FOREWORD

This workshop manual has been prepared to provide information regarding repair procedures on Hino Vehicles.

Applicable for J05D-TI, J05E-TI engine

When making any repairs on your vehicle, be careful not to be injured through improper procedures.
As for maintenance items, refer to the Owner's Manual.
All information and specifications in this manual are based upon the latest product information available at the time of printing.
Hino Motors reserves the right to make changes at any time without prior notice.

Hino Motors, Ltd.

6. UNIT

(1) This manual uses the SI unit system. The SI unit is an international unit which is based on one unit per quantity unlike the conventional unit system which differs from country to country, in order to facilitate technology exchange.

(2) This manual writes the SI unit and a conventional unit side by side, the conventional unit enclosed in parentheses { }.

	SI unit	Conventional unit	Conversion value*1 (1[Conventional unit] = X [SI unit])		SI unit	Conventional unit	Conversion value*1 (1[Conventional unit] = X [SI unit])
Force	N	kgf	1 kgf=9.80665 N	Spring constant	N/mm	kgf/mm	1 kgf/mm= 9.80665 N/mm
Torque*2	N·m	kgf·cm	1 kgf·cm= 0.0980665 N·m	Volume	L	cc	1 cc=1 mL
Pressure	Pa	kgf/cm^2	$1kgf/cm^2$= 98.0665 kPa= 0.0980665 MPa	Efficiency	W	PS	1 PS=0.735499 kW
		mmHg	1 mmHg= 0.133322 kPa	Quantity of heat	W·H	cal	1 kcal=1.13279 W·h
Rotation speed	r/min.	rpm	1 rpm=1 r/min.	Fuel consumption ratio	g/W·h	g/PS·h	1 g/PS·h= 1.3596 g/kW·h
	$min.^{-1}$		1 rpm=1 $min.^{-1}$				

*1: X is a value obtained by converting 1 [conventional unit] to an SI unit and is used as a conversion factor of the conventional unit and SI unit.

*2: The torque conversion value may depend on the unit. Follow the specific value described for each unit.

TIGHTENING OF FLARE NUTS AND HOSES

EN00Z0101C100006

1. TIGHTENING TORQUE OF PIPE FLARE NUT

Unit: N·m {kgf·cm, lbf·ft}

Pipe outer diameter / Material	ϕ4.76	ϕ6.35	ϕ8	ϕ10	ϕ12	ϕ15
Steel pipe	15±5 {150±50, 10.8±3.6}	25±5 {250±50, 18.1±3.6}	36±5 {370±50, 26.8±3.6}	52±7 {530±70, 38.3±5.0}	67±7 {680±70, 49.2±5.0}	88±8 {900±80, 65.1±5.7}

2. TIGHTENING TORQUE OF HOSE

Unit: N·m {kgf·cm, lbf·ft}

	Hose outer diameter ϕ10.5 metal fitting	Hose outer diameter ϕ13, ϕ20, ϕ22 metal fitting for packing	Hose outer diameter PF3/8 metal fitting
Air hose	21.5±1.5 {215±15, 15.5±1.0} / Meter gauge only 10 {100, 7.2}	41.5±2.5 {425±25, 30.7±1.8}	—
Brake hose	Packing 51.5±7.5 {525±75, 38.0±5.4}	—	—

3. TIGHTENING TORQUE OF FLARE JOINT FOR NYLON TUBE

Unit: N·m {kgf·cm, lbf·ft}

Nominal diameter of screw	M12	M16	M20
Tightening torque	14.7±2 {150±20, 10.8±1.4}	29.4±5 {300±50, 21.7±3.6}	51.9±5 {530±50, 38.3±3.6}

4. TIGHTENING TORQUE OF LOCK NUT FOR BRASS JOINT

Unit: N·m {kgf·cm, lbf·ft}

Nominal diameter of screw	M12	M16	M20	M27
Tightening torque	15±2 {150±20, 10.8±1.4}	66±6 {670±60, 48.4±4.3}	97±9 {990±90, 71.6±6.5}	209±19 {2,130±190, 154±13}

TROUBLESHOOTING USING A DIAGNOSIS MONITOR

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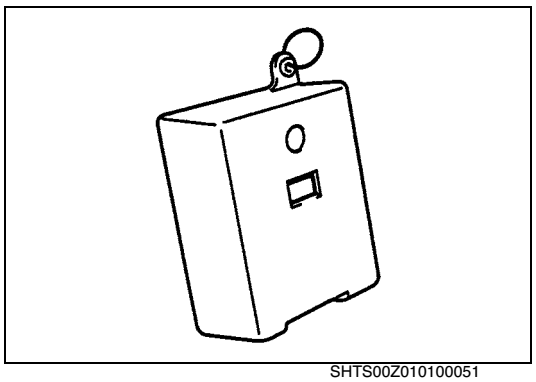

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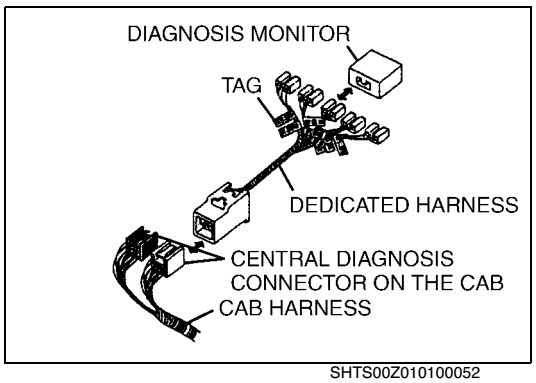
1. DIAGNOSIS MONITOR

(1) When connected to the diagnosis connector dedicated to each system, the diagnosis monitor indicates a faulty section with sound and light.
SST: Diagnosis Monitor (S0963-01370)



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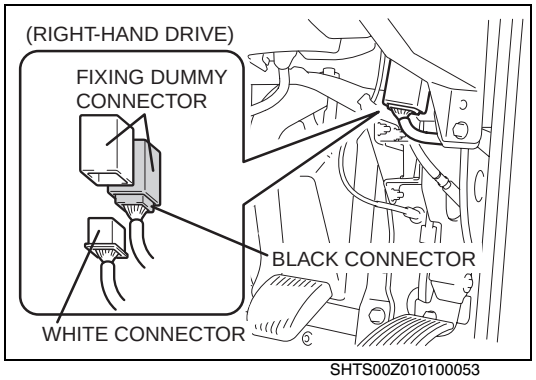
2. CONNECTION OF DIAGNOSIS MONITOR

(1) Turn "ON" the starter switch.
(2) Connect a dedicated harness to the black (or white) connector out of the central diagnosis connectors (total 2) at the lower right section of the instrumental panel at the driver's seat, and connect the diagnosis monitor to the connector having the tag of "each system name".
SST: Dedicated Harness (S0963-02300)



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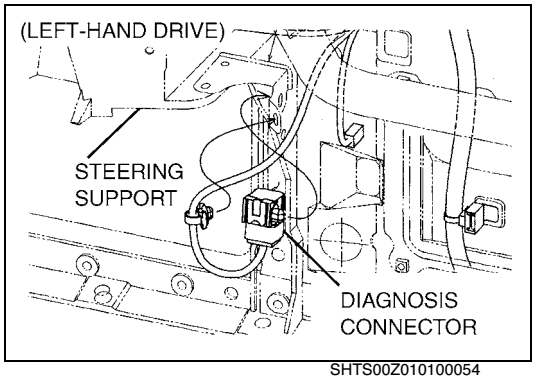
⚠ CAUTION

The central diagnosis connectors are normally connected to the fixing dummy connectors. Remove the central diagnosis connectors from the dummy connectors before using them. When the central diagnosis connectors are not used, they should be engaged into the fixing dummy connectors.

HINT

- **Turning "ON" the starter switch with the diagnosis monitor connected causes the diagnosis monitor to keep sounding without outputting diagnosis monitor codes. First turn "ON" the starter switch, wait at least ten seconds, and connect the diagnosis monitor.**
- **The method for outputting diagnosis monitor codes differs from system to system. Follow the instruction in the chapter for each system.**



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ENGINE ASSEMBLY

DATA AND SPECIFICATIONS

EN01Z0101I200001

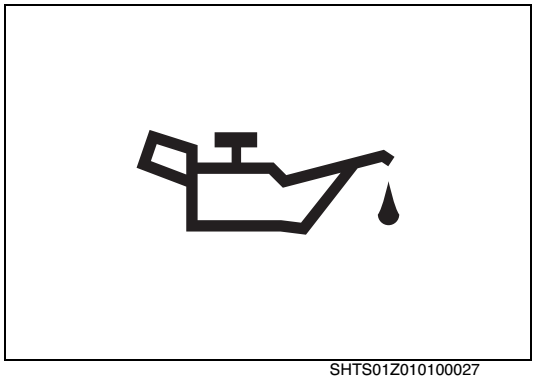
ENGINE SERIES: J05D-TG

Type		**Diesel, 4 cycle, vertical, 4 cylinder, in-line overhead camshaft, water-cooled, direct injection**
Aspiration		**Turbocharged with intercooler**
Bore and stroke		**112x120 mm {4.41x4.72 in.}**
Piston displacement		**4.728 L {288.5 cu.in.}**
Compression ratio		**18: 1**
Firing order		**1-3-4-2 (The cylinder numbers are counted in order from the crankshaft pulley side)**
Direction of rotation		**Counterclockwise viewed from flywheel**
Compression pressure		**2.9-3.1 MPa {30-31 kgf/cm^2, 421-449 lbf/in.^{2}} at 150 r/min.**
Maximum revolution (at full load)		**2,600 r/min.**
Idling revolution		**650 r/min.**
Dry weight		**Approximately 470 kg {1,036 lb.}**
Valve seat angle	**Intake**	**30°**
	Exhaust	**45°**
Valve face angle	**Intake**	**30°**
	Exhaust	**45°**
Valve timing (flywheel travel)	**Intake opens**	**13° before top dead center**
	Intake closes	**21° after bottom dead center**
	Exhaust opens	**59° before bottom dead center**
	Exhaust closes	**13° after top dead center**
Valve clearance (when cold)	**Intake**	**0.30 mm {0.0118 in.}**
	Exhaust	**0.45 mm {0.0177 in.}**
Engine oil pump	**Type**	**Full forced pressure feed by gear pump**
	Drive	**By gear**
Engine oil cooler		**Multi-plate type, water cooled**
Injection nozzle	**Type**	**Multi-hole nozzle type**
Coolant pump	**Type**	**Forced circulation by volute pump**
	Drive	**By V-belt**
Thermostat Type		**Wax.type, bottom bypass system**
Injection timing (flywheel travel)		**0° before top dead center for No.1 cylinder of the compression stroke**

Unusual engine noise

Symptom	Possible cause	Remedy/Prevention
Unusual engine noise (Piston)	Wear of piston pin boss or piston pin	Replace piston and/or piston pin
	Seized, damaged, or worn piston pin bushing	Replace piston pin bushing.
	Worn pistons or cylinder liners	Replace piston or cylinder liner.
	Damaged or seized piston	Replace piston and cylinder liner.
	Foreign matter on top surface of the piston	Remove foreign matter and repair or replace piston, cylinder liner, and/or cylinder head.
Unusual engine noise (Valve mechanism)	Incorrect valve clearance	Adjust valve clearance.
	Valve cotter out of place	Replace valve cotter.
	Seized valve stem	Replace valve and valve guide.
	Broken valve	Replace valve.
	Damaged rocker arm support	Replace rocker arm support.
	Broken valve spring	Replace valve spring.
Unusual engine noise (Bearings seizure)	Insufficient lubricating oil	Add oil.
	Excessive or insufficient tightening of bearing housings	Retighten to specified torque.
	Pits and scratches on bearing surface	Replace bearing and crankshaft.
	Oil film formed on back of bearing	Replace bearing.
	Improper installation of bearing	Replace bearing.
	Reduction of spread dimension of bearing	Replace bearing.
	Distorted bearing housing	Replace or correct bearing housing.
	Excessive oil clearance	Replace bearing.
Unusual engine noise (Various other parts)	Exhaust gas leakage from exhaust pipe joints	Retighten joints.
	Loosen or missing intake manifold flange gasket	Retighten or replace.
	Intake valve seating is not concentric	Replace or correct the valve and valve seat.
	Intake gas leakage	Retighten.
Unusual engine noise (Other problems)	Loose cooling fan mounting bolts or fan pulley nut	Tighten the fan and crankshaft pulley.
	Lack of lubricating oil (coolant pump, valves, etc.)	Lubricate.
	Worn timing gear	Replace the timing gear.
	Breakage of turbine or blower	Replace turbocharger.

NOTICE
The items on this page concern unusual engine noise which is due to causes other than those given for diesel knock.



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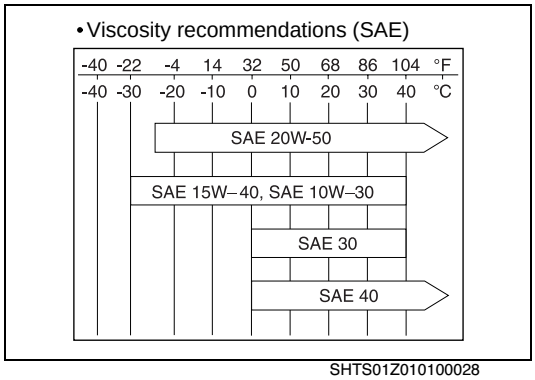

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2. ENGINE OIL PRESSURE

(1) Check the oil pressure warning light when the oil and coolant temperature is hot [about 80°C {176°F}].

a. If the warning light lightens, check the oil level.

b. Check oil deterioration.
If oil quality is poor, replace with a suitable grade oil.

c. Remove the oil pressure switch and install the oil pressure gauge.

d. Measure the oil pressure at a coolant temperature of 80°C {176°F} or more.

Oil pressure

Standard	Limit
49-490 kPa {0.5-5.0 kgf/cm^2, 7.11-71.10 lbf/in.^{2}}	**Less than 49 kPa {0.5 kgf/cm^2, 7.11 lbf/in.^{2}}**

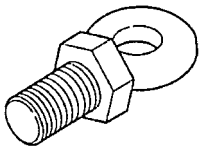
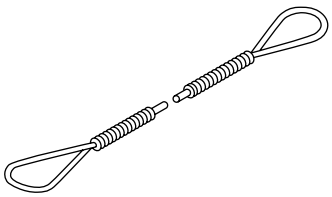
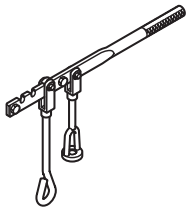
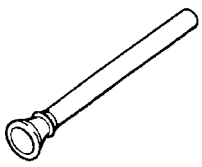
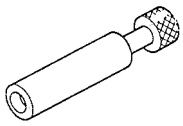
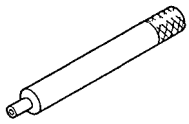
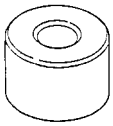
3. OTHER FACTORS

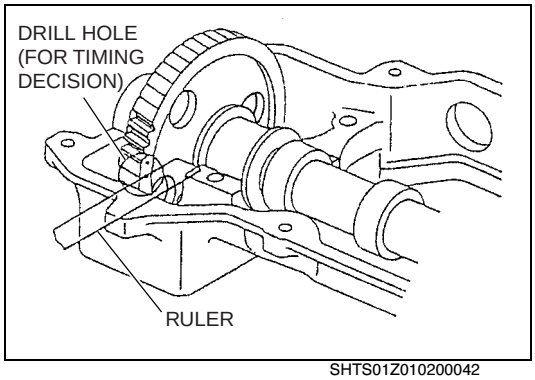
(1) Increase of blowby gas
(2) Defective engine start
(3) Decrease of engine output
(4) Increase of fuel consumption
(5) Increase of engine noise
(6) Increase of oil consumption

SPECIAL TOOL

EN01Z0102K100001

Prior to starting an engine overhaul, it is necessary to have these special tools.

Illustration	Part number	Tool name	Remarks
	S0943-31070	EYE BOLT	
	S0949-11010	WIRE	
	S0947-01170	VALVE SPRING PRESS	
	S0943-11020	VALVE LAPPING TOOL	
	S0947-22100	VALVE STEM SEAL PRESS	
	S0947-21210	BAR	For Nozzle sleeve
	SN441-00160	STEEL BALL	Used with S0947-21210
	S0947-11520	GUIDE	



SHTS01Z010200042

7. INSTALL THE CAMSHAFT.

(1) Align the mark on the flywheel with the flywheel housing pointer to set the No.1 piston to top dead center of the compression stroke.

