

5. How to read troubleshooting

(1) Failure diagnosis in this manual describes Step 2 and Step 3 below :

(1) Question	"Step 1"	Hear from customers for conditions and environments of failures and check the fact.
(2) Pre-inspection (3) Reproduction method	"Step 2"	Perform diagnosis inspection, status inspection, function inspection and basic inspection. Check the failure status. If it is difficult to reproduce the problem with status inspection, use the reproduction method.
(4) Troubleshooting for each diagnosis code (5) Troubleshooting for each failure status	"Step 3"	Summarize inspection results obtained from Step 2. Perform inspection systematically according to troubleshooting procedures for each diagnosis code or failure status.
(6) Confirmation test	"Step 4"	Check if failure occurs again after repair. If it is difficult to reproduce a failure, perform the confirmation test under the conditions and environment of the failure.

(2) Pre-inspection

Pre-inspection	<ul style="list-style-type: none"> • Pre-inspection is performed in the following steps : Diagnosis inspection →Diagnosis deletion →Failure status check (Use the reproduction method if not reproduced.) →Diagnosis reconfirmation • Estimate the failure system before the reproduction test. Attach a tester and evaluate estimated failure together with failure status. Refer to the troubleshooting chart for estimated cause of a failure. • An error code is displayed if a failure occurs instantaneously. If any specific failure is not found, perform troubleshooting using the reproduction method. • Failure status check If failure is reproduced, perform Step 2 →Step 3 →Step 4. If failure is not reproduced, use the reproduction method (simulation of external conditions or check of each wire harness and connector, etc.)
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Tightening of engine bolts and nuts

JP30002010102003

1. Tightening torque of general standard bolts

(1) For bolts with seatings

Unit : N·m{kgf·cm}

Screw diameter x Pitch	7T	9T
M8 x 1.25 (Coarse thread)	28.5{290}	36{370}
M10 x 1.25 (Fine thread)	60{610}	74.5{760}
M10 x 1.5 (Coarse thread)	55{560}	68.5{700}
M12 x 1.25 (Fine thread)	108{1, 100}	136{1, 390}
M12 x 1.75 (Coarse thread)	97{990}	125{1, 280}
M14 x 1.5 (Fine thread)	171.5{1, 750}	216{2, 210}
M14 x 2 (Coarse thread)	154{1, 570}	199{2, 030}
Remark	Bolt with number "7" on the head	Bolt with number "9" on the head

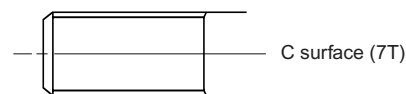
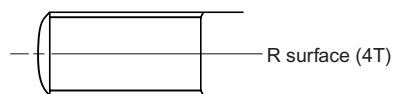
⚠ CAUTION • 8T bolt is in accordance with 7T bolt.

(2) For bolts with washers

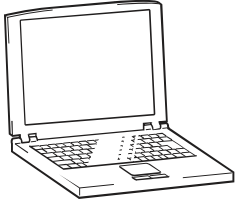
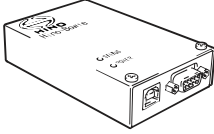
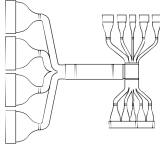
Unit : N·m{kgf·cm}

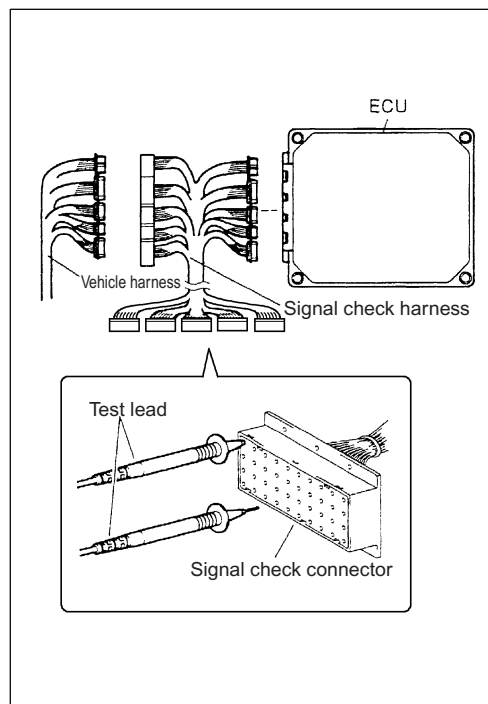
Screw diameter x Pitch	4T	7T	9T
M6 x 1 (Coarse thread)	6{60}	10{100}	13{130}
M8 x 1.25 (Coarse thread)	14{140}	25{250}	31{320}
M10 x 1.25 (Fine thread)	29{300}	51{520}	64{650}
M10 x 1.5 (Coarse thread)	26{270}	47{480}	59{600}
M12 x 1.25 (Fine thread)	54{550}	93{950}	118{1, 200}
M12 x 1.75 (Coarse thread)	49{500}	83{850}	108{1, 100}
M14 x 1.5 (Fine thread)	83{850}	147{1, 500}	186{1, 900}
M14 x 2 (Coarse thread)	74{750}	132{1, 350}	172{1, 750}
Remark	Bolt with number "4" on the head Projection bolt Stud with R surface at free end	Bolt with number "7" on the head Stud with C surface at free end	Bolt with number "9" on the head

⚠ CAUTION • 8T bolt is in accordance with 7T bolt.



