE AND BALL REMOVAL

When removing the armature, do not lose the ball placed at the end as a bearing.



◀C▶ SNAP RING/STOP RING REMOVAL

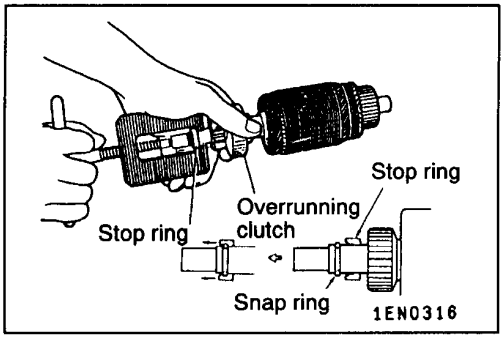
1. Using an appropriate wrench socket, push the stop ring toward the overrunning clutch.



2. Remove the snap ring with snap ring pliers and then remove the stop ring and overrunning clutch.

STARTER MOTOR PARTS CLEANING

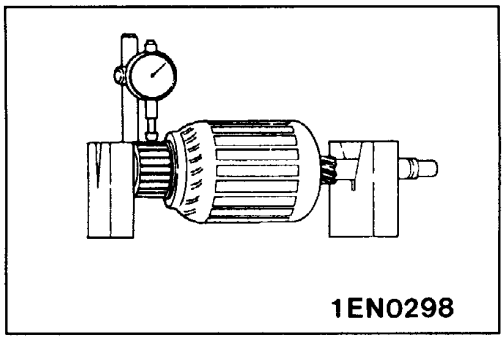
1. Do not immerse the parts in cleaning solvent. Immersing the yoke and field coil assembly and/or armature will damage insulation. Wipe these parts with a cloth only.
2. Do not immerse the drive unit in cleaning solvent. The overrunning clutch is pre-lubricated at the factory and solvent will wash lubrication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



REASSEMBLY SERVICE POINTS

▶A◀ STOP RING/SNAP RING INSTALLATION

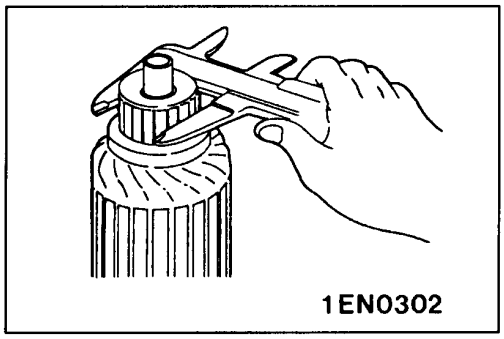
Using an appropriate tool, pull the stop ring over the snap ring.



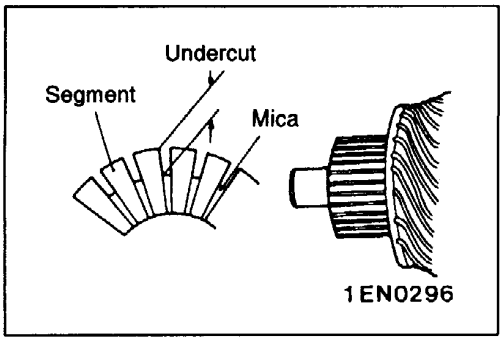
INSPECTION

COMMUTATOR

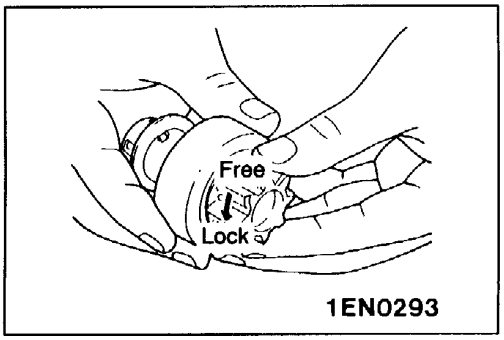
1. Place the armature in a pair of "V" blocks and check the runout with a dial indicator.
   Standard value: 0.05 mm
   Limit: 0.1 mm



2. Measure the commutator outer diameter.
   Standard value: 29.4 mm
   Limit: 28.4 mm

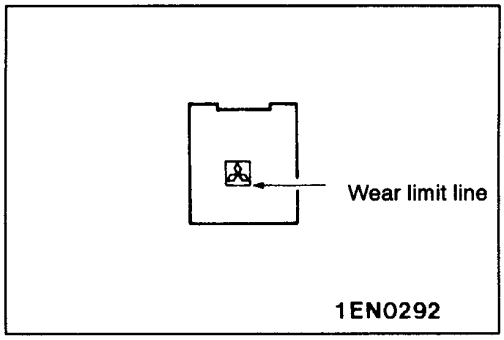


3. Check the undercut depth between segments.
   Standard value: 0.5 mm
   Limit: 0.2 mm



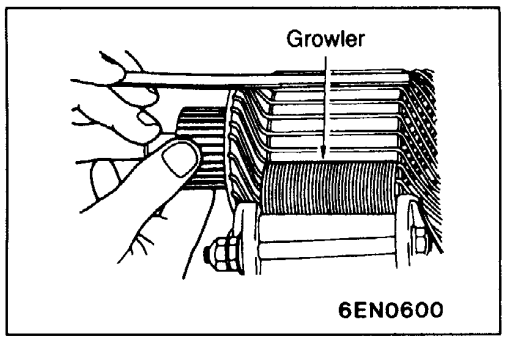
OVERRUNING CLUTCH

1. Check that the pinion locks when it is turned counterclockwise and moves smoothly when it is turned clockwise.
2. Check the pinion for wear or damage.



BRUSH

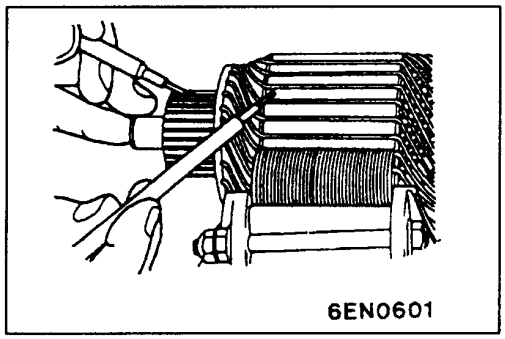
1. Check the brush for roughness of the surface that contacts the commutator and check the brush length.
   Limit: Wear limit line
2. In case the contacting surface has been corrected or the brush has been replaced, correct the contacting surface by winding sandpaper around the commutator.



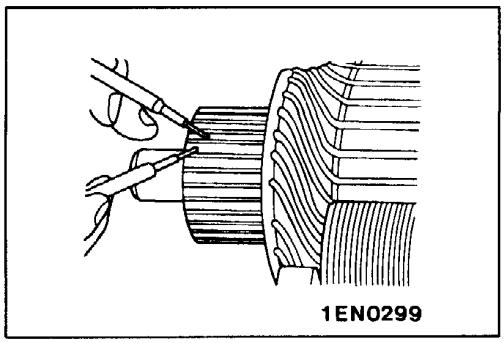
ARMATURE COIL SHORT-CIRCUIT TEST

1. Place armature in a growler.
2. Hold a thin steel blade parallel and just above while rotating armature slowly in growler. A shorted armature will cause blade to vibrate and be attracted to the core. Replace shorted armature.

   Caution
   Clean the armature surface thoroughly before checking.



3. Check the insulation between each commutator segment and armature coil core.
   If there is no continuity, the insulation is in order.



ARMATURE COIL OPEN-CIRCUIT INSPECTION

Check the continuity between segments. If there is continuity, the coil is in order.

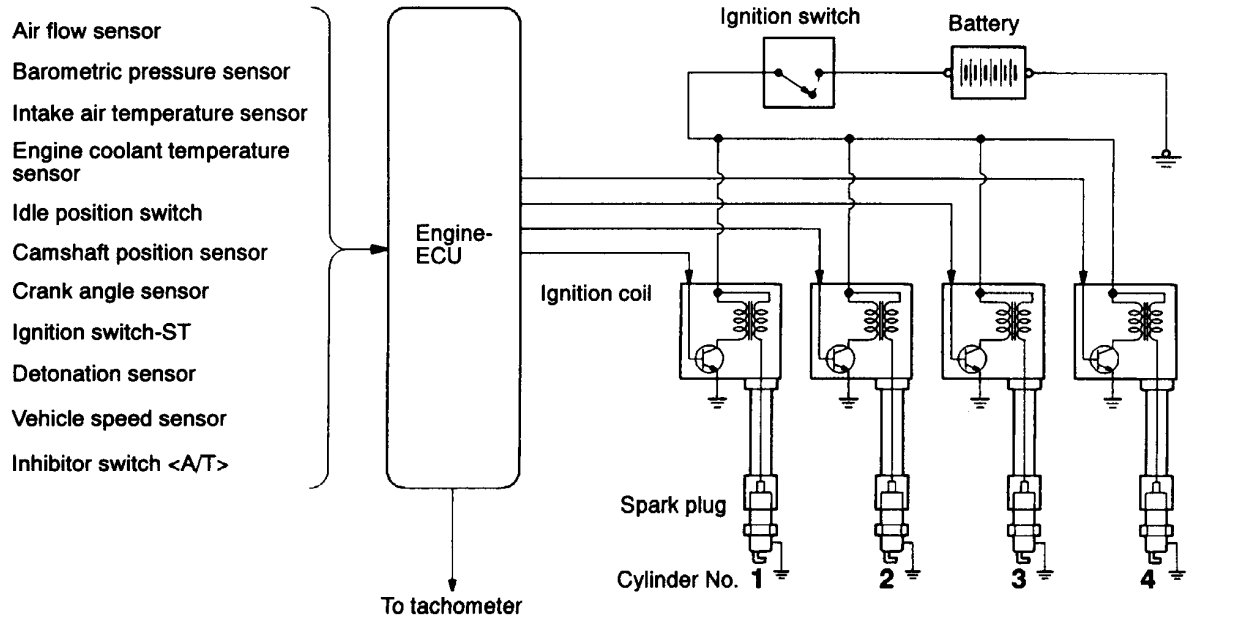
IGNITION SYSTEM

GENERAL INFORMATION

This system is equipped with four ignition coils with built-in power transistors for each of the cylinders. Interruption of the primary current flowing in the primary side of an ignition coil generates a high voltage in the secondary side of the ignition coil. The high voltage thus generated is applied to the spark plugs to generate sparks.
The engine-ECU turns the power transistors inside the ignition coils alternately on and off. This causes the primary currents in the ignition coils to be alternately interrupted and allowed to flow to fire the cylinders in the order 1 – 3 – 4 – 2.