NOTICE

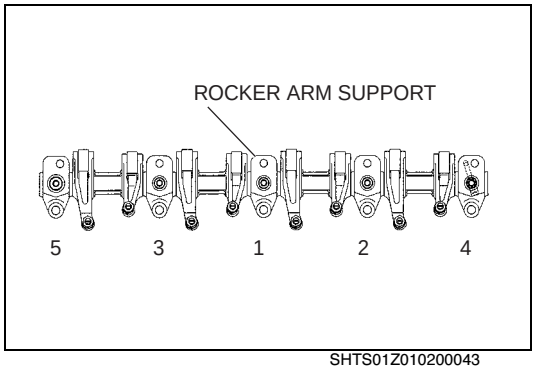
Engine adjustment - Refer to "PREPARATION OF CHECKING AND ADJUSTMENT" in the section "ENGINE TUNEUP" in the chapter "ENGINE INTRODUCTION".

(2) Install the camshaft into the cam housing.

NOTICE

Two drill holes on the camshaft gear should be located at left side and lower drill hole should match with the camshaft housing upper surface.

(3) Install the camshaft bearing cap, and tighten the bolts.



SHTS01Z010200043

8. INSTALL THE ROCKER ARM ASSEMBLY.

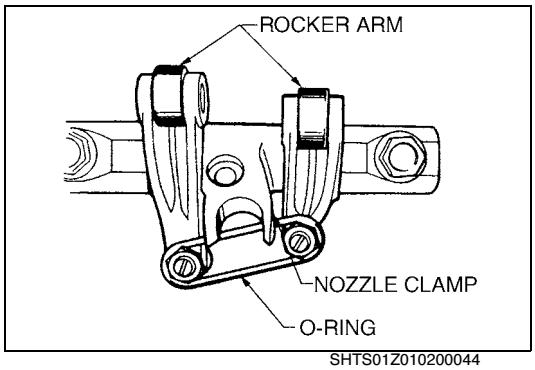
(1) Make sure that the cross head is on each valve.

NOTICE

If the cross head is assembled whilst off the valve, the upper seat will be pressed, resulting in a loose valve.

(2) Make sure that the adjusting screw at the end of the rocker arm is completely screwed in.

(3) Tighten the rocker arm support bolt as shown in the figure to the specified torque.
Tightening Torque:
28.5 N·m {290 kgf·cm, 21 lbf·ft}



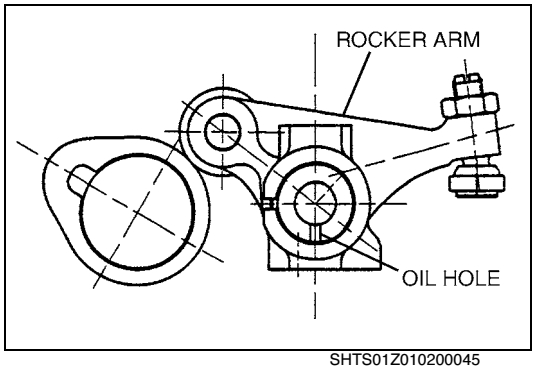
SHTS01Z010200044

(4) (J05E-TE) Tighten the nozzle clamp bolt to the specified torque.
Tightening Torque:
25 N·m {250 kgf·cm, 18 lbf·ft}

(5) Make sure that the rocker arm moves smoothly.

HINT

(J05E-TE) When assembling the rocker arm assembly, fix the arm and nozzle clamp with an O-ring as shown in the figure to facilitate installation.



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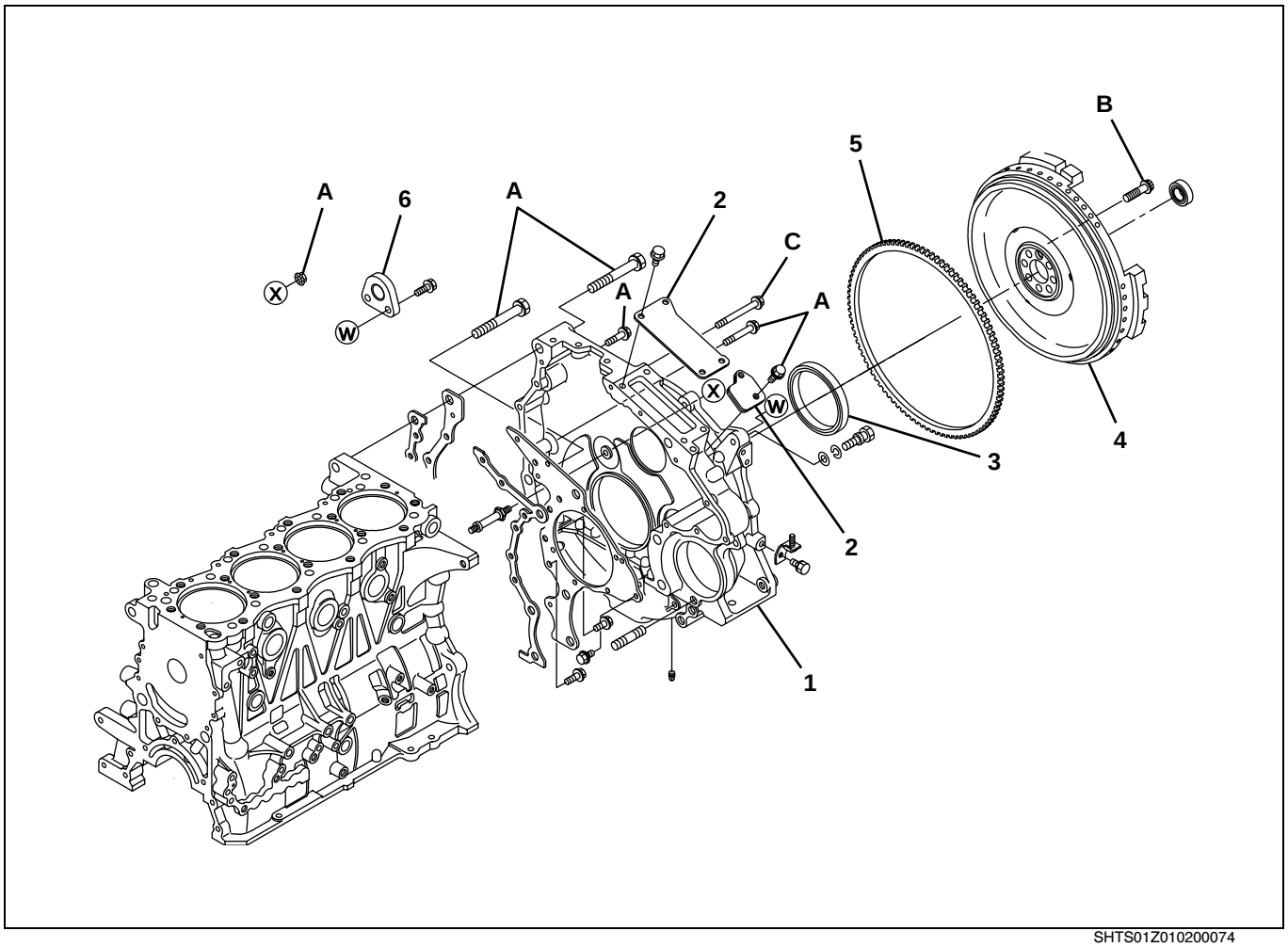
NOTICE

Make sure the oil hole is placed below.

FLYWHEEL AND FLYWHEEL HOUSING

COMPONENT LOCATOR

EN01Z0102D100003



SHTS01Z010200074

1	Flywheel housing	4	Flywheel
2	Dust cover	5	Ring gear
3	Crankshaft oil seal	6	Hanger bracket

Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

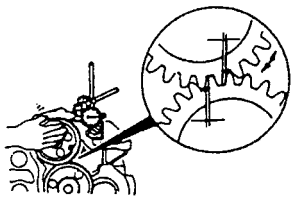
A	M8: 28.5 {290, 21}	B	186 {1,900, 137}#○
	M10: 55 {560, 40.5}	C	36 {367, 27}
	M16: 196 {2,000, 145}		

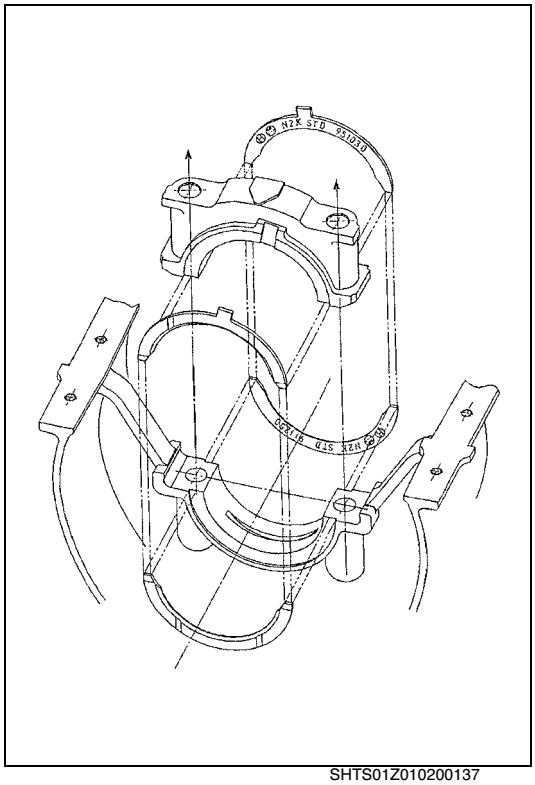
#=Apply oil to the threads and seat surface before tightening.
○=Tighten the bolt to the specified torque, then loosen it. Tighten to the specified torque again.

INSPECTION AND REPAIR

EN01Z0102H300003

Unit: mm {in.}

Inspection item		Standard	Limit	Remedy	Inspection procedure
Timing gear backlash	Crankshaft-Main idle	0.030-0.167 {0.0012-0.0065}	0.30 {0.0118}	Replace gear.	Measure 
	Main idle-Air compressor idle	0.032-0.096 {0.0013-0.0038}	0.10 {0.0039}		
	Air compressor idle-Air compressor	0.020-0.083 {0.0008-0.0033}	0.10 {0.0039}		
	Air compressor-Power steering pump	0.030-0.134 {0.0012-0.0052}	0.30 {0.0118}		
	Main idle-Sub idle	0.030-0.113 {0.0012-0.0044}	0.30 {0.0118}		
	Sub idle-Oil pump	0.030-0.131 {0.0012-0.0051}	0.30 {0.0118}		
	Sub idle-Cam idle	0.050-0.218 {0.0020-0.0085}	0.30 {0.0118}		
	Cam idle-Camshaft	0.030-0.253 {0.0012-0.0099}	0.30 {0.0118}		



SHTS01Z010200137

5. INSTALL THE CRANKSHAFT.

(1) Install the main bearing onto the bearing caps and the cylinder block.

NOTICE

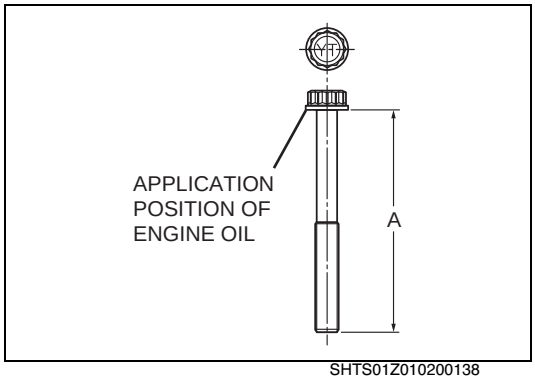
- **Install the bearing with the oil hole on the block side and the bearing without the oil hole on the cap side.**
- **Apply clean engine oil to inner surfaces of the bearings.**

(2) Install the thrust bearing with the groove side (front) toward the crank arm and with the part No. stamp (back) toward the main bearing cap or cylinder block.

HINT

Apply engine oil or grease to the back of the bearing to prevent loosening during installation.

(3) Install the crankshaft onto the cylinder block.



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6. INSTALL THE MAIN BEARING CAP.

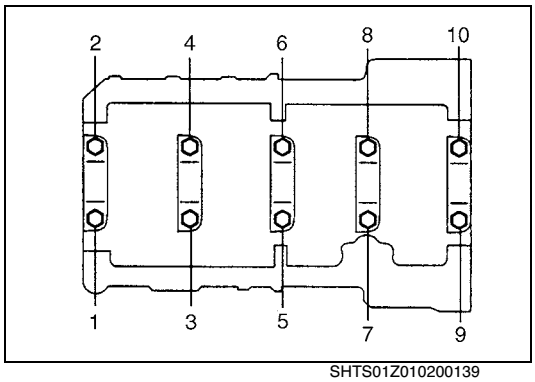
(1) Install the main bearing cap onto the cylinder block.

NOTICE

Check the number stamped on the cap.

(2) Measure the length below the head of the bearing cap bolt and replace any bolts not meeting the limit with new ones.

Dimension A	108 mm {4.252 in.}



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(3) Apply clean engine oil to the bolt seat and bolt threads.

(4) Tighten the bolts in the order as shown in the figure to the specified torque.
Tightening Torque:
69 N·m {700 kgf·cm, 51 lbf·ft}

(5) Loosen all bolts, tap the front and back ends of the crankshaft using a plastic hammer.

(6) Tighten the bolts as in step (4).

(7) Mark the bolt heads with paint.

AIR INTAKE SYSTEM (J05D, J05E)

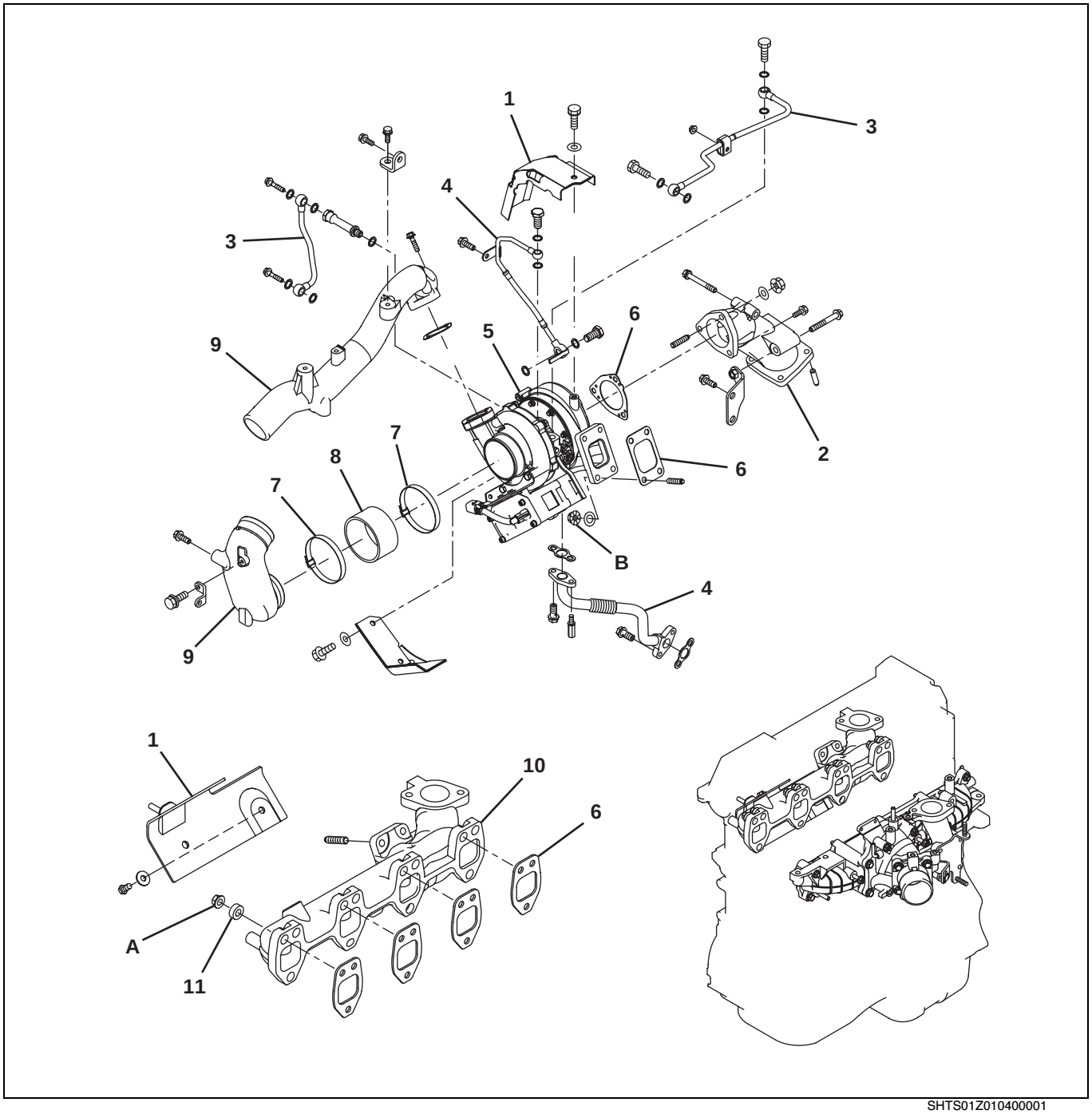
EN03-001

EXHAUST MANIFOLD AND PIPE

COMPONENT LOCATOR

EN01Z0104D100001

MODELS FOR TAIWAN, AUSTRALIA AND NEW ZEALAND (J05D-TG)