2. List of failure diagnosis tools

Part name	Part No.	External shape	General description and function
PC (DOS/V standard)	—		<ul style="list-style-type: none"> Operating system(OS) : Windows95, Windows98(IE5.0 or later), Windows2000(SP3, IE5.0 or later), WindowsXP(SP1a, IE6.0 or later) CPU and memory : Conditions that assure operation of the above operating system Display : 800 x 600, 256 colors or more
Hino-Bowie (Interface box)	09121 - 1040 Cable between vehicle and Hino-Bowie (09042 - 1190)		<ul style="list-style-type: none"> PC interface
Signal check harness	09049 - 1080 (for common rail fuel injection system)		Interrupting installation between vehicle harness and ECU allows inspection with a tester rod while the power is supplied.



SAPH300020100040

3. Connection of signal check harness

- (1) To prevent damage to the ECU connector and to improve accessibility, connect the signal check harness and put a testing rod on the signal check connector of the signal check harness for measurement.

- a. Disconnect the connector from the ECU.

⚠ CAUTION • Do not break the locking tab of the connector.

- b. Connect the signal check harness to the machine harness and the ECU.
Signal check harness
(for common rail fuel injection system)

Part No.
380100048

Inspection item		Standard value	Repair limit	Service limit	Action	
Camshaft	Camshaft journal outer diameter	40{1.5748}	—	-0.15 {-0.0059}	Replace camshaft	
	Camshaft bearing inner diameter	40{1.5748}	—	+0.15 {+0.059}	Bearing Replacement	
	Camshaft bearing oil Clearance	0.020 - 0.063 {0.0008 - 0.0025}	—	—	Replace camshaft or bearing	
	Cam height	IN	50.046{1.9703}	—	-0.08 {-0.0031}	Replace camshaft
		EX	52.739{2.0763}	—		
	Cam lift	IN	8.046{0.3168}	—	-0.08 {-0.0031}	Replace camshaft
EX		10.739{0.4228}	—			
Camshaft	Camshaft journal width (Rear journal)	33{1.2992}	—	—		
	Camshaft end play	0.100 - 0.178{0.0039 - 0.0070}	—	—	Replace camshaft	
	Camshaft runout	0.04 {0.0016}	—	0.1{0.039}	Replace camshaft	
Rocker shaft outer diameter		22{0.8661}	—	-0.08 {-0.0031}	Replace rocker shaft	
Rocker arm bushing inner diameter		22{0.8661}	—	+0.08 {+0.0031}	Replace rocker arm bushing	
Rocker arm oil clearance		0.030 - 0.101 {0.00012 - 0.0040}	0.15 {0.0059}	—		
Valve stem outer diameter	IN	7{0.2756}	—	—	Replace valve	
	EX	7{0.2756}	—	—		
Valve guide inner diameter	IN	7{0.2756}	—	—	Replace valve guide	
	EX	7{0.2756}	—	—		
Oil clearance between valve guide and valve stem	IN	0.023 - 0.058 {0.0009 - 0.0020}	—	—	Replace valve or valve guide	
	EX	0.050 - 0.083 {0.0020 - 0.0033}	—	—		
Valve sink	IN	0.55 - 0.85 {0.0217 - 0.0335}	—	1.1{0.0433}	Replace valve and valve seat	
	EX	1.15 - 1.45 {0.0453 - 0.0571}	—	1.7{0.0669}		
Valve seat angle	IN	30°	Allowable angle 30° - 30° 35'		Correction	
	EX	45°	Allowable angle 45° - 30° 30'			
Valve face angle	IN	30°	Allowable angle 29° 30' - 45°			
	EX	45°	Allowable angle 44° 30' - 45°			

Exhaust

Tightening torque

JP30002020205008

Unit : N · m {kgf · cm, lbf · ft}

Tightening area	Tightening torque	Remark
Exhaust manifold mounting nut	53{540, 40}	
Exhaust pipe mounting nut	70±14{715±140, 52±10}	

Cooling

Standard value

JP30002020205009

Inspection item	Standard value	Repair limit	Service limit	Action
Thermostat valve open temperature	74.5 - 78.5 °C {166.1 - 173.3 °F}	—	—	Replacement
Thermostat valve lift (Set temperature 95 °C)	13mm {0.5118 in.} or more	—	—	Replacement