The engine-ECU determines which ignition coil should be controlled by means of the signals from the camshaft position sensor and the crank angle sensor. It also detects the crankshaft position, in order to provide ignition at the most appropriate timing in response to the engine operation conditions.
When the engine is cold or running at high altitudes, the ignition timing is slightly advanced to provide optimum performance. Furthermore, if knocking occurs, the ignition timing is gradually retarded until knocking ceases.

SYSTEM DIAGRAM



IGNITION COIL SPECIFICATION

Items	Specification
Type	Molded 4-coil

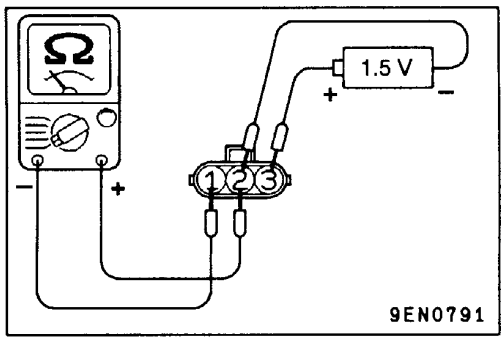
SPARK PLUG SPECIFICATION

Items	Specification
NGK	PZFR6B

SERVICE SPECIFICATIONS

SPARK PLUG

Items	Standard value	Limit
Spark plug gap mm	0.5 – 0.6	0.75
Spark plug insulation resistance MΩ	–	1



ON-VEHICLE SERVICE

POWER TRANSISTOR CONTINUITY CHECK

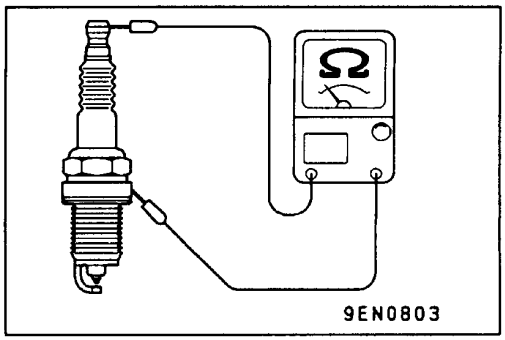
NOTE
1. An analogue-type circuit tester should be used.
2. Connect the negative (–) prove of the circuit tester to terminal 1.

Caution
This test must be performed quickly (in less than 10 seconds) to prevent coil from burning and power transistor from breakage.

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

SPARK PLUG CHECK AND CLEANING

Caution
1. **The spark plug gap for platinum plugs should not be adjusted.**
2. **Cleaning platinum plugs may result in damage to the platinum tip. Therefore, if cleaning is necessary because the plug is sooty, use a plug cleaner, and do not clean the plug for more than 20 seconds in order to preserve the electrodes. A wire brush should never be used.**
3. **The spark plugs in GDI engines are special platinum plugs in which the electrodes can become black even when the plugs are working normally. Carbon which may become deposited on these plugs burns off more readily than with conventional plugs, and so should not cause any problems with spark plug performance. Judgement of whether a spark plug is operating normally or not should be made by checking the insulation resistance.**



1. Remove the ignition coils.
2. Remove the spark plugs.
3. Check the spark plug gap. Replace the spark plug if the gap exceeds the limit.

   Limit: 0.75 mm

   Standard value: 0.5 – 0.6 mm
4. Measure the spark plug insulation resistance. Replace the spark plug if the measured value is lower than the limit value.

   Limit: 1 MΩ
5. Clean the spark plug holes.
6. Install the spark plugs.
7. Install the ignition coils.

CAMSHAFT POSITION SENSOR CHECK

Refer to GROUP 13J – Troubleshooting.

CRANK ANGLE SENSOR CHECK

Refer to GROUP 13J – Troubleshooting.

DETONATION SENSOR CHECK

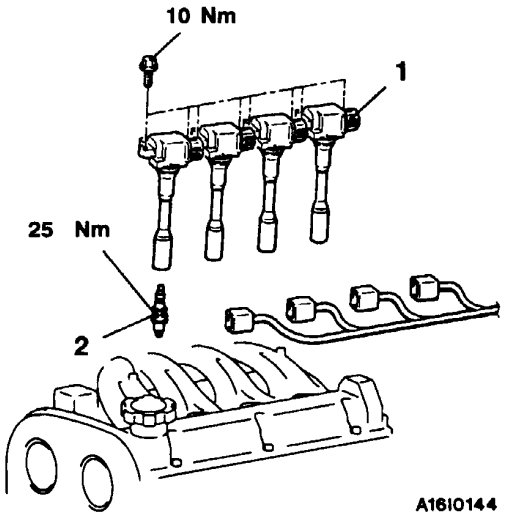
Check the detonation sensor circuit if self-diagnosis code, No. 31 is shown.

NOTE
For information concerning the self-diagnosis codes, refer to GROUP 13J – Troubleshooting.

IGNITION COIL

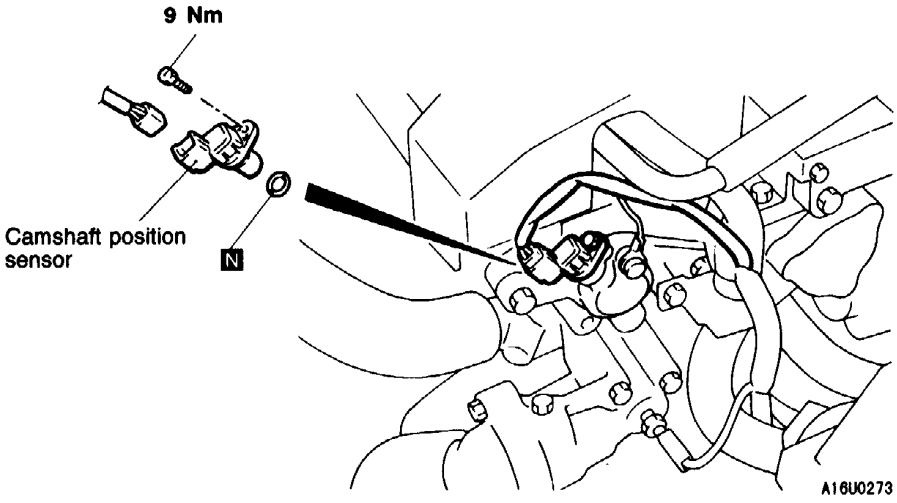
REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
Engine Cover Removal and Installation



Removal steps
1. Ignition coil assembly
2. Spark plug

CAMSHAFT POSITION SENSOR



ENGINE AND EMISSION CONTROL

CONTENTS

EMISSION CONTROL SYSTEM

GENERAL INFORMATION

The emission control system consists of the following subsystems:
- Crankcase emission control system
- Evaporative emission control system
- Exhaust emission control system

Items	Name	Specification
Crankcase emission control system	Positive crankcase ventilation (PCV) valve	Variable flow type (Purpose: HC reduction)
Evaporative emission control system	Canister Purge control solenoid valve	Equipped Duty cycle type solenoid valve (Purpose: HC reduction)
Exhaust emission control system	Air-fuel ratio control device–GDI system	Oxygen sensor feedback type (Purpose: CO, HC, NOx reduction)
	Exhaust gas recirculation system • EGR control servo	Equipped Stepper motor type (Purpose: NOx reduction)
	Catalytic converter	Monolith type (Purpose: CO, HC, NOx reduction)

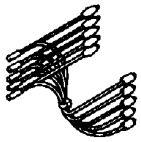
EMISSION CONTROL DEVICE REFERENCE TABLE

Related parts	Crankcase emission control system	Evaporative emission control system	Air/fuel ratio control system	Catalytic converter	Exhaust gas recirculation system	Reference page
PCV valve	×					17-6
Purge control solenoid valve		×				17-9
GDI system component		×	×			GROUP 13J
Catalytic converter				×		17-12
EGR control servo					×	17-11

SERVICE SPECIFICATIONS

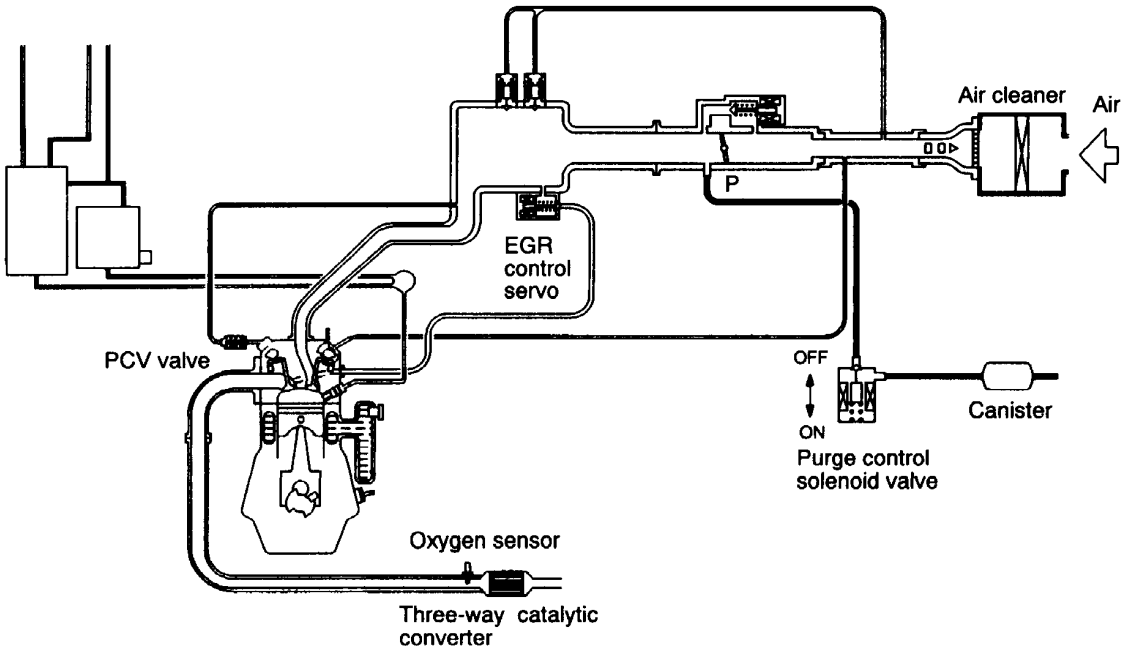
Items	Standard value
Purge control solenoid valve coil resistance (at 20°C) Ω	36 – 44
EGR control servo coil resistance (at 20°C) Ω	10 – 20