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1	Heat insulator	7	Clamp
2	Exhaust connector	8	Hose
3	Coolant pipe	9	Intake pipe
4	Oil pipe	10	Exhaust manifold
5	Turbocharger	11	Spacer
6	Gasket		

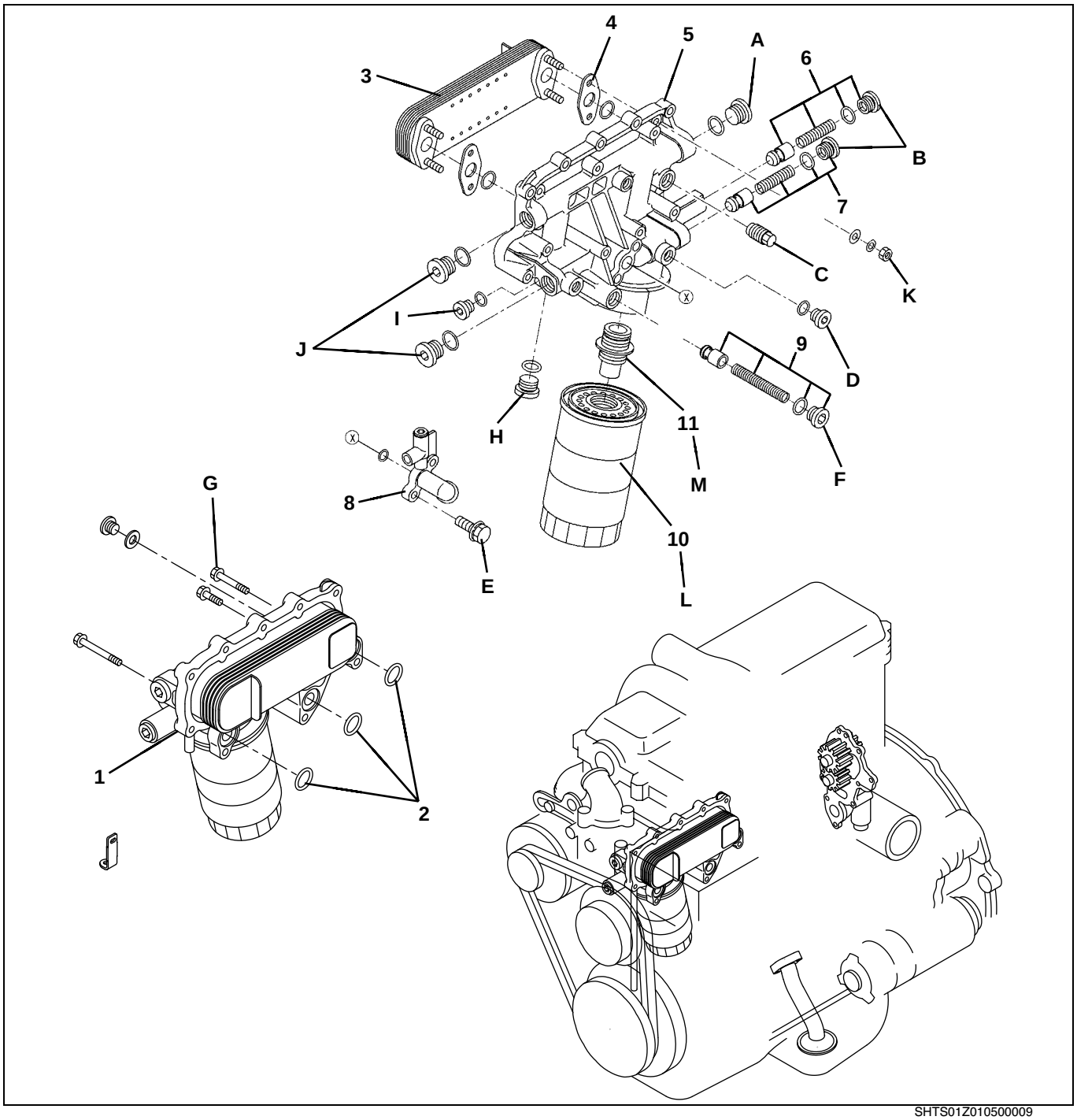
Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

A	53 {540, 39}	B	56 {570, 41}

OIL FILTER AND OIL COOLER

COMPONENT LOCATOR

EN01Z0105D100002



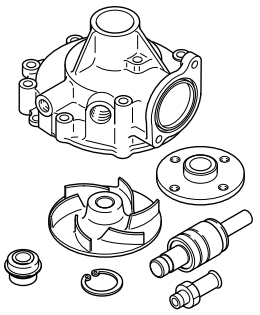
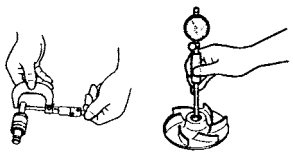
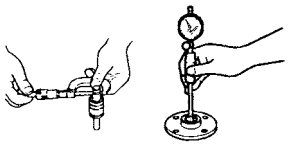
SHTS01Z010500009

1	Oil cooler with filter assembly	7	Oil filter safety valve
2	O-ring	8	Check valve
3	Oil cooler element	9	Oil cooler safety valve
4	Gasket	10	Oil filter element
5	Oil cooler case	11	Insert
6	Regulator valve		

INSPECTION AND REPAIR

EN01Z0106H300001

Unit: mm {in.}

Inspection item	Standard	LImit	Remedy	Inspection procedure
Wear, damage and corrosion	0.6-1.2 {0.0237-0.0472}	—	Replace parts.	Visual check 
Tightness of shaft and vane	0.015-0.048 {0.0006-0.0018}	—	Replace shaft and/or vane.	Measure 
Tightness of shaft and pulley center	0.017-0.051 {0.0007-0.0020}	—	Replace shaft and/or pulley center.	Measure 

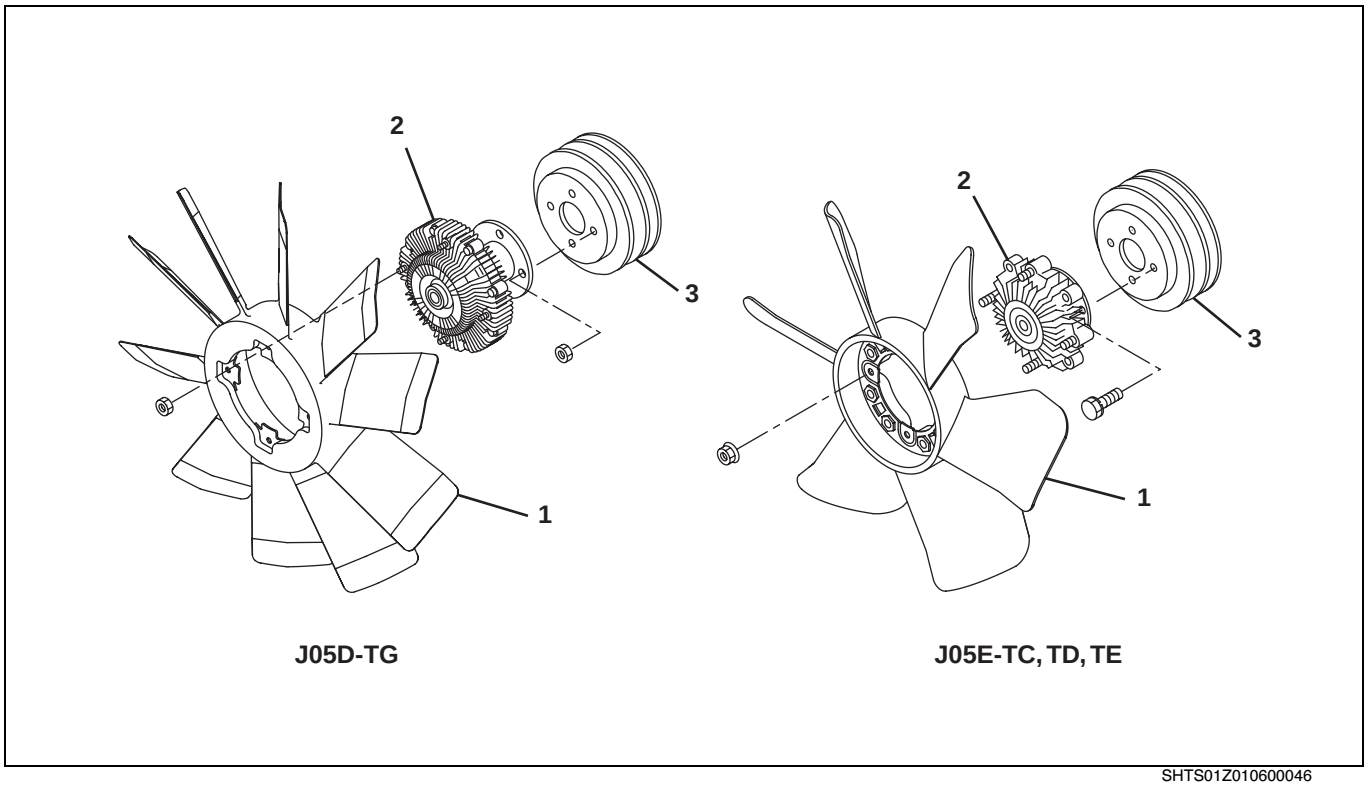
NOTICE

- **Tightness= Outside diameter - Inside diameter**
- **Prevent a reassembly more than three times even if it is within the standard value.**

COOLING FAN

COMPONENT LOCATOR

EN01Z0106D100004



SHTS01Z010600046

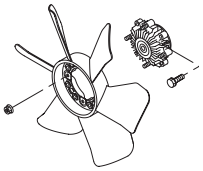
1	Cooling fan	3	Coolant pump pulley
2	Fan clutch		

NOTICE

- **Shock to the fan clutch and fan.**
  During maintenance and inspection, be careful not to drop or strike the fan clutch or fan itself. The resulting damage may lower the performance of the fan. Also, note that the fan is made of plastic and may become damaged or deformed if force is applied to it.
- **Replace the fan.**
  Do not replace the fan unless it is faulty. When replacing the fan, replace with the same type. If the fan is replaced with one of a larger capacity because of overheating or, conversely is replaced with one of a smaller capacity due to overcooling, the performance may in fact be reduced and durability may be jeopardized.
- **Other items**
  Check the bimetal to see if there is any mud or dust on it. If the bimetal is covered with mud or dust, the fan performance will be erratic, and may result in overheating or overcooling. In such case, carefully remove mud and dust adhering to the surface of the bimetal, using a wire brush, or the like.
  Take particular care not to apply excessive force.
  Do not paint the fan or fan clutch. Do not place any paint or other reagents which are likely to dissolve plastic in contact with the fan.

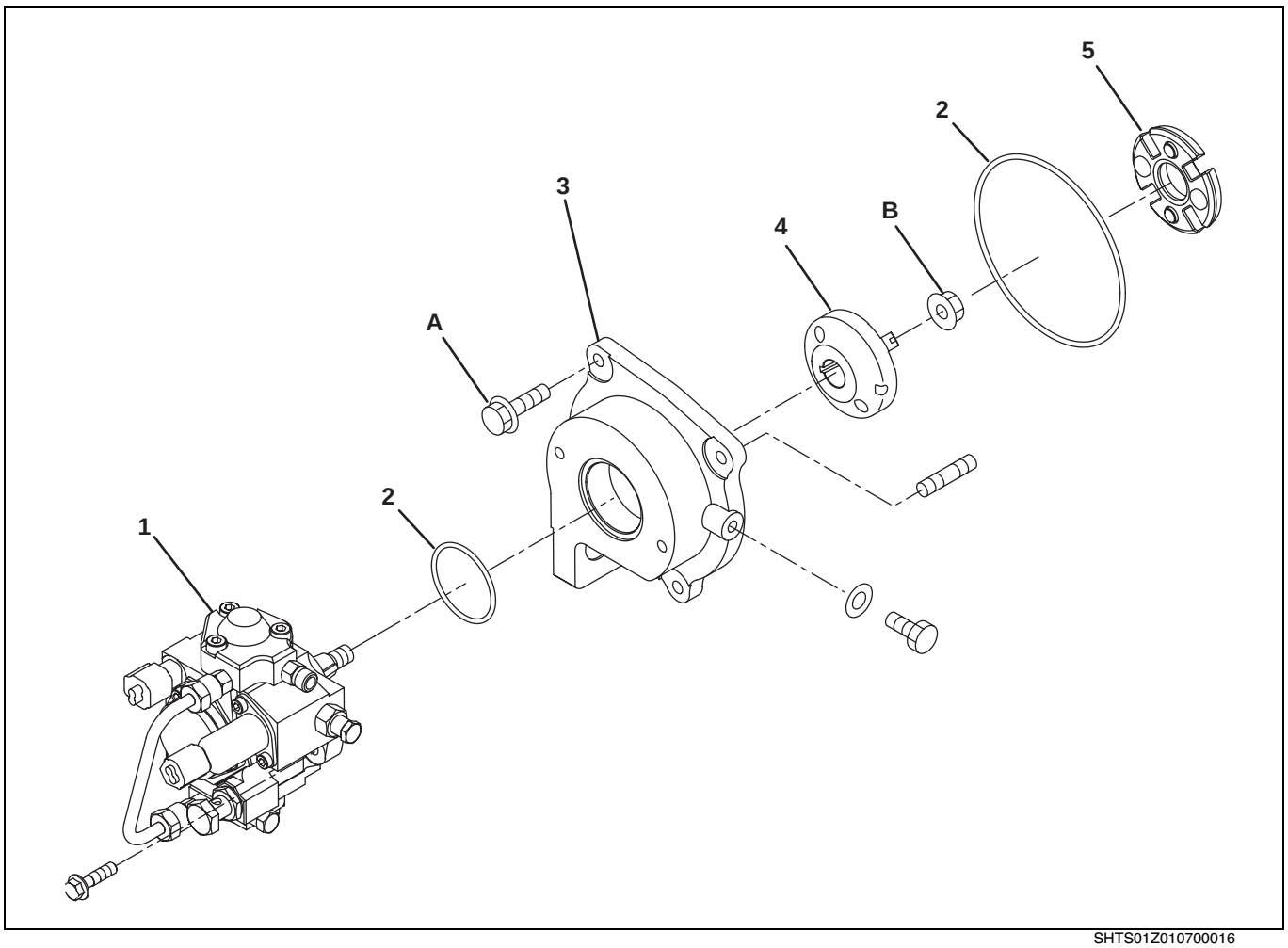
INSPECTION AND REPAIR

EN01Z0106H300003

Inspection item	Standard	Limit	Remedy	Inspection procedure
Cooling fan and fan clutch deformation and damage	—	—	Replace, if necessary.	Visual check 

COMPONENT LOCATOR

EN01Z0107C100003



SHTS01Z010700016

1	Supply pump assembly	4	Coupling flange
2	O-ring	5	Coupling
3	Bearing holder case		

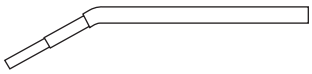
Tightening torque **Unit: N·m {kgf·cm, lbf·ft}**