Lubrication

Standard value

JP30002020205010

Unit : mm {in.}

Inspection item	Standard value	Repair limit	Service limit	Action
Hydraulic alarm switch operation pressure	39kPa {0.4kgf/cm ² , 5.66lbf/in. ² }	—	—	

Engine Body

Removal

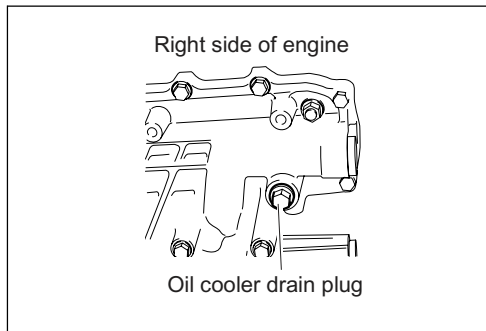
JP30002040702002

1. Preliminary work before removal of engine

- (1) Place the vehicle on a level ground.
- (2) Block tires with scotch.
- (3) Remove the battery cable from the battery minus terminal.

2. Drain of coolant and engine oil

- (1) Drain coolant from the radiator drain cock and the oil cooler drain plug.



NOTICE

- Removal of the filler cap facilitates quick drain.
- Connection of an appropriate hose to the oil cooler drain pipe facilitates drain of coolant without spread.



CAUTION

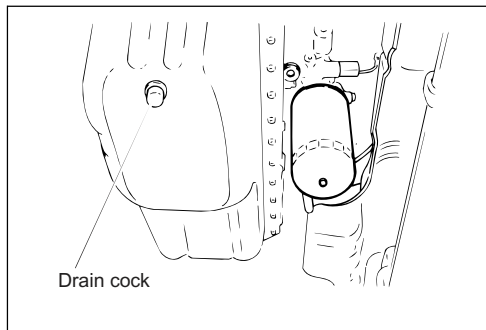
- To prevent burn, drain coolant after the temperature is sufficiently low.
- To dispose coolant, observe the specified method (waste disposal) or the method with attention to environment.

- (2) Drain engine oil from the oil pan drain plug as required.



CAUTION

- To prevent burn, drain coolant after the temperature is sufficiently low.
- Dispose coolant according to the specified method (waste treatment) or with a method considering the environment.



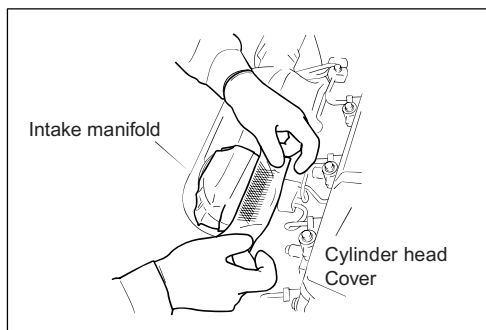
3. Removal of intake hose, intercooler hose and exhaust pipe

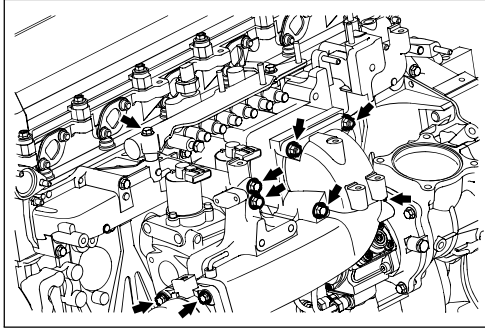
- (1) Loosen the clamp and remove the intake hose.
- (2) Remove nuts and remove the exhaust pipe.



CAUTION

- Close the opening of the intake manifold with a packing tape to prevent entry of dirt inside the engine.





SAPH300020600003

2. Installation of EGR valve

- (1) Replace the EGR valve gasket with a new one and install the EGR valve on the intake air pipe paying attention to the direction

Tightening torque : 68.5 N · m {700 kgf · cm, 51 lbf · ft}

- (2) Apply liquid gasket (Threebod TB1207B: Black) to the intake air pipe and connect it to the intake manifold.

Tightening torque : 55 N · m {560 kgf · cm, 41 lbf · ft}

- (3) Connect each coolant pipe to the EGR valve.
- (4) Connect the EGR pipe.

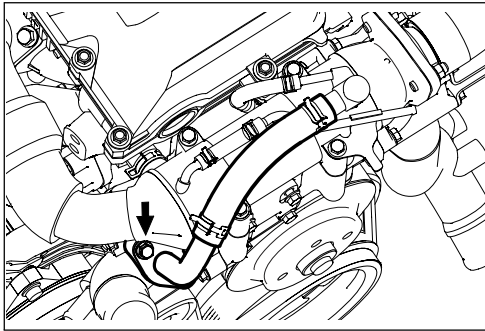
Tightening torque :

57±11 N · m {582±116 kgf · cm, 42±8 lbf · ft}

- (5) Connect the connector to the EGR solenoid valve.