SPECIAL TOOL

Tool	Number	Name	Use
 B991658	MB991658	Test harness set	Inspection of EGR control servo

VACUUM HOSE

VACUUM HOSE PIPING DIAGRAM



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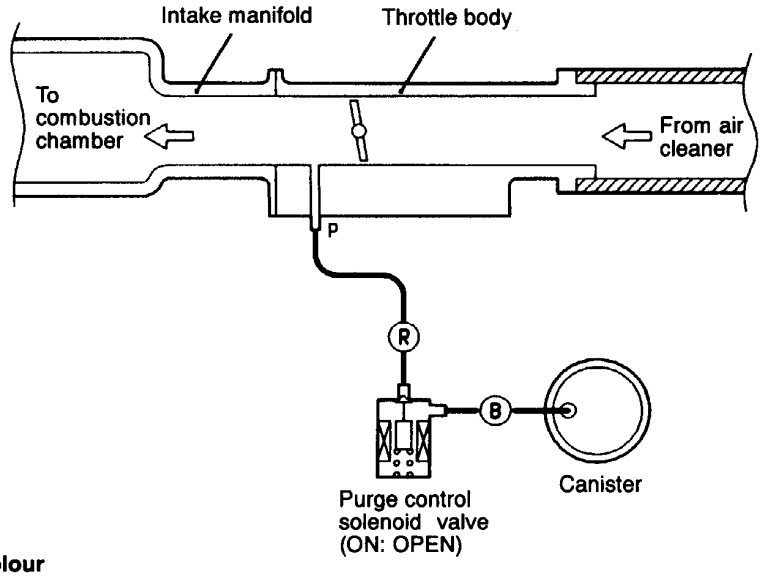
VACUUM CIRCUIT DIAGRAM



Vacuum hose colour
B: Black
R: Red

9EM0247

VACUUM HOSE CHECK

1. Using the piping diagram as a guide, check to be sure that the vacuum hoses are correctly connected.
2. Check the connection condition of the vacuum hoses, (removed, loose, etc.) and check to be sure that there are no bends or damage.

VACUUM HOSE INSTALLATION

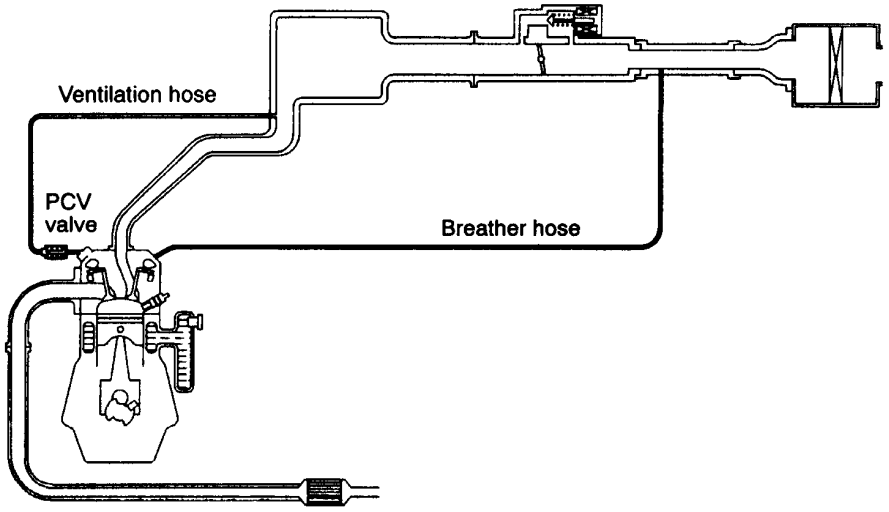
1. When connecting the vacuum hoses, they should be securely inserted onto the nipples.
2. Connect the hoses correctly, using the vacuum hose piping diagram as a guide.

CRANKCASE EMISSION CONTROL SYSTEM

GENERAL INFORMATION

The crankcase emission control system prevents blow-by gases from escaping inside the crankcase into the atmosphere.
Fresh air is sent from the air cleaner into the crankcase through the breather hose. The air becomes mixed with the blow-by gases inside the crankcase.
The blow-by gas inside the crankcase is drawn into the intake manifold through the positive crankcase ventilation (PCV) valve.
The PCV valve lifts the plunger according to the intake manifold vacuum so as to regulate the flow of blow-by gas properly. In other words, the blow-by gas flow is regulated during low load engine operation to maintain engine stability, while the flow is increased during high load operation to improve the ventilation performance.

SYSTEM DIAGRAM



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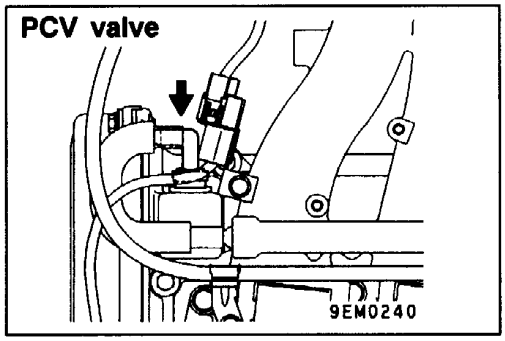
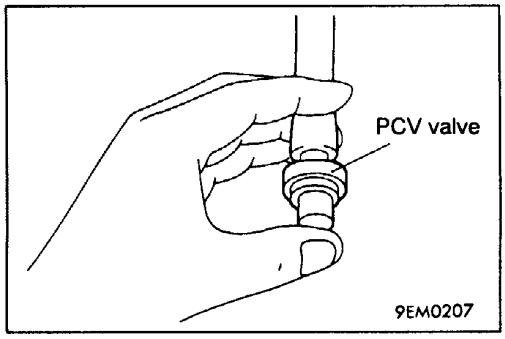
COMPONENT LOCATION



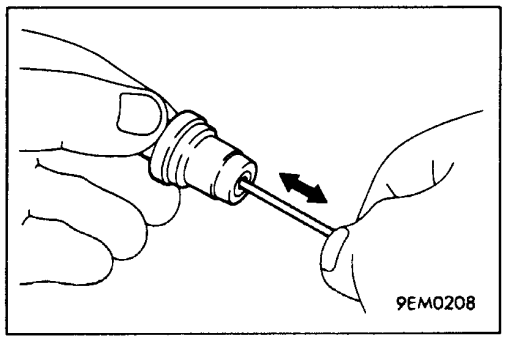
POSITIVE CRANKCASE VENTILATION SYSTEM CHECK

1. Remove the ventilation hose from the PCV valve.
2. Remove the PCV valve from the rocker cover.
3. Reinstall the PCV valve at the ventilation hose.
4. Start the engine and run at idle.



5. Place a finger at the opening of the PCV valve and check that vacuum of the intake manifold is felt.

   NOTE
   At this moment, the plunger in the PCV valve moves back and forth.
6. If vacuum is not felt, clean the PCV valve or replace it.



PCV VALVE CHECK

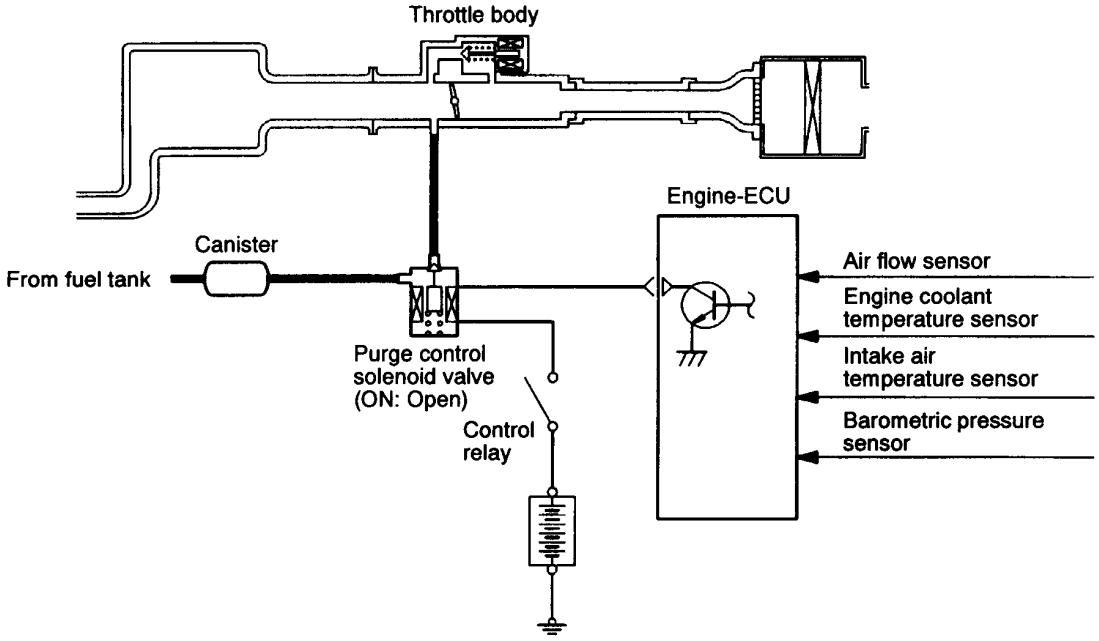
1. Insert a thin rod into the PCV valve from the side shown in the illustration (rocker cover installation side), and move the rod back and forth to check that the plunger moves.
2. If the plunger does not move, there is clogging in the PCV valve. In this case, clean or replace the PCV valve.