A	28.5 {290, 21}	B	63.7 {650, 47}

SPECIAL TOOL

EN01Z0107K100002

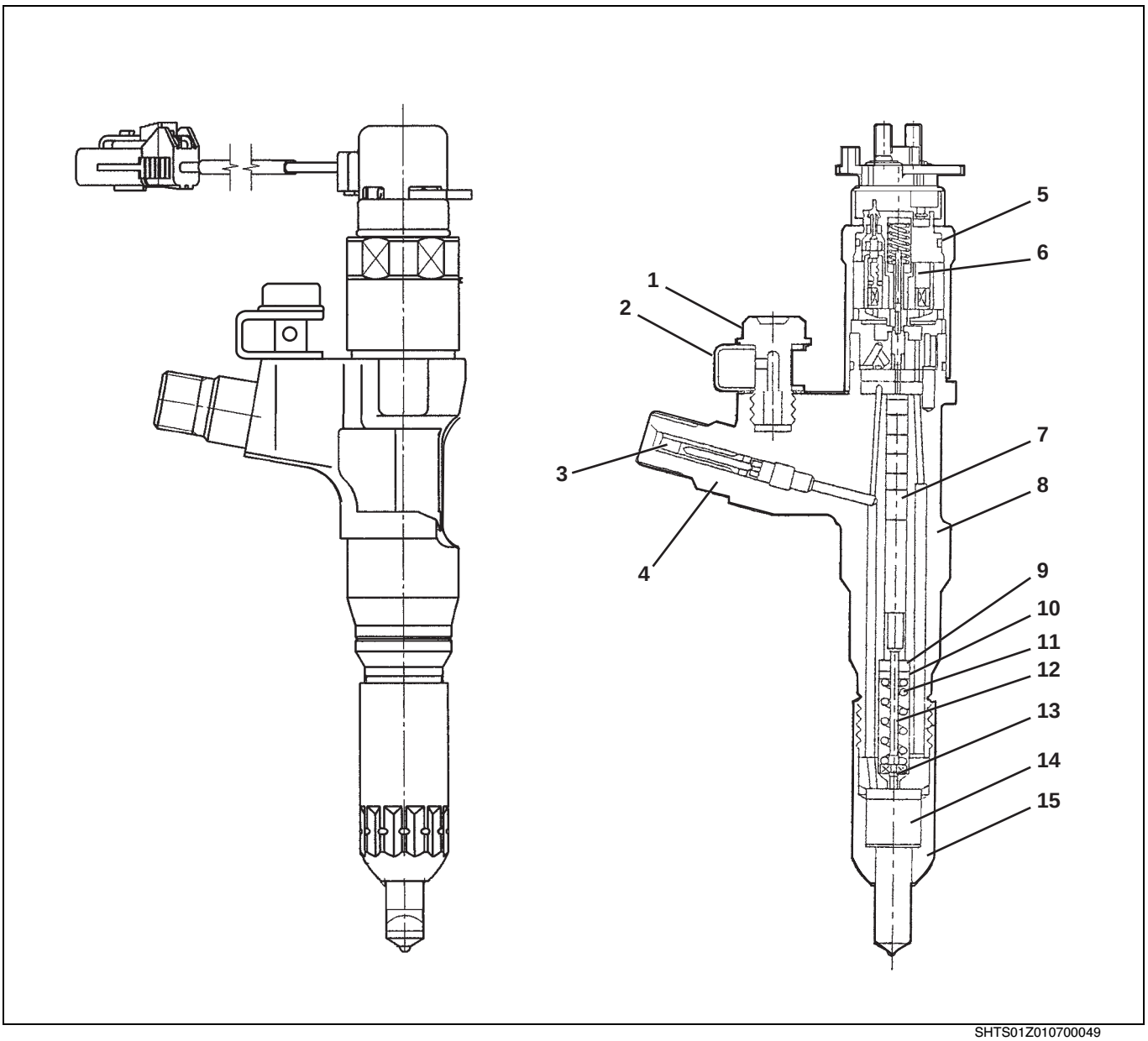
Prior to starting an engine overhaul, it is necessary to have this special tool.

Illustration	Part number	Tool name	Remarks
	S0904-81040	GUIDE PIN	

INJECTOR (EXCEPT J05E-TE)

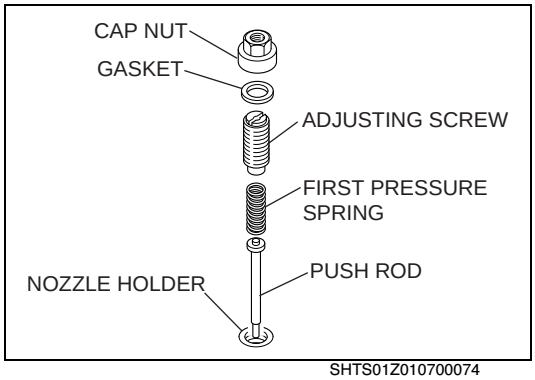
DESCRIPTION

EN01Z0107C100004



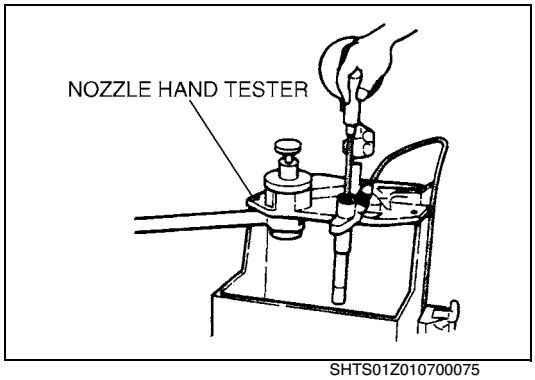
SHTS01Z010700049

1	Return joint bolt	9	Guide bushing
2	Gasket	10	Shim
3	Filter	11	Nozzle spring
4	Inlet connector	12	Pressure pin
5	O-ring	13	Tip seal
6	Two way valve (TWV)	14	Nozzle
7	Piston	15	Retaining nut
8	Lower body		



SHTS01Z010700074

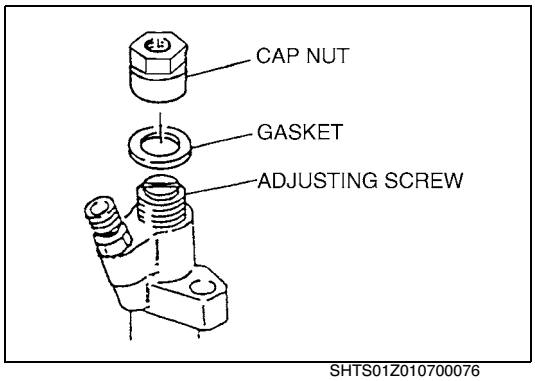
(3) Insert the push rod and first pressure spring to the nozzle holder body. Tighten the adjusting screw.
(4) Assemble the new gasket, tighten temporarily the cap nut.



SHTS01Z010700075

(5) Mount the above stated nozzle holder on the nozzle hand tester to determine the pressure at the start of injection.
This value is used as the first opening pressure. The adjusting screw is tightened or loosened to keep this value within a set range.
First opening pressure
With new parts: 18.14-18.92 MPa {185-193 kgf/cm^2, 2,632-2,745 lbf/in.^{2}}
With reused parts: 17.66-18.43 MPa {180-188 kgf/cm^2, 2,561-2,673 lbf/in.^{2}}

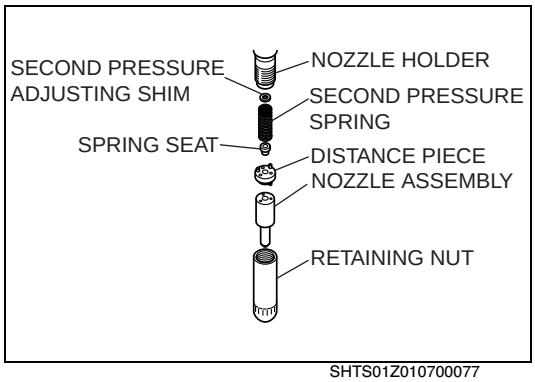
NOTICE
- **Tightening the adjusting screw → increases pressure**
- **Loosening the adjusting screw → decreases pressure**



SHTS01Z010700076

(6) After adjustment, a gasket is installed and the cap nut is tightened down to anchor the adjusting screw.
Tightening Torque:
53.9 N·m {550 kgf·cm, 40 lbf·ft}

NOTICE
Make sure that the adjusting screw does not turn at the same time.



SHTS01Z010700077

3. ADJUSTMENT OF SECOND OPENING PRESSURE

NOTICE
This operation is necessary only when changing the second pressure adjusting shim, second pressure spring, spring seat, and distance piece. This procedure is not required in other cases.

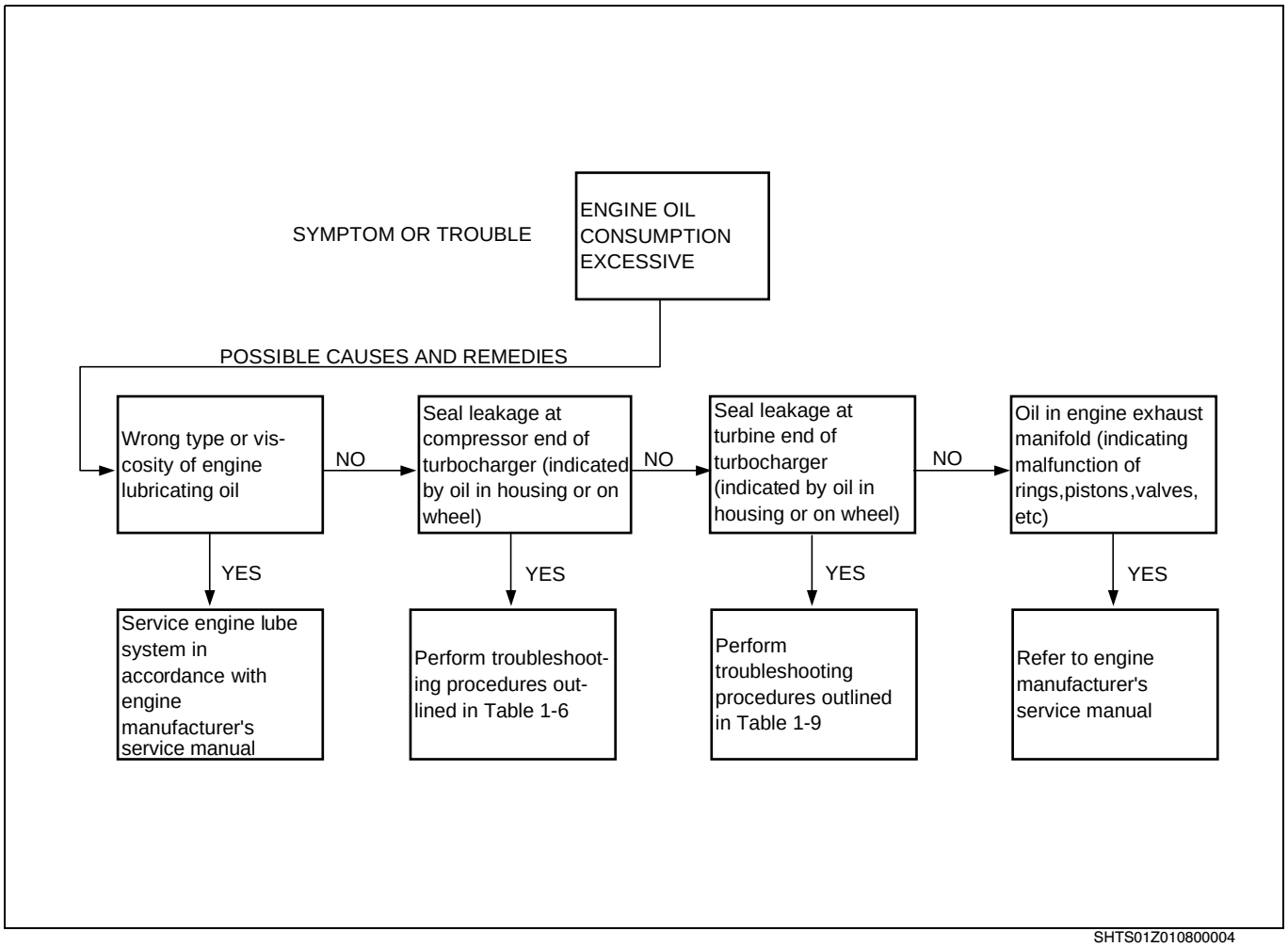
(1) Preparation
After adjusting the first opening pressure, dismantle the bottom of the nozzle and remove the pre-lift shim. Then assemble the second pressure adjusting shim (generally 1.4 mm {0.055 in.}), second pressure spring, spring seat, distance piece, and nozzle assembly. Then attach and tighten the retaining nut.

NOTICE
Do not install the pre-lift shim.

Tightening Torque:
63.7 N·m {650 kgf·cm, 47 lbf·ft}

SST: Socket wrench (95991-10150)

3. Table 1-3. Troubleshooting Engine Oil Consumption Excessive

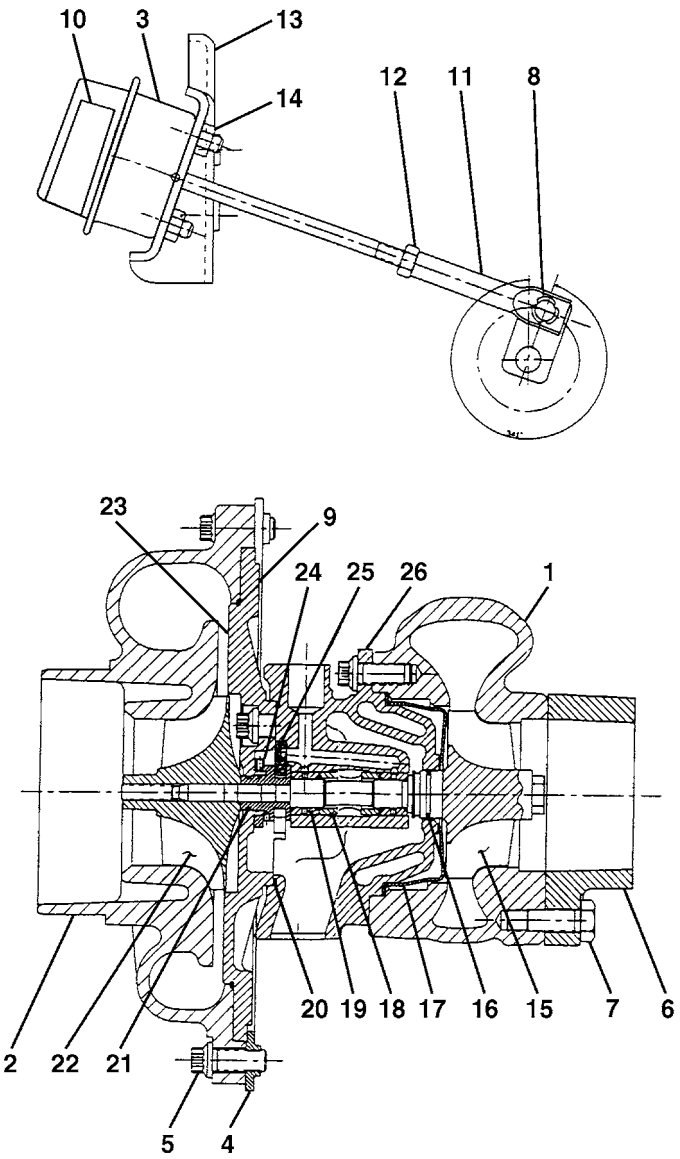


SHTS01Z010800004

TURBOCHARGER

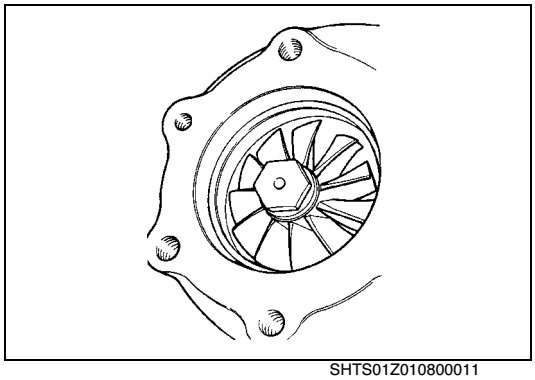
DESCRIPTION

EN01Z0108C100001



SHTS01Z010800001

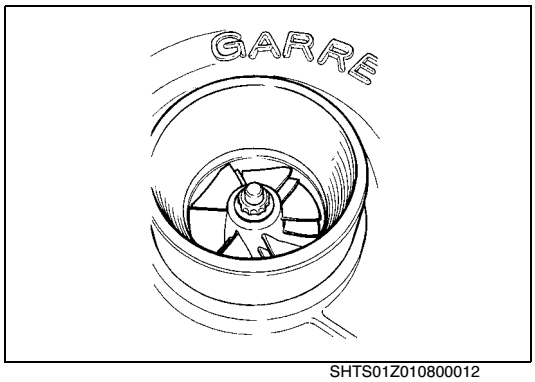
1	Turbine housing	14	Hexagon nut
2	Compressor housing	15	Turbine wheel assembly
3	Actuator assembly	16	Piston ring
4	Clamp	17	Wheel shroud
5	Bolt	18	Spacer
6	Elbow assembly	19	Journal bearing
7	Bolt	20	Seal ring
8	Retaining ring	21	Piston ring
9	O-ring	22	Compressor wheel
10	Label caution	23	Back plate
11	Rod end	24	Thrust collar
12	Rod end nut	25	Thrust bearing
13	Actuator bracket	26	Center housing


SHTS01Z010800011

3. INSPECTION TURBINE WHEEL AND HOUSING.

Remove the duct from the turbine outlet. Using a flash-light, check the turbine for wheel to housing rub, evidence of oil leakage or foreign object damage. Foreign object damage to the turbine is not usually visible through the turbine outlet unless the damage is severe.