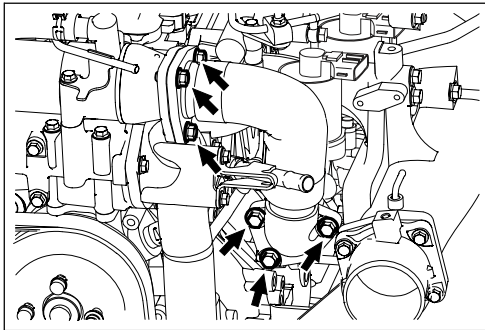
3. Removal of EGR cooler

- (1) Remove hoses and pipes from the EGR cooler.



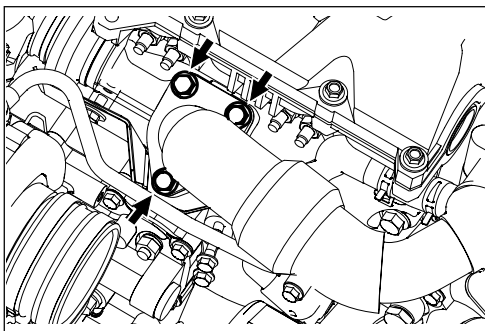
SAPH300020600005

- (2) Loosen bolts connecting the EGR cooler and the EGR pipe.



SAPH300020600006

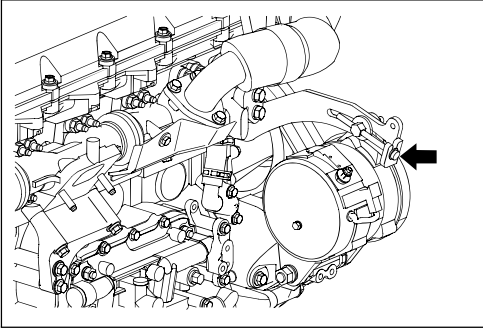
- (3) Remove the EGR pipe.



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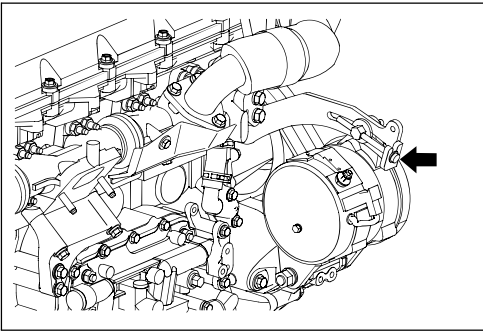
Removal of alternator

JP300020702004



SAPH300020700013

1. Remove the through bolt.

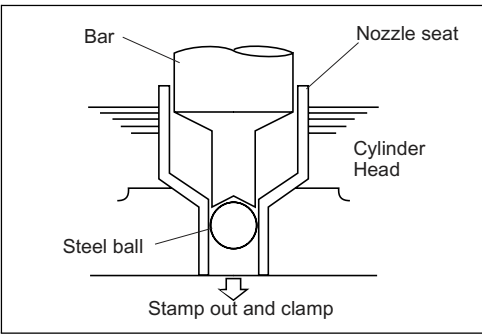


SAPH300020700013

2. Remove the alternator adjusting bolt.

3. Remove the through bolt while supporting the alternator, and remove the alternator.

⚠ CAUTION • When the through bolt is removed, the alternator falls. The alternator must be firmly supported during removal.

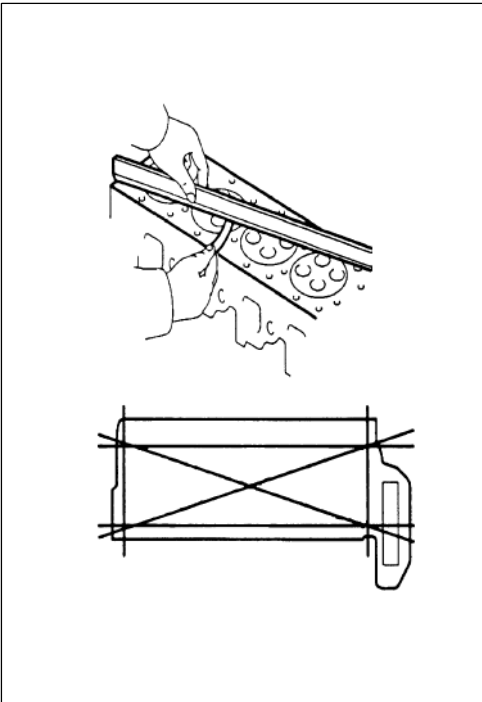


SAPH300020900027

- (5) Clamp the nozzle seat using a special tool.