EVAPORATIVE EMISSION CONTROL SYSTEM

GENERAL INFORMATION

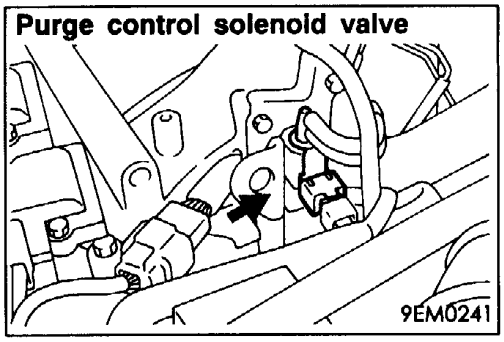
The evaporative emission control system prevents fuel vapours generated in the fuel tank from escaping into the atmosphere.
Fuel vapours from the fuel tank flow through the fuel tank pressure control valve and vapour pipe/hose to be stored temporarily in the canister.
When driving the vehicle, fuel vapours stored in the canister flow through the purge solenoid and purge port and go into the intake manifold to be sent to the combustion chamber.
When the engine coolant temperature is low or when the intake air quantity is small (when the engine is at idle, for example), the engine control unit turns the purge solenoid off to shut off the fuel vapour flow to the intake manifold.
This does not only insure the driveability when the engine is cold or running under low load but also stabilize the emission level.

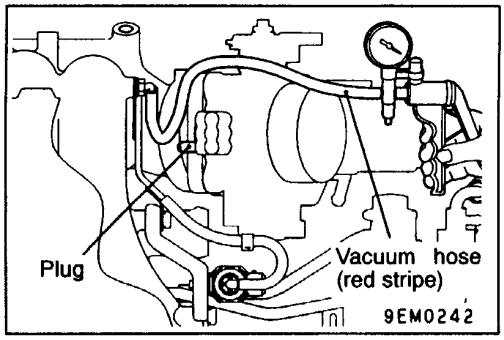
SYSTEM DIAGRAM



9EM0248

COMPONENT LOCATION





PURGE CONTROL SYSTEM CHECK

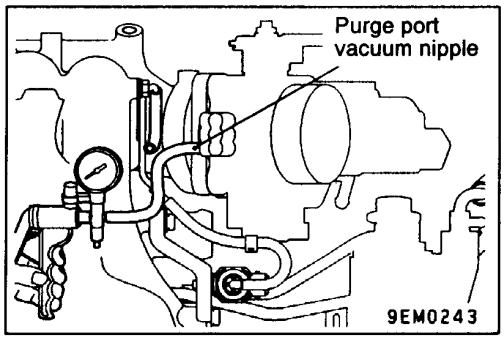
1. Disconnect the vacuum hose (red stripe) from the throttle body and connect it to a hand vacuum pump.
2. Plug the nipple from which the vacuum hose was removed.
3. When the engine is cold or hot, apply a vacuum of 53 kPa, and check the condition of the vacuum.

When engine is cold
(Engine coolant temperature: 40°C or less)

Engine condition	Normal condition
At idle	Vacuum is maintained
3,000 r/min	

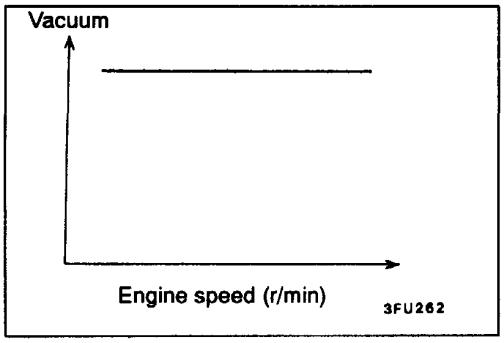
When engine is hot
(Engine coolant temperature: 80°C or higher)

Engine condition	Normal condition
At idle	Vacuum is maintained
3,000 r/min (fore approximately 3 minutes after the engine is started.)	Vacuum will leak.



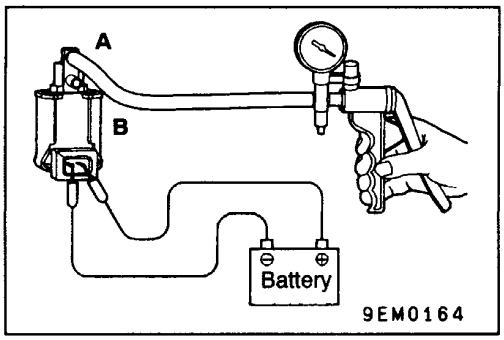
PURGE PORT VACUUM CHECK

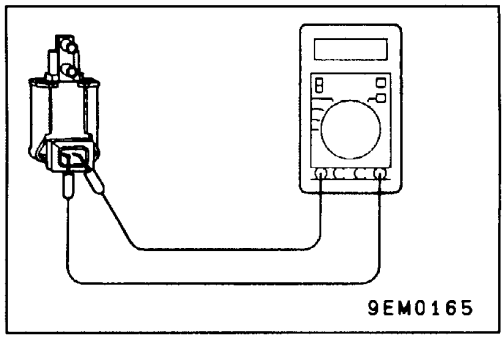
1. Disconnect the vacuum hose (red stripe) from the throttle body purge vacuum nipple and connect a hand vacuum pump to the nipple.



2. Start the engine and check that the vacuum remains fairly constant after racing the engine.

NOTE
If vacuum changes, it is possible that the throttle body purge port may be clogged and require cleaning.





PURGE CONTROL SOLENOID VALVE CHECK

NOTE
When disconnecting the vacuum hose, always make a mark so that it can be reconnected at original position.

1. Disconnect the vacuum hose (black stripe, red stripe) from the solenoid valve.
2. Disconnect the harness connector.
3. Connect a hand vacuum pump to nipple (A) of the solenoid valve (refer to the illustration at left).
4. Check airtightness by applying a vacuum with voltage applied directly from the battery to the purge control solenoid valve and without applying voltage.

Battery voltage	Normal condition
Applied	Vacuum leaks
Not applied	Vacuum maintained

5. Measure the resistance between the terminals of the solenoid valve.

   Standard value: 36–44 Ω (at 20°C)

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

GENERAL INFORMATION

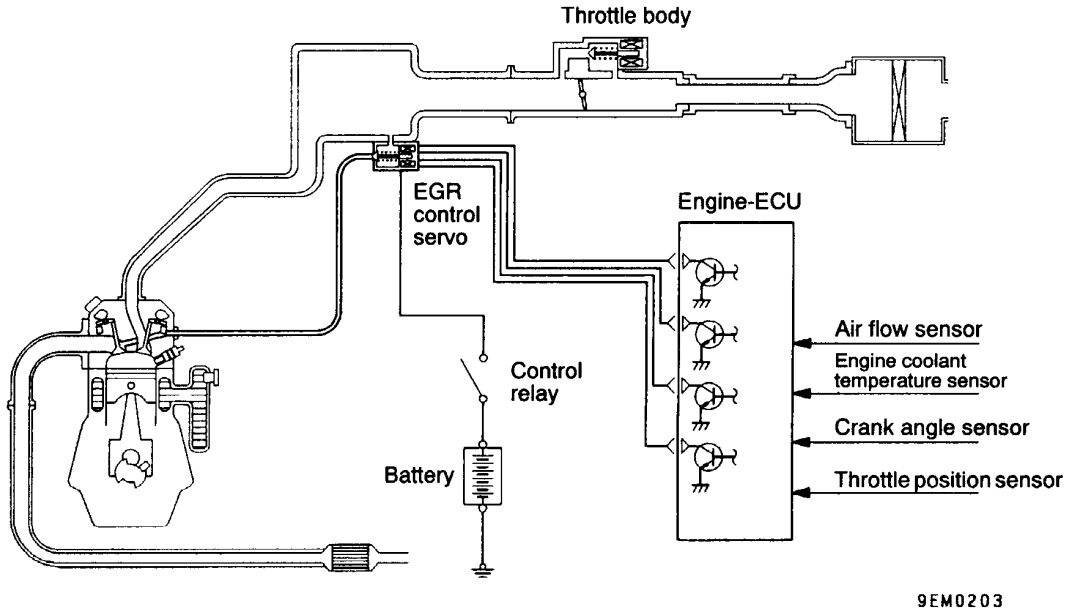
The exhaust gas recirculation (EGR) system lowers the nitrogen oxide (NOx) emission level. When the air/fuel mixture combustion temperature is high, a large quantity of nitrogen oxides (NOx) is generated in the combustion chamber. Therefore, this system recirculates part of emission gas from the exhaust port of the cylinder head to the combustion chamber through the intake manifold to decrease the air/fuel mixture combustion temperature, resulting in reduction of NOx.
The EGR flow rate is controlled by the EGR control servo so as not to decrease the driveability.

OPERATION

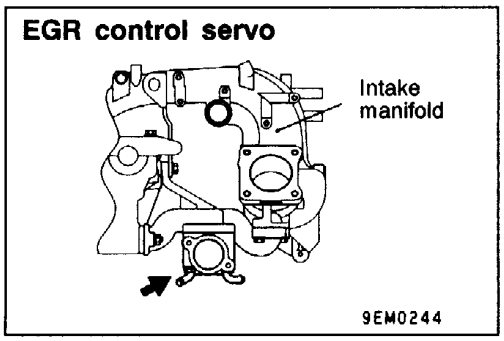
The EGR control servo is being closed and dose not recirculate exhaust gases under one of the following conditions. Otherwise, the EGR control servo is opened and recirculate exhaust gases.

- The engine coolant temperature is low.
- The engine is at idle.
- The throttle valve is widely opened.

SYSTEM DIAGRAM

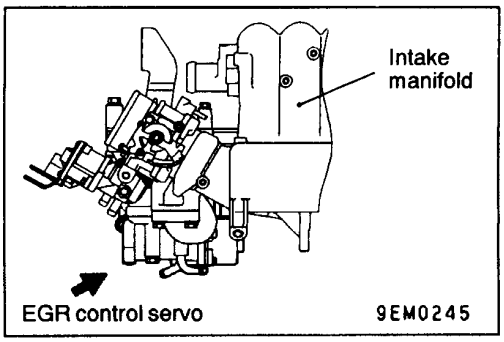


COMPONENT LOCATION



EXHAUST GAS RECIRCULATION (EGR) CONTROL SYSTEM CHECK

Refer to GROUP 13J – Troubleshooting.