(1) Wheel to housing rub
   a. If wheel rub is found, and the housing attaching hardware is secure, then the turbocharger is probably damaged internally and must be overhauled.
(2) Oil leakage
   a. If oil deposits are found, determine whether the oil has come from the engine exhaust or from the turbocharger center housing.
   b. If the oil has come from the engine, consult chapter **"ENGINE MECHANICAL"** and correct the problem. If oil deposits on the wheel are heavy the turbocharger should be disassembled, cleaned, and overhauled if necessary.
(3) Foreign object damage
   a. If foreign object damage to the turbine is visible, the turbocharger must be overhauled. Such damage destroys the wheel's balance and causes internal damage to the seal bores and journal bearings. Be sure to find the source of the foreign object. In many cases, the object has come out of the engine, and there may be engine damage as well.

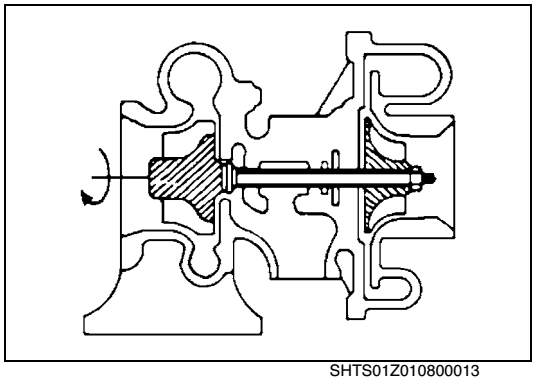


SHTS01Z010800012

4. EXAMINE COMPRESSOR WHEEL AND HOUSING.

Remove the ducting from the compressor inlet. Using a flashlight, check the compressor for wheel to housing rub, evidence of oil leakage, or foreign object damage.

(1) Wheel to housing rub
   If wheel rub is found, and the housing attaching hardware is secure, then the turbocharger is probably damaged internally and must be overhauled.
(2) Oil leakage
   Oil leakage into the compressor can be caused by:
   a. Long periods of idling on a restricted oil drain line.
   b. Oil leakage into the compressor can also be caused by a restricted air intake system.
   c. Oil leakage into the compressor can be caused by frequent use of the engine as a brake. In this case, nothing is wrong with either the engine or the turbocharger, but frequent compressor wheel and housing clean-up is recommended.
(3) Foreign object damage
   If the compressor wheel has been damaged by a foreign object, the turbocharger must be overhauled.


SHTS01Z010800013

5. CHECK ROTATING ASSEMBLY FOR NOISE OR EXCESSIVE PLAY.

(1) If no damage is visible in the turbine and compressor areas, spin the rotating assembly by hand. It should spin freely with no drag or grinding noises.

Low idle speed irregular

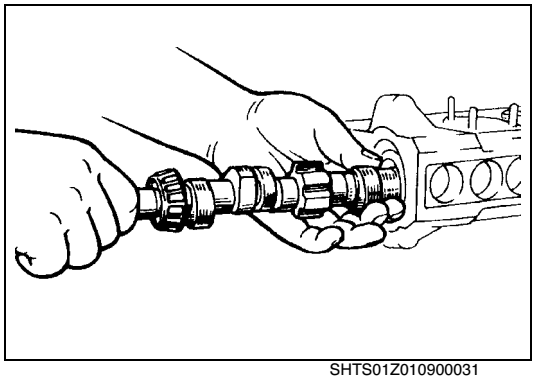
Symptom	Possible cause	Remedy/Prevention
Low idle speed irregular	Improper adjustment of idle button	Correct it.
	Bad fuel spray characteristic of nozzles	Check and repair them.
	Incorrect injection timing	Correct it.
	Incorrect initial tension setting of idling spring or the spring broken	Adjusting or replace it.
	Control rack not smoothly move	Disassemble pump and repair it.
	Large spread in fuel delivery	Adjust it.
	Plunger worn	Replace it.
	Governor linkage not moving smoothly	Correct it.
	Defective feed pump	Disassemble and repair it.

Engine always runs at high speed

Symptom	Possible cause	Remedy/Prevention
Engine always runs at high speed	Accelerator cable sticking	Check and correct it.
	Governor linkage sticking	Disassemble and repair the governor.
	Check rack sticking	Check and correct it.

Engine starts and stops

Symptom	Possible cause	Remedy/Prevention
Engine starts and stops	Fuel lines clogged	Clean or replace fuel lines.
	Air in fuel caused by damaged fuel lines or improper connection of fuel lines	Repair fuel lines or replace fuel lines and gaskets.

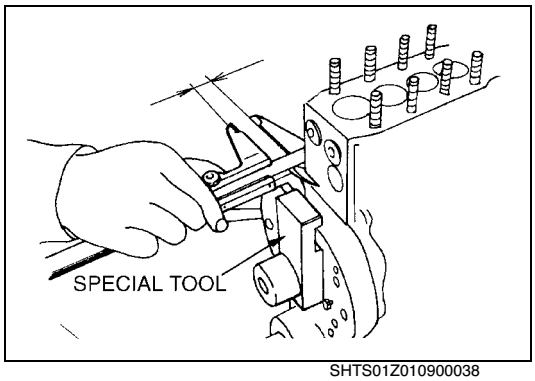

SHTS01Z010900031

2. INSTALL THE CAMSHAFT.

(1) Place the center bearing on the camshaft and insert the camshaft into the pump body, then tighten the center bearing set screws.

3. INSTALL THE BEARING COVER AND GOVERNOR HOUSING.

Tightening Torque:
Bearing cover: 7.8 N·m {80 kgf·cm, 6 lbf·ft}
Governor housing: 12.7 N·m {130 kgf·cm, 9 lbf·ft}

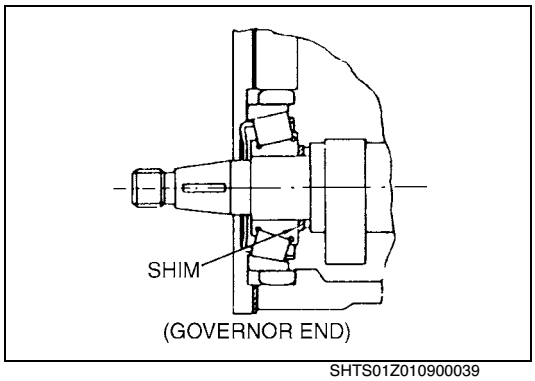


SHTS01Z010900038

4. MEASURE THE PROTRUDING LENGTH OF THE CAMSHAFT.

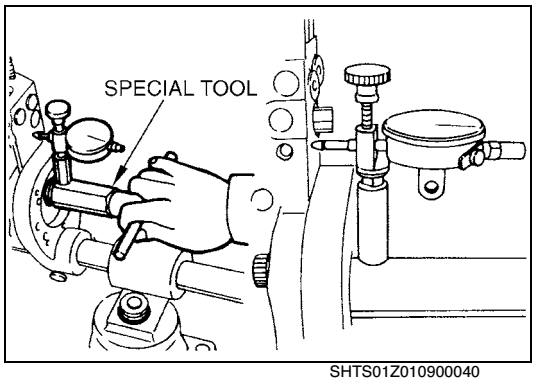
(1) Measure the distance from the surface of the end of the pump housing to the surface of the end of the special tool (where the tapered section of the camshaft starts).
SST: Camshaft protrudance guide rail (S0951-22340)

Standard length: 16-17 mm {0.63-0.66 in.}



SHTS01Z010900039

(2) If the specification is not met, use appropriate shim at the governor end of camshaft until the specification is met.

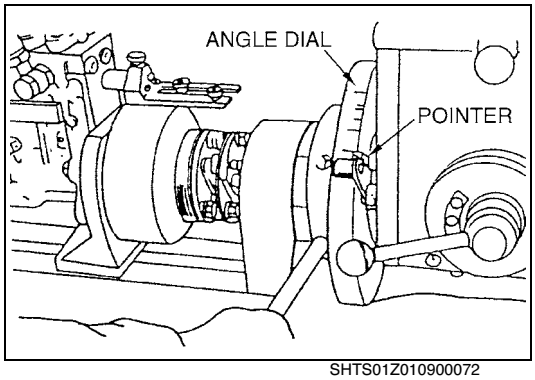


SHTS01Z010900040

5. MEASURE THE CAMSHAFT END PLAY.

(1) Attach the special tool onto the camshaft drive end and measure the thrust clearance of the camshaft with a dial gauge.
SST: Camshaft end play gauge (S0951-01150)

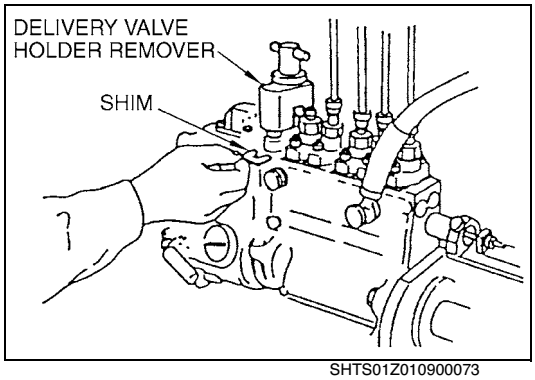
Standard end play: 0.03-0.05 mm {0.0012-0.0020 in.}



SHTS01Z010900072

4. ADJUST THE INJECTION INTERVAL.

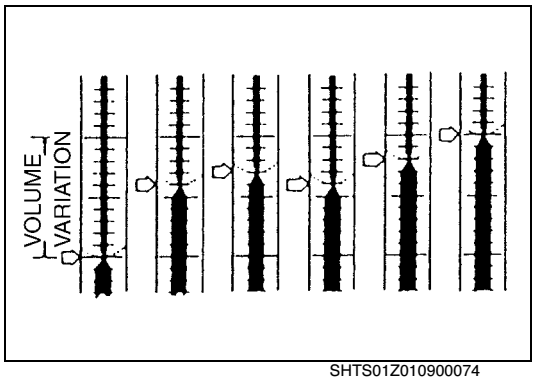
(1) Using the No.1 cylinder injection starting point as a base, inspect and adjust the injection interval in the order of injection.
Injection interval: 59°45'-60°15'
Injection order: 1-3-4-2



SHTS01Z010900073

(2) If the injection intervals are not within specification, adjust by using the same procedure as for pre-stroke adjustment.

(3) After adjustment, make sure the injection timing is correct.

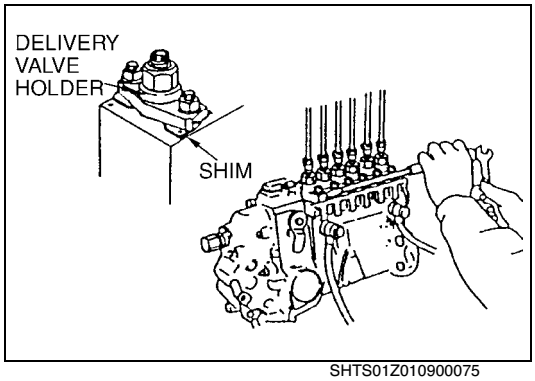


SHTS01Z010900074

5. MEASURING AND ADJUSTING THE INJECTION VOLUME.

(1) Connect the fuel line and the overflow valve in their correct positions.

(2) Measure the injection volume for each control rack position and pump revolution.
Injection volume: "DATA AND SPECIFICATIONS".



SHTS01Z010900075

a. To adjust the injection volume, loosen the delivery valve holder tightening nut and rotate the delivery valve holder.

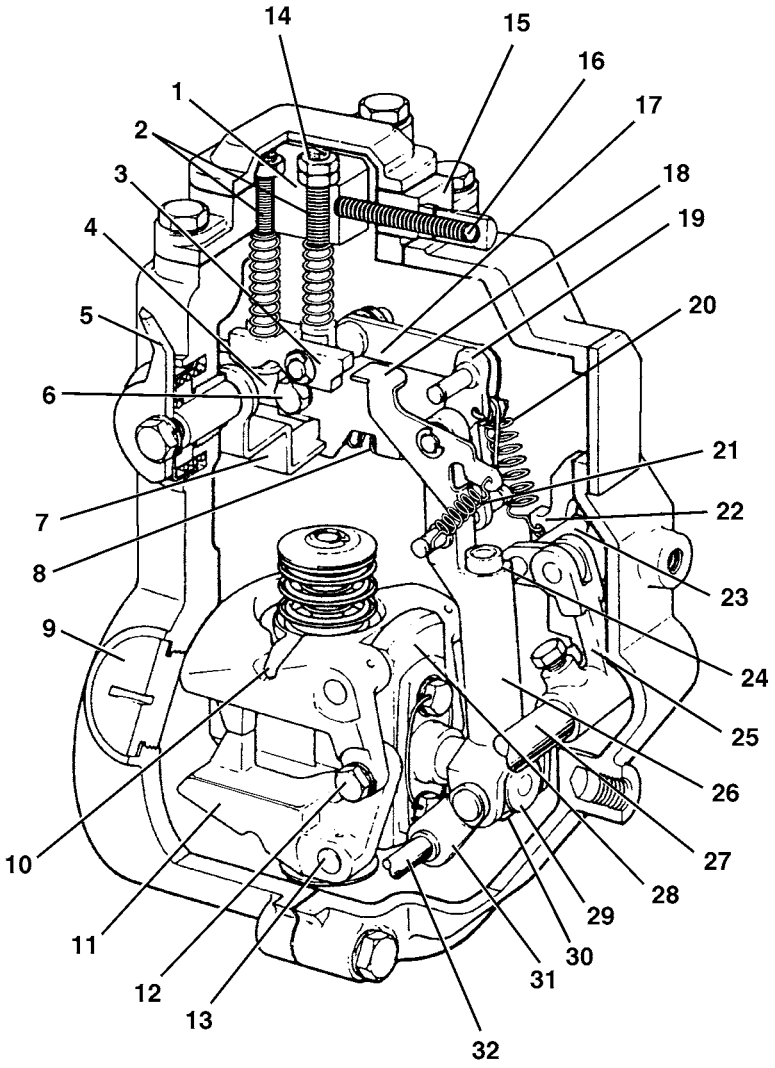
b. After adjustment has been completed, tighten the nuts alternately to the specified torque.
Tightening Torque:
19.1 N·m {195 kgf·cm, 14 lbf·ft}

GOVERNOR (R901)

DESCRIPTION

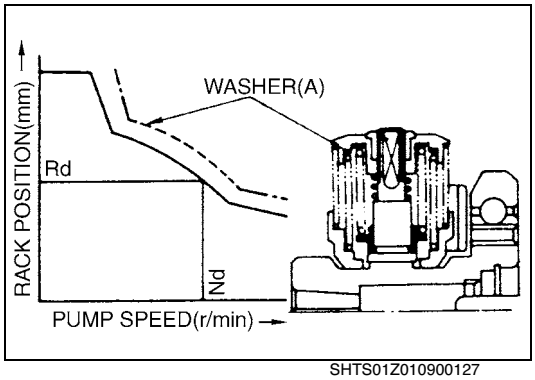
EN01Z0109C100002

(EXAMPLE)



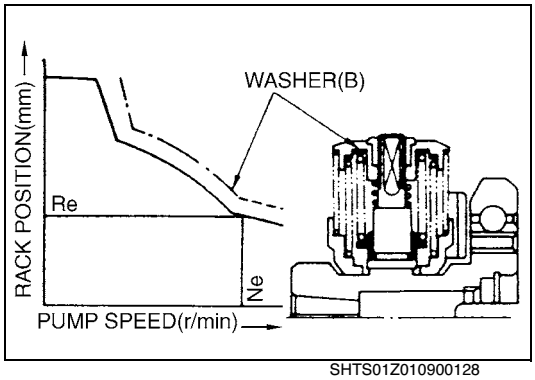
SHTS01Z010900098

1	Diaphragm plate	17	Inner lever
2	Adapter	18	Floating lever
3	Cam plate	19	Control lever
4	Control rack	20	Return spring
5	Stopper	21	Return spring
6	Connecting bolt	22	Cam plate
7	Guide lever	23	Guide shaft
8	Return spring	24	Sliding block
9	Screw plug	25	Guide lever
10	Spring seat	26	Floating lever
11	Flyweight	27	Adjusting lever shaft
12	Bolt	28	Flyweight holder
13	Bell crank shaft	29	Bolt
14	Nut	30	Bushing
15	Rack limiter	31	Control lever
16	Stopper screw	32	Straight pin



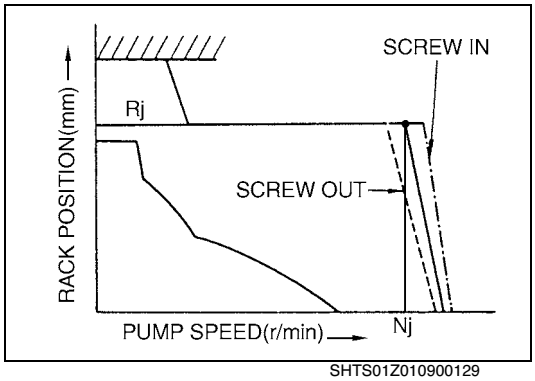
SHTS01Z010900127

d. At a pump speed of **Nd** r/min, measure the control rack position **Rd** mm.
Nd and Rd: Refer to "DATA AND SPECIFICATIONS".
If not within specification, replace the washer (A).