Special tool : 380100031 Bar

380100032 Steel ball



SAPH300020900028

5. Inspection of cylinder head

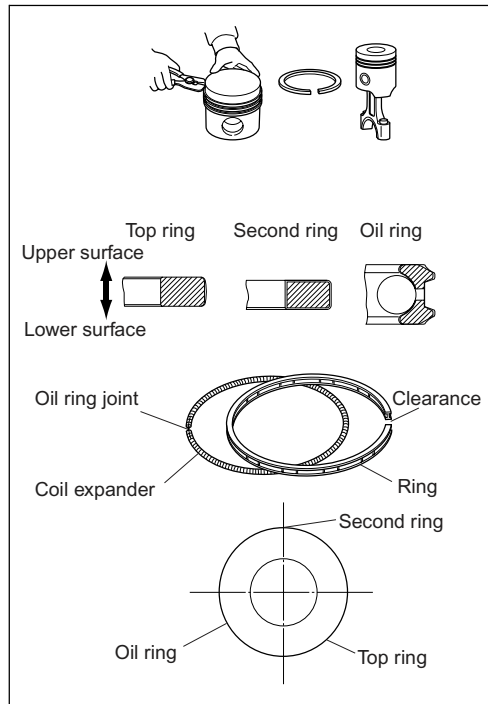
- (1) Inspection of cylinder head distortion
- a. Measure distortion of the cylinder head lower surface and the manifold mounting surface using a ruler.

Standard value (mm{in.})	Service limit (mm{in.})
Longitudinal direction 0.06{0.0024}	0.2{0.0079}
Square direction 0.03{0.0012}	

- b. If the measurement value is beyond the service limit, replace it.

⚠ CAUTION • **Repair of the lower surface by grinding can change backlash of the timing gear. Do not grind it.**

- (2) Inspection of cylinder head crack
- a. With dye penetrant test method (red check), make sure that there is no crack or damage in the cylinder head.

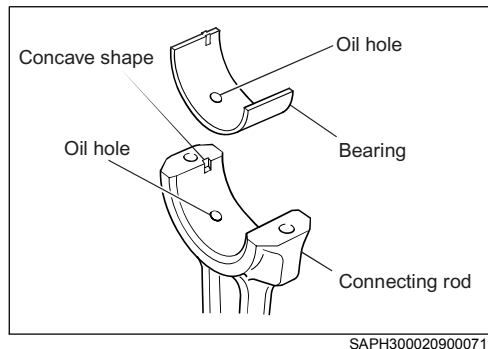


- (3) Face the side with the piston ring identification print upward and install in the order of the oil ring, second ring and top ring using a special tool.

NOTICE • The identification print is present only on the secondary ring and the top and bottom of the top ring and the oil ring are not identified.

Piston ring expander

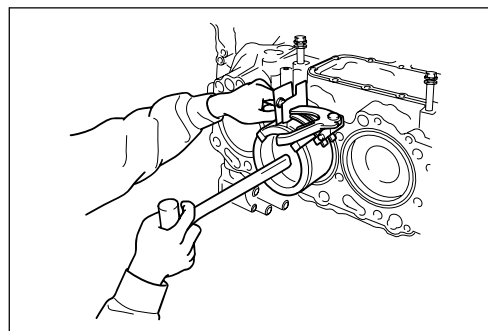
- (4) Connect the joint of the coil expander and fit the oil ring inside the ring. Offset the coil expander joint with the ring joint by 180 deg for installation.
- (5) Allocate the joints of the piston ring with uniform intervals as shown in the figure.



4. Installation of piston and connecting rod

- (1) Allocate the joints of the piston ring with uniform intervals as shown in the figure.
- (2) Install the connecting rod bearing to suit concave shape of the connecting rod.

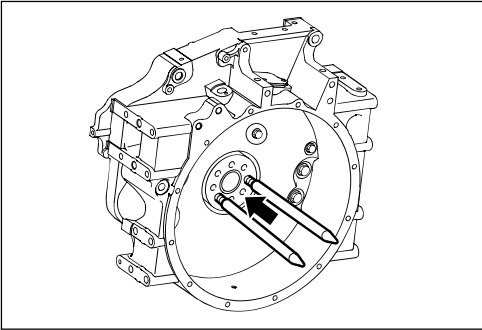
CAUTION • Make sure that the oil hole of the connecting rod bearing is aligned with the oil hole of the connecting rod.



- (3) Apply engine oil to the piston, cylinder liner and connecting rod bearing and compress the piston ring using a special tool.

Piston ring holder

CAUTION • Make sure that there is no deformation or damage to the special tool piston ring holder.