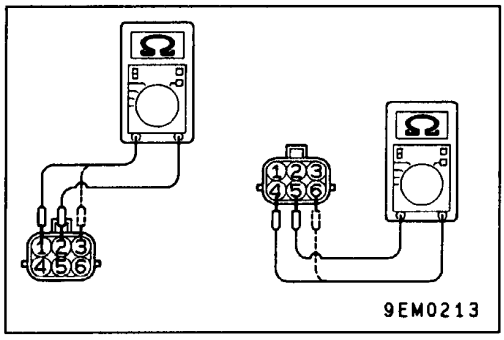


EGR CONTROL SERVO (STEPPER MOTOR) CHECK

Checking the Operation Sound

1. Check that the operation sound of the stepper motor can be heard from the EGR control servo when the ignition switch is turned to ON (without starting the engine).
2. If the operation sound cannot be heard, check the stepper motor drive circuit.

   NOTE
   If the circuit is normal, the cause is probably a malfunction of the stepper motor or of the engine-ECU.

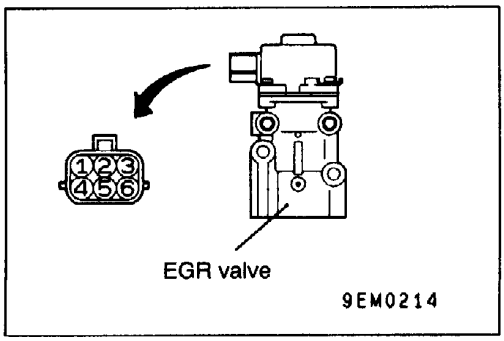


Checking the Coil Resistance

1. Disconnect the EGR control servo connector.
2. Measure the resistance between the EGR control servo-side connector terminal No.2 and terminal No.1 or terminal No.3.

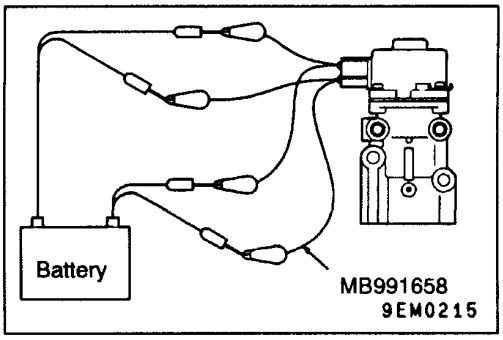
   Standard value: 10 – 20 Ω (at 20°C)
3. Measure the resistance between the EGR control servo-side connector terminal No.5 and terminal No.4 or terminal No.6.

   Standard value: 10 – 20 Ω (at 20°C)



Operation Check

1. Remove the EGR control servo.
2. Connect the special tool (test harness set) to the EGR control servo-side connector.
3. Connect terminal No.2 and terminal No.5 to the positive (+) terminal of power supply of approximately 6 V.
4. Connect each clip to the negative (–) terminal of power supply in the order given below to test if any vibration occurs (as though the stepper motor is shaking slightly) due to the operation of the stepper motor.



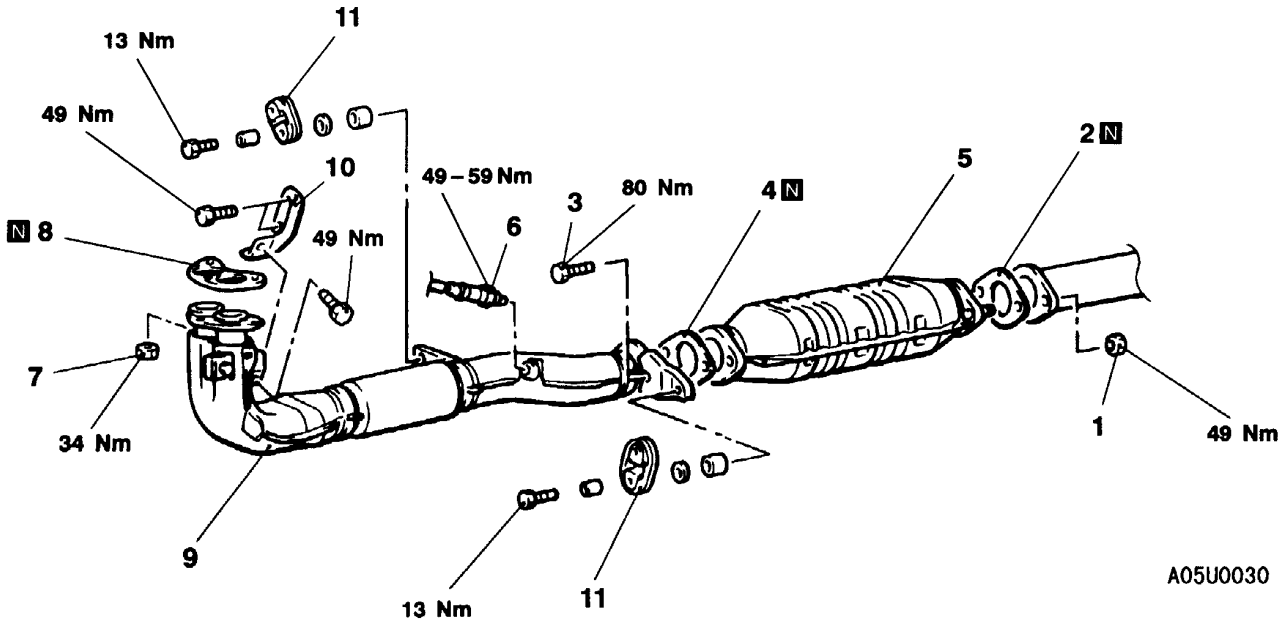
(1) Connect terminal No.1 and terminal No.4 to the negative (–) terminal of the power supply.
(2) Connect terminal No.3 and terminal No.4 to the negative (–) terminal of the power supply.
(3) Connect terminal No.3 and terminal No.6 to the negative (–) terminal of the power supply.
(4) Connect terminal No.1 and terminal No.6 to the negative (–) terminal of the power supply.
(5) Connect terminal No.1 and terminal No.4 to the negative (–) terminal of the power supply.
(6) Repeat the test in the order from (5) to (1).

5. If the results of testing show that the vibration could be felt, the stepper motor is normal.

CATALYTIC CONVERTER

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
Under Cover Removal and Installation



Removal steps

1. Self-locking nut
2. Gasket
3. Bolt
4. Gasket
5. Catalytic converter
6. Oxygen sensor
7. Self-locking nut
8. Gasket
9. Front exhaust pipe
10. Front exhaust pipe bracket
11. Hunger

MANUAL TRANSMISSION

CONTENTS

WARNING REGARDING SERVICING OF SUPPLEMENTAL RESTRAINT SYSTEM (SRS) EQUIPPED VEHICULES

WARNING!

(1) Improper service or maintenance of any component of the SRS, or any SRS-related component, can lead to personal injury or death to service personnel (from inadvertent firing of the air bag) or to driver and passenger (from rendering the SRS inoperative).

(2) Service or maintenance of any SRS component or SRS-related component must be performed only at an authorized MITSUBISHI dealer.

(3) MITSUBISHI dealer personnel must thoroughly review this manual, and especially its GROUP 52B – Supplemental Restraint System (SRS) before beginning any service or maintenance of any component of the SRS or any SRS-related component.

NOTE

The SRS includes the following components: SRS-ECU, SRS warning lamp, air bag module, clock spring and interconnecting wiring. Other SRS-related components (that may have to be removed/installed in connection with SRS service or maintenance) are indicated in the table of contents by an asterisk (*).

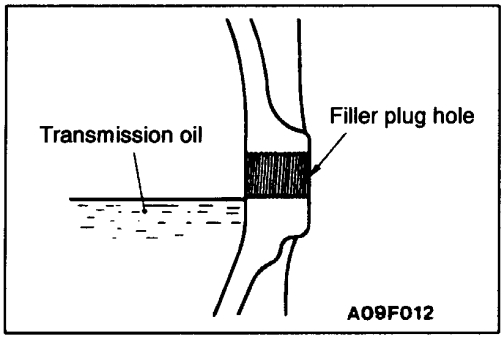
GENERAL

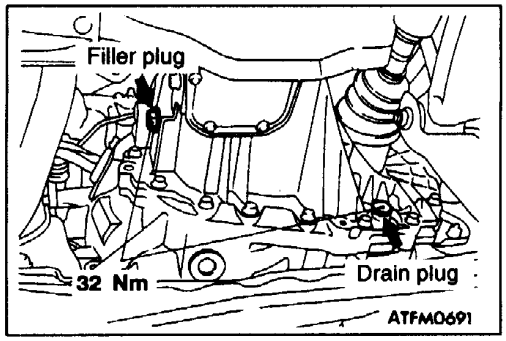
OUTLINE OF CHANGES

An F5M42 manual transmission has been adopted in vehicles with 4G93-GDI engine. Maintenance service procedures have been established to correspond to this.

LUBRICANT

Item	Specified lubricant	Quantity ℓ
Transmission oil	Hyper gear oil SAE 75W – 90 or 75W – 85W conforming to API GL-4	2.2





ON-VEHICLE SERVICE

TRANSMISSION OIL CHECK

(1) Remove the oil filler plug.
(2) Oil level should be at the lower portion of the filler plug hole.
(3) Check that the transmission oil is not noticeably dirty, and that it has a suitable viscosity.
(4) Tighten the filler plug to the specified torque.

Tightening torque: 32 Nm

TRANSMISSION OIL REPLACEMENT

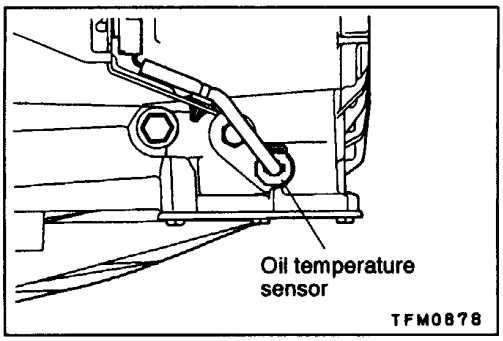
(1) Remove the drain plug to drain oil.
(2) Tighten the drain plug to the specified torque.
(3) Remove the filler plug and fill with specified oil till the level comes to the lower portion of filler plug hole.