SHTS01Z010900128

e. At a pump speed of **Ne** r/min, measure the control rack position **Re** mm.
Ne and Re: Refer to "DATA AND SPECIFICATIONS".
If not within specification, replace the washer (B).



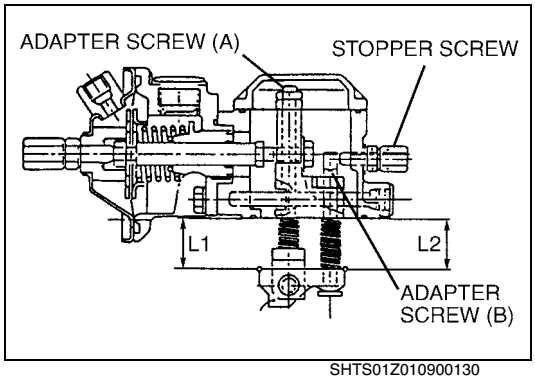
SHTS01Z010900129

(4) Preliminary adjustment of maximum speed control.

a. Apply a P mmHg boost pressure to the boost compensator.
P: Refer to "DATA AND SPECIFICATIONS".

b. The speed control lever should be in the "FULL-LOAD" position.

c. At a pump speed of **Nj** r/min, measure the control rack position **Rj** mm.
Nj and Rj: Refer to "DATA AND SPECIFICATIONS".
If not within specification, adjust with the idle adjusting screw.

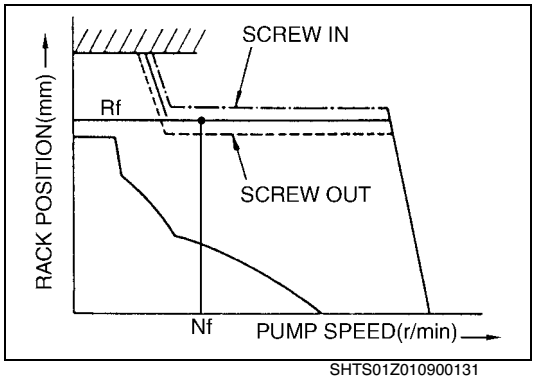


SHTS01Z010900130

(5) Adjusting of medium speed control.

NOTICE

- **The speed control lever should always be in the "FULL-LOAD" position during adjustment of the medium speed control.**
- **Apply a 13.3 kPa {100 mmHg} boost pressure to the boost compensator.**

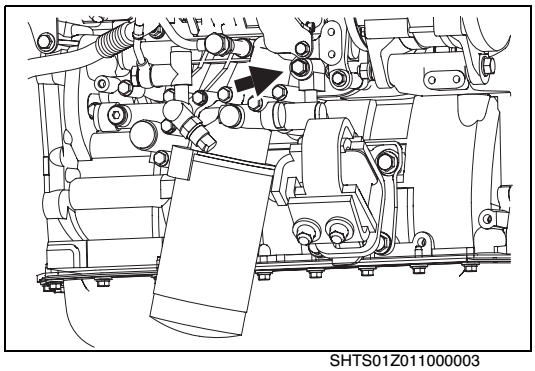


SHTS01Z010900131

a. At a pump speed of **Nf** r/min, measure the control rack position **Rf** mm.
Nf and Rf: Refer to "DATA AND SPECIFICATIONS".
If not within specification, adjust with the stopper screw.

DISMOUNTING AND MOUNTING

EN01Z0110H200001



SHTS01Z011000003

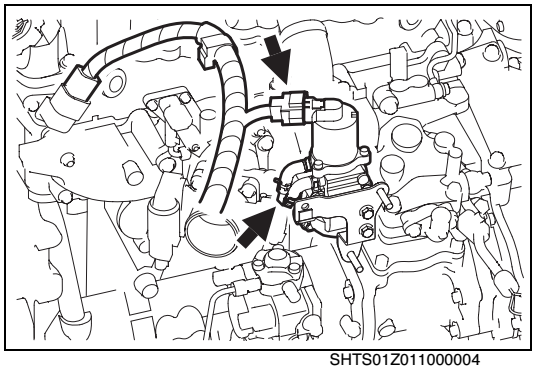
IMPORTANT POINT - DISMOUNTING

1. REMOVE THE EGR VALVE.

NOTICE

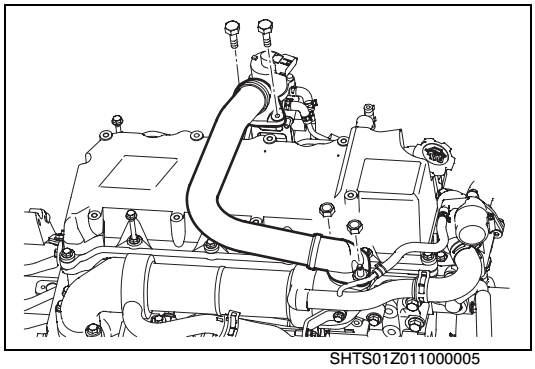
To prevent burns ensure the engine is cold before changing the valve. (At least 30 minutes after switching off the engine)

(1) Drain the coolant out of the drain plug of oil cooler situated on the right side of the engine.



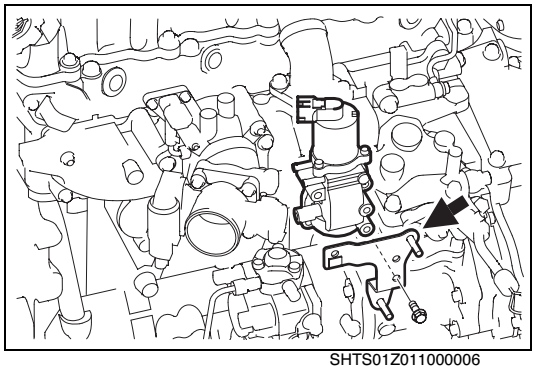
SHTS01Z011000004

(2) Disconnect the harness coupler.
(3) Disconnect the hose between EGR valve and coolant pipe.



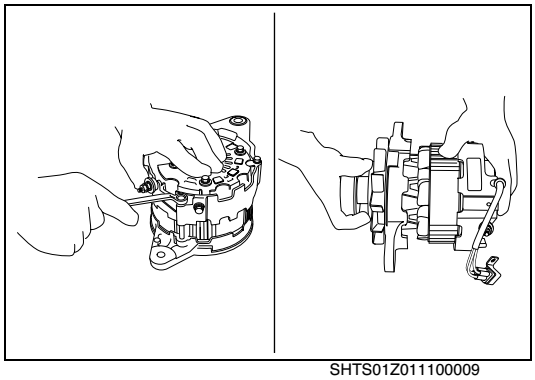
SHTS01Z011000005

(4) Remove EGR pipe.

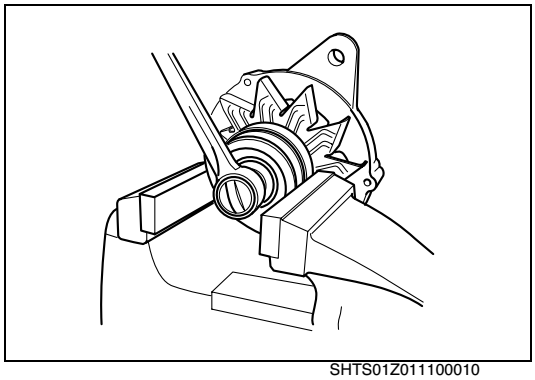


SHTS01Z011000006

(5) Remove the EGR valve bracket.


SHTS01Z011100009

(3) Remove the through bolts, disassemble the rectifier end frame and drive end frame.


SHTS01Z011100010

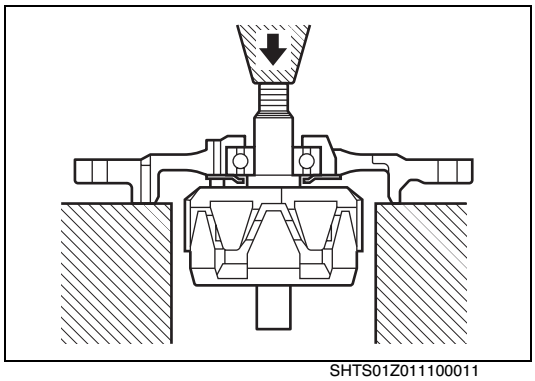
2. REMOVE THE ROTOR.

(1) Remove the pulley lock nut.

NOTICE

Wind V-belt around pulley groove and grip it securely in a vise so that pulley is held with V-belt as a cushion.

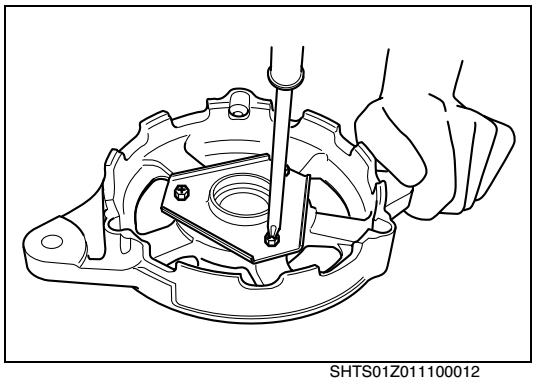
(2) Remove the pulley, fan and space collar.


SHTS01Z011100011

(3) Remove the rotor from drive end frame, using a press.

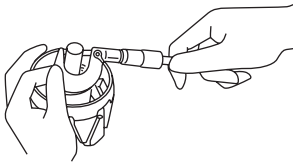
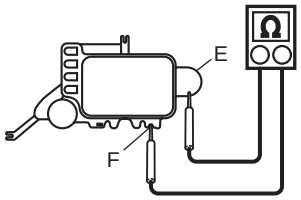
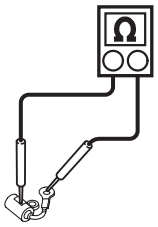
NOTICE

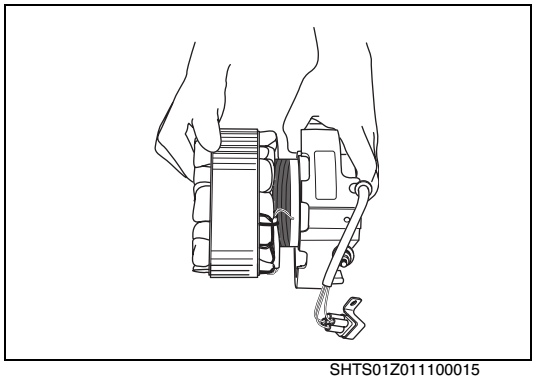
- **Do not damage to the screw tip.**
- **Hold rotor by hand so that it will not fall off.**


SHTS01Z011100012

3. REMOVE THE FRONT BALL BEARING.

(1) Remove the retainer plate.

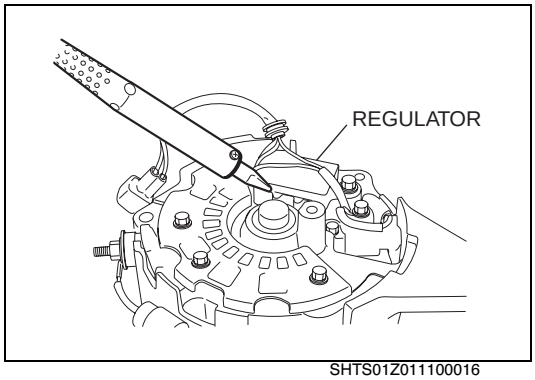
Inspection item	Standard	Limit	Remedy	Inspection procedure
Rotor shaft outside diameter (Rear bearing portion)	**17 {0.669}**	**16.98 {0.6685}**	**Replace.**	**Measure** 
Resistance of regulator	**Normal direction APPROX. 10 Ω Reverse direction ∞ Ω**	**—**	**Replace.**	**Measure** 
Resistance of condenser NOTICE Do not use digital tester.	**Indicate 800 Ω ↓ (Immediately) Indicate ∞ Ω**	**—**	**Replace.**	


SHTS01Z011100015

(2) Remove the stator from the rectifier end frame.

NOTICE

Be careful not to damage the stator.



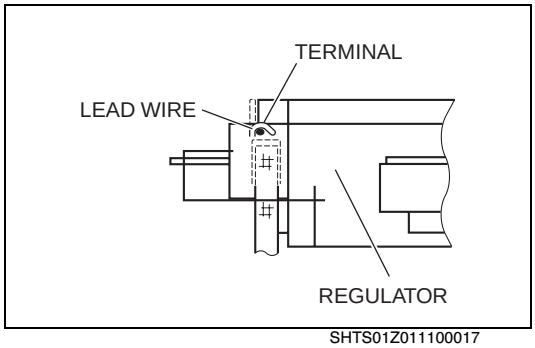
SHTS01Z011100016

5. REMOVE THE RECTIFIER HOLDER, REGULATOR AND FIELD COIL.

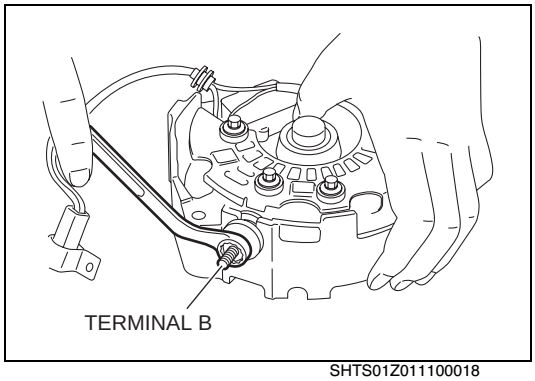
(1) Unsolder lead wire from field coil.

NOTICE

- **Unsolder lead wire after opening the terminal of regulator.**
- **Unsoldering work should be done for short moment (Within 5 sec.).**



SHTS01Z011100017

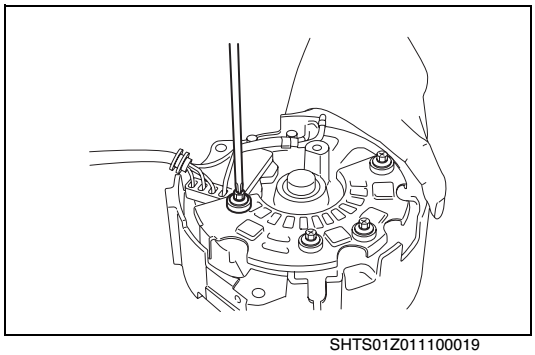


SHTS01Z011100018

(2) Loosen the "B" terminal nut.