SAPH300020900116

4. Installation of flywheel

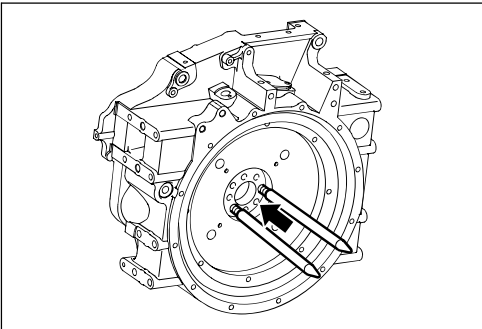
- (1) Make sure that there is no burr or dirt on the joint surface of the crankshaft and the flywheel and the screw hole.
- (2) Install the tool into the bolt hole of the crankshaft.

Guide

NOTICE • Install one special tool on the collar dowel and the other at the opposite side of the collar dowel.

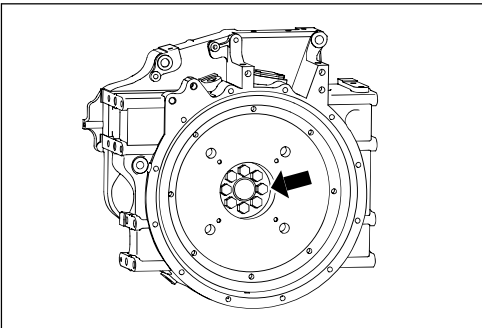
- (3) Insert the flywheel until it comes in contact with the collar dowel of the crankshaft and adjust the position.

CAUTION • Since the flywheel is heavy, be careful for handling.
• Do not give impact to the special tool during work.



SAPH300020900117

- (4) Insert the flywheel until it comes in contact with the crankshaft.
- (5) Apply engine oil to the bolt seat and the bolt thread of the flywheel mounting bolt.



SAPH300020900118

- (6) Tighten 6 bolts by 2 to 3 threads temporarily with hand in the bolt holes without installation of the tool.
- (7) Tighten 6 bolts gradually and tighten temporarily.
- (8) Remove the tool and tighten remaining two bolts temporarily as in (6) and (7).

- (9) Tighten the flywheel according to the order in the figure.

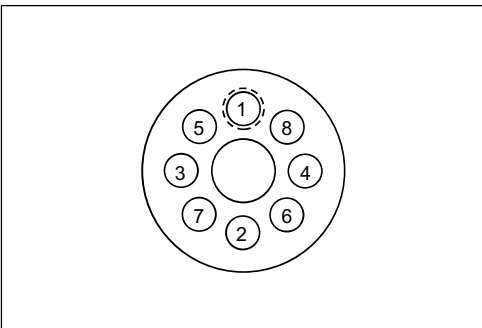
Tightening torque : 186 N · m {1,900 kgf · cm, 137 lbf · ft}

NOTICE • Insert a large flat tip screwdriver into the flywheel gear from the flywheel housing inspection hole to prevent turning of the crankshaft.

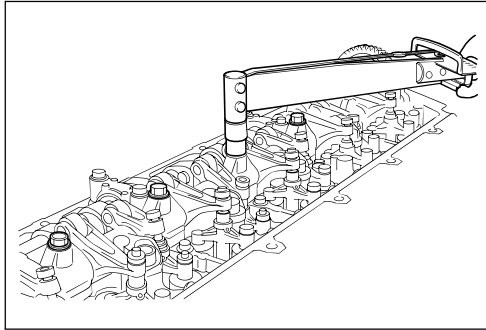
- (10) Loosen all bolts.
- (11) Tighten the bolts again.

Tightening torque : 186 N · m {1,900 kgf · cm, 137 lbf · ft}

- (12) Install the engine revolution sensor.



SAPH300020900119

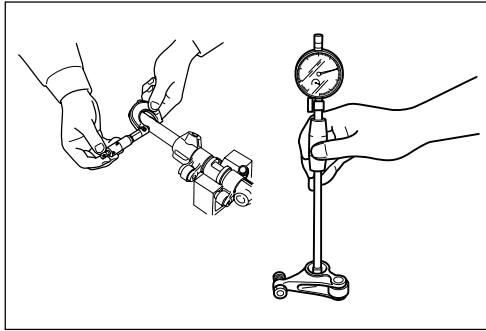


SAPH300020900164

- (4) Place the rocker arm and the rocker arm shaft on the camshaft housing and make sure that the rocker arm is correctly on the crosshead. Tighten the rocker arm support bolts gradually several times.

Tightening torque : 59 N · m {600 kgf · cm, 44 lbf · ft}

- ⚠ CAUTION**
- After tightening, make sure that the rocker arm moves smoothly.
 - Make sure that there is no undue force on the injection pipe oil seal.
(Otherwise, oil leak or poor assembly of injection pipe may occur.)



SAPH300020900165

3. Inspection of rocker arm oil clearance

- (1) Measure the outer diameter of the rocker shaft using a micrometer.