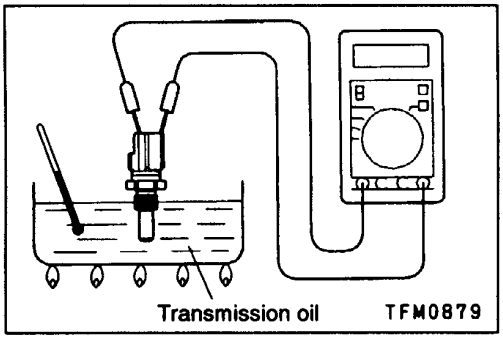
Transmission oil

Specified oil:
Hypoid gear oil SAE 75W – 90 or 75W – 80W conforming to API GL-4

Quantity: 2.2 ℓ

(4) Tighten the filler plug to the specified torque.





OIL TEMPERATURE SENSOR CHECK

(1) Remove the oil drain plug to drain the transmission oil.
(2) Remove the oil temperature sensor.

(3) Measure the resistance between terminals No.1 and No.2 of the oil temperature sensor-side connector.

Standard value:

Oil temperature (°C)	Resistance (kΩ)
20	2.31 – 2.59
110	0.145 – 0.149

(4) If the resistance is outside the standard value, replace the oil temperature sensor.
(5) Install the oil temperature sensor and tighten it to the specified torque.

Tightening torque: 20 – 25 Nm

(6) Tighten the oil drain plug to the specified torque, and then replenish the transmission oil. (refer to P.22-2.)

AUTOMATIC TRANSMISSION

CONTENTS

WARNING REGARDING SERVICING OF SUPPLEMENTAL RESTRAINT SYSTEM (SRS) EQUIPPED VEHICULES

WARNING!

(1) Improper service or maintenance of any component of the SRS, or any SRS-related component, can lead to personal injury or death to service personnel (from inadvertent firing of the air bag) or to driver and passenger (from rendering the SRS inoperative).

(2) Service or maintenance of any SRS component or SRS-related component must be performed only at an authorized MITSUBISHI dealer.

(3) MITSUBISHI dealer personnel must thoroughly review this manual, and especially its GROUP 52B – Supplemental Restraint System (SRS) before beginning any service or maintenance of any component of the SRS or any SRS-related component.

NOTE
The SRS includes the following components: SRS-ECU, SRS warning lamp, air bag module, clock spring and interconnecting wiring. Other SRS-related components (that may have to be removed/installed in connection with SRS service or maintenance) are indicated in the table of contents by an asterisk (*).

GENERAL

OUTLINE OF CHANGES

Vehicles with GDI-type 4G93 engines have a separate A/T-ECU and engine-ECU, in contrast to non-GDI-type 4G93 engines. To correspond to this, maintenance service procedures have been established for items which are different from before.

TROUBLESHOOTING

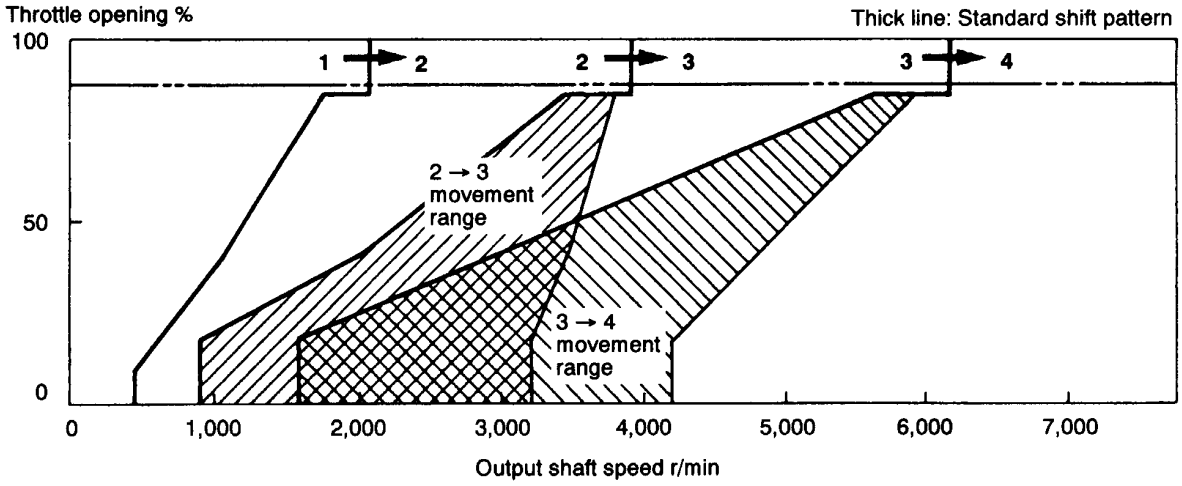
ROAD TEST

The test procedure is basically the same as that for '97 and prior vehicle models, except that the vehicle speed sensor system inspection procedures have been changed.

- Refer to P.23-6 for details on the vehicle speed sensor system inspection procedures.

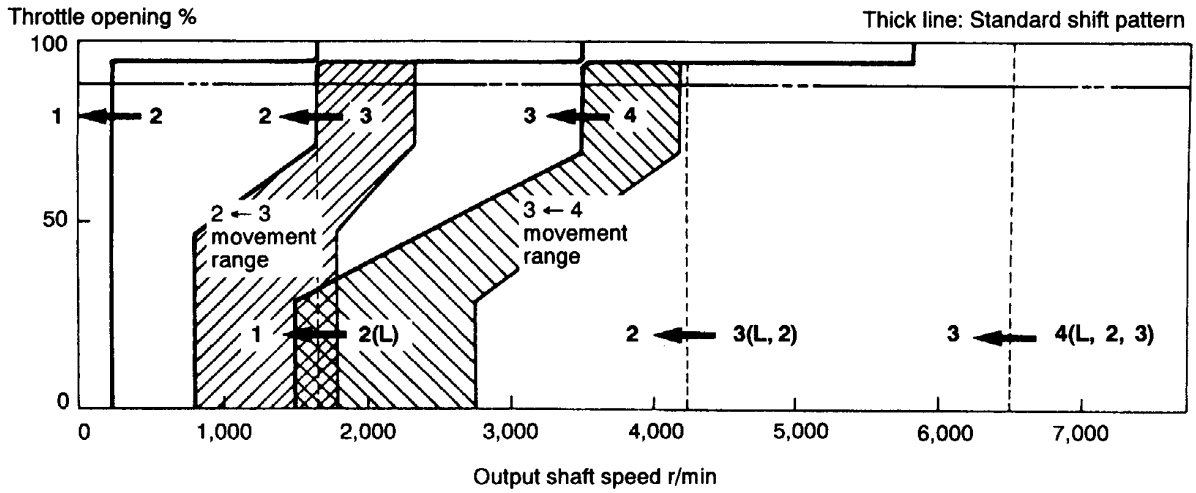
SHIFT PATTERN

UPSHIFT PATTERN



TFA2033

DOWNSHIFT PATTERN



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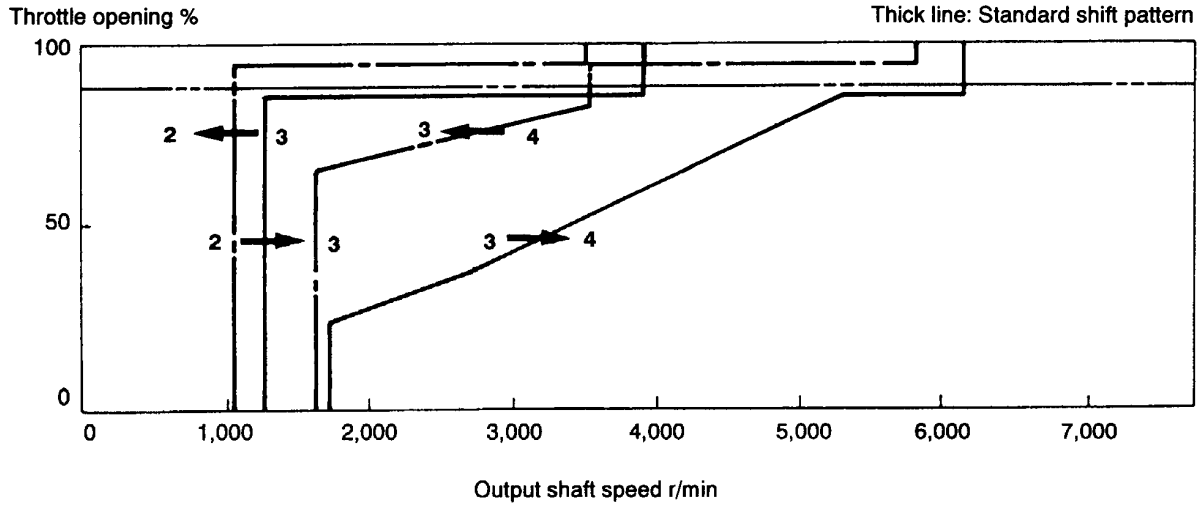
HOLD MODE PATTERN



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INSPECTION CHART FOR DIAGNOSIS CODE

Inspection procedures are basically the same as those for '97 and prior vehicle models.

Code	Diagnosis item		Reference page
11	Throttle position sensor system	Short circuit	23-14*
12		Open circuit	23-14*
14		Sensor maladjustment	23-14*
15	Oil temperature sensor system	Open circuit	23-14*
21	Crank angle sensor system	Open circuit	23-15*
22	Input shaft speed sensor system	Short circuit/open circuit	23-15*
23	Output shaft speed sensor system	Short circuit/open circuit	23-16*
25	Wide open throttle switch system	Short circuit	23-17*
26	Stop lamp switch system	Short circuit/open circuit	23-17*
31	Low and reverse solenoid valve system	Short circuit/open circuit	23-18*
32	Underdrive solenoid valve system	Short circuit/open circuit	23-18*
33	Second solenoid valve	Short circuit/open circuit	23-18*
34	Overdrive solenoid valve	Short circuit/open circuit	23-18*
36	Damper control clutch solenoid valve	Short circuit/open circuit	23-18*
41	1st gear ratio is not specified		23-19*
42	2nd gear ratio is not specified		23-20*
43	3rd gear ratio is not specified		23-21*
44	4th gear ratio is not specified		23-22*
46	Reverse gear ratio is not specified		23-23*
51	Abnormal communication with the engine-ECU		23-24*
52	Damper control clutch solenoid valve system	Defective system	23-18*
54	A/T Control relay system	Short circuit to earth/ open circuit	23-24*
56	N range lamp system	Short circuit to earth	23-25*
71	Malfunction of A/T-ECU		23-25*

NOTE
*: Refer to '96 CARISMA Workshop Manual (Pub. No. PWDE9502).