NOTICE

Loosen the nut to some extent and do not take it out of terminal B.


SHTS01Z011100019

(3) Remove the rectifier holder and regulator.

NOTICE

- **Lock agent is used not to be unscrewed easily. So, be careful not to damage the groove on bolt head.**
- **Make sure to clean the screw hole when reusing rear bracket.**

STARTER

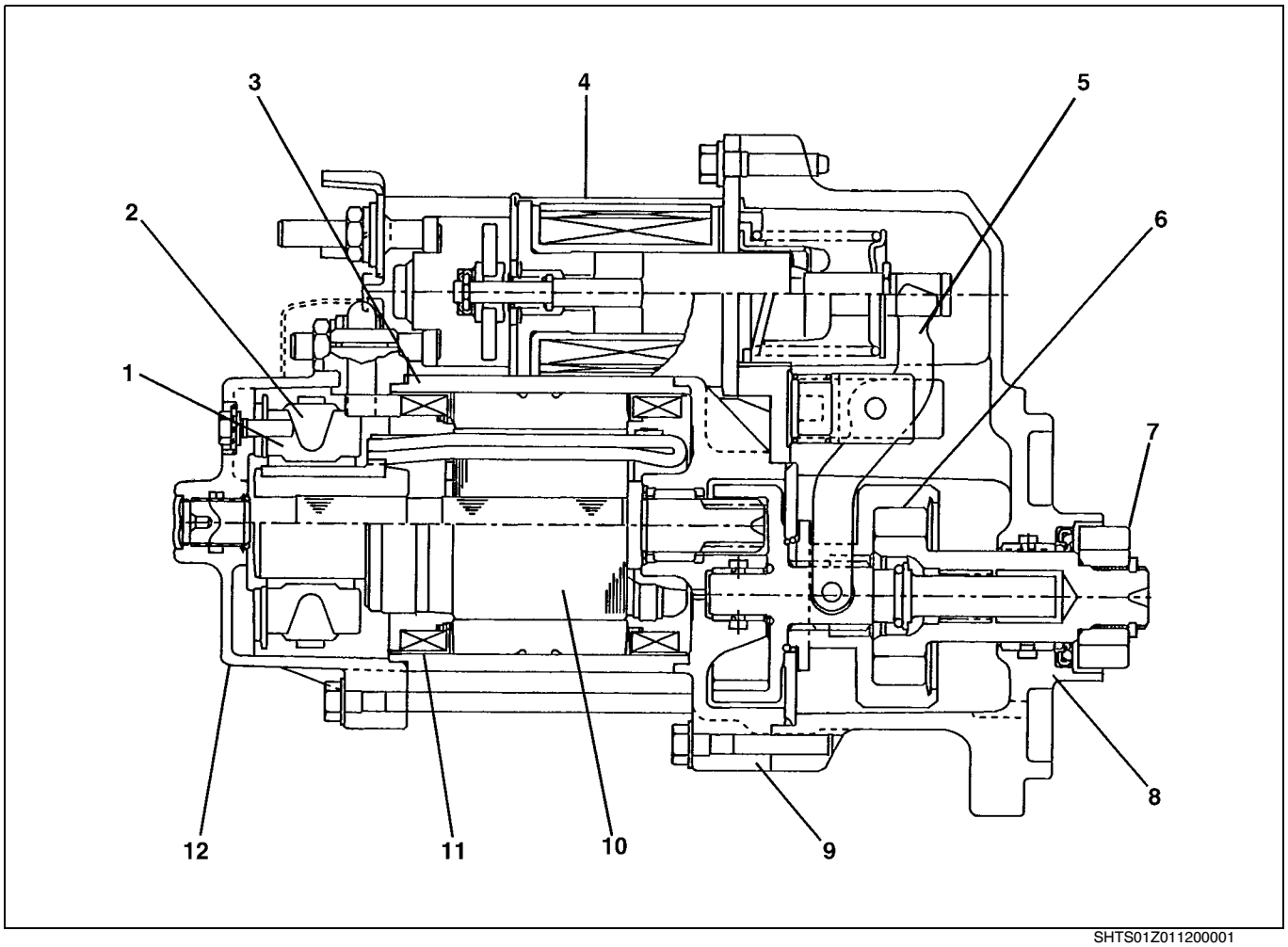
DATA AND SPECIFICATIONS

EN01Z0112I200001

Type	**Reduction gear type**
Rated output	**24 V, 4.5 kW**
Number of teeth of pinion	**11**
Module	**3**
Rotating direction	**Clockwise (Seen from pinion side)**

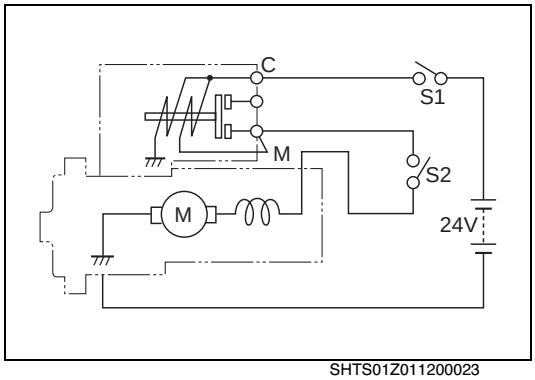
DESCRIPTION

EN01Z0112C100001



SHTS01Z011200001

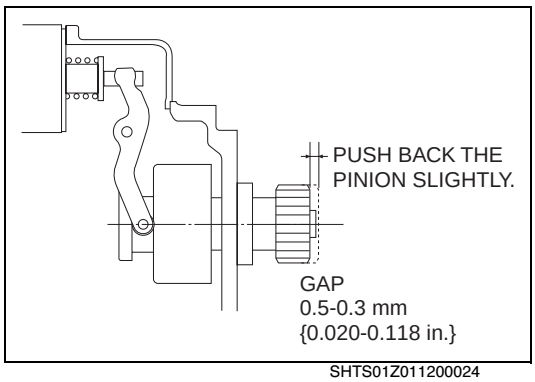
1	Holder assembly	7	Pinion gear
2	Brush	8	Drive housing assembly
3	Yoke assembly	9	Gear housing
4	Magnetic switch assembly	10	Armature assembly
5	Lever	11	Field coil
6	Drive shaft assembly	12	Commutator end frame



SHTS01Z011200023

8. AFTER ASSEMBLING THE STARTER, MEASURE THE PINION GEAR THRUST GAP.

(1) Arrange the circuit.
(2) Close switches S1 and S2.
(3) Open S2 alone when the pinion pops out.



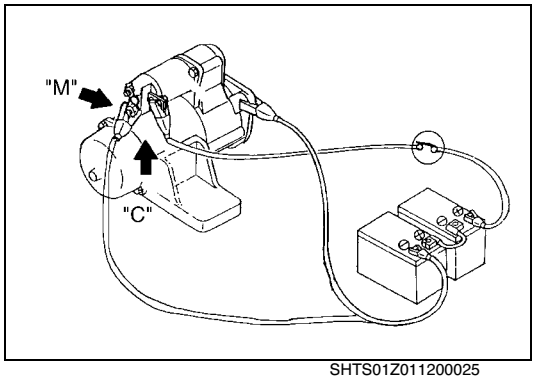
SHTS01Z011200024

(4) If the above condition, push pinion back to measure the gap.
Standard: 0.5-0.3 mm {0.020-0.118 in.}

NOTICE
Perform the inspection work for an instance (within 15 seconds).

IMPORTANT POINTS - INSPECTION

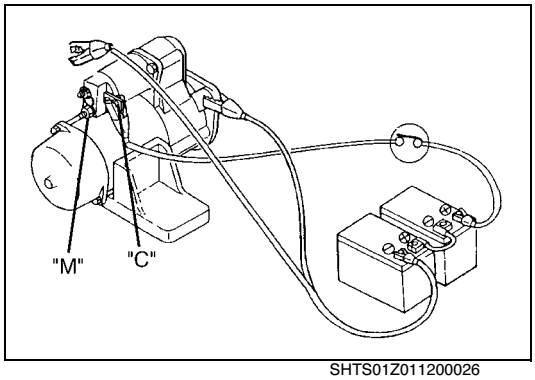
NOTICE
These tests must be performed within 3 to 5 seconds to avoid burning out the coil.



SHTS01Z011200025

1. PERFORM PULL-IN TEST.

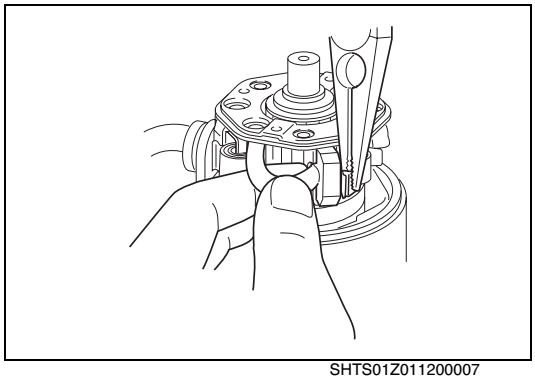
(1) Disconnect the field coil lead wire from the terminal M.
(2) Connect battery to the magnetic switch as shown.
(3) Check that the pinion gear moves outward.



SHTS01Z011200026

2. PERFORM HOLD-IN TEST.

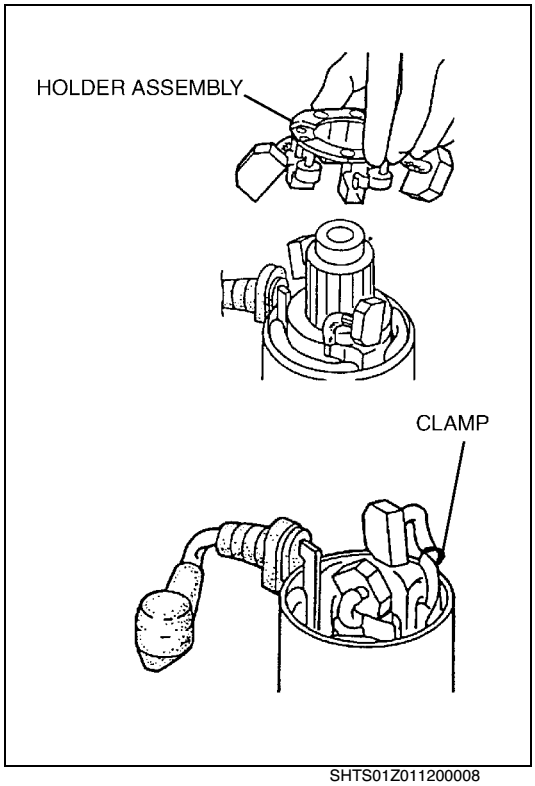
(1) While connected as above with the pinion gear out, disconnect the negative (-) lead from terminal M.
(2) Check that the pinion gear remains out.



SHTS01Z011200007

3. REMOVE THE HOLDER ASSEMBLY.

(1) Using a long nose plier, remove the brush of the yoke from the holder.

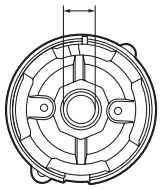
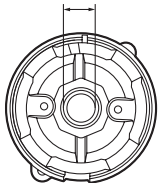
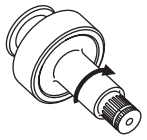
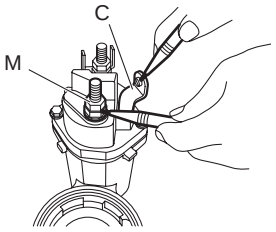
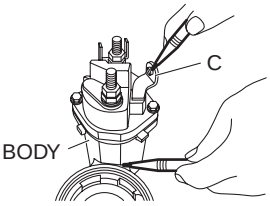
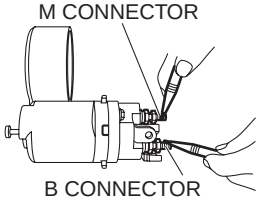
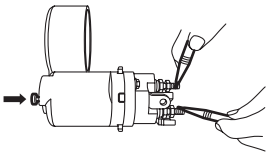


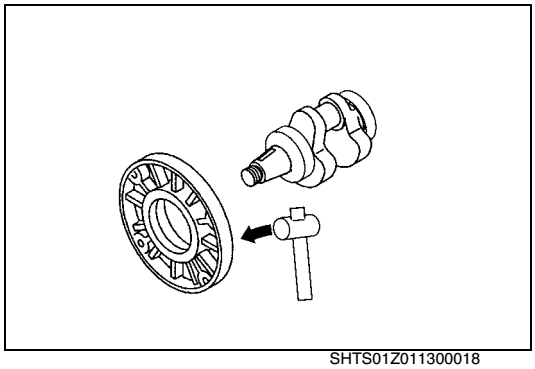
SHTS01Z011200008

(2) Remove the holder assembly from the armature.

NOTICE

Do not cut the fixed clamp of brush lead.

Inspection item	Standard	Limit	Remedy	Inspection procedure
Inside diameter of commutator end frame	28.0 {1.102}	28.1 {1.106}	Replace.	Measure 
Rotating of ball bearing	—	—	Replace.	Visual check 
Rotating of pinion	—	—	Replace, if both side turn or does not turn at all.	Visual check 
Resistance between the C terminal and M terminal (Pulling coil)	0.12-0.14 Ω	—	Replace.	Measure 
Resistance between the C terminal and the body (Holding coil)	1.13-1.25 Ω	—	Replace.	Measure 
Continuity between B terminal and M terminal	No continuity	—	Replace.	Measure 
Continuity between B terminal and M terminal	Continuity	—	Replace.	Measure 

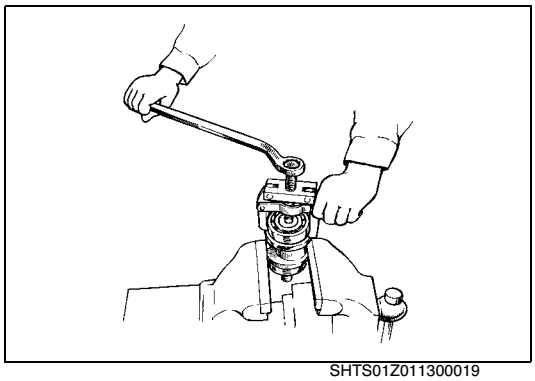

SHTS01Z011300018

7. REMOVE THE BEARING HOLDER.

(1) Strike the circumference of the holder lightly with a plastic hammer or a mallet and remove the holder.

NOTICE

Be careful not to damage the bearing holder.


SHTS01Z011300019

8. REMOVE THE BALL BEARING.

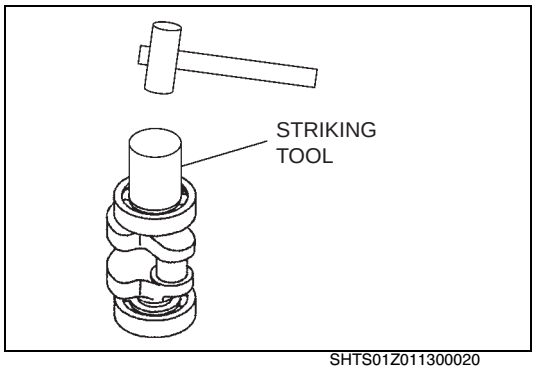
(1) Using the special tool, remove the ball bearing from the end of the crankshaft.

SST:

Bearing puller (S0965-01101, for supply pump side)

Puller assembly (S0965-01310, for drive gear side)

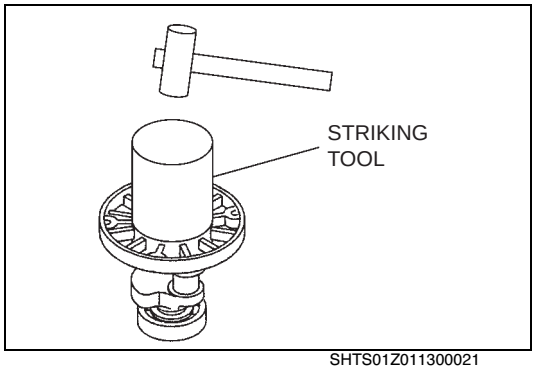
IMPORTANT POINTS - ASSEMBLY



SHTS01Z011300020

1. INSTALL THE BALL BEARING.

(1) Install the ball bearing.