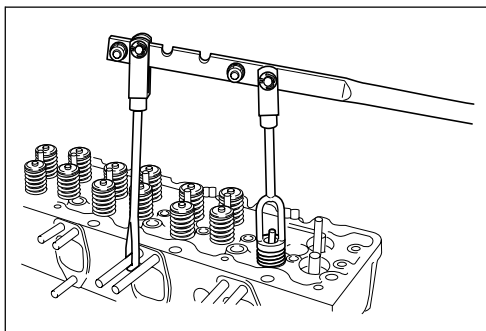
Standard value (mm{in.})	Service limit (mm{in.})
22{0.8661}	21.92{0.8630}

- (2) Measure the rocker arm bushing inner diameter using a cylinder gauge.

Standard value (mm{in.})	Service limit (mm{in.})
22{0.8661}	20.08{0.7905}

- (3) Calculate the difference between the outer diameter of the rocker shaft and the inner diameter of the rocker arm bushing. If it is beyond the standard value, replace the rocker shaft or the rocker arm bushing.

Standard value (mm{in.})	Service limit (mm{in.})
0.03 - 0.101 {0.0012 - 0.0039}	0.15{0.0059}



SAPH300020900166

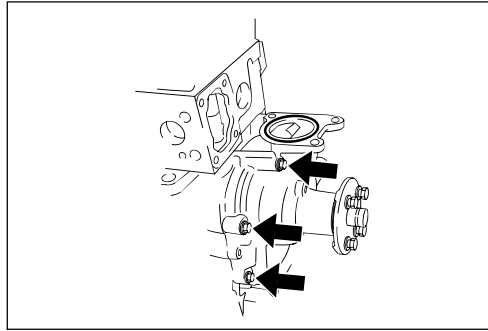
4. Removal of valve spring

- (1) Compress the valve spring using a tool and remove the valve spring retainer.

Valve spring press

Replacement of coolant pump

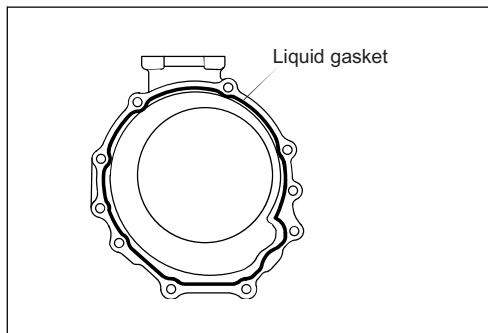
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SAPH300021100009

1. Removal of coolant pump

- (1) Remove bolts and remove the coolant pump.



SAPH300021100010

2. Installation of coolant pump

- (1) Remove contamination on the joint surface between the coolant pump and the cylinder block using a scraper and degrease the surface.
- (2) Apply the liquid gasket [Threebond TB1207B (black) or equivalent] to the coolant pump as shown in the figure.



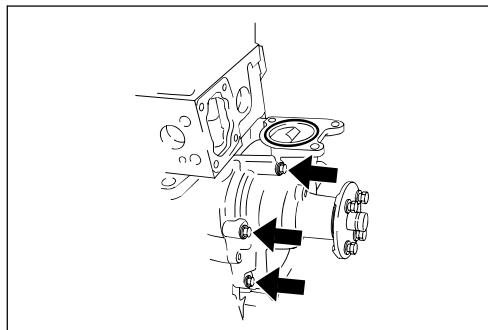
CAUTION

- Apply it continuously.
- Apply the liquid gasket at the width of 2 to 3mm{0.0787 to 0.1181in.}.
- Install the oil cooler within 20 minutes after application of the liquid gasket.
- Fill the groove on the water pump flange with the liquid gasket.

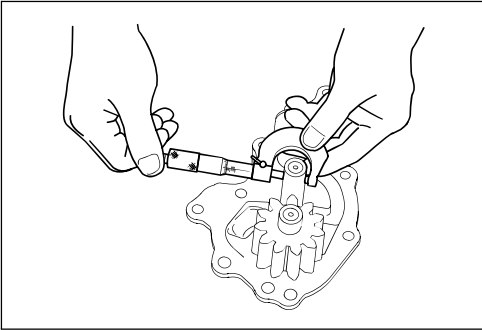
- (3) Install the coolant pump to the dowel pin of the cylinder block.

NOTICE

- When the coolant pump is installed using a guide bolt, displacement of the liquid gasket does not occur.



SAPH300021100009



SAPH300021200023

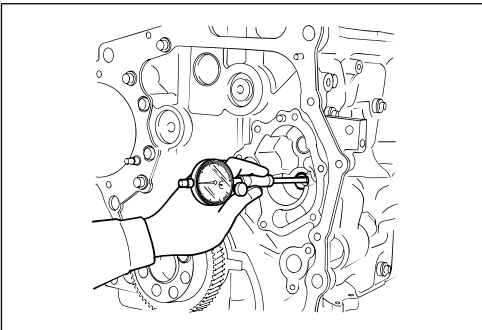
6. Inspection of clearance between outer diameter of driven gear shaft and inner diameter of driven gear bushing

- (1) Measure the outer diameter of the driven gear shaft using a micrometer and measure the inner diameter of the driven gear bushing using a cylinder gauge.