INSPECTION CHART FOR TROUBLE SYMPTOMS

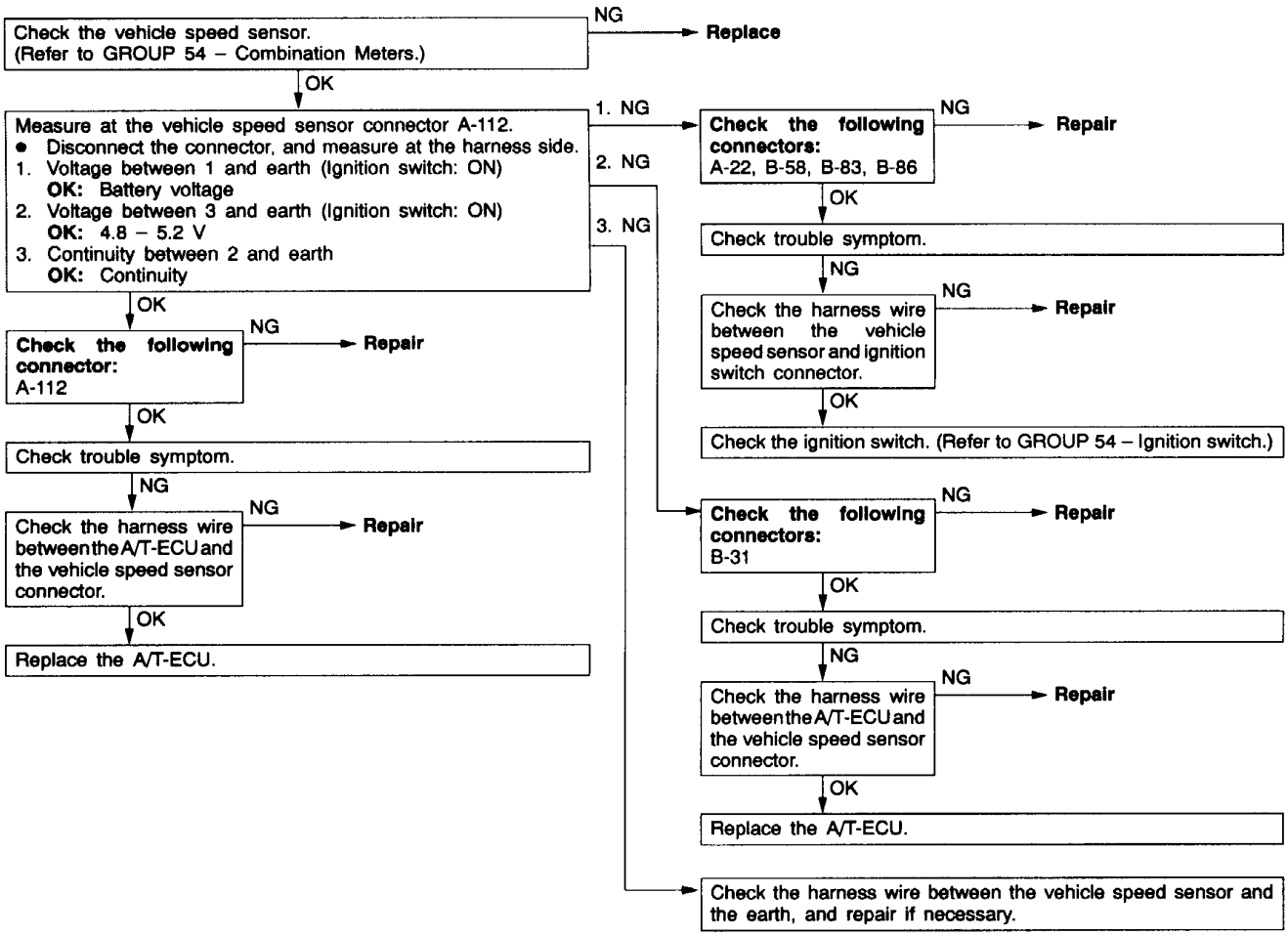
Inspection procedures are basically the same as those for '97 and prior vehicle models, except that the vehicle speed sensor system inspection procedures have been changed to correspond to the adoption of an electronic speedometer.

Trouble symptom		Inspection procedure No.	Reference page
Communication with MUT-II is not possible		1	23-26*
Driving impossible	Starting impossible	2	23-27*
	Does not move forward	3	23-27*
	Does not reverse	4	23-28*
	Does not move (forward or reverse)	5	23-28*
Malfunction when starting	Engine stalling when shifting	6	23-29*
	Shocks when changing from N to D and large time lag	7	23-29*
	Shocks when changing from N to R and large time lag	8	23-30*
	Shocks when changing from N to D, N to R and large time lag	9	23-31*
Malfunction when shifting	shocks and running up	10	23-31*
Displaced shifting points	All points	11	23-32*
	Some points	12	23-33*
Does not shift	No diagnosis codes	13	23-33*
Malfunction while driving	Poor acceleration	14	23-34*
	Vibration	15	23-34*
Inhibitor switch system		16	23-35*
Mode control switch system		17	23-35*
Idle position switch system		18	23-36*
Dual pressure switch system		19	23-36*
Vehicle speed sensor system		20	23-6

NOTE
*: Refer to '96 CARISMA Workshop Manual (Pub. No. PWDE9502).

INSPECTION PROCEDURE 20

Vehicle speed sensor system	Probable cause
The cause is probably a defective vehicle speed sensor circuit or a defective A/T-ECU.	• Malfunction of the vehicle speed sensor • Malfunction of connector • Malfunction of the A/T-ECU



SERVICE DATA REFERENCE TABLE

The following items have been added to correspond to the addition of vehicles with 4G93-GDI engine. Moreover, item No.57 (engine volumetric efficiency) is not included for vehicles with 4G93-GDI engine.

Item No.	Check item	Check requirement	Normal value
73	Target engine effective pressure	N range with accelerator pedal fully closed → depressed	Data changes

CHECK AT THE A/T-ECU TERMINALS

Inspection procedures are basically the same as those for '97 and prior vehicle models, except that the input terminal No. for the vehicle speed sensor has been changed from terminal No.46 to terminal No.69.

Terminal No.	Check item	Check requirement	Standard value
69	Vehicle speed sensor	When stopped	0 V
		Move forward slowly	0 → 5 V alternating

GROUP 35A
BASIC BRAKE SYSTEM

GENERAL

OUTLINE OF CHANGES

The following maintenance service points have been established to correspond to the addition of a pressure sensor. Maintenance service procedures not listed below are the same as before.

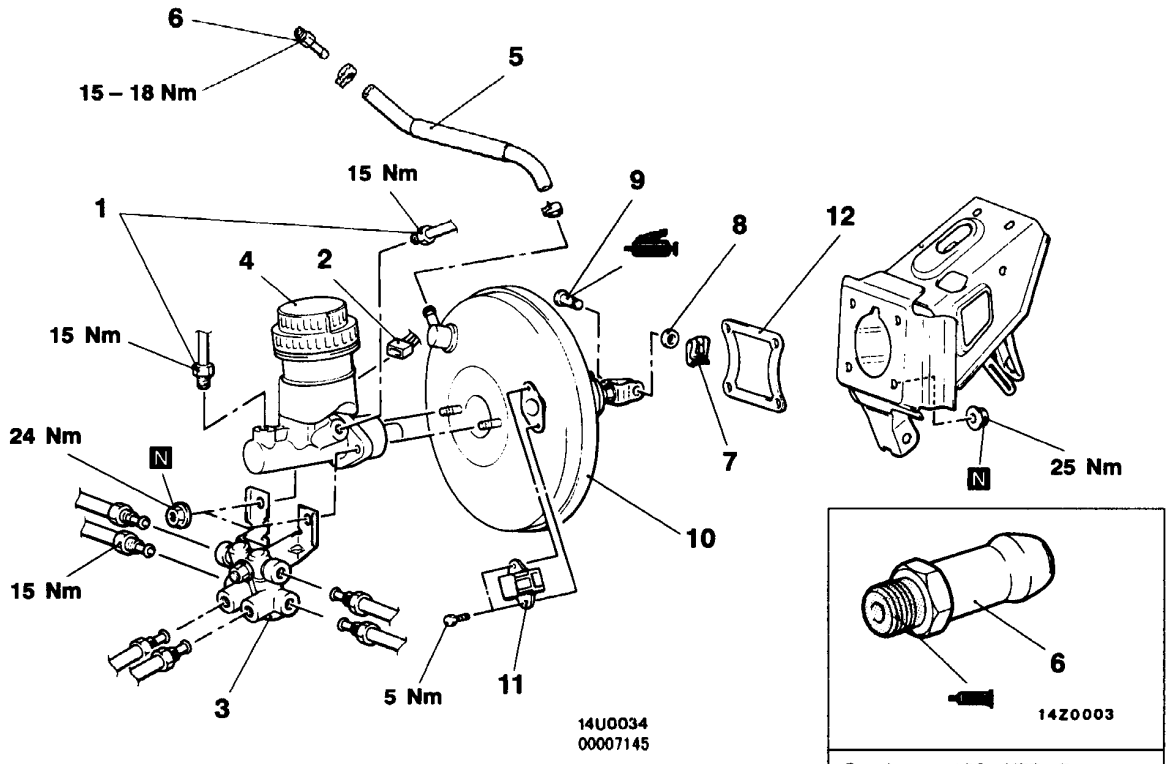
MASTER CYLINDER AND BRAKE BOOSTER

REMOVAL AND INSTALLATION

Pre-removal Operation
- Brake Fluid Draining

Post-installation Operation
- Brake Fluid Supplying
- Brake Line Bleeding
- Brake Pedal Adjustment