SHTS01Z011300021

2. INSTALL THE CRANKSHAFT.

(1) Using a copper hammer, install the crankshaft to the bearing holder.

FUEL CONTROL (J05D, J05E: COMMON RAIL)

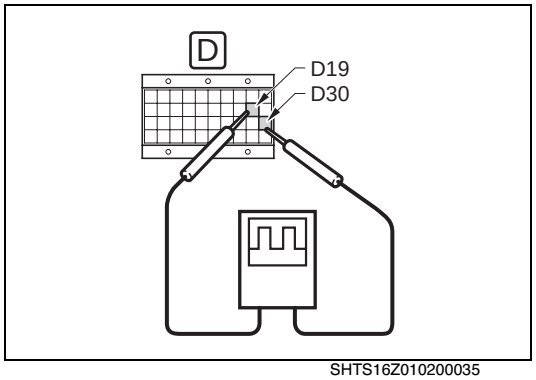
DN02-001

9. COMPUTER (ECU) PIN CONNECTION

- The terminal number in the table correspond with the contact box of signal check harness.

CONTACT BOX (A)					
No.	**Signal**	**Connection destination**	**No.**	**Signal**	**Connection destination**
1	–		21	ACS1	Accelerator sensor (Signal 1)
2	–		22	ACS2	Accelerator sensor (Signal 2)
3	–		23	ACCS	P.T.O. accelerator sensor (Signal)
4	–		24	–	
5	VB1	ECU main relay	25	–	
6	VB2	ECU main relay	26	–	
7	VB3	Exhaust clutch switch	27	VS	Vehicle speed pulse converter
8	–		28	–	
9	TACH	Tachometer	29	–	
10	–		30	IVS	Idle volume (Signal)
11	–		31	–	
12	–		32	AFT+	Air flow sensor [Power (Temperature)]
13	–		33	–	
14	–		34	–	
15	–				
16	–				
17	BATT	Fuse 25 (Room light)			
18	–				
19	ISOK	Diagnosis connector (16P)			
20	–				

CHECK ENGINE LIGHT	SYMPTOM	MC No.	DTC No.	PRESUMED CAUSE OF TROUBLE	REFER PAGE
YES	C	51	P0201	Injector circuit malfunction -cylinder 1	DN02-60
YES	C	52	P0202	Injector circuit malfunction -cylinder 2	DN02-60
YES	C	53	P0203	Injector circuit malfunction -cylinder 3	DN02-60
YES	C	54	P0204	Injector circuit malfunction -cylinder 4	DN02-60
YES	C	37	P0237	Boost pressure sensor circuit low input	DN02-35
YES	C	88	P0400	Abnormal flow amount of EGR	DN02-69
YES	C	88	P0404	EGR valve 1 sticking	DN02-70
YES	C	86	P0405	EGR lift sensor 1 circuit low input	DN02-71
YES	C	86	P0406	EGR lift sensor 1 circuit high input	DN02-71
YES	C	81	P0489	EGR solenoid 1 malfunction (Open circuit or ground line short)	DN02-67
YES	C	81	P0490	EGR solenoid 1 malfunction (Power source line short)	DN02-67
YES	C	3	P0605	Flash ROM error	DN02-55
YES	C	3	P0607	Monitoring IC malfunction in CPU	DN02-55
YES	C	75	P0628	Supply pump SCV malfunction (All discharge mode)	DN02-65
YES	C	57	P1211	Injector common 1 ground line short	DN02-56
YES	C	57	P1212	Injector common 1 power source line short	DN02-58
YES	C	57	P1212	Injector common 1 open circuit	DN02-58
YES	C	58	P1214	Injector common 2 ground line short	DN02-56
YES	C	58	P1215	Injector common 2 power source line short	DN02-58
YES	C	58	P1215	Injector common 2 open circuit	DN02-58
YES	C	2	P1601	Injector correction data conformity error	DN02-76
YES	C	15	P2227	Abnormality of atmospheric pressure sensor characteristic	DN02-55
YES	C	15	P2228	Atmospheric pressure sensor circuit low input	DN02-55
YES	C	15	P2229	Atmospheric pressure sensor circuit high input	DN02-55
YES	C	75	P2635	Supply pump SCV sticking	DN02-66
YES	C	8	U1123	CAN communication error (VNT)	DN02-73
YES	C	8	U0073	CAN communication malfunction (Engine)	DN02-73
YES		16	P0112	Intake air temperature sensor circuit low input	DN02-40
YES		16	P0113	Intake air temperature sensor circuit high input	DN02-40
YES		14	P0182	Fuel temperature sensor circuit low input	DN02-34
YES		14	P0183	Fuel temperature sensor circuit high input	DN02-34
YES		12	P0340	Engine speed sub sensor circuit malfunction	DN02-28
YES		21	P0500	Vehicle speed sensor circuit low input	DN02-54
YES		21	P0501	Vehicle speed sensor circuit high input	DN02-54
YES		5	P0686	Main relay malfunction	DN02-77
YES		22	P2121	Accelerator sensor 1 malfunction (Open sticking)	DN02-46



SHTS16Z010200035

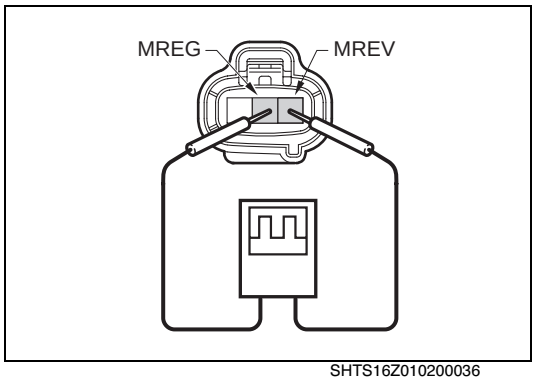
3. CHECK THE INPUT PULSE GENERATION TO ENGINE ECU.
(1) Connector of engine speed sub sensor remains connected.
(2) Start the engine.
(3) Measure the pulse generation between terminals G3+ (D19) and CGND (D30) terminals using an oscilloscope.

Standard: 5 pulse (Including extra signal pin)
(4) After measurement, stop the engine.

NO → Proceed to 4.

YES →

- Malfunction of ECU.
- Malfunction of ECU connectors.



SHTS16Z010200036

4. CHECK THE OUTPUT PULSE GENERATION FROM SENSOR.
(1) Connector of engine speed sub sensor remains connected.
(2) Start the engine.
(3) Measure the pulse generation between MREG and MREV terminals using an oscilloscope.

Standard: 5 pulse (Including extra signal pin)

NOTICE
This figure is viewed from the coupling surface side.

NO →

- Engine speed sub senor malfunction.
- Camshaft gear signal pin abnormal.

YES → Bad contact of connector.

ENGINE SPEED MAIN AND SUB SENSOR

EN16Z0102F200017

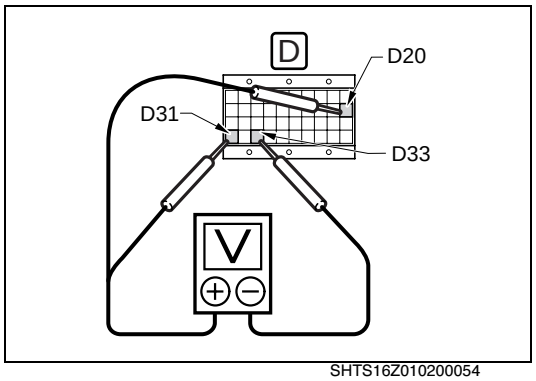
MC No.	13	DTC No.	P0335	Engine speed main and sub sensor circuit malfunction

1. MAKE SURE TO INSPECT IT IN ACCORDANCE WITH THE CONTENTS OF MC No. 12, 13 OR DTC No. P0335, P0340.

COMMON RAIL EXCESSIVE PRESSURE, CONTROL SYSTEM

EN16Z0102F200028

MC No.	68	DTC No.	P0088	Excessive common rail pressure (1st step)
MC No.	69	DTC No.	P0088	Excessive common rail pressure (2nd step)



SHTS16Z010200054

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

(1) Set the starter switch to "LOCK" and connect the signal check harness.
(2) Set the starter switch to "ON" (The engine is stopped).
(3) Measure the voltage between PCR1 (D20), PCR2 (D31) and AGD1 (D33) terminals.

Standard: 3.6-4.7V

NO

- Malfunction of ECU.
- Bad contact of harness connector.

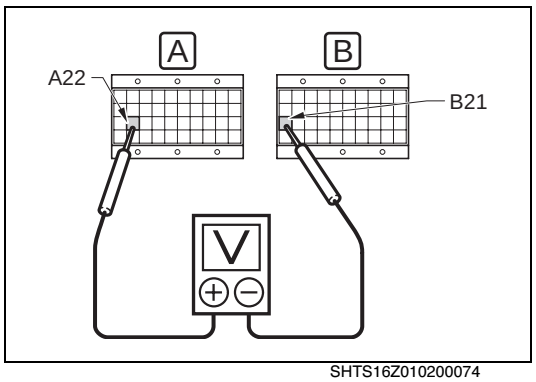
YES

Malfunction of common rail pressure sensor.

ACCELERATOR SENSOR 2

EN16Z0102F200035

MC No.	22	DTC No.	P2127	Accelerator sensor 2 circuit low voltage
MC No.	22	DTC No.	P2128	Accelerator sensor 2 circuit high voltage



SHTS16Z010200074

1. CHECK THE VOLTAGE BETWEEN TERMINALS.

(1) Set the starter switch to "LOCK" and connect the signal check harness.

(2) Set the starter switch to "ON" (The engine is stopped).

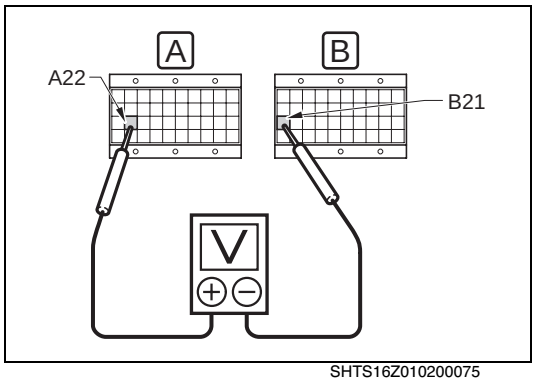
(3) Measure the voltage between ACS2 (A22) and AGD5 (B21) terminals.

Standard: 0.7-1.0V: Release the accelerator pedal.

NO

Malfunction of accelerator sensor.

YES



SHTS16Z010200075

(4) Measure the voltage between ACS2 (A22) and AGD5 (B21) terminals while depressing the accelerator pedal.

Standard: 1V or more, with the voltage change proportional to the accelerator pedal depression amount.
(After measurement, turn the starter switch to "LOCK" position.)

NO

Malfunction of accelerator sensor.

YES

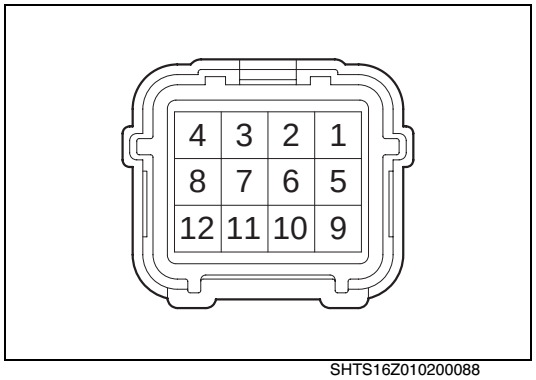
Malfunction of harness.

ACCELERATOR SENSOR 1 & 2

EN16Z0102F200036

MC No.	22	DTC No.	P2120	Accelerator sensor 1 and 2 malfunction

1. MAKE SURE TO INSPECT IT IN ACCORDANCE WITH THE CONTENTS OF MC No.22 or DTC No. P2121, 2126.



SHTS16Z010200088

3. CHECK THE RESISTANCE BETWEEN TERMINALS.

(1) Set the starter switch to "LOCK".
(2) Disconnect the injector harness connector that is located at the front side of the cylinder head.
(3) Measure the resistance between the terminals of the injector harness connector (Injector side).

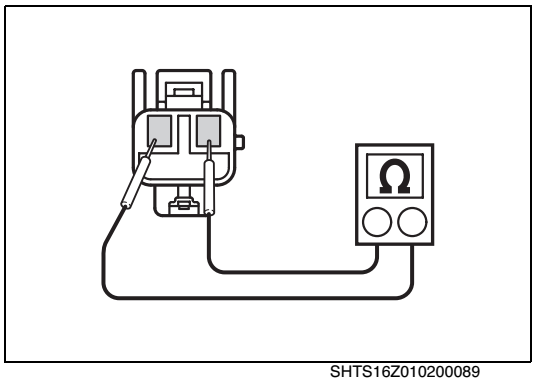
MC No.	DTC No.	Failure position (Breaking position)	Resistance measurement
51	P0201	No.1 injector	2 ↔ 5
52	P0202	No.2 injector	3 ↔ 7
53	P0203	No.3 injector	8 ↔ 11
54	P0204	No.4 injector	6 ↔ 10

Standard: Less than 2 Ω

NO → Proceed to 4.

YES →

Harness disconnections (Vehicle harness side).
(Check the harness between ECU and the injector connector.)



SHTS16Z010200089

4. CHECK THE RESISTANCE BETWEEN TERMINALS OF THE INJECTOR.

(1) Set the starter switch to "LOCK".
(2) Dismount the head cover.
(3) Disconnect the injector connector (Injector side) of the cylinder displayed by MC or DTC. Measure the resistance between the terminals of the injector (Injector side).

Standard: 0.35-0.55 Ω at 20°C {68°F}

NO → Proceed to 5.

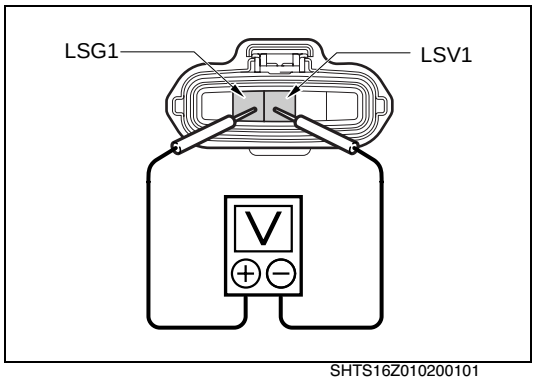
YES →

Bad contact of the connector or the harness in the head cover.
(Check the connector or the harness in the head cover.)

EGR LIFT SENSOR 1

EN16Z0102F200049

MC No.	86	DTC No.	P0405	EGR lift sensor 1 circuit low input
MC No.	86	DTC No.	P0406	EGR lift sensor 1 circuit high input



SHTS16Z010200101

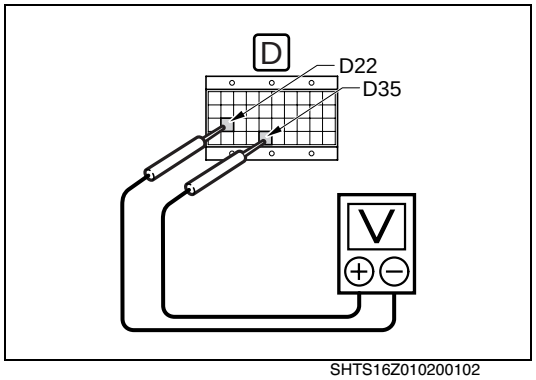
1. CHECK THE VOLTAGE BETWEEN TERMINALS.

(1) Set the starter switch to "LOCK" position and connect the signal check harness.
(2) Disconnect the connectors of EGR valve1.
(3) Set the starter switch to "ON" position.
(4) Measure the voltage between LSG1 and LSV1 terminals of connector (Vehicle harness side) of EGR sensor.

Standard: 4.5-5.5V
(After measurement, turn the starter switch to "LOCK" position.)

NO → Proceed to 2.

YES → Proceed to 3.



SHTS16Z010200102

2. CHECK THE VOLTAGE BETWEEN TERMINALS.

(1) Measure the voltage between AGD3 (D35) and AVC3 (D22) terminals of signal check harness.

Standard: 4.5-5.5V

NO →
- Malfunction of ECU.
- Malfunction of ECU connector.

YES → Proceed to 3.