Measuring area	Standard value (mm{in.})
Outer diameter of driven gear shaft	18{0.7087}
Cylinder block hole diameter	18{0.7087}

- (2) Calculate the difference between the outer diameter of the driven gear and the cylinder block hole diameter. If it is beyond the service limit, replace the oil pump assembly.

Standard value (mm{in.})	0.030 - 0.075 {0.0012 - 0.0030}
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SAPH300021200024

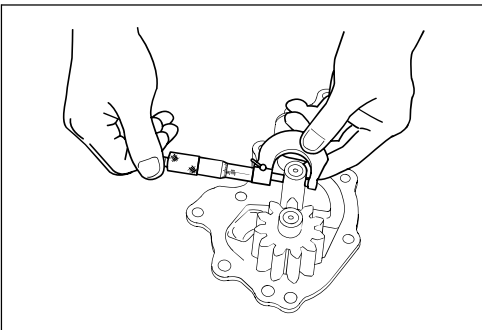
7. Inspection of clearance between outer diameter of driven gear shaft and inner diameter of driven gear bushing

- (1) Measure the outer diameter of the driven gear shaft using a micrometer and measure the inner diameter of the driven gear bushing using a cylinder gauge.

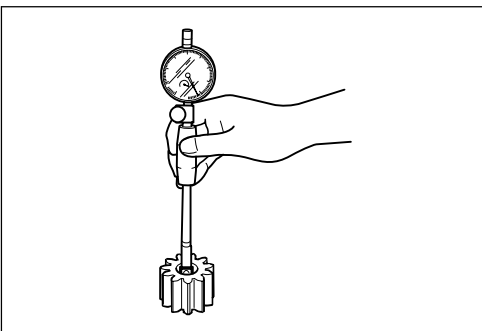
Measuring area	Standard value (mm{in.})
Outer diameter of driven gear shaft	18{0.7087}
Inner diameter of driven gear bushing	18{0.7087}

- (2) Calculate the difference between the outer diameter of the driven gear shaft and the inner diameter of the driven gear bushing. If it is beyond the service limit, replace the oil pump assembly or the driven gear bushing.

Standard value (mm{in.})	Service limit (mm{in.})
0.040 - 0.083 {0.0016 - 0.0033}	0.15{0.00059}



SAPH300021200023



SAPH300021200025

Table of lubricant

Code	Lubricating point	Lubricant used	Amount (g{oz})	Remark	Lubricant manufacturer
1	Pinion case metal and grease reservoir	Multemp AC-N	0.8 - 1.5 {0.03 - 0.05}		Kyodo Yushi
2	Bracket center metal and grease reservoir	Multemp AC-N	0.5 - 1.5 {0.03 - 0.05}		Kyodo Yushi
3	Shim washer	Multemp AC-N	0.2 - 0.5 {0.01 - 0.02}	Applied to both sides of washer.	Kyodo Yushi
4	Armature front metal	Multemp AC-N	0.5 - 1 {0.02 - 0.04}		Kyodo Yushi
5	Shim washer	Multemp AC-N	0.2 - 0.5 {0.01 - 0.02}	Applied to both sides of washer.	Kyodo Yushi
6	Internal gear	Multemp AC-N	7 - 11 {0.25 - 0.39}		Kyodo Yushi
	Armature gear				
	Planetary gear				
7	Pinion straight Spline	Multemp AC-N	0.5 - 1 {0.02 - 0.04}		Kyodo Yushi
8	Inner sleeve metal	Multemp AC-N	0.3 - 0.6 {0.01 - 0.02}		Kyodo Yushi
9	Helical spline	Multemp AC-N	0.5 - 1 {0.02 - 0.04}		Kyodo Yushi
10	Clutch case lever shifter	Pyroknock No.2	1 - 2 {0.04 - 0.07}		Nippon Oil Corporation
11	Bracket rear bearing housing	Pyroknock No.2	0.2 - 0.5 {0.01 - 0.02}		Nippon Oil Corporation
12	Planetary gear metal	Multemp AC-N	1 - 2 {0.04 - 0.07}		Kyodo Yushi
13	Lever holder	Multemp AC-N	0.4 - 0.8 {0.01 - 0.03}		Kyodo Yushi
14	Lever roller rod	Pyroknock No.2	0.2 - 0.5 {0.01 - 0.02}	Assemble the roller after application of grease to prevent fall of the roller in assembly.	Nippon Oil Corporation