<L.H. drive vehicles>

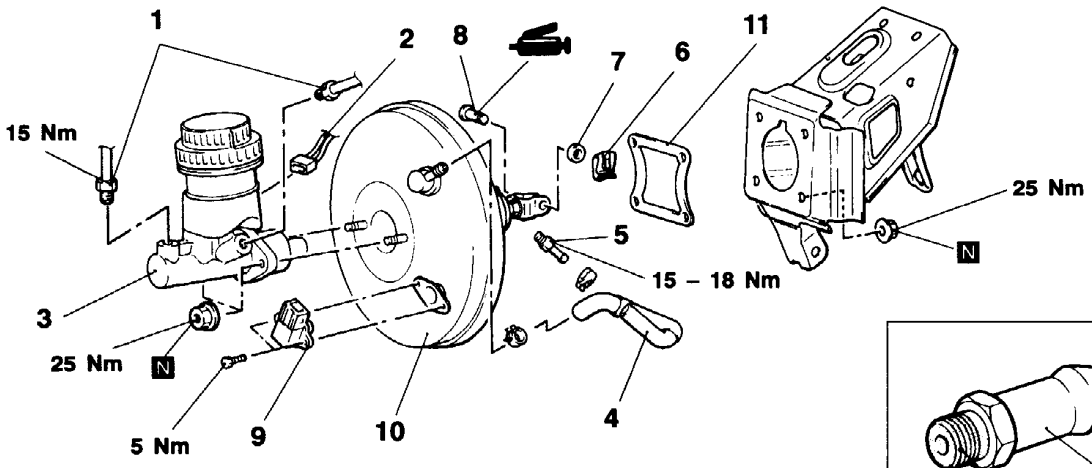


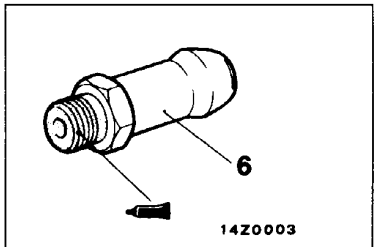
Removal steps

1. Brake pipe connection
2. Brake fluid level sensor connector
3. Proportioning valve bracket
4. Master cylinder assembly
- ▶B◀ • Clearance adjustment between brake booster push rod and primary piston
- ▶A◀ 5. Vacuum hose (With built-in check valve)
6. Fitting
7. Retaining clip
8. Washer
9. Retaining ring bolt
10. Brake booster
11. Brake vacuum sensor
12. Sealer

NOTE
For each service point, refer to Basic Manual.

<R.H. drive vehicles>





Sealant: 3M ATD Part No.8661 or equivalent

Removal Steps

1. Brake pipe connection
2. Brake fluid level sensor connector
3. Master cylinder assembly

▶B◀ • Clearance adjustment between brake booster push rod and primary piston

▶A◀ 4. Vacuum hose (With built-in check valve)

5. Fitting
6. Retaining clip
7. Washer
8. Retaining ring bolt
9. Brake vacuum sensor
10. Brake booster
11. Sealer

NOTE
For each service point, refer to Basic Manual.

GROUP 37A
STEERING

GENERAL

OUTLINE OF CHANGES

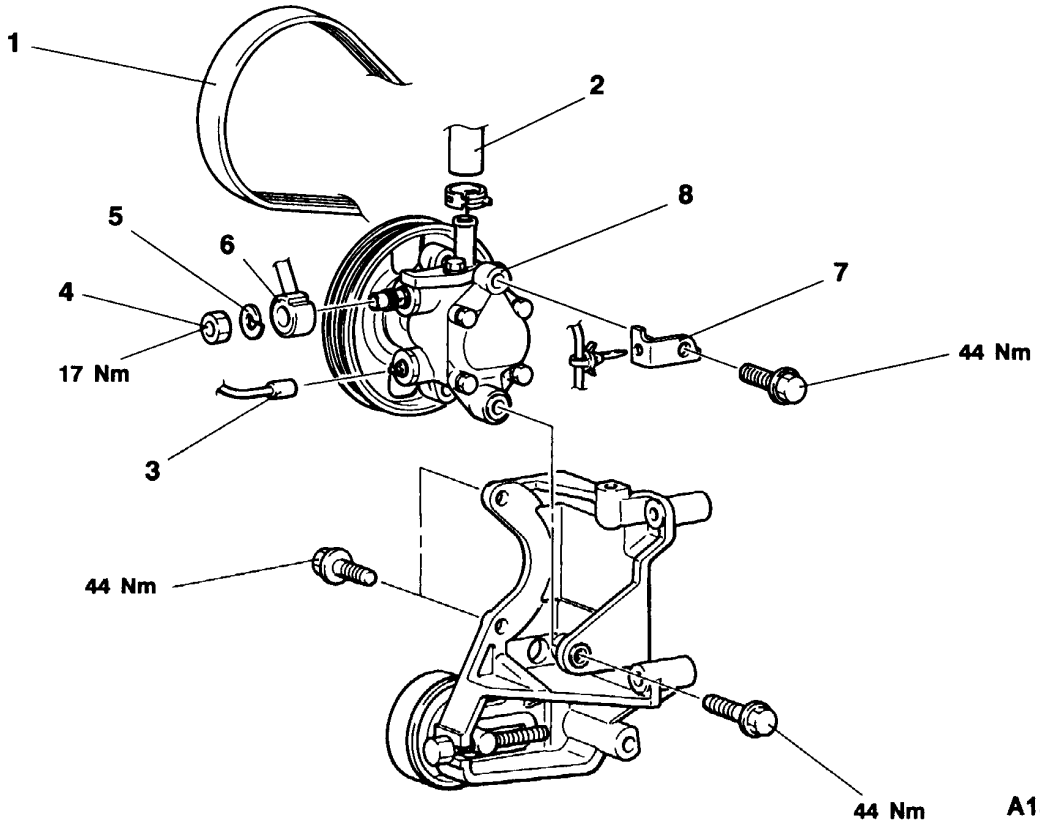
The following maintenance service points have been established to correspond to changes in the power steering oil pump. Maintenance service procedures not listed below are the same as before.

POWER STEERING OIL PUMP

REMOVAL AND INSTALLATION

Pre-removal Operation
- Power Steering Fluid Draining

Post-installation Operation
- Power Steering Fluid Supplying
- Drive-belt Tension Adjusting
- Power Steering Fluid Line Bleeding
- Oil Pump Pressure Check



Removal steps

1. Drive belt
2. Suction hose
3. Pressure switch connector
4. Eye bolt
5. Washer
6. Banjo block
7. Power steering switch bracket
8. Oil pump

INSPECTION

Check the drive-belt for cracks.
Check the pulley assembly for uneven rotation.

GROUP 51
EXTERIOR

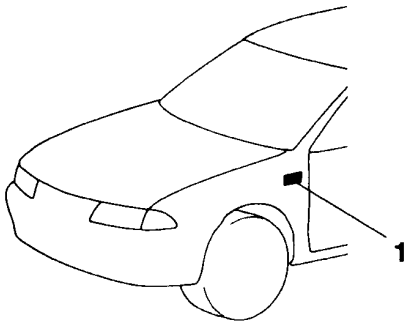
GENERAL

OUTLINE OF CHANGES

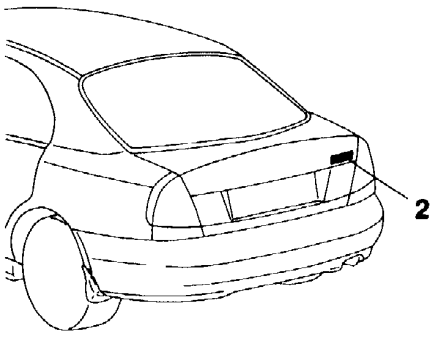
The following maintenance service points have been established to correspond to the addition of vehicles with 4G93-GDI engine. Maintenance service procedures not listed below are the same as before.

MARKS

REMOVAL AND INSTALLATION



18U0498



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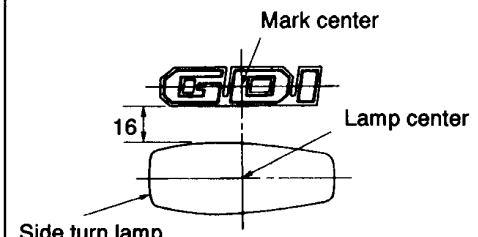
Unit: mm

GDI MARK



18U0502

CARISMA GDI MARK

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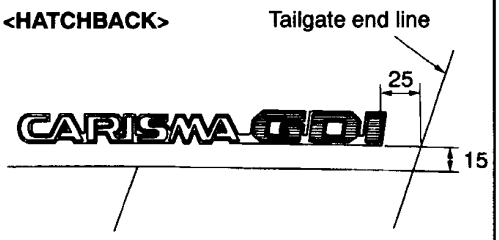

18U0501

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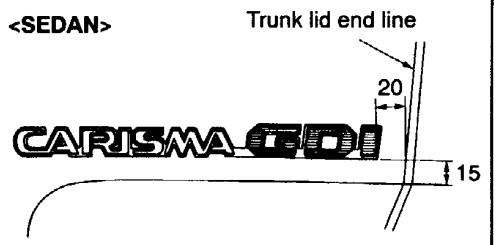

18U0500

1. GDI MARK
2. CARISMA GDI MARK

GROUP 54
CHASSIS ELECTRICAL

GENERAL

OUTLINE OF CHANGES

The fuel average consumption and fuel instant consumption indicating functions have been added to the multi-function digital odometer. To correspond to this, the following maintenance service procedures have been established.

TROUBLESHOOTING

INSPECTION CHART FOR TROUBLE SYMPTOMS

Trouble symptom	Inspection procedure	Reference page
Only fuel average consumption and fuel instant consumption indications do not function.	1	54-1

INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

Inspection Procedure 1

Only fuel average consumption and fuel instant consumption indications do not function.	**Probable cause**
The cause is probably a malfunction of the fuel consumption signal input system.	• Malfunction of the engine-ECU • Improper connector contact, open circuit or short-circuited harness wire • Malfunction of the combination